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CENTERS OF GRAVITY: THE EFFECT OF STABLE SHARED LEADERSHIP IN TOP MANAGEMENT TEAMS ON FIRM GROWTH AND INDUSTRY EVOLUTION

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Working Paper 24742
http://www.nber.org/papers/w24742

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 2018

This research was supported by the NSF grant No.1632833 and JSPS KAKENHI Grant No. 15KK0078. We thank Tetsuji Okazaki and Takenobu Yuki for helpful advice and data sharing; Gakushikai (the Association of University Graduates) for permission to use their restricted-use alumni lists; and Hiroko Ohga, Tomohiro Hara, Kohei Yamagata, Jun Sakamoto, and Takao Takasago for able research assistance. The manuscript has benefited from comments from two anonymous reviewers, editor Nicolai Foss, and seminars given at Erasmus, HEC Paris, Maryland, Queens University and UT Austin. Braguinsky thanks Osaka University Institute of Social and Economic Research and Ohyama thanks the University of Maryland Robert H. Smith of Business for their hospitality when conducting research on this project. All interpretations and errors are ours. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 24742
June 2018
JEL No. L2,L25,L26,M12,M13,N85

ABSTRACT

We study the processes of firm growth in the evolution of the Japanese cotton spinning industry during 1883-1914 by integrating strategy and historical approaches and utilizing rich quantitative firm-level data and detailed business histories. The resultant conceptual model highlights growth outcomes of path dependencies as firms evolve across periods of single vs. shared leadership, establish stability in shared leadership, or experience repeated discord-induced TMT leader departures. While most firms do not experience smooth transitions to stable shared TMT leadership, a focus on value creation, in conjunction with talent recruitment and promotion, enabled some firms to achieve stable shared leadership in spite of discord-induced departures, engage in long term expansion, and emerge as "centers of gravity" for output and talent in the industry.

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A data appendix is available at http://www.nber.org/data-appendix/w24742

Dominance of a few firms in an industry often results as industries evolve from early stages of entrepreneurial entry through shakeouts and consolidation of market shares (Gort and Klepper, 1982; Klepper, 1996; Jovanovic and MacDonald, 1994). In explaining firm growth and dominance, evolutionary scholars have largely focused on firm characteristics such as first mover advantage and pre-entry experience (Bayus and Agarwal, 2007; Klepper and Simons, 2000), and scale economies and returns to innovation (Klepper, 2002). While employee entrepreneurship/mobility have been recognized, they are nonetheless discussed at the firm level (e.g. spinouts) leading Felin, Foss and Ployhart (2015) to note: "evolutionary arguments in strategy…are fundamentally silent about individuals" (p. 581). Meanwhile, separate literature streams reviewed below examine the creation and evolution of entrepreneurial teams and the critical role of top management teams (TMT) in growth and strategic renewal, even as they manage internal conflict arising from strategic or interpersonal differences.

Our study examines the microfoundation of firm's managerial talent by addressing the questions: What characteristics of top management team determine which firms are likely to grow and dominate in an industry? How do these characteristics impact the strategies undertaken by the firm, as they leverage opportunities or confront impediments to growth?

We answer the above questions by conducting a study at the intersection of history and economics/strategy that permits an examination of TMT, firm and industry evolution in the historical context of the early Japanese cotton spinning industry, the first mechanized modern industry to emerge outside of Western Europe and the United States. This industry is ideal for two reasons: One, the industry exhibits the classic patterns documented in industry evolution studies, and represents a context where some firms rose among seemingly identical others to become "centers of gravity," a term we use to denote those firms who represented the industry's leading share for talent and output, and thus dominance in an industry. Two, rich firm and industry historical accounts documented *at the time of occurrence* enable triangulation of both qualitative and quantitative data over entire firm and industry lifecycles, and also uncover the underlying TMT transitions and evolution through entry and exit of key managerial personnel. In undertaking such a triangulation, we depart from the typical hypothesis-testing used in strategic management studies, and also from the typical narrative approach used in historical research. Instead, we integrate both approaches, consistent with studies combining deep dives into phenomena over long periods with rigorous empirical methods (Braguinsky and Hounshell, 2016; Ingram, Rao, and Silverman, 2012). We utilize rich qualitative and historical information to inform the quantitative panel data analysis

