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Organization capital and firm life cycle☆

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ABSTRACT

We hypothesize, and examine empirically, two types of association between organization capital and firm life cycle. Are firms with high organization capital more likely to be in a particular stage of their life cycle than firms with low organization capital? Are firms' transitions from one life cycle stage to another over time associated with how much they invest in organization capital? Our findings suggest that firms with high (low) organization capital are more likely to be in the introduction and decline (growth and maturity) stages. Our results also show that firms that invest more in organization capital (i.e., changes in organization capital) are less (more) likely to move to the introduction, shake-out and decline (growth and maturity) stages in the subsequent five years. Our results are robust to alternative specifications of organization capital, life cycle proxies and endogeneity concerns.

1. Introduction

Firm-level organization capital may be defined as the accumulation of firm-specific knowledge that "enables superior operating, investment and innovation performance, represented by the agglomeration of technologies—business practices, processes and designs" (Lev et al., 2009, p. 277). It manifests itself in the form of organization practices, processes, systems, and culture. Recent studies suggest that organization capital plays an important role in improving the efficiency and productivity of the firm. In recent studies, both Peters and Taylor (2017) and Eisfeldt and Papanikolaou (2014) note that organization capital is an increasingly important part of the US and global capital stock. Prior studies (Lev and Radhakrishnan, 2005; Lev et al., 2009) also show that investment in organization capital forms the basis of sustainable competitive advantage.

As Atkeson and Kehoe (2005) (hereafter called A&K, 2005) remark, economists have long thought that firm life cycle (hereafter FLC) is driven by organization capital. Based on this idea, they develop a simple growth model of FLC where firm life cycle, as captured by the life cycle of firm's profit (or organization rent), is expressed as a function of firm-specific knowledge (or organization capital) in equilibrium, and used to measure the overall size of this capital in the US economy by calibration. Their analysis demonstrates that organization capital is relatively important, because payments from organization capital are

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more than one-third of payments from physical capital, net of new investment. However, the role of organization capital in influencing the progression of a firm in its life cycle stages remains unclear and deserves a systematic study. We aim to fill this gap in the literature.

Our paper is different from that of A&K (2005) in the following ways. First, the objective of A&K (2005) is to measure the aggregate size (or share) of organization capital in an economy, while our objective is to examine the association between life cycle and organization capital at firm level empirically. Second, A&K (2005)'s approach is, by way of calibration, to assess the ability of their model to mimic features of the actual economy, but our approach is concerned about estimation and hypothesis testing for the relation between life cycle and organization capital. Thus, our approach compliments that of A&K (2005). Third, they analyze firms from the product side but we look at firms from the resource side. In particular, our approach adopts the resource-based view (RBV) of the firm pioneered by Penrose (1959), who articulates that the general patterns and paths in the evolution of organization capabilities depend on the existence and application of the bundle of valuable, rare, immobile and imperfectly imitable resources that generate the basis of the competitive advantage of a firm.[1] Since organization capital may be viewed as an important firm-specific resource base and can be a source of sustainable competitive advantage (Lev et al., 2009), the RBV implies that organization capital serves as one of the precursors that allow firms to move from one stage to another progressively. Thus, by taking both the role of organization capital in forming the resource base and the role of the resource base in influencing the life cycle stages, we address two important yet unanswered questions. Are firms with high organization capital more likely to be in a particular life cycle stage than firms with low organization capital? Are firms' transitions from one life cycle stage to another over time associated with how much they invest in organization capital? Note that the former question is about a cross-sectional comparison between firms (i.e., a between-firm effect), while the latter is about a time series/dynamic comparison within a firm (i.e., a within-firm effect).We argue that firms with high (low) organization capital are likely to be in the introduction (growth or mature) stage. Organization capital can help introduction-stage firms to maximize growth opportunities by creating a sustainable advantage over competitors, and by making the product market unattractive to potential entrants (Porter, 1980; Spence, 1979). Due to limited capital and access to external finance, introduction-stage firms cannot afford large physical investment, but they find it relatively easy to spend time and effort to improve firm performance by developing organization processes, practices, culture, language and know-how: commonly known as organization capital. Firms in the growth and maturity stages are more concerned with maximizing the benefits from the existing stock of organization capital (A&K, 2005). Since the cost incurred in developing organization capital in the introduction stage is not expected to increase significantly in the growth and maturity stages, during which firms also have incentives to acquire tangible assets,[2] we expect that firms in later stages are likely to be associated with less organization capital.

Furthermore, since organization capital deepens the resource base or capabilities that "enhances firms' ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997), it enables firms to *progress favorably* from one stage to the next in subsequent years. In particular, the 'dynamic resource-based view'[3] posits that organization capital, as a resource base, facilitates efficient and effective interaction of the firm's resources and management (human beings) (Penrose, 1959), provides the basis of heterogeneity in organizational capabilities (Penrose, 1959; Wernerfelt, 1984) and helps firms to utilise valuable resources in the optimal way, outperform their peers (Adizes, 1979), and move to their prime life stage. Therefore, we hypothesize that firms investing more in organization capital are less (more) likely to move to the introduction, shake-out and decline stages (growth and maturity stages) in subsequent years.

To test the above predictions, we follow Eisfeldt and Papanikolaou (2013) in measuring organization capital. Our life cycle proxy is based on the methodology of Dickinson (2011). By using a large sample of US public firms from 1987 to 2016, we find firms with high organization capital are more likely to be in the introduction and decline stages, than in the shake-out stage. However, firms with a lower level of organization capital are more likely to be in the growth and maturity stages, as these firms concentrate more on exploiting benefits from their existing stock of organization capital, and have a greater incentive to acquire tangible assets. These results are robust after controlling for other predictors of FLC, as well as to alternative specifications of organization capital and life cycle proxies. To mitigate the endogeneity concern, we use a two-stage instrumental variable approach, and the results suggest that endogeneity cannot explain the relationship between organization capital and FLC.

In addition, we test the role of organization capital in the transition between firm life cycle stages in subsequent years. Our results reveal that firms that invest more in organization capital are less (more) likely to move to introduction, shake-out and decline (growth and maturity) stages in the subsequent five years. This result is consistent with the argument that firms' investment in organization capital enables them to develop their resource base and, thus, progress to the favorable life cycle stages (growth and maturity stages). In additional analyses, we include both static and dynamic measures of organization capital in the regression model along with the controls, and examine how static and dynamic organization capital are associated with a firm's life cycle and its transition in subsequent years.[4] Our analyses reveal that firms with more static organization capital are likely to be in the introduction, shake-out or decline stages in the $t + 1$ to $t + 4$ years. Interestingly, on the other hand, firms with more than average organization capital are *less* likely to move to the introduction, shake-out or decline stages in the $t + 1$ to $t + 5$ years, confirming the beneficial role of organization capital in firm life cycle transition.

1 See Lockett and Thompson (2001) for a survey of the RBV in economics.

2 See Section 2 for a discussion of these incentives.

3 The 'dynamic resource-based view' of the firm articulates the theory that the general patterns and paths in the evolution of organizational capabilities change over time, and the evolution of the firm's competitiveness in terms of its resource base and capabilities is the foundation of the firm's life cycle.

4 See H4 for detail discussion on static and dynamic organization capital.

The remainder of the paper is organized as follows: Section 2 reviews the related literature and develops testable hypotheses. Section 3 focuses on research design, data collection and sample selection. Section 4 documents the results of the study, while Section 5 concludes the paper.

2. Literature review and hypothesis development

2.1. Organization capital

The economics and management literature has long recognized the importance of organization capital in improving firm-level (and national-level) efficiency and productivity. The early management literature defines organization capital in terms of firm-specific management practice, such as decentralization (Caroli and Reenen, 2001), high performance work systems (Bailey et al., 2000) and the opportunity to communicate with employees outside the work group, while the economics literature defines organization capital in terms of information assets (Prescott and Visscher, 1980; Squicciarini and Mouel, 2012), and estimates its effect on firm-level outcome (e.g., Carlin et al., 2012; Eisfeldt and Papanikolaou, 2013; Lev et al., 2009). Furthermore, there are two views regarding the existence of organization capital in the firm. One school of thought views it as something embodied in an organization's employees and their social networks (e.g., Eisfeldt and Papanikolaou, 2013; Prescott and Visscher, 1980). On the contrary, another school of thought considers organization capital as being embodied in the organization itself, since this is rooted in organization practices, processes and systems, which do not change even if the employees of the organization are replaced (A&K, 2005; Lev and Radhakrishnan, 2005; Lev et al., 2009; Tomer, 1987).[5] In this regard, we take the second view because that view is consistent with the RBV that critical resources are those that are not tradable, and difficult to be imitated and substituted (Dierickx and Cool, 1989). We define it as sets of standardized practices, processes, designs, culture and know-how that develop systems of production, and integrate human skills and physical capital in order to generate a higher level of returns from a given resource endowment both consistently and efficiently. Evenson and Westphal (1995, p. 2213) emphasize that “much of the knowledge about how to perform elementary processes, and how to combine them in efficient systems is tacit … neither codified nor readily transferable”. Moreover, motivated by prior studies (e.g., Autor et al., 2007; Carlin et al., 2012) that suggest that employment protection regulations make it expensive to fire incumbents and hire new employees, we posit that organization capital is embodied in the firm.

2.2. Organization capital as a source of resource base

The RBV argues that the resources possessed by a firm are the primary determinants of its performance (e.g., Wernerfelt, 1984). A firm is viewed as a ‘bundle’ of resources, developed over time, that are integrated and exploited in ongoing productive activities to provide business value. The concept of resources refers to all tangible and intangible assets and capabilities (Barney, 1991). Makadok (2001, p. 389) defines capabilities as “a special type of resource, specifically an organizationally embedded non-transferable firm-specific resource whose purpose is to improve the productivity of the other resources possessed by the firm”. Capabilities are based upon routinized behavior, such as organization processes, policies, information system, knowledge, culture, etc. (Helfat and Peteraf, 2003). Only when the activities of organizational members become routinized, can tasks be completed efficiently and reliably.

Prior studies extensively document the view that organization capital enables the firm to achieve efficient production, stable business operation and transactions, and that this leads to higher productivity (Black and Lynch, 2005) and better firm performance (Attig and Cleary, 2014; Evenson and Westphal, 1995; Lev et al., 2009). Recent studies in finance and accounting also acknowledge the implication of organization capital in explaining stock return (Eisfeldt and Papanikolaou, 2013), investment cash flow sensitivity (Attig and Cleary, 2014), corporate social responsibility (Attig and Cleary, 2015) and employee turnover and diversity in skill and wages (Carlin et al., 2012). Eisfeldt and Papanikolaou (2013) show that firms with more organization capital are more productive, have higher Tobin's Q and higher risk-adjusted returns, and display a higher level of executive compensation. Lev et al. (2009) also find that organization capital is associated with long-term operating and stock performance positively. They also note that investment in organization capital serves as a source of sustainable competitive advantage. A&K (2005) estimate that the payments from organization capital are more than one-third of the payments from physical capital. Carlin et al. (2012) also admit that organization capital is a significant source of firm value.

The RBV literature also views organization capital as a firm-specific resource and an important source of competitive advantage (Squicciarini and Mouel, 2012). This RBV stipulates that the fundamental sources and drivers of firms' competitive advantage and superior performance are associated with resources that are valuable and scarce (Barney, 1991; Barney et al., 2001). In this regard, Barney (1991) also argues that resources that are difficult to imitate and substitute provide firms with sustainable competitive advantage. Organization capital is valuable because it allows productive interaction between tangible and intangible resources in creating economic value and growth (Lev et al., 2009). Organization capital (e.g., business processes, practices etc.) is difficult to imitate by competitors because of the adjustment cost.[6] Carlin et al. (2012) also suggest that organization capital

[5] See Lev et al. (2009) for a detailed explanation of how organization capital is embodied in the organizational process.