and adjudicate across plausible relationships among key variables of interest. In turn, the sustained and consistent patterns observed in the quantitative analysis across different empirical specifications and over different historical periods serve as guiding lights for the historical narrative, and enable separating the wheat from the chaff. Together, these inform the path dependencies through which TMT characteristics manifest into growth implications, and uncover the mechanisms at play.

The quantitative analysis reveals an association of firm growth with stable shared TMT leadership. Shared leadership is defined as the presence of two or more active TMT leaders at the helm. We leverage historical data to discern actual leaders within the TMT rather than simply rely on titular designations. Stability in TMT is defined as the *lack* of discord-induced departures (when one of the leaders is ousted or resigns due to a conflict within shared leadership teams). We find reduced growth rates during periods of single leadership. Moreover, growth is impaired *after,* rather than before discord-induced departure events, suggesting that firms incur disruption or adjustment costs, rather than disagreement costs. Importantly, firms with stable shared leadership accumulate more resources, most notably, they recruit and accumulate better engineering talent, and this eventually leads them to become "centers of gravity" in the industry. In contrast, neither size and diversity of the TMT, nor their external ties systematically predict firm growth.

The quantitative findings set the stage for an in-depth examination of business histories. A comparison of seemingly similar firms (early movers with similar size) reveals salient pathways of TMT evolution for growth consequences. Becoming a center of gravity through smooth transition to stable shared leadership (Path 1) was the exception rather than the norm. Similarly, only one later entrant with single leadership became a center of gravity; firms with single leadership all through their history experienced limited growth and exit (Path 4). The business histories of the majority of the firms reveal transitions to shared leadership were not always stable, as each experienced at least one discord-induced departure of a TMT leader. Regardless of whether the underlying reasons for the departure related to strategic, interpersonal or ethical discords; these firms followed one of two distinct pathways. Firms in Path 2 were able to establish stable shared leadership because they focused on value-creation in their resolution of these discords, and were willing to break from tradition to promote talent to their TMT based on merit for human capital complementarities. In turn, stable shared leadership permitted these firms to become centers of gravity through long term expansion strategies such as superior product choice, expansion of scale (including acquisition of less well managed firms), and downstream integration. In contrast, firms in Path 3 showed consistent lack of stable shared leadership; their business histories revealed either multiple discord-

induced departures stemming from politics and power struggles, or single leadership. These firms, hampered in their ability to pursue growth strategies, experienced limited growth to ultimately exit the industry.

Our findings provide contributions to several literature streams noted above (and briefly reviewed below). To industry evolution studies we contribute by uncovering managerial talent as the underpinnings of factors important for firm and industry evolution. To scholarly work at the intersection of entrepreneurship and strategy, we highlight the growth of entrepreneurial firms as intricately related to their ability to create stable shared leadership. Our contribution to the TMT literature is in examining TMT composition/turnover and their performance effects over the entire firm lifecycle and over an industry census of firms.

THE EVOLUTION OF THE JAPANESE COTTON SPINNING INDUSTRY

The Industrial revolution started with the mechanization of cotton spinning, which was also key to Japan's status as the only industrialized nation in the East during much of the 20th century (Saxonhouse, 1974). Emerging from feudalism and autarky in the 1860s, Japan's opening of the economy introduced imports which obsolesced its pre-industrial cotton spinning manufacturing (Bernhofen and Brown, 2004), but subsequently enabled the creation of an entirely new, mechanized cotton-spinning industry (Ohyama, Braguinsky and Murphy, 2004). Figures 1 and 2 represent the industry's evolution between inception in the early 1880s to the start of World War I in 1914, divided into seven periods of roughly equal length corresponding to major industry evolution events.[2] The first period is characterized by heavy government involvement, although the firm producing almost half of the industry output was an entirely independent, private organization with no government support (Braguinsky and Hounshell, 2016). The second period represents "firm take-off," when the government withdrew industry support, and there was a first wave of entrepreneurial entrants. Periods 3 through 5 represent the growth, shakeout and onset of the maturity stages of the industry, while periods 6 and 7 represent increased consolidation and subsequent stabilization.

Figure 1 depicts the now classic patterns in the evolution of the number of firms, along with the shares of the top firm and of the seven leading firms in industry output.[3] While the first two

[2] See Appendix A for source information and data compilation. We focus on the first complete observation of the industry life cycle. As is characteristic of industries observed over a century (e.g. computers (Malerba, Nelson, Orsenigo and Winter, 1999)), the Japanese cotton spinning industry went through additional periods of punctuated evolution (subsequent periods of renewed entry and consolidation); these periods are outside the current study scope.

[3] These seven firms are (in the order of their 1914 size): Kanegafuchi Spinning (Kanebo), Mie Spinning (Mie), Settsu

periods show high output shares for the top and leading firms, they are at a time of very limited domestic production in a market dominated by imports; the few Japanese firms were still at a very small scale of production. Domestic production exceeded imports for the first time in the middle of period 2 (1890), and imports became negligible towards the end of period 3 (Braguinsky and Hounshell, 2015). Post period 3, the shares of the seven leading firms increased significantly, even as the number of firms remained relatively large and the Herfindahl index was low.[4] A similar pattern is observed for product scope (the number of product varieties): post period 3, the leading firms have significantly higher and growing average number of product varieties, relative to the average varieties of all other firms in the industry (data on product varieties become available only starting in period 3).

In Figure 2, history affords us a rare window of opportunity to examine human capital evolution within an industry, given the concurrence of the Japanese cotton spinning industry's evolution with the development of its modern education system. The first cohort of domestically-educated mechanical engineers graduated from what later became the Department of Engineering of the Imperial (Tokyo) University in 1879, and there were a grand total of 57 graduates in the whole country in 1892, the end of period 2 depicted in Figures 1 and 2. Most graduates were employed by the government and public companies, only seven of them worked in the cotton spinning industry. The situation changed dramatically in the next two decades with openings of more universities and technical schools (such as the future Tokyo Institute of Technology). The bars in Figure 2 show the dramatic growth in both university educated and technical school educated engineers employed in the cotton spinning industry in periods 3-7. More importantly, Figure 2 also shows the seven leading firms' share of these engineers: their share of university educated engineers grew from approximately 45% to more than 75%, and their share of technical school educated engineers grew from approximately a third to almost 70% of the total talent pool in the industry.

[Figures 1 and 2 about here]

Taken together, Figures 1 and 2 provide trends of product scale and scope, and of underlying talent. The increased concentration of educated engineers in the leading firms post period 3 exceeds in magnitude the patterns of output concentration, even as the total pool of educated

Spinning (Settsu), Amagasaki Spinning (Amabo), Osaka Godo Spinning (Godo), Fuji Gasu Spinning (Fujibo), and Osaka Spinning (Osaka). We describe and analyze their business histories in the qualitative analysis section below. Appendix F contains a brief account of their evolution after the end of our sample period.

[4] The Herfindahl index is well below the 0.15 lower bound threshold used to define "moderately concentrated" industry (see https://www.justice.gov/atr/herfindahl-hirschman-index)

engineers employed in the industry grew exponentially. Hence, despite their overall rapidly growing numbers, educated engineers were increasingly "sucked into" the seven leading firms as if those were some "black holes" or "centers of gravity." Figures 1 and 2 motivate our study, which at its core is interested in understanding the following fundamental question: At the early stages of the industry, how could someone have predicted which ones of the seemingly identical startups would grow and develop into "centers of gravity" and which would fizzle?