[6] Lev and Radhakrishnan (2005) and Lev et al. (2009) cite a well-known example of how Wal-Mart's vendor-managed inventory and supply chains and electronic data exchange systems help the firm achieve a long-lasting competitive advantage that major competitors (such as K-Mart) have been largely unsuccessful in replicating.

is tied to the firm and, hence, employees departing from the firm cannot carry it. They also argue that the learning and experience necessary for generating organization capital makes the acquisition and replacement of organization capital difficult and time consuming.

Thus, the concepts and lessons drawn from the above economics and management literature lend support to the view that organization capital comprises the knowledge, know-how and business practices and processes that empower firms to integrate physical and human capital in the most efficient and effective way to generate production efficiency and to gain a sustainable competitive advantage. Moreover, from a strategic point of view, organization capital is valuable, rare and difficult to replicate and replace. In short, organization capital is a valuable resource base that allows firms to achieve sustainable competitive advantage.

2.3. Resource base as the foundation of FLC

The RBV posits that the existence and application of the bundle of valuable, scarce, immobile and inimitable resources generates the basis of sustainable competitive advantage (Barney, 1991), and that this resource base determines the firms' transition across the life cycle stages (Miller and Friesen, 1984; Quinn and Cameron, 1983). Wernerfelt (1984) argues that firms possess resources, because these resources allow them to achieve competitive advantage over others, and help them to attain superior long-term performance and, thus, to earn above-average profits. Dynamic resource-based theory incorporates the founding, development and maturity of capabilities and, thereby, suggests that competitive advantages and disadvantages in terms of resources and capabilities evolve over time in important ways (Helfat and Peteraf, 2003). This theory proposes that the growth of the firm depends on efficient and effective interaction between its resources and management. Thus, the evolution of the firm's competitiveness, in terms of its resource base and capabilities, results in different stages in the FLC.

Dierickx and Cool (1989) point out that imitation of resources depends on how easily these resources can be replicated or substituted. To protect these resources from being imitated, substituted or bid away to competitors, firms usually “build” or “accumulate” resources of their own to form a resource base that is non-tradable, non-imitable and non-substitutable. This building or accumulation process suggests that the resource base is the *cumulative* result of making appropriate strategic choices about investment and financing activities in accordance with a set of consistent systems, policies or knowledge (i.e., capabilities) over a period of time. It also suggests that while strategic choices can be adjusted in the short run, the resource base cannot. Thus, firms who are the first movers to accumulate resources will be less subject to the threat of imitation.

2.4. Organization capital as a determinant of FLC

Recent empirical studies in finance and accounting investigate the impact of FLC on corporate financial decisions. These studies demonstrate the role of FLC in determining financial structure (Bender and Ward, 1993; Berger and Udell, 1998), dividend payout policy (e.g. DeAngelo et al., 2006; Fama and French, 2001), secondary equity offerings (DeAngelo et al., 2010), cash holdings (Faff et al., 2016), acquisition rate and corresponding benefits (Arikan and Stulz, 2016), firm risk taking (Habib and Hasan, 2017), the cost of capital (Hasan et al., 2015), and restructuring strategies during financial distress (Koh et al., 2015). Despite the research effort to understand the role of FLC in affecting corporate financial decisions, no study to date has examined how FLC is influenced by firm's organization capital, one source of a sustainable resource base.

The discussion in previous sections reveals that organization capital, in terms of organization structure, culture, management processes and practices, harmonizes physical and human capital to improve production efficiency and enhance a firm's ability to react and adapt to ever-changing business environments. This is because organization capital, in the course of accumulation, stores, retains, integrates and institutionalizes knowledge regarding business process, practice and system within databases, documents, patents and manuals (Wright et al., 2001), so that it becomes a critical resource base for a firm. Thus, given that organization capital is a valuable resource base and source of sustainable competitive advantage, and that FLC is driven by the accumulation of firm-specific resources, we argue that the accumulation of firm-specific knowledge, practices, processes and overall systems is the driving force that can explain a firm's situation in, and progression across, life cycle stages.

2.5. Hypothesis development

Dickinson (2011) develops a parsimonious firm-specific life cycle measure by deploying data from the firm's cash flow statement. She argues that cash flows capture differences in a firm's profitability, growth and risk and, hence, one may use cash flow from operating (OANCF), investing (IVNCF) and financing (FINCF) to group firms into life cycle stages such as ‘introduction’, ‘growth’, ‘maturity’, ‘shake-out’ and ‘decline’.[7] The methodology is based on the following cash flow pattern:

(1) introduction: if $OANCF < 0$, $IVNCF < 0$ and $FINCF > 0$;
(2) growth: if $OANCF > 0$, $IVNCF < 0$ and $FINCF > 0$;
(3) maturity: if $OANCF > 0$, $IVNCF < 0$ and $FINCF < 0$;
(4) decline: if $OANCF < 0$, $IVNCF > 0$ and $FINCF \leq$ or ≥ 0; and
(5) shake-out: the remaining firm years will be classified under the shake-out stage.

[7] For a detailed justification of classifying firms into different life cycle stages based on cash flow statement data, see Dickinson (2011).

Introduction stage firms lack an established customer base and suffer from knowledge deficits about potential revenues, costs and industry dynamics (Jovanovic, 1982). Time compression diseconomies and asset mass efficiencies prompt firms at this stage to invest more to develop a sustainable resource base in order to deter potential entrants (Spence, 1977, 1979). A&K (2005) suggest that owners incur substantial expenditure in organization capital in the initial stage of a plant's life cycle so that they may reap organization rents in the future. As a result, firms in the introduction stage incur substantial costs in developing organization practices, processes, systems, structures, capacities, and employee skills (Pérez et al., 2004), most of which are operation-related expenses rather than capital-related expenditures. Thus, the lack of established customers and knowledge base, and the substantial cost incurred for organization capital, result in negative operating cash flows (i.e., OANCF < 0) for introduction-stage firms.[8] Introduction-stage firms also need to decide on financing their operations. Note that the negative operating cash flows problem in introduction firms implies that these firms cannot access sufficient internally-generated funds to finance their business operations, resulting in a higher external financing need and, hence, a positive cash flow from financing (i.e., FINCF > 0). It is not uncommon for introduction firms to have a negative cash flow from investing activities (i.e., IVNCF < 0), as they invest in long term growth. However, owing to resource and external finance constraints,[9] firms in this stage may find it attractive to substitute alternative forms of productive physical resources with organization capital (Carlin et al., 2012; Cui and Mak, 2002), because investment in organization capital can solve their knowledge deficit problems effectively. In short, the cash flow pattern (OANCF < 0, IVNCF < 0 and FINCF > 0) with more organization capital makes these firms a suitable candidate to be in the introduction stage.

H1. Firms with high organization capital are likely to be in the introduction stage.[10]

Firms in the growth stage of the life cycle are characterized by a dramatic increase in sales and in the number of products, while firms in the maturity stage are characterized by sales stabilization and acute market competition. Growth (mature) firms have already overcome the 'liability of newness' and initial exit probabilities and, therefore, have modest (adequate) knowledge regarding their competitiveness and can focus more on product modification and improvement (product differentiation). The accumulated organization capital helps growth and mature firms to achieve productivity, growth and competitiveness. Moreover, due to the effect of asset mass efficiencies and interconnectedness, growth and maturity firms have less incentive to invest substantially in their resource base. In particular, the (high) initial cost incurred in the introduction stage of the life cycle for developing organization capital is not re-incurred in the growth and maturity stages as management processes, practices and know-how are reused in business operations (OECD, 2012). Cohen and Levinthal (1990, p. 131) note that, "the ability to assimilate information is a function of the richness of the pre-existing knowledge structure: learning is cumulative, and learning performance is greatest when the object of learning is related to what is already known". Miyagawa and Kim (2008) note that, "the conventional total factor productivity (TFP) growth rate decreases when investment in organization capital increases rapidly. After organization capital is sufficiently accumulated, it starts to contribute to conventional TFP growth". A&K (2005) suggest that firms in the growth and maturity stages concentrate to reap the benefits from the existing stock of organization structure, processes, practices and corporate culture. Therefore, increased efficiency in production and sales resulting from the existing organization capital, but reduced costs incurred for organization capital, leads growth- and maturity-stage firms to generate positive operating cash flow (i.e., OANCF > 0).

Growth-oriented firms attempt to expand operation to capitalize on the benefits from existing resources (e.g., business practices, processes, designs, culture, know-how etc.). Wernerfelt (1985) shows that in the presence of learning curves, declining price sensitivity, and declining growth rates, growth maximization early in the life cycle can be a means of profit maximization. In achieving this objective, firms in the growth stage focus more on investment in physical assets and in the efficient use of capabilities and resource-base (Hambrick et al., 1982). In the maturity stage, firms also continue to invest in physical assets as some of these assets become obsolete (Wernerfelt, 1985). Thus, for both growth- and maturity-stage firms, investing cash flow is expected to be negative (i.e., IVNCF < 0).

Growth firms continue to resort to debt financing for capital investment, and further growth and development, resulting in positive financing cash flow (i.e., FINCF > 0). On the contrary, limited growth opportunities in the maturity-stage prompts firms to focus on debt servicing and distribution of excess funds among shareholders (i.e., FINCF < 0). In sum, firms in the growth and maturity stages do not invest further in organization capital; rather, they tend to invest more in tangible assets, and maximize the benefits from existing organization capital. Therefore, the resulting cash flow patterns ((OANCF > 0, IVNCF < 0 and FINCF > 0) and (OANCF > 0, IVNCF < 0 and FINCF < 0)) make these firms suitable candidates to be in the growth and maturity stages, respectively.

H2. Firms with low organization capital are more likely to be in the growth and maturity stages.

Firms in the decline stage are characterized by very low or negative profit margins, low levels of efficiency and low capacity utilization (Dickinson, 2011). In this stage, other firms begin to adopt and improve upon the innovating entrepreneur's new idea and, hence, firms' competitive advantage in terms of resource base and organization capital begins to decline (Mueller, 1972), owing to the asset erosion effect and/or the asset substitution effect. If firms cannot match their innovation and business process,

[8] Consistent with this view, the Return on Equity (ROE) of introduction-stage firms is negative in our sample.

[9] Most of the assets are firm-specific or intangible and, thus, cannot be pledged as collateral (Denis, 2004).

[10] As Dickinson (2011) remarks, the literature clearly spells out the cash flow pattern of the different stages of the life cycle except for the shake-out stage. As a result, the impact of organization capital in shaping this stage is unclear. Thus, we use the shake-out stage as a basis for developing hypotheses and interpreting the impact of organization capital in determining the other stages of the life cycle. In the robustness check, we use other life cycle stages as benchmark.

practice and culture with that of competitors, the functioning of the firms becomes irrelevant to the innovative activities of the other firms in the market. The '*liability of senescence*' phenomenon also suggests that decline firms face a relatively high likelihood of exiting the market owing to their internal inefficiencies, erosion of technology, products, business concepts and management strategies over time. We argue that investment in organization capital helps decline firms to overcome such limitations, and to strengthen their existing business practice, processes, culture and network (Dickinson, 2011; Habib and Hasan, 2017). Sørensen and Stuart (2000, p. 82) also note that "older firms may innovate more frequently, and their innovations may have greater significance than those of younger enterprises". Thus, poor sales performance, together with an increased emphasis on reformulating organization capital, results in negative operating cash flow (i.e., OANCF < 0). On the other hand, the liquidation of assets to service debt and support operations results in positive cash flows from investment (i.e., IVNCF > 0).[11] Moreover, decline firms may focus on debt repayment and/or the renegotiation of debt to finance investment in organization capital and to meet other costs, leading cash flow from financing activities to be positive or negative (FINCF ≥ 0 or FINCF ≤ 0). In sum, since organization capital strengthens the outdated business practice, process and culture, and reinforces the lost efficiency and productivity, firms with declining sales, profitability, productivity and market share are likely to increase their stock of organization capital. Therefore, we conjecture that firms with a high stock of organization capital are more likely to be in the decline stage, leading to the following hypothesis:

H3a. Firms with high organization capital are likely to be in the decline stage.