LITERATURE REVIEW, RESEARCH QUESTIONS, AND DESIGN

Brief Literature Review

Industry evolution scholars seeking to explain well established patterns similar to Figure 1 across industries have modeled (pre-entry) technical and market experience, first mover advantage, economies of scale, and returns to innovation as critical factors in explaining dominance in industries characterized by shakeouts and oligopolistic market structures (Bayus and Agarwal, 2007; Klepper, 1996; 2002; Klepper and Simons, 2000). Majority of these studies focus on either *firm* or *environmental* characteristics as determinants of industry evolution (Malerba et al., 1999; Klepper, 1996; Winter, 1994), and firm performance (Agarwal, Sarkar and Echambadi, 2002; Suarez and Lanzolla, 2007; Teece, 1986), while the role individuals may play in firm and industry evolution is largely missing (Felin et al., 2015). Even scholars who have examined individuals typically transform them to firm level constructs: firm level capabilities such as technological/marketing knowledge and complementary resources through individuals' creation of new ventures or mobility (cf. review in Agarwal and Shah, 2014; Klepper, 2016); firm routines representing managerial knowledge (Zollo and Winter, 2002); or firm inertia due to managerial cognition (Tripsas and Gavetti, 2000; Christensen, 1997).

In part, the missing focus on individuals—particularly top management teams—as potential drivers of firm and industry evolution may be due to a lack of micro-level data. In part, it may be due to literature stream silos; the lack of integration or linkages of insights from related work on entrepreneurial founding teams and firm performance (e.g. Delmar and Shane, 2006; Ruef, Aldrich and Carter, 2003; Stinchcombe, 1965); dynamic managerial capabilities (e.g. Adner and Helfat, 2003; Helfat and Martin, 2015); and top management teams (TMT) literature (e.g. Boeker and Karichalil, 2002; Beckman and Burton, 2008; Bourgeois and Eisenhardt, 1988; Eisenhardt and Bourgeois, 1988; Hambrick, 2007). And in part, it may be due to the reliance of most industry evolutionary scholars on quantitative analysis using secondary data on measurable capabilities without a concomitant

attention to business histories and the role of the "human element" in developing organizational capabilities (Chandler, 1977; 1990).

It is important to note here that such lack of attention on the individual is *not* observed in the classics underpinning the above literature streams. Schumpeter's (1949 [1911]) almost poetic description makes it clear the only way in which an entrepreneur can put new combinations to work is by directly assembling, assigning and commanding the necessary resources. For Penrose (1959), the limits to a firm's growth are not bound by a production function but by its (entrepreneurial) managerial talent and experience. Crucially, experience relates not only to each manager's individual knowledge, but also to the "working unit" of the TMT, such that the knowledge embodied in a TMT is intrinsically linked to the individuals comprising a particular TMT and "cannot be separated from them." (Penrose, 1959, p. 53). Similarly, Chandler's emphasis on the "visible hand" for determining scale and scope underscores that "coordination…demanded the constant attention of a managerial team or hierarchy…and actual economies of scale and scope…depend on [their] knowledge, skills, experience and teamwork" (Chandler, 1992; p 81).

Research Questions and Design

Our fundamental research questions deal with characteristics of top management teams (TMT) that determine which firms are likely to grow and dominate in an evolving industry, and how these characteristics impact the strategies undertaken by the firm. We note that studies of firm growth, particularly with a focus on managerial diseconomies and span of control (Penrose, 1959; Lucas, 1978) are not typically conducted within an industry evolution perspective. While Penrose explicitly and unapologetically stated her interest only in firms that do grow (Penrose, 1959, p. 33), there may be additional insights regarding which characteristics are most salient for firm and industry evolution through an inclusion of firms that do not grow into the analysis.