Other studies, however, show that firms can enter the decline stage from any other stage. The '*liability of newness*' phenomenon (Freeman et al., 1983; Jovanovic, 1982) suggests that initial endowments (monetary resources, technological or managerial capability, etc.) interact with mortality rates. Thus, young and growth-stage firms that succumb to initially high mortality rates may switch from the growth stage to the decline stage. Firms in this stage prefer to distribute the earnings among investors, rather than investing in future growth (DeAngelo et al., 2006). Thus, firms with low levels of organization capital are likely to be in the decline stage.

H3b. Firms with low organization capital are likely to be in the decline stage.

We, so far, take a 'static view' to link organization capital with firm life cycle stages. However, extant studies indicate that organization capital integrates the human skills and physical capital that enable the firm to achieve efficient production and a stable business operation, both of which then lead to higher productivity (Black and Lynch, 2005) and better *future* firm performance (Attig and Cleary, 2014; Evenson and Westphal, 1995; Lev et al., 2009). The foreseeable future benefits stemming from organization capital have the potential to cause firms to move to other favorable life cycle stages progressively: the 'dynamic view' of organization capital.

Since organization capital, as a resource base, allows firms to strengthen their capabilities that integrate, build, and reconfigure internal and external competencies to address rapidly changing environment (Teece et al., 1997), and helps them attain superior long-term performance and, thus, to earn above-average profits in the future (A&K, 2005; Wernerfelt, 1984), we contend that, regardless of their initial stage(s), firms investing more in organization capital are less (more) likely to move to introduction, or shakeout or decline (growth or maturity) stages in the future.

H4. Firms that invest more in organization capital are less (more) likely to move to introduction or shake-out or decline (growth or mature) stages in the future.

3. Research design

3.1. Sample and data

Our sample includes all non-financial firms (excluding SIC 6000–6799) traded on NYSE, AMEX and NASDAQ (EXCHG = 11, 12 and 14) that are available from the Compustat fundamentals annual file from 1987 to 2016 and that have the required financial information.[12] Our sample period begins in 1987 because, prior to that year, cash flow data required to estimate the life cycle are unavailable.[13] To avoid the undesirable influence of outliers, we winsorize key variables at the 1st and 99th percentiles. Variable definitions are presented in Appendix A.

Panel A of Table 1 shows that there are 334,729 firm-year observations initially within the sample. The exclusion of financial firms (89,267 firm years), firms listed outside NYSE, AMEX and NASDAQ (116,518 firm years), firms for which financial data are not available in USD (3386 firm years), and firms with missing values for the variables used in the regression model (51,116 firm years) yields a final sample size of 74,442 firm-year observations. The number of observations in any given regression varies depending on the model-specific data requirements.

[11] It is worth noting that investment in organization capital, in an accounting sense, results in an increase in expenses (especially SG&A) but not in an increase in assets.
[12] We follow the sample selection procedure of Eisfeldt and Papanikolaou (2013).
[13] Since 1987, firms have been required to disclose cash flow data under the Statement of Financial Accounting Standards No. 95 (SFAS 95 (1987)).

Table 1
Sample selection and distribution of the sample.

Panel A: Data and Sample

Description	Total number of observations
Data available in COMPUSTAT fundamentals annual file from 1987 to 2016	334,729
Less:	
Financial firms	(89,267)
	245,462
Firms listed outside NYSE, AMEX and NASDAQ	(116,518)
	128,944
Firms for which financial data are not available in USD	(3386)
	125,558
Firms with missing values for the variables used in the regression model	(51,116)
Final sample (firm years)	74,442

Panel B: Industry Distribution

Industry name	Total Number of Observations	% of Observations
Consumer nondurables	5100	6.85
Consumer durables	2200	2.96
Manufacturing	10,764	14.46
Oil, gas and coal extraction and products	4511	6.06
Chemicals and allied products	2594	3.48
Business equipment	18,834	25.3
Telephone and television transmission	2517	3.38
Utilities	271	0.36
Wholesale, retail and some services	9239	12.41
Healthcare, medical equipment and drugs	7752	10.41
Other	10,660	14.32
Total	74,442	100.00%

Table 1, Panel B reports the distribution of the sample by the Fama-French 12 industry groups. The sample is unevenly distributed across industries, with the business equipment and manufacturing industries being dominant at 25.30% and 14.46% respectively.

3.2. Empirical model

We test the relation between organization capital and FLC using a multinomial logistic regression model. Multinomial logistic regression is suitable, because the dependent variable (i.e., FLC) is a categorical variable which contains a set of mutually exclusive and unordered categories. Suppose that our data comprises a set of n ($i = 1, \ldots, n$) independent firms, where the ith firm consists of T_i observations. Let Y_{it} denote the t^{th} life cycle stage in firm i ($t = 1, \ldots, T_i$), where this life cycle stage is from one of r ($r = 1, \ldots, R$) distinct categories. Further, x_{it} denotes a column vector of p independent variables for the tth observation in the ith firm.

Our multinomial logistic model is specified as follows:

$$log\left(\frac{\pi_{itr}}{\pi_{it1}}\right) = \alpha_r + x'_{it}\beta_r + u_{ir}, \quad r = 1\ldots, R \tag{1}$$

where $\pi_{itr} = Pr\ (Y_{it} = \text{r})$ are the probabilities of firm i in the rth stage of FLC in year t; α_r are constant terms; β_r is a p-vector of regression coefficients that captures the impact of regressors x_{ij}; and u_{ir} is the error term that follows a multivariate normal distribution with zero mean and variance-covariance matrix Σ. Two groups of regressors are included in x_{ij}; they are our main variable of interest $OC_{i,\ t}$ and a set of control variables that are known to be determinants of FLC. These control variables include firm size (SIZE), market to book value (MTB) ratio, capital structure (LEV), firm profitability (ROE), sales growth ($\Delta SALES_{i,\ t}$), capital expenditure (CAPEX), firm age (AGE), asset turnover (ATO), and investment in advertising (ADVERT) and R&D (R&D).[14] We predict the coefficient of $OC_{i,\ t}$ to be positive for H1 but negative for H2.

The likelihood function of firm i is,

$$l(\alpha_r, \beta_r, \Sigma) = \int_{-\infty}^{+\infty} \left\{ \prod_t^{T_i} \left[\frac{exp(\alpha_r + x'_{it}\beta_r + u_{ir})}{\sum_q^R exp\left(\alpha_q + x'_{it}\beta_q + u_{iq}\right)} \right]^{I(Y_{it}=r)} \right\} f_u(u_i, \Sigma)\text{du}_\text{i} \tag{2}$$

where $I(.)$ is an indicator function and $f_u(u_i, \Sigma)$ is the multivariate normal density. The overall likelihood function is the product of

[14] See Section 3.5 for a discussion of why these control variables are relevant.

the above likelihood function from each firm and cannot be solved in closed form. As a result, maximum likelihood estimation of the parameters is done via numerical integration.

To identify the parameters (namely, α_r, β_r, and Σ), we impose a normalization by restricting $\alpha_4 = 0$, $\beta_4 = 0$, and $u_{i4} = 0$, so that the interpretation of parameters is with reference to the fourth category (i.e., shake-out stage). The shake-out stage is chosen because its role in the life cycle is ambiguous in theory (Dickinson, 2011).

Note that because of the normalization, the parameters so estimated are generally not directly interpretable. For example, a negative coefficient on x_{it} does not imply that a decrease in x_{it} reduces the probability that firm i is in a particular FLC stage. Instead, the marginal effect (ME) can be computed for firm i for the rth stage of firm life cycle and regressor k, and is defined as follows:

$$ME_{irk} = \frac{dPr(Y_{it} = r)}{dx_{ik}} \tag{3}$$

Since there are five stages with Dickinson's (2011) firm cycle measure, five corresponding marginal effects can be computed. These marginal effects capture, as their definition implies, the extent to which a one-unit change in regressor k increases or decreases the probability of firm i being in the rth stage of FLC.

3.3. Dependent variables: FLC proxies

We follow Dickinson (2011) to develop proxies for the firms' stage in the life cycle.[15] The identification of life cycle stages based on Dickinson (2011) combines the implications from diverse research areas such as production behavior, learning/experience, investment, market share and entry/exit patterns. As a result, this process can capture the performance and the allocation of the firm's resources. We classify firms into different FLCs based on the following cash flow pattern:

(1) introduction: if OANCF < 0, IVNCF < 0 and FINCF > 0;
(2) growth: if OANCF > 0, IVNCF < 0 and FINCF > 0;
(3) maturity: if OANCF > 0, IVNCF < 0 and FINCF < 0;
(4) decline: if OANCF < 0, IVNCF > 0 and FINCF ≤ or ≥ 0; and
(5) shake-out: the remaining firm years will be classified under the shake-out stage.

We also use DeAngelo et al.'s (2006) life cycle proxies as alternative measures in the robustness section of the study.

3.4. Independent variable: organization capital

We follow the methodology of Eisfeldt and Papanikolaou (2013) to estimate organization capital based on selling, general and administrative (SG&A) expenses. Eisfeldt and Papanikolaou (2013, p. 1380) argue that "a large part of SG&A consists of expenses related to labor and IT (white collar wages, training, consulting, and IT expenses), consistent with the idea that any accrued value will be somewhat firm specific…" Lev et al. (2009) also argue that SG&A expenses include costs relating to developing information systems, employee training, R&D, consultant fees and brand promotion, which aid in building organization capital.

We construct organization capital based on the perpetual inventory method.[16] More specifically, we calculate the stock of organization capital (OC) each year by accumulating the deflated value of SG&A expenses based on the following equation:

$$OC_{i,t} = OC_{i,t-1}(1-\delta_0) + \frac{SGA_{i,t}}{cpi_t} \tag{4}$$

where $OC_{i,\ t}$ (and δ_0) denote the firm-specific stock of organization capital at time t (and depreciation rate of OC), while SGA and cpi_t are the SG&A expenses and consumer price index, respectively.

The initial stock of organization capital is estimated as

$$OC_{i,t_0} = \frac{SGA_{i,t_0}}{g + \delta_0}, \tag{5}$$

where t_0 = initial year for the firm in the sample. Following Eisfeldt and Papanikolaou (2013), we use a depreciation rate (δ_0) of 15%. Hall and Mairesse (1995), Zhang et al. (2012) and the Bureau of Economic Analysis also use this rate in the estimation of R&D capital. Growth (g) in the flow of organization capital is estimated as the average real growth of firm-level SG&A expenses, which is 10.31% in our estimates. We replace missing values of SG&A with zero.