To examine the role of TMT and to explore the underlying mechanisms at play, we create and utilize, for the first time, unusually rich quantitative and qualitative data at multiple levels—individuals, teams and firms—within the historical evolution of the Japanese cotton spinning industry. Our research design integrates the standard econometric analysis employed in strategic management studies with the historical approach which leverages rich information on events, strategies, and processes that transpire over time. Such an integration has numerous advantages. Combining quantitative analysis with the historical method enriches our understanding of strategy through the examination of long-term outcomes, rather than mere snapshots of relationships at some particular point in time. The historical approach is perhaps the only way to combine rich

qualitative information with large *n* "census"-like data. Rather than employing *either* qualitative case studies where a researcher cannot ascertain consistency across a census of firms for the observed processes, *or* panel data studies where an econometrician doesn't "see" any individual firm and the strategies/processes they employ, the use of historical data and methodology accomplishes a triangulation across both qualitative and quantitative methods in a comprehensive manner. Such triangulation enables a deeper understanding of both *why* and *how* the critical variables of interest influence outcomes such as firm performance, through interim effects on strategies and firm attributes. The quantitative analysis helps identify which of the correlations and associations among the variables are most salient, and the qualitative analyses of business histories help rule out alternative explanations and "identify" mechanisms at play.

Specifically in this study, we first report on our quantitative analysis to examine potential relationships between TMT characteristics and firm growth, as well as interim effects that TMTs may have on resource acquisition (e.g. engineering talent). This analysis is consistent with most firm/industry evolution studies. However in our study, these patterns are not intended to establish causal relationships, even though we conduct tests to assess what plausible relationships may be ruled out, and which ones are deserving of more in-depth examination. Instead, the quantitative analysis guides the historical deep-dive into potential cause and effect relationships where we seek to uncover the importance of the human element: the strategic decisions that were made by TMT leaders at key junctures, and the contextual explanations for how these transformed into critical firm level outcomes. Such a qualitative analysis of firms that were seemingly identical to others at the onset, but evolved and emerged as centers of gravity provide both texture to the quantitative analysis, and enhance causal inferences regarding TMT characteristics salient to firm growth and dominance.

DATA DESCRIPTION AND QUANTITATIVE ANALYSIS

To conduct the study for the Japanese cotton spinning industry data for 1883-1914, we use a unique database compiled through careful matching of information from various archival sources. (See Appendix A for detailed information on data sources and the construction of key variables.) For industry, firms and TMT, information was obtained from the monthly and semi-annual bulletins of the All-Japan Cotton Spinners Association (Geppo and Sankosho), containing firm-level input-output, product varieties and financial information; from the seven-volume history of the industry with a chapter dedicated to each and every firm (Kinugawa, 1964); from semi-annual firm reports to shareholders; and from company histories (Toyo Boseki, 1986; Kanebo, 1988; Unitika, 1989; Fuji

Boseki, 1998). Additional biographical data on human capital—executives and engineers—was obtained from annual registries, including the "Zenkoku Shogaisha Yakuinroku" ("All-Japan Registry of Firms Executives," hereafter "Yakuinroku"), the "Nihon Zenkoku Shoko Jinmeiroku" ("All-Japan Registry of Traders and Craftsmen"), and university/technical schools' alumni lists. These data were cross-checked across multiple sources (e.g. comparing of information across work affiliations in alumni lists and white-collar workers in "Yakuinroku," company reports, and Kinugawa (1964)).

Together, these sources helped create a comprehensive, almost census panel on TMTs, engineers, and firms operating in the industry over all evolutionary stages. The unbalanced panel contains 1,350 observations on 125 firms from 1883-1914, all those operating in the industry during those years for at least one year. Twenty eight firms either entered right before the end of our sample or exited almost immediately upon entry; the lack of observations for at least three years precludes their meaningful analysis. We also lack systematic data on TMTs of seven small privately held firms, which are also excluded. The final dataset used for the quantitative analysis includes 90 firms (77 of them chartered corporations) and 1,192 firm-year observations, with a firm on average observed for 13.2 years. Eighty one firms (90%) were startups and nine were diversifying entrants, reflecting the early stage of industrialization in Japan. Of the 81 (nine) startups (diversifying entrants), 74 (three) were greenfield entrants that constructed their own plants, while seven (six) utilized production facilities of failed predecessors. The vast majority of entering firms thus built their own production facilities, bought their own machines, and recruited their own personnel.