[15] Anthony and Ramesh (1992) provide one of the first empirical procedures for classifying firms in different LCS. However, we do not use their method for three reasons: (1) a life cycle classification based on Anthony and Ramesh (1992) requires a five year history of variables, removing true "introduction stage" firms from the sample. Thus, no data (and as such, no meaningful analysis) on introduction stage firms are available; (2) Dickinson (2011) has shown that the life cycle classification based on the Anthony and Ramesh (1992) procedure leads to an erronous classification of the stage of firms in the life cycle; (3) this classification procedure is 'ad hoc' and relies on portfolio sorts to classify the firm into different life cycle stages.

[16] Eisfeldt and Papanikolaou (2013) use a similar process to construct the stock of organization capital. Moreover, Zhang et al. (2012) and the Bureau of Economic Analysis use a similar methodology to construct R&D stock.

In Section 4.4.3 we also use the Peters and Taylor (2017) and Lev et al. (2009) approach to measure organization capital in order to check the robustness of the result.

3.5. Control variables

We include firm-specific, and industry and economy-specific control variables that influence FLC stages. Prior studies (e.g., Mata and Portugal, 1994; Pérez et al., 2004) suggest that large firms enjoy better access to capital and labor markets and this advantage, in turn, improves the possibility of firms' survival and growth. On the contrary, small firms suffer from the *liability of newness* and *liability of smallness*, which increase their exit probability (Pérez et al., 2004). Hence, we control for firm size (SIZE) in the regression model. FLC stages depend on the growth and progress of the firm. Growth opportunities are plenteous in the introduction and growth stages, while limited in the maturity and decline stages (Dickinson, 2011). We control for firm growth by using the market to book value (MTB) ratio. The availability of capital at favorable terms and rates also affects a firm's ability to grow and expand its operations (Diamond and Verrecchia, 1991). Therefore, we control for a firm's capital structure (LEV). Profitability is frequently used in the context of life cycle analysis (Anthony and Ramesh, 1992). Since profitability conveys an important signal about a firm's position in the life cycle, we control for firm profitability (ROE). Anthony and Ramesh (1992) argue that a firm maximizes revenue growth in the early stages of its life cycle, to create permanent cost or demand advantages over competitors. They also note that in the maturity stage market growth slows and investments are less rewarding. Therefore, in the regression model, we also control for sales growth ($\Delta SALES_{i,\ t}$) and capital expenditure (CAPEX). Prior studies provide inconclusive evidence regarding the effect of a firm's age on survival possibility. Pérez et al. (2004) suggest that both younger and older firms face a higher hazard of exit. Dickinson (2011) documents that a firm's age is usually at its maximum in the maturity stage and at its minimum in the introduction and decline stages. We measure firm age (AGE) as the number of years since the firm's first appearance in the CRSP database. Asset turnover (ATO) reflects firms' capacity utilization, which forms a basis of competitive advantage and, thus, influences firms' stage in the life cycle. The study of Selling and Stickney (1989) suggests that product-differentiating firms concentrate on R&D, advertising and capacity growth, all of which are functions of business strategy and competitiveness. Dickinson (2011) also finds that advertising intensity and R&D are more pronounced in early-stage firms. The RBV of the firm (Barney, 1991; Wernerfelt, 1984) also posits that a firm's survival greatly depends on its ability to develop specific capabilities, which may be improved by investing in R&D. To control for these determinants, we explicitly use a firm's investment in advertising (ADVERT) and R&D (R&D).[17] Firms belonging to different industries may experience different rates of growth and development, which affect their life cycle transition processes. Hence, we control for industry effect. We also control for year effect to address the concern that firms' life cycles may be adversely (favorably) affected by economic recession (expansion).

4. Results and discussion

4.1. Descriptive statistics

Table 2 presents the descriptive statistics for the variables included in the recession estimates. Panel A shows that the mean (median) value of organization capital as a proportion of total assets (i.e., OC/TA) and organization capital as a proportion of property, plant and equipment (i.e., OC/PPE) are 1.750 (1.281) and 7.306 (3.659), respectively. Panel A also reveals that, on average, OC/TA and OC/PPE are higher in the introduction, shake-out and decline stages, compared with the growth and maturity stages.[18] Consistent with the data of Eisfeldt and Papanikolaou (2013), our statistics also reveal that high OC/TA and OC/PPE firms tend to have higher intangible capital of other forms (such as ADVERT and R&D). The mean values of MTB, AGE, ROE, SIZE, ADVERT and R&D across the life cycle stages are also largely consistent with those of Dickinson (2011). Further analysis reveals that SIZE, ROE and AGE increase progressively as firms move from the introduction to the maturity stage and that these estimates then drop as firms move from the maturity to the decline stage; the opposite pattern is observed for R&D and ADVERT.

Table 2, Panel B reveals that the introduction, shake-out and decline stages are correlated positively (at $p < 0.001$) with the organization capital (OC/TA and OC/PPE), while growth and maturity stages are correlated significantly and negatively (at $p < 0.001$) with the organization capital. Moreover, SIZE and ROE are correlated negatively (positively) ($p < 0.001$) with the introduction, shake-out and decline (growth and maturity) stages, while ΔSALE is correlated positively (negatively) ($p < 0.001$) with the introduction and growth (maturity, shake-out and decline) stages. Overall, the correlations among organization capital, the life cycle proxies and the control variables are all in the expected directions and, thus, provide strong univariate support for the validity of our key measures and constructs.

[17] In the regression model, we do not control for intangibles explicitly, as the MTB variable is highly correlated with intangibles ($\rho = 0.77$). Brynjolfsson et al. (2002) and Edmans (2011) note that the market value of a firm may differ markedly from the value of its tangible assets alone, as investors attempt to incorporate intangible assets into their valuations of firms. In other words, MTB incorporates, not only anticipated growth opportunities, but also intangible assets.

[18] Unreported analysis of the dynamics of OC and TA also confirms that the OC median is typically higher than the TA median, over time, in the introduction, shake-out and decline stages compared with the growth and maturity stages. The results are available upon request.

Table 2
Descriptive statistics.

Panel A: Pooled and Life Cycle-wise Descriptive Statistics

Variables	Statistics	Pooled	Introduction	Growth	Maturity	Shake-out	Decline
OC/TA	Mean	1.750	2.469	1.467	1.660	1.931	2.544
	Median	1.281	1.722	1.080	1.273	1.364	1.817
	Standard Deviation	1.771	2.441	1.509	1.549	1.982	2.382
OC/PPE	Mean	7.306	12.950	6.019	5.570	9.746	15.019
	Median	3.659	7.464	2.977	3.062	5.159	8.608
	Standard Deviation	12.300	18.157	9.933	8.904	15.650	20.533
SIZE	Mean	5.829	4.566	5.969	6.254	5.360	4.613
	Median	5.782	4.463	5.974	6.272	5.254	4.578
	Standard Deviation	2.140	1.687	1.925	2.239	2.168	1.637
MTB	Mean	2.962	3.680	3.159	2.790	2.423	2.829
	Median	2.034	2.201	2.230	1.978	1.635	1.709
	Standard Deviation	4.188	5.889	3.933	3.862	3.839	4.748
LEV	Mean	0.249	0.303	0.322	0.212	0.166	0.153
	Median	0.191	0.221	0.270	0.179	0.079	0.049
	Standard Deviation	0.271	0.334	0.319	0.207	0.222	0.232
ROE	Mean	0.104	−0.238	0.158	0.200	0.041	−0.278
	Median	0.141	−0.114	0.165	0.184	0.066	−0.206
	Standard Deviation	0.713	1.168	0.540	0.601	0.700	1.008
ΔSALE	Mean	0.168	0.356	0.263	0.084	0.061	0.130
	Median	0.085	0.144	0.161	0.059	0.016	−0.003
	Standard Deviation	0.482	0.858	0.484	0.257	0.440	0.742
CAPEX	Mean	0.072	0.073	0.109	0.057	0.035	0.032
	Median	0.044	0.039	0.067	0.042	0.023	0.019
	Standard Deviation	0.090	0.103	0.123	0.053	0.041	0.042
AGE	Mean	2.525	2.087	2.375	2.751	2.592	2.226
	Median	2.580	2.088	2.403	2.852	2.647	2.217
	Standard Deviation	0.905	0.866	0.894	0.867	0.880	0.826
ATO	Mean	1.299	1.384	1.345	1.352	1.053	0.840
	Median	1.102	1.106	1.145	1.168	0.877	0.663
	Standard Deviation	0.917	1.133	0.933	0.868	0.793	0.739
ADVERT	Mean	0.014	0.023	0.012	0.013	0.014	0.019
	Median	0.000	0.000	0.000	0.000	0.000	0.000
	Standard Deviation	0.045	0.078	0.039	0.034	0.043	0.069
R&D	Mean	0.274	0.670	0.266	0.119	0.321	0.828
	Median	0.005	0.083	0.000	0.000	0.023	0.288
	Standard Deviation	1.046	2.127	0.815	0.367	1.029	2.173
	N	74,442	7505	23,388	32,798	7169	3582
	% of total N	100%	10.08%	31.42%	44.06%	9.63%	4.81%

Panel B: Correlation Matrix

Variables	Introduction	Growth	Maturity	Shake-Out	Decline	RE/TA	RE/TE
OC/TA	0.136	−0.108	−0.045	0.033	0.101	−0.406	−0.179
OC/PPE	0.019	−0.012	−0.019	*0.007*	0.033	−0.046	−0.022
SIZE	−0.198	0.044	0.176	−0.072	−0.128	0.234	0.153
MTB	0.057	0.032	−0.037	−0.042	−0.007	−0.066	−0.372
LEV	0.067	0.183	−0.118	−0.100	−0.079	−0.053	0.036
ROE	−0.161	0.052	0.119	−0.029	−0.121	0.209	0.409
ΔSALE	0.131	0.134	−0.154	−0.072	−0.018	−0.085	−0.037
CAPEX	*0.005*	0.282	−0.144	−0.134	−0.100	0.046	0.035
AGE	−0.162	−0.112	0.221	0.024	−0.074	0.138	0.098
ATO	0.031	0.033	0.051	−0.088	−0.113	0.063	0.060
ADVERT	0.066	−0.029	−0.022	*−0.005*	0.026	−0.032	*−0.006*
R&D	0.120	−0.016	−0.116	0.019	0.108	−0.308	−0.131

Variable definitions are provided in Appendix A.
All numbers except those in *italics* are significant at $p < 0.001$.

4.2. Life cycle-wise mean difference of organization capital: HSD test and TK test

Table 3 exhibits the pair-wise comparison of organization capital for different life cycle stages. We perform an ANOVA test followed by Tukey's HSD (honest significant difference) and the Tukey–Kramer (TK) method to determine whether the mean organization capital for the various pair-wise relationships are significantly different from each other (Tukey, 1949). This table shows that the mean level of organization capital (both OC/TA and OC/PPE) decreases significantly from the introduction to the growth stage, from the introduction to the maturity stage, and from the introduction to the shake-out stage. However, the mean level of organization capital increases significantly from the introduction to the decline stage, from the growth to the

Table 3
Mean difference test of organization capital.