TMT Characteristics and Growth of Firms

In undertaking our quantitative exploration regarding TMT characteristics and firm growth outcomes, we are guided by the received literature in our choice of variables. These include founding team/TMT size and diversity, the centralization of power, and stability/lack of discord. Table 1 summarizes the variable definitions and their empirical operationalization. Several variables, such as output growth, TMT size, functional diversity, firm size, number of employees (including technical, marketing and financial personnel), have definitions and empirical operationalizations that are standard in the literature.[5] Here, we briefly describe how our focal TMT characteristics draw upon

[5] There was no variance in demographic characteristics of TMT members as all were male and ethnically Japanese. Also, as cotton spinning was the first modern industry in Japan, with the exception of a few later entrants, founders had no pre-entry industry experience. We also note that our regression specification includes firm fixed effects, and these absorb all time invariant (founding) characteristics, including timing of entry, pre-entry experience and initial scale at entry.

received literature, and are constructed from the data (a detailed description is in Appendix A).

[Table 1 about here]

Single vs. Shared Leadership: Consistent with the literature (Carson, Tesluk and Marrone, 2007; Eisenhardt and Bourgeois, 1988; Gibb, 1954; Katz and Kahn, 1978), we define the distinction between single vs. shared leadership based on whether the authority for strategic decision making within TMT rests with one person, or is distributed across two or more members. For each firm in each given year, we capture whether the strategic leadership rests with a single person (*Single Leadership Dummy = 1)* or is shared by two or more key individuals (*Shared Leadership Dummy = 1).* Rich qualitative data included in company reports and histories, along with biographical information, enable us to ascertain the roles and responsibilities for each TMT member, beyond what is provided in the titles they hold (see Appendix A for details). Sixty-six firms had shared leadership in at least one year, representing 512 firm-year observations. Conditional on being among the 66 firms with shared leadership episodes, an average firm had shared leadership in about 55% of observations.

Stability in TMT Shared Leadership (Lack of Discord-induced departure): Shared leadership increases the odds of discord (Amason, 1996; Eisenhardt and Bourgeois, 1988), and we define stable shared leadership as the absence of discord-induced departures in that year through resignation or ousting of a TMT leader, for reasons other than death, illness or personal circumstances.[6] We identify most such instances through shareholder reports of companies which record all TMT changes and their ratification at shareholder meetings, and through documents of company histories when such shareholder reports are not available. Chapters dedicated to each firm in Kinugawa (1964) provide us with more information about TMT leaders' departures[7]. Accordingly, we code departures due to discord (*Discord-induced departure Dummy = 1)*, and define TMT stability as the lack of this event in that year. Further, we also create a dummy for the three year period preceding the year of discord-induced departure (*Discord Period = 1),* and a dummy for three year periods preceding years when no such discord was observed (*No Discord Period = 1*). To distinguish between shared leadership firms experiencing single and multiple discord related departures within a three year period, we create

[6] We note our interest here is on departure associated with discord, not discord *per se*. There is a rich literature examining performance effects of conflict in teams (e.g. review in De Dreu and Weingert, 2003). Within top management teams specifically, prior research has noted that discord could be productive or unproductive (Amason, 1996; Eisenhardt and Burgeois 1988; Eisenhardt, Kahwajy and Bourgeois, 1997). These studies note productive discord—when managers challenge each other to develop a cognitively richer understanding of choices and make more effective decisions—has been associated with higher performance. Our variable here aims to capture unproductive discord heightened to the level that it induces the departure of a TMT leader. In later analysis, we probe deeper into pre-and post-departure periods, the qualitative reasons for the discord, and the post-discord-induced departure governance changes.