Mean Difference Test of Organization Capital Using Dickinson (2011)'s Life Cycle Measure					
Estimates	(Stage 1)	(Stage 2)	Mean difference	HSD-test[a]	TK-test[a]
	Introduction	Growth			
OC/TA	2.469	1.467	−1.002	51.556*	61.453*
OC/PPE	12.9503	6.0186	−26.048	51.695*	61.687*
	Introduction	Maturity			
OC/TA	2.469	1.660	−0.809	41.622*	51.437*
OC/PPE	12.9503	5.5703	−26.048	55.038*	68.090*
	Introduction	Shake-out			
OC/TA	2.469	1.931	−0.537	27.669*	26.523*
OC/PPE	12.9503	9.7461	−3.743	23.896*	22.886*
	Introduction	Decline			
OC/TA	2.469	2.544	0.074	3.815	2.971
OC/PPE	12.9503	15.0185	8.329	15.425*	12.007*
	Growth	Maturity			
OC/TA	1.467	1.660	0.193	9.934*	18.354*
OC/PPE	6.019	5.570	−0.448	3.344*	6.193*
	Growth	Shake-out			
OC/TA	1.467	1.931	0.464	23.856*	27.945*
OC/PPE	6.019	9.746	3.727	27.798*	32.570*
	Growth	Decline			
OC/TA	1.467	2.544	0.077	55.371*	48.800*
OC/PPE	6.019	15.019	9.000	67.119*	59.132*
	Maturity	Shake-out			
OC/TA	1.660	1.931	0.271	13.923*	16.886*
OC/PPE	5.570	9.746	4.176	31.142*	37.778*
	Maturity	Decline			
OC/TA	1.660	2.544	0.884	45.437*	40.831*
OC/PPE	5.570	15.019	9.448	70.463*	63.290*
	Shake-out	Decline			
OC/TA	1.931	2.544	0.613	31.515*	24.356*
OC/PPE	9.746	15.019	5.273	39.321*	30.369*

Variable definitions are provided in Appendix A.
[a] For both Tukey HSD (honest significant difference) pairwise comparisons and Tukey-Kramer (TK) pairwise comparisons studentized range critical value at 5% significance level is 3.858.

shake-out stage, from the growth to the decline stage, from the mature to the shake-out stage, from the maturity to the decline stage, and from the shake-out to the decline stage. Overall, the fluctuations in OC/TA and OC/PPE imply that organization capital is higher in the introduction, shake-out and decline stages but lower in the growth and maturity stages, resembling a 'U' shaped pattern.

4.3. Regression analysis

4.3.1. Organization capital and FLC

Table 4 reports the multinomial logistic regression results and associated marginal effect for the association between organization capital (OC/TA and OC/PPE) and Dickinson's (2011) life cycle proxies. As there are five life cycle stages with the dependent variable and we are interested in finding out the likelihood of observing a firm in a particular stage, we create five categorical variables for each life cycle stage (introduction = 1, growth = 2, maturity = 3, shake-out = 4 and decline = 5).

The coefficients of organization capital as a proportion of total assets (OC/TA) are positive and significant for firms in either the introduction or decline stages (both at $p < 0.01$), while they are negative and significant for those firms in the growth or maturity stages (both at $p < 0.01$). These results suggest that compared with the shake-out stage, firms with high levels of organization capital are more likely to be in the introduction and decline stages, whereas firms with less organization capital are more likely to be in the growth and maturity stages. Thus, the regression coefficients in Column 1 to Column 3 ($\beta_1 = 0.047$, -0.124 and -0.080, respectively) do not reject H1 and H2. The regression result in Column 4 ($\beta_1 = 0.109$, $p < 0.01$) reveals that firms with high levels of organization capital are likely to be in the decline stage, lending support to H3a rather than H3b.

Panel A shows that the coefficients of all the control variables have the predicted signs and statistical significance. For example, consistent with FLC theory and the empirical findings (e.g., Pérez et al., 2004; Mata and Portugal, 1994; Anthony and Ramesh, 1992; Dickinson, 2011), SIZE and ROE are positively (negatively) associated with the growth and maturity (introduction and decline) stages, implying that large and profitable (small and loss-making) firms belong to the growth and maturity (introduction and decline) stages. The negative associations of AGE with the introduction, growth and decline stages support the findings of Pérez et al. (2004) that young and old firms have higher exit possibilities. Moreover, the positive (negative) association of ΔSALE and R&D with the introduction and growth (maturity) stages is consistent with the prior empirical studies (Anthony and Ramesh, 1992; Spence, 1979).

Table 4
Regression results.

Panel A: Association between OC/TA and Life Cycle Stages

Dep. Var. =	(1) Introduction	(2) Growth	(3) Maturity	(4) Decline
OC/TA	0.047***	−0.124***	−0.080***	0.109***
	[4.49]	[−12.04]	[−8.46]	[9.62]
SIZE	−0.229***	0.139***	0.181***	−0.189***
	[−20.60]	[15.88]	[22.09]	[−13.85]
MTB	0.026***	−0.002	−0.011**	0.003
	[5.23]	[−0.38]	[−2.47]	[0.51]
LEV	2.714***	2.558***	0.588***	0.760***
	[31.50]	[32.30]	[7.52]	[6.39]
ROE	−0.395***	0.073***	0.277***	−0.420***
	[−14.51]	[2.84]	[10.90]	[−13.33]
ΔSALE	0.627***	0.454***	−0.186***	0.410***
	[12.81]	[9.53]	[−3.70]	[7.56]
CAPEX	17.381***	19.504***	11.496***	4.269***
	[35.82]	[41.81]	[24.85]	[5.80]
AGE	−0.530***	−0.222***	0.004	−0.349***
	[−23.16]	[−11.74]	[0.21]	[−12.38]
ATO	0.332***	0.594***	0.556***	−0.787***
	[11.41]	[22.71]	[21.95]	[−17.28]
ADVERT	1.363***	−0.980**	−0.738**	1.005**
	[3.52]	[−2.56]	[−2.00]	[2.33]
R&D	0.070***	0.051***	−0.218***	0.053***
	[10.10]	[7.32]	[−20.00]	[7.36]
Constant	0.291	−1.361***	−0.685**	1.547***
	[0.71]	[−3.93]	[−2.09]	[3.21]
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Pseudo R^2				0.168
Observations	74,442	74,442	74,442	74,442
Number of firms	7050	7050	7050	7050

Marginal Effect – OC/TA	Delta-method dy/dx	Std. Err.	Z	P > Z
Introduction	0.009	0.000	15.66	0.000
Growth	−0.016	0.001	−12.19	0.000
Maturity	−0.004	0.001	−3.31	0.001
Shake-out	0.005	0.001	7.04	0.000
Decline	0.006	0.000	17.28	0.000

Panel B: Association between OC/PPE and Life Cycle Stages

Dep. Var. =	(1) Introduction	(2) Growth	(3) Maturity	(4) Decline
OC/PPE	0.004***	−0.009***	−0.014***	0.005***
	[2.86]	[−6.61]	[−10.46]	[3.57]
SIZE	−0.241***	0.158***	0.188***	−0.223***
	[−22.21]	[18.41]	[23.40]	[−16.68]
MTB	0.026***	−0.003	−0.012**	0.006
	[5.30]	[−0.65]	[−2.57]	[1.05]
LEV	2.702***	2.565***	0.571***	0.686***
	[31.30]	[32.34]	[7.28]	[5.71]
ROE	−0.409***	0.080***	0.289***	−0.466***
	[−14.75]	[3.07]	[11.14]	[−14.57]
ΔSALE	0.624***	0.517***	−0.129**	0.375***
	[12.65]	[10.79]	[−2.56]	[6.81]
CAPEX	17.108***	18.971***	10.739***	4.390***
	[35.18]	[40.55]	[23.13]	[5.97]
AGE	−0.512***	−0.258***	−0.023	−0.314***
	[−22.43]	[−13.66]	[−1.28]	[−11.12]
ATO	0.349***	0.525***	0.520***	−0.677***
	[12.53]	[20.93]	[21.39]	[−15.47]
ADVERT	1.273***	−1.242***	−0.610	0.982**
	[3.28]	[−3.22]	[−1.64]	[2.27]
R&D	0.068***	0.053***	−0.202***	0.051***
	[9.27]	[7.07]	[−17.90]	[6.70]

(continued on next page)

Table 4 *(continued)*

Panel B: Association between OC/PPE and Life Cycle Stages

	(1)	(2)	(3)	(4)
Dep. Var. =	Introduction	Growth	Maturity	Decline
Constant	0.340	−1.379***	−0.614*	1.635***
	[0.84]	[−3.98]	[−1.87]	[3.39]
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Pseudo R^2				0.167
Observations	74,205	74,205	74,205	74,205
Number of firms	7030	7030	7030	7030

Marginal Effect – OC/PPE	Delta-method			
	dy/dx	Std. Err.	Z	P > Z
Introduction	0.0009	0.000	12.41	0.000
Growth	−0.0002	0.000	−0.78	0.434
Maturity	−0.0020	0.000	−8.85	0.000
Shake-out	0.0007	0.000	7.97	0.000
Decline	0.0005	0.000	10.07	0.000

This table estimates Eq. (1) on the sample partitioned by life cycle stage as defined in Dickinson (2011). The indicator for the shake-out stage is omitted and thus the intercept term captures the effect of the shake-out stage. Other life cycle stage coefficients are compared with the shake-out stage. *Z*-statistics are in brackets. Variable definitions are provided in Appendix A. dy/dx = marginal effect, where x = OC/TA and y = life cycle stages (introduction, growth, maturity, shake-out, and decline).

*** $p < 0.01$.

** $p < 0.05$.

* $p < 0.10$.

We also estimate the marginal effects of OC/TA from the above regression models for different stages of FLC. Tabulated results indicate that a one unit increase in OC/TA may increase the probability of firms being stayed in the introduction stage (0.9%), shake-out stage (0.5%) and decline stage (0.6%) but reduce the probability of firms remaining in the growth stage (−1.6%) and maturity stage (−0.4%), respectively.

Table 4, Panel B reports the multinomial logistic regression results for the alternative measure of organization capital (OC/PPE). Consistent with Eisfeldt and Papanikolaou (2014), we scale the stock of organization capital by property, plant, and equipment (PPE) instead of by book assets.[19] Overall, Panel B provides results that are consistent with those in Table 4, Panel A. In particular, the coefficients of organization capital as a proportion of property, plant and equipment (OC/PPE) are positive and significant in the introduction and decline stages (both at $p < 0.01$), while they are negative and significant in the growth and maturity stages (both at $p < 0.01$). The marginal effects estimated from this regression suggest that a firm with more OC/PPE is likely to be in the introduction, shake-out or decline stage, while a firm with less OC/PPE is likely to be in the maturity stage. Thus, the regression results and associated marginal effects imply that both OC/TA and OC/PPE are associated with the FLC stages significantly.

The regression and marginal effect results in Table 4 are also consistent with the theoretical and prior empirical findings. The positive and significant coefficient of the introduction stage with OC/TA and OC/PPE provides support to the argument that organization capital is directly related to the *future* productivity and efficiency of firms and, therefore, firms should invest more in the early stages of the life cycle to create sustainable competitive advantage, maximize growth opportunities and deter potential entrants (Porter, 1980; Spence, 1979). The negative and significant coefficients of the growth and maturity stages with both OC/TA and OC/PPE are in line with the argument that growth- and maturity-stage firms invest more in physical capital compared with organization capital, while simultaneously maximizing the benefit from their existing stock of organization capital. The findings of Eisfeldt and Papanikolaou (2013) that low OC/TA firms have higher investment rates in physical capital (12.6% vs. 10.1%) also lend support to our findings. The positive association between the decline stage and OC/TA (and OC/PPE) is somewhat interesting in the sense that it lends support to the argument that firms in the decline stage of the life cycle are more likely to invest in organization capital as a means of deepening or refreshing the organization process, system and know-how. This finding is also consistent with those of prior studies, e.g., Greiner (1972), that firms without adequate learning abilities can move from the later part of the success stage to the decline stage and that these crises can be solved by introducing new structures and programs that help employees revitalize them. These results largely concur with the findings of Bloom and Bloom and Van Reenen (2007) who argue that management practice influences the productivity, profitability and survival rate of an enterprise. Further, the recent findings of Lev et al. (2009) that organization capital captures fundamental efficiency attributes affecting long-term performance also support our findings.

4.3.2. Organization capital and transition of firm life cycle in subsequent years

Results in the previous section show that firms with more organization capital are likely to be in the introduction and decline stages (compared with the likelihood of being in the shake-out stage). Dickinson (2011) observes that around 57% of introduction

[19] We scale stock of organization capital (OC) by gross PPE (PPEGT). However, the results are "qualitatively" similar if OC is scaled by net PPE (PPENT).

Table 5
Organization capital and transition of firm life cycle stages in subsequent years.

Panel A: Logistic Regression – Change in Organization capital (ΔOC/TA) and Likelihood of Firms' Transition to Introduction/Shake-out/ Decline stage

Dep. Var. =	(1)	(2)	(3)	(4)	(5)
	Introduction or Shake-out or Decline t + 1	Introduction or Shake-out or Decline t + 2	Introduction or Shake-out or Decline t + 3	Introduction or Shake-out or Decline t + 4	Introduction or Shake-out or Decline t + 5
ΔOC/TA	−0.024*	−0.029**	−0.054***	−0.065***	−0.020
	[−1.71]	[−1.99]	[−3.61]	[−4.11]	[−1.16]
SIZE	−0.289***	−0.263***	−0.242***	−0.225***	−0.213***
	[−48.68]	[−42.76]	[−37.95]	[−33.73]	[−30.50]
MTB	0.025***	0.027***	0.025***	0.020***	0.020***
	[8.55]	[9.21]	[8.24]	[6.07]	[5.88]
LEV	−0.120***	−0.266***	−0.301***	−0.393***	−0.434***
	[−2.82]	[−5.86]	[−6.27]	[−7.63]	[−7.95]
ROE	−0.440***	−0.351***	−0.261***	−0.215***	−0.183***
	[−26.16]	[−20.51]	[−15.07]	[−11.96]	[−9.61]
ΔSALE	0.064***	0.145***	0.113***	0.102***	0.142***
	[2.64]	[5.78]	[4.28]	[3.65]	[4.88]
CAPEX	−2.750***	−2.550***	−2.313***	−2.243***	−1.957***
	[−16.49]	[−14.76]	[−12.87]	[−11.82]	[−9.99]
AGE	−0.137***	−0.123***	−0.120***	−0.114***	−0.089***
	[−10.64]	[−9.09]	[−8.45]	[−7.62]	[−5.59]
ATO	−0.359***	−0.292***	−0.256***	−0.215***	−0.176***
	[−23.73]	[−18.98]	[−16.13]	[−13.06]	[−10.26]
ADVERT	2.352***	1.859***	1.519***	0.987***	0.979***
	[9.85]	[7.39]	[5.68]	[3.47]	[3.32]
R&D	0.087***	0.085***	0.076***	0.066***	0.070***
	[15.81]	[14.54]	[12.56]	[10.90]	[10.59]
Constant	0.934***	0.662***	0.571**	0.553**	0.511*
	[3.99]	[2.71]	[2.27]	[2.12]	[1.89]
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.132	0.115	0.101	0.092	0.086
Observations	64,699	58,391	52,768	47,679	43,063
Marginal Effect – ΔOC/TA					
dy/dx	−0.004	−0.004	−0.008	−0.010	−0.003
Delta-method Std. Err.	0.002	0.002	0.002	0.002	0.003
Z	−1.71	−1.99	−3.62	−4.11	−1.16
P > Z	0.087	0.047	0.000	0.000	0.245

Panel B: Logistic regression – Change in Organization Capital (ΔOC/PPE) and Likelihood of Firms' transition to Introduction/Shake-out/Decline stage

Dep. Var. =	(1)	(2)	(3)	(4)	(5)
	Introduction or Shake-out or Decline t + 1	Introduction or Shake-out or Decline t + 2	Introduction or Shake-out or Decline t + 3	Introduction or Shake-out or Decline t + 4	Introduction or Shake-out or Decline t + 5
ΔOC/PPE	−0.024***	−0.023***	−0.023***	−0.016***	−0.015***
	[−8.62]	[−7.95]	[−7.54]	[−5.01]	[−4.33]
SIZE	−0.289***	−0.263***	−0.242***	−0.225***	−0.213***
	[−48.68]	[−42.76]	[−37.95]	[−33.73]	[−30.50]
MTB	0.025***	0.027***	0.025***	0.020***	0.020***
	[8.55]	[9.21]	[8.24]	[6.07]	[5.88]
LEV	−0.120***	−0.266***	−0.301***	−0.393***	−0.434***
	[−2.82]	[−5.86]	[−6.27]	[−7.63]	[−7.95]
ROE	−0.440***	−0.351***	−0.261***	−0.215***	−0.183***
	[−26.16]	[−20.51]	[−15.07]	[−11.96]	[−9.61]
ΔSALE	0.064***	0.145***	0.113***	0.102***	0.142***
	[2.64]	[5.78]	[4.28]	[3.65]	[4.88]
CAPEX	−2.750***	−2.550***	−2.313***	−2.243***	−1.957***
	[−16.49]	[−14.76]	[−12.87]	[−11.82]	[−9.99]
AGE	−0.137***	−0.123***	−0.120***	−0.114***	−0.089***
	[−10.64]	[−9.09]	[−8.45]	[−7.62]	[−5.59]
ATO	−0.359***	−0.292***	−0.256***	−0.215***	−0.176***
	[−23.73]	[−18.98]	[−16.13]	[−13.06]	[−10.26]
ADVERT	2.352***	1.859***	1.519***	0.987***	0.979***
	[9.85]	[7.39]	[5.68]	[3.47]	[3.32]
R&D	0.087***	0.085***	0.076***	0.066***	0.070***
	[15.81]	[14.54]	[12.56]	[10.90]	[10.59]
Constant	0.889***	0.625**	0.537**	0.532**	0.489*

(continued on next page)

Table 5 *(continued)*

Panel B: Logistic regression – Change in Organization Capital (ΔOC/PPE) and Likelihood of Firms' transition to Introduction/Shake-out/Decline stage

Dep. Var. =	(1)	(2)	(3)	(4)	(5)
	Introduction or Shake-out or Decline t + 1	Introduction or Shake-out or Decline t + 2	Introduction or Shake-out or Decline t + 3	Introduction or Shake-out or Decline t + 4	Introduction or Shake-out or Decline t + 5
	[3.79]	[2.56]	[2.13]	[2.03]	[1.81]
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.132	0.114	0.100	0.092	0.086
Observations	64,421	58,152	52,562	47,500	42,906
Marginal Effect – ΔOC/PPE					
dy/dx	−0.004	−0.004	−0.004	−0.003	−0.002
Delta-method Std. Err.	0.000	0.000	0.000	0.001	0.001
Z	−8.64	−7.97	−7.56	−5.02	−4.33
P > Z	0.000	0.000	0.000	0.000	0.000

*** $p < 0.01$,
** $p < 0.05$,
* $p < 0.10$.

firms are likely to move to the growth or maturity stages at the end of five years. Moreover, she notes that only a small proportion of decline firms (18%) remain in the decline stage after five years. It is our view that higher organization capital provides sustainable competitive advantage and improves efficiency and productivity of the firm. Therefore, firms investing more in organization capital are less likely to move to introduction, shake-out or decline stages in subsequent years. By the same token, higher levels of investment in organization capital helps firms to move to the growth and maturity stages in subsequent years. Table 5 reports results that support our view.

In Table 5, Panel A, we run a logistic regression, where the dependent variable is the introduction, shake-out or decline stage. In particular, we create a dummy variable that takes a value of 1 if a firm is in the introduction, shake-out or decline stage in t + n years; 0 otherwise. Consistent with our expectation, logistic regression results show that firms that invest more in organization capital (ΔOC/TA) are less likely to move to the introduction, shake-out or decline stage in the subsequent five-years. This result also suggests that firms investing more in organization capital are more likely to move to favorable life cycle stages: growth or mature stages. Panel B of Table 5 repeats the analysis for the OC/PPE measure of organization capital and documents consistent evidence. Furthermore, marginal effects estimated from the logistic regressions also support this finding. Overall, our analysis reveals a positive role for organization capital in the *subsequent* life cycle transition process, and confirms that organization capital helps firms progress in the transition to favorable life cycle stages (growth or mature stages).

4.4. Sensitivity analysis and robustness checks

4.4.1. Alternative FLC stages as benchmark

Recall that our regression results are interpreted with reference to the shake-out stage as it is used as the benchmark. To ensure that the results are not specific to any benchmark FLC stage, we repeat estimations in Eq. (1) using other FLCs as the benchmark. Table 6, Panel A, shows that compared to firms in introduction stage, firms with more (less) OC/TA are likely to be in the decline (growth, maturity and shake-out) stage. Moreover, when the maturity stage is used as a benchmark, regression results suggest that firms with more (less) OC/TA are likely to be in the introduction, shake-out, and decline (growth) stages. Furthermore, compared to any other stage, firms with more OC/TA are likely to be in the decline stage. We obtain mostly consistent results when OC/PPE is used as an alternative measure of organization capital in the regressions. Overall, the regression results corroborate the results reported earlier in our main analysis.

4.4.2. Alternative specification of FLC

To mitigate the concerns that our results are driven by the choice of life cycle proxies, we use the two alternative measures of FLC proposed by DeAngelo et al. (2006), namely Retained Earnings to Total Assets (RE/TA) and Retained Earnings to Total Equity (RE/TE). DeAngelo et al. (2006) observe that firms with high RE/TA and RE/TE are typically more mature or old with declining investment, while firms with low RE/TA and RE/TE tend to be young and growing. Panel B of Table 6 reports the OLS estimates[20]

[20] Multinomial logistic regression is used to predict the probabilities of the different possible outcomes of a categorically distributed dependent variable. Since RE/TA and RE/TE (dependent variables) in Table 6, Panel B, are continuous measures (not categorically distributed), we use OLS to estimate the association between the life cycle proxies (RE/TA and RE/TE) and organization capital.

Table 6
Sensitivity analysis and robustness checks.