[7] The underlying reasons for discord-induced departures are expanded upon in detail in the qualitative section below.

dummies (*Shared Leadership with Single Discord-induced departure in Period = 1; Shared Leadership with Multiple Discord-induced departures in Period = 1).* Finally, we interact *Discord-induced departure* with shared leadership dummies to distinguish among shared leadership firms that experienced or didn't experience these events (e.g. *Shared Leadership*Discord-induced departure = 1; Shared Leadership*No Discord-induced departure = 1).*

Other TMT Turnover Variables: We also code TMT turnover not related to discord through two additional variables. Using information from shareholder meetings and company histories, we identify departure of a TMT leader for exogenous reasons such as death, retirement, or personal circumstances unrelated to the firm; e.g. illness or family commitments (*Exogenous Departure Dummy = 1),* as well as additions to the TMT leadership (*Expansion of TMT Dummy = 1).*

Results of Analysis

We regress 3- and 5- year moving average firm growth rates on TMT characteristics using a firm fixed effect specification[8] with robust standard errors and various time-varying controls for firm, industry and years. While firm fixed effects absorb all time-invariant characteristics (first-mover advantage; founding team characteristics, including pre-entry experience; and the initial scale), we control for relevant time-variant characteristics by including firm age, current output levels, the numbers of university-educated engineers and technical school graduates, as well as variables capturing market, and financial ties. All regressions include year dummies to control for various time-varying economy- and industry-wide conditions and shocks (including but not limited to business cycle fluctuations, number of firms in the industry, demand and technology shocks, etc.). Our estimation results are conditional on survival, but to the extent that exit is correlated with *lack of growth,* this should render conservative estimates of the effects. Note that our specifications are designed to mitigate the potential reverse causality problem because we estimate effects of TMT size at time *t* on future output growth rates over the next 3-year span or 5-year span.

Table 2 provides the effects of TMT characteristics on growth. In Specification I, the coefficient of *Shared Leadership* is 0.058 for 3-year growth rates and 0.087 for 5-year growth rates, and the 90-percent confidence interval is [-0.015, 0.131] and [0.017, 0.156], respectively. This implies that

[8] Our choice of firm fixed-effects is premised on the research purpose of examining the effect of stable and shared leadership for within-firm growth. That is, we are interested in investigating how a change in the TMT within a firm affects the growth of that firm, rather than how differences in TMT across firms influences their growth rates. Table A3 in Appendix C provides robustness to random-effect and Arellano-Bond-type estimations: both estimations provide qualitatively similar results, though higher standard errors for some of the coefficients render them less statistically significant at conventional levels.

firms with shared leadership achieve 5.8% (8.7%) higher growth rates over a three-year (five-year) span respectively, relative to firms with a single leader. Given these high magnitudes, shared leadership alone is associated with about 20% output gap over the 10-year span, and 45% over the 20-year span. In Specification II, we replace TMT team size with number of TMT leaders. The coefficient on the shared leadership becomes larger, indicating a stronger relationship between growth rates and shared leadership. Firm age is economically and statistically positively associated with growth rates in all specifications, suggesting that firms who entered earlier and/or had longer tenure had higher growth. Scale (logged current output) is negatively associated with future growth rates, which is a common finding in growth literature. Table 2 also includes the numbers of engineers, and TMT members with market and financial ties; while engineers contribute positively to output growth, the latter two have no discernable impact. Doubling the number of educated engineers in a given year raises future 3-year growth rates of output by 19.3% and 5-year growth rates by about 16.5%.

[Table 2 about here]

Though Table 2 provides evidence that a firm grows faster when it has shared leadership than when it has a single leader, firms with shared leadership are also at risk of developing conflicts, due to either strategic disagreements or power struggles. Table 3A provides the number of times such discords resulted in a TMT leader's departure, and Table 3B tabulates frequencies of firm-year observations with single or shared leadership, and the periods of time shared leadership firms experienced discord-induced departures. Seventy seven percent of the firms with shared leadership experienced at least one such event, suggesting stability in TMT is not easily achieved, and may be critical for firm growth. At the firm-year level, TMT leaders departures due to discord constitute about 25% of the observations of firms with shared leadership.