Panel A: Association between OC/TA (and OC/PPE) and Life Cycle Stages

Life Cycle Stage	(1) OC/TA				(2) OC/PPE			
Benchmark stage	Introduction	Growth	Maturity	Decline	Introduction	Growth	Maturity	Decline
Introduction	–	0.171***	0.126***	−0.063***	–	0.013***	0.018***	−0.001
	–	(18.99)	(14.47)	(−6.07)	–	(10.63)	(13.78)	(−1.00)
Growth	−0.171***	–	−0.045***	−0.234***	−0.013***	–	0.005***	−0.014***
	(−18.99)	–	(−5.61)	(−21.16)	(−10.63)	–	(3.89)	(−9.86)
Maturity	−0.126***	0.045***	–	−0.189***	−0.018***	−0.005***	–	−0.019***
	(−14.47)	(5.61)	–	(−18.02)	(−13.78)	(−3.89)	–	(−13.09)
Shake-Out	−0.046**	0.124***	0.079***	−0.109***	−0.004***	0.009***	0.014***	−0.005***
	(−4.49)	(12.04)	(8.46)	(−9.62)	(−2.86)	(6.61)	(10.46)	(−3.57)
Decline	0.063***	0.234***	0.189***	–	0.001	0.014***	0.019***	–
	(6.07)	(21.16)	(18.02)	–	(1.000)	(9.86)	(13.09)	–

Panel B: Alternative Specification of the Firm Life Cycle

Dep. Var. =	(1) RE/TA	(2) RE/TE	(3) RE/TA	(4) RE/TE
OC/TA	−0.373***	−0.261***	–	–
	(−15.74)	(−9.19)		
OC/PPE	–	–	−0.021***	−0.015***
			(−6.65)	(−4.28)
Constant	−0.206	−0.656*	−0.453***	−0.828**
	(−1.37)	(−1.72)	(−2.66)	(−2.06)
Other controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adj. R-squared	0.355	0.385	0.247	0.385
Observations	73,413	73,413	73,225	73,225

Panel C: Alternative Specification of Organization Capital (Peters and Taylor, 2017)

Dep. Var. =	(1) Introduction	(2) Growth	(3) Maturity	(4) Decline	(5) RE/TA	(6) RE/TE
OC/TA	0.319***	−0.650***	−0.357***	0.851***	−2.478***	−1.371***
	(4.23)	(−9.18)	(−5.42)	(9.37)	(−15.55)	(−6.55)
Constant	−0.293	−1.356***	−0.778**	1.559***	−0.707***	−1.021**
	(−0.73)	(−4.49)	(−2.40)	(3.30)	(−4.68)	(−2.47)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	74,655	74,655	74,655	74,655	73,705	73,705
Pseudo R^2/Adj. R-squared	0.167	0.167	0.167	0.167	0.345	0.409

Marginal Effect – OC/TA	Delta-method			
	dy/dx	Std. Err.	Z	P > Z
Introduction	0.050	0.004	12.04	0.000
Growth	−0.097	0.008	−11.97	0.000
Maturity	−0.018	0.008	−2.13	0.033
Shake-out	0.020	0.005	4.00	0.000
Decline	0.045	0.003	14.20	0.000

z-statistics are in brackets. Intercepts, controls and industry and year fixed effects are included but not reported.
Robust *t*-statistics are in brackets. Standard errors are clustered by firm.
Variable definitions are provided in Appendix A.
Column (1) to Column (4) estimate Eq. (1) on the sample partitioned by life cycle stage as defined in Dickinson (2011). Column (5) and Column (6) show the regression estimates for DeAngelo et al. (2006)'s life cycle proxies and OC/TA.
dy/dx = marginal effect, where x = OC/TA and y = life cycle stages (introduction, growth, maturity, shake-out, and decline).
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

of the relationship between organization capital (OC/TA or OC/PPE) and these two new alternative FLC measures. The coefficients of RE/TA and RE/TE are negative and significant (at $p < 0.01$), regardless of whether organization capital is measured as OC/TA or OC/PPE. The regression results indicate that firms with more OC/TA or OC/PPE tend not to be in the mature stage. The coefficients on control variables have the predicted sign and significance. Thus, the results using RE/TA and RE/TE (alternative measures of FLC) are similar to those obtained in our main analysis (Table 4), and this helps justify our claim that the results are not sensitive to the choice of life cycle proxy.

4.4.3. Alternative specification of organization capital

To mitigate the concerns as to whether the main results are sensitive to the specification of organization capital, we use several alternative specifications.

4.4.3.1. Organization capital measure of Peters and Taylor (2017). In a recent study, Peters and Taylor (2017) apply the perpetual-inventory method to a firm's fraction of past SG&A expenses, to measure the replacement cost of organization capital. In the spirit of Eisfeldt and Papanikolaou (2013), Peters and Taylor (2017) argue that a fraction of SG&A expenses is used to develop human capital, brand, customer relationships, and distribution systems. For our empirical analysis, we download this replacement cost of organization capital from Wharton Research Data Services (WRDS).

The results tabulated in Panel C of Table 6 are quantitatively similar when we employ the organization capital measure of Peters and Taylor (2017). In particular, the coefficient of OC/TA has the expected sign and statistical significance for the different life cycle proxies. Moreover, marginal effect results support the idea that firms with high (low) organization capital are more likely to be associated with introduction, shake-out and decline (growth and maturity) stages, which also corroborates the marginal effect results reported earlier in our main analysis.

4.4.3.2. Organization capital measure of Lev et al. (2009). Lev et al. (2009) develop a firm-specific measure of organization capital that captures the contribution of organization capital to revenue growth and cost saving. In estimating organization capital, they compare the efficiency of using resources across companies in generating revenues as well as in cost containment.[21]

As a further robustness test, we use the organization capital estimation of Lev et al. (2009), and obtain qualitatively similar results (un-tabulated).[22]

4.4.3.3. Other robustness test. Our results are quantitatively similar when we employ the following robustness tests: (i) Using 30%[23] of SG&A expenses to construct the book stock of organization capital (Eisfeldt and Papanikolaou, 2014); (ii) dropping the first five years of data for every firm to mitigate the effect of the initialization scheme in the perpetual inventory method; (iii) measuring investment in organization capital as SG&A expenses minus advertising expenditures.[24]

4.4.4. Exclusion of computers, software, and electronic equipment firms (business equipment industry)

Our analysis in Panel B of Table 1 shows that 25.30% of our sample belongs to the business equipment industry (computers, software, and electronic equipment firms). Technology firms usually start business with less physical capital, and with more expenses on intangibles (e.g., R&D). One may argue that our documented association is driven mainly by the business equipment industry. To alleviate this concern, we re-run the regressions after excluding the business equipment industry from the sample. Un-tabulated regression results reveal that our inferences from the main analysis remain qualitatively similar, even with the reduced sample, implying that our results are not driven by the business equipment industry.

4.5. Endogeneity

Our analysis so far suggests that firms with more organization capital are more likely to be in the introduction and decline stages, while firms with less organization capital are likely to be in the growth and maturity stages. However, the sign, magnitude and statistical significance of these estimates may be biased due to endogeneity. Motivated by Terza et al. (2008), we use a Two-Stage Residual Inclusion (2SRI) approach to multinomial logistic regression for Dickinson (2011)'s life cycle proxy, because the 2SRI approach is more appropriate for nonlinear regression, such as multinomial logistic regression. This should also alleviate any concerns with reverse causality or omitted variable bias (Wooldridge, 2002). Terza et al. (2008) show that in a nonlinear modeling framework, 2SRI is generally statistically consistent in this broader class, and overwhelmingly outperforms two-stage predictor substitution (2SPS), a method that is commonly used to deal with endogeneity issues in linear regression frameworks. Similar to the 2SPS method, the first stage of the 2SRI procedure involves regressing the endogenous variable (organization

[21] Refer to Lev et al. (2009) for a detailed estimation of organization capital.

[22] In the regression estimates, we use non-negative values of organization capital.

[23] Corrado et al. (2009) also find that organization capital is the single largest category of business intangible capital, and accounts for about 30% of all intangible assets in the United States.

[24] For brevity, the results are not tabulated; they may be requested from the authors.

Table 7
Endogeneity test.

Panel A: 2SRI/2SLS Regression

I: First-Stage Regressions	OC/TA	OC/TA
Explanatory Variable	(Dickinson's FLC)	(DeAngelo et al.'s FLC)
Instrument		
IND_OC/TA	1.005***	0.808***
	(199.85)	(70.17)
All Variables in Main Specification	Yes	Yes
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observation (N)	74,442	73,413
Adjusted R^2	0.116	0.388
Underidentification Test		
Kleibergen-Paaprk LM statistic	485.73	3691.034
p-Value	0.000	0.000
Weak Identification Test		
Cragg-Donald Wald F statistic	40,000	9541.704
Stock and Yogo (2005) Critical Value	16.38	16.38

II: Second-Stage Regressions

Explanatory Variable	Introduction	Growth	Maturity	Decline	RE/TA	RE/TE
Potentially Endogenous Variable						
OC/TA	0.085**	−0.077***	−0.103***	0.147***	−0.218***	−0.072***
	(2.37)	(−2.57)	(−3.66)	(3.27)	(−20.40)	(−2.90)
Unreported Control Variables Included in the Regression						
All Variables in Main Specification	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Hausman Test for the Effect of the Organization Capital (Coefficient 2SRI/2SLS = Coefficient Multinomial Logistic Regression/OLS)						
Estimated residuals	−0.043	−0.053	0.028	−0.041	216.908	60.243
p-Value	0.262	0.089	0.352	0.383	0.000	0.000
Observations(N)	74,442	74,442	74,442	74,442	73,413	73,413

Panel B: Marginal Effect Results

Marginal Effect – OC/TA	dy/dx	Std. Err.	Z	P > Z
Introduction	0.011	0.002	5.26	0.000
Growth	−0.006	0.003	−1.86	0.063
Maturity	−0.016	0.003	−4.83	0.000
Shake-out	0.004	0.002	1.93	0.053
Decline	0.008	0.002	4.79	0.000

dy/dx = marginal effect, where x = OC/TA and y = life cycle stages (introduction, growth, maturity, shake-out, and decline).
*** $p < 0.01$,
** $p < 0.05$,
* $p < 0.10$.

capital) on the selected instrument and the exogenous variables from the main analysis in Table 4, and the results are used to generate predicted values for the endogenous variables. In the second stage, residuals (rather than predicted values) from the first-stage are included as additional regressors, with the endogenous and exogenous variables from the main analysis. To allay the concern with the standard errors problem associated with two-stage estimations, we use the bootstrap method to estimate standard error.[25]

Motivated by prior studies (Carlin et al., 2012), we use industry-level mean organization capital in each year as an instrumental variable.[26] Carlin et al. (2012) argue that firms in rapidly changing industries are less likely to invest in organization capital, because such industries have a greater technology obsolescence risk. It follows that the organization capital of firms in an industry might be similar, and closely correlated with the industry-level organization capital. It is also unlikely that the industry-level

[25] We use 1000 replications to generate the bootstrap standard errors.
[26] We use the four-digit SIC codes as industry groupings. The first two digits of the SIC code represent the major industry sector to which a business belongs. The third and fourth digits represent the sub-classification of the business group and specialization, respectively. We argue that four-digit SIC codes can capture industry-level variations in organization capital closely.

organization capital affects firm life cycle stages other than through the firm-level organization capital, thus, the essential requirements of the instruments are satisfied.

Table 7, Panel A (Section I) reports the first-stage regression results in which the endogenous variable, OC/TA, is regressed on the selected instrument (*IND_OC/TA*) and the exogenous variables from our analyses in Table 4. Consistent with our expectations, the coefficient of the instrumental variable (IND_OC/TA) is significant at $p < 0.01$, suggesting that firm-level organization capital (OC/TA) is associated positively ($p < 0.01$) with industry-level organization capital. Panel A of Table 7 (Columns 1 to 4 in Section II) shows that the positive association between organization capital and the introduction and decline stages, and the negative association between organization capital and the growth and maturity stages, remain robust after accounting for the endogeneity problem. Moreover, Columns (5) and (6) also confirm the robustness of the result using the DeAngelo et al. (2006) life cycle proxies (RE/TA and RE/TE). The estimated coefficients of the introduction (0.085), growth (−0.077), maturity (−0.103) and decline (0.147) stages are significant (mostly at $p < 0.01$) in the 2SRI model. Furthermore, the estimated coefficients for RE/TA and RE/TE are −0.218 and −0.072, respectively (both significant at $p < 0.01$). These results suggest that endogeneity cannot explain the results in the main analysis that indicate a significant association between organization capital and a firm's life cycle pattern.

In Table 7, the under-identification test results (LM statistic) reveals that the excluded instruments are 'relevant' because the Kleibergen-Paaprk LM statistic is significant at $p < 0.01$. The weak instrument test results show that the excluded instruments are correlated with the endogenous regressors, because the Cragg–Donald Wald F-statistic is greater than is the Stock and Yogo (2005) critical value. Finally, for Columns 1 to 4 (Columns 5 and 6), we include (perform) the estimated residuals (Hausman (1978) test) to ascertain whether the endogeneity problem is really a concern for the estimates. For our analysis, Hausman's test rejects the exogeneity of OC/TA, thus, justifying the use of the 2SRI and 2SLS regression estimates.[27]

Finally, we estimate the marginal effect of OC/TA for the second stage multinomial logistic regression results. Panel B reports that one unit increase in OC/TA may increase the likelihood of firms remaining in the introduction stage (1.1%), shake-out stage (0.04%) and decline stage (0.08%), but reduce the likelihood of firms remaining in the growth stage (−0.06%) and maturity stage (−1.6%), respectively. Thus, the reported marginal effect of OC/TA is consistent with the results reported in our main analysis (Table 4).

4.6. Additional test on static and dynamic association of organization capital with the FLC

One may argue that both the static and dynamic associations of organization capital with firm life cycle stages can co-exist. To investigate this issue explicitly, we include both organization capital (i.e., $\frac{OC}{TA_{i,t}}$) and changes in organization capital ($\frac{OC}{TA_{i,t}} - \frac{OC}{TA_{i,t-1}}$) as two separate explanatory variables in the logistic regression along with the controls, and examine how these two measures of organization capital are associated with the introduction, shake-out or decline stages in subsequent years. Table 8 shows the estimation results. Consistent with H1, H2, H3a and our previous results, the results reported in Panel A of Table 8 show that firms with high organization capital are likely to be in the introduction, shake-out or decline stages in the $t + 1$ to $t + 4$ years. Interestingly, on the other hand, firms who invest more than average in organization capital are less likely to move to the introduction, shake-out or decline stages in the $t + 1$ to $t + 5$ years; this result provides further support to H4. Results from the marginal effect also support these findings.

Panel B of Table 8 shows the estimation results of the logistic regression for an alternative organization capital measure (i.e., OC/PPE). Both logistic regressions and marginal effects show that the inference drawn from the prior analysis remains qualitatively similar in terms sign and significance.

5. Concluding remarks

This paper provides evidence of the association between organization capital and FLC. Extant studies suggest that organization capital (e.g., business practices, processes, systems, designs and unique corporate culture) develops the resource base for the firm, and serves as a source of sustainable competitive advantage. Building on these studies, we hypothesize that firms with more organization capital are likely to be in the introduction (and decline) stage as these firms focus more on developing sustainable competitive advantage, either to deter potential entrants or to deepen organizational practice, process or culture. On the other hand, firms with less organization capital are likely to be in the growth and mature stage as these firms are more concerned with maximizing benefits from their existing stock of organization capital. Our empirical results confirm these predictions. Our analysis also shows that firms that invest more in organization capital are less likely to move to unfavorable life cycle stages: i.e., the introduction, shake-out or decline stages, in subsequent years. These results concur with the findings of Lev et al. (2009) that organization capital is a source of future benefit and that it is associated with future firm performance.

[27] As a robustness check, we use the 2SRI model to test the endogeneity problem with DeAngelo et al. (2006)'s life cycle measures (RE/TA and RE/TE) and find that the results are qualitatively similar to those obtained by using 2SLS models.

Table 8
Logistic regression – static and dynamic measures of organization capital and likelihood of firms' transition to introduction/shake-out/ decline stages.

Panel A: Organization Capital Scaled by Total Assets (OC/TA)

Dep. Var. =	(1)	(2)	(3)	(4)	(5)
	Introduction or Shake-out or Decline t + 1	Introduction or Shake-out or Decline t + 2	Introduction or Shake-out or Decline t + 3	Introduction or Shake-out or Decline t + 4	Introduction or Shake-out or Decline t + 5
OC/TA (Static)	0.131***	0.117***	0.119***	0.113***	0.100***
	[19.20]	[16.46]	[15.90]	[14.41]	[12.08]
ΔOC/TA (Dynamic)	−0.048***	−0.052***	−0.081***	−0.090***	−0.042**
	[−3.48]	[−3.64]	[−5.41]	[−5.70]	[−2.51]
Constant	0.828***	0.607**	0.413	0.461*	0.372
	[3.53]	[2.49]	[1.63]	[1.76]	[1.36]
Other controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.138	0.119	0.106	0.096	0.090
Observations	64,695	58,387	52,764	47,675	43,061
Marginal Effect – OC/TA (Static)					
dy/dx	0.020	0.018	0.018	0.018	0.015
Std. Err.	0.001	0.001	0.001	0.001	0.001
Z	19.41	16.60	16.04	14.53	12.16
P > Z	0.000	0.000	0.000	0.000	0.000
Marginal Effect – ΔOC/TA (Dynamic)					
dy/dx	−0.007	−0.008	−0.013	−0.014	−0.006
Std. Err.	0.002	0.002	0.002	0.002	0.002
Z	−3.48	−3.64	−5.42	−5.71	−2.51
P > Z	0.001	0.000	0.000	0.000	0.012
Difference of Coefficients OC/TA (Static) - ΔOC/TA (Dynamic)					
dy/dx	0.179	0.169	0.200	0.203	0.142
Std. Err.	0.016	0.017	0.018	0.018	0.019
Z	11.19	10.15	11.41	11.01	7.32
P > Z	0.000	0.000	0.000	0.000	0.000
χ2	125.20***	104.07***	130.24***	121.26***	53.53***

Panel B: Organization Capital Scaled by Property, Plant and Equipment (OC/PPE)

Dep. Var. =	(1)	(2)	(3)	(4)	(5)
	Introduction or Shake-out or Decline t + 1	Introduction or Shake-out or Decline t + 2	Introduction or Shake-out or Decline t + 3	Introduction or Shake-out or Decline t + 4	Introduction or Shake-out or Decline t + 5
OC/PPE (Static)	0.016***	0.016***	0.017***	0.016***	0.015
	[15.86]	[15.03]	[15.05]	[13.76]	[12.17]
ΔOC/PPE (Dynamic)	−0.018***	−0.017***	−0.017***	−0.010***	−0.010***
	[−6.49]	[−5.82]	[−5.56]	[−3.22]	[−2.80]
Constant	0.984***	0.315	0.414	0.428	0.388
	[4.38]	[1.30]	[1.64]	[1.64]	[1.44]
Other controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.136	0.118	0.105	0.096	0.089
Observations	64,421	58,152	52,562	47,500	42,906
Marginal Effect – OC/PPE (*Static*)					
dy/dx	0.002	0.002	0.003	0.002	0.002
Std. Err.	0.000	0.001	0.000	0.000	0.000
Z	15.98	15.15	15.18	13.87	12.26
P > Z	0.000	0.000	0.000	0.000	0.000
Marginal Effect – ΔOC/PPE (*Dynamic*)					
dy/dx	−0.003	−0.002	−0.003	−0.002	−0.001
Std. Err.	0.000	0.000	0.000	0.001	0.001
Z	−6.49	−5.83	−5.56	−3.22	−2.80
P > Z	0.000	0.000	0.000	0.001	0.005
Difference of Coefficients OC/PPE (*Static*) - ΔOC/PPE (*Dynamic*)					
dy/dx	0.034	0.033	0.034	0.026	0.024
Std. Err.	0.003	0.003	0.003	0.003	0.003

(continued on next page)

Table 8 *(continued)*

Panel B: Organization Capital Scaled by Property, Plant and Equipment (OC/PPE)					
Dep. Var. =	(1)	(2)	(3)	(4)	(5)
	Introduction or Shake-out or Decline t + 1	Introduction or Shake-out or Decline t + 2	Introduction or Shake-out or Decline t + 3	Introduction or Shake-out or Decline t + 4	Introduction or Shake-out or Decline t + 5
Z	11.82	10.93	10.66	7.93	7.01
P > Z	0.000	0.000	0.000	0.000	0.000
$\chi2$	139.61***	119.49***	113.66***	62.94***	49.16***

dy/dx = marginal effect, where x = OC/TA or ΔOC/TA and y = life cycle stages (introduction, shake-out, and decline vs growth and maturity).
dy/dx = marginal effect, where x = OC/PPE or ΔOC/PPE and y = life cycle stages (introduction, shake-out, and decline vs growth and maturity).
*** $p < 0.01$,
** $p < 0.05$,
* $p < 0.10$.

We triangulate our results by using different measures of organization capital and FLC proxies, and eventually find that they are robust.

Overall, our empirical evidence contributes to the growing body of literature that focuses on organization capital. Our primary contribution is to extend this body of research by documenting the association of organization capital with the FLC and its progression, confirming the long-held view among economists that firm life cycle is driven by organization capital. Our findings strongly support the RBV of competitive advantage as well as FLC theory. The RBV suggests that the general patterns and paths in the evolution of organization capabilities depend on the existence and application of the bundle of valuable, interchangeable, immobile and imitable resources that generate the basis of the competitive advantage of a firm. Consistent with the RBV that organization capital is a source of competitive advantage, we show that organization capital is associated significantly with the progression of firms across different life cycle stages. Our results also largely concur with the findings of Adizes (1979) that management practice, style and process influence the life and effectiveness of an enterprise. From a practitioner's perspective, our results have direct implications for the financial management and strategic direction of the firm. Our results provide evidence suggesting that organization capital could be the channel through which managers can lead firms to reach and maintain growth and maturity stages, the prime stages of the FLC. Overall, our study contributes to the area of research that stresses the importance of organization capital as a major driver of firms' (and national) growth and competitiveness.

Appendix A. Variable definition and measurement

Variables	Definition and Measurement
Main Independent Variable	
OC/TA	Organization capital measured as the stock of organization capital (for details, see Section 3.4) scaled by lagged real total assets (AT).
OC/PPE	Organization capital estimated as the stock of organization capital scaled by lagged real PPE (PPEGT).
Dependent Variable: FLC Proxies	
FLC	Categorical variables that capture firms' different stages in the life cycle (introduction = 1, growth = 2, maturity = 3, shake-out = 4 and decline = 5)
RE/TA	Retained earnings as a proportion of total assets. Measured as: retained earnings (RE)/lagged total assets (AT).
RE/TE	Retained earnings as a proportion of total assets. Measured as: retained earnings (RE)/lagged total assets (AT).
Control Variables	
SIZE	Natural logarithm of market value of equity (PRCC_F X CSHO) at the beginning of the year.
MTB	Market-to-book ratio at the beginning of year, measured as the market value of equity (PRCC_F X CSHO) scaled by the book value of equity (CEQ).
LEV	Leverage, measured as total short-term and long-term debt (DLC + DLTT) scaled by lagged assets (AT).
ROE	Return on Equity, measured as operating income (PI - XI) scaled by lagged equity (CEQ).
ΔSALE	Changes in sales (SALE) scaled by lagged sales (SALE).
CAPEX	Capital expenditure (CAPEX) scaled by lagged assets (AT).
AGE	Age is measured as the number of years since the firm was first covered by the Center for Research in Securities Prices (CRSP) (DATADATE – BEGDAT). For the regression analysis, we measure AGE as the natural log of (1 + age of the firm).
ATO	Asset Turnover ratio, measured as net sales (SALE) scaled by lagged total assets (AT).
ADVERT	Advertising expenses (XAD) scaled by lagged sales (SALE). We replace any missing values of XAD with 0.
R&D	R&D expenses (XRD) scaled by lagged PPE (PPEGT). We replace any missing values of XAD with 0.
Year	Dummy variables to control for fiscal year effect.
IND	Industry dummy (two-digit SIC code) to control for industry fixed effect.
Instrumental Variable	
IND_OC/TA	Industry-level (four-digit SIC codes) mean organization capital in each year.

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