[Table 3 about here]

We next explore the effects of single and shared leadership and TMT changes on growth rates. In Specification I of Table 4, the analysis focuses on discord-induced departures; the baseline growth rate is for single leadership firms and the main variables of interest are the interaction terms *Shared Leadership*Discord-induced departure* and *Shared Leadership*No Discord-induced departure*. Relative to single leadership firms, when firms with shared leadership experience a discord-induced departure, they have 3-year growth rates lower by 5.7% and 5-year growth rates lower by 4.2%, with the 90% confidence intervals of [-0.149, 0.035] and [-0.132, 0.048], respectively; in contrast, the 3-year growth rates for firms with shared leadership that experience no discord-induced departure are higher by

4.6% while 5-year growth rates are higher by 10.3%, with the 90 percent confidence interval [-0.029, 0.120] and [0.032, 0.174], respectively. The null hypothesis of no significant difference between the coefficients of shared leadership with discord and shared leadership without discord is rejected at a p-value of 0.07 and 0.01, for 3-year and 5-year growth rates, respectively. Once again, educated engineers have an independent and large positive contribution to output growth but there is no discernible impact of market and financial ties.

[Table 4 about here]

In Specifications (II) and (III) of Table 4, we examine exogenous departures of a TMT leader, and expansions respectively; this permits comparisons of growth rates due to different changes, and the examination of potential endogeneity concerns stemming from joint determinants of growth prospects and TMT leadership departures. In contrast to Specification (I), the coefficients on the interaction terms of *Shared Leadership*Exogenous Departure* and *Shared Leadership*No Exogenous Departure* are very similar in Column (II), and we cannot reject the null hypothesis that these coefficients are the same. In Specification III, the analysis examines the effect of TMT expansions (with interaction terms of *Shared Leadership*TMT Expansion* and *Shared Leadership*No TMT Expansion).* Again, there seems to be little difference in the growth rates of shared leadership firms due to expansion as the null hypotheses of no difference cannot be rejected. Overall, our regression results suggest future growth rates of firms that maintain stable TMT with no departures exceed those of both single-leader firms and firms that have shared leadership but are unable to keep it stable. Given statistical insignificance of the coefficient on TMT functional diversity in Tables 2 and 4, the results indicate that it is not so much TMT functional diversity, but shared leadership and stability that matter for firm growth. Also, the comparisons across specifications in Table 4 suggest disruptions of the TMT structure through discord among its members are most costly and result in biggest differences in future firm growth.

We probe deeper into effects of discord-related departures by examining one-time versus repeated TMT leader departures. Repeated discords are indicative of more systemic leadership problems, and pose greater disruptions to the firm than one-off departures and subsequent quick stabilization (we will expand on this further below, in the qualitative section). Indeed, this bears out in the estimates reported in Table 5; the coefficient on *Shared Leadership with Single Discord-induced departure in Period* exhibits no statistically significant difference from the coefficient on *Shared Leadership with No TMT departure* (p-value for test 1 is 0.80 and 0.63 for 3- and 5-year growth rates, respectively). On the other hand, relative to the baseline of single leader firms, firms with *Shared*

Leadership with Multiple Discord-induced departures in Period have 16.7 % and 22.6% lower growth rates, with 90th confidence intervals of [-0.308, -0.026] and [-0.393, -0.059] for 3-for 5-year spans, respectively. The null hypotheses of no significant differences between these firms, and firms with shared leadership and no departure is rejected at p values of 0.002 and 0.001, respectively.

[Table 5 about here]

Preliminary Examination of Possible Mechanisms

The advantages of historical data replete with qualitative information captured *at the time of occurrence* is the ability to directly examine the mechanisms underlying the observed quantitative relationships, rather than having to rely on indirect inferences. We do so in the next section, and report here additional analysis as preliminary examinations of the underlying mechanisms by pushing the quantitative data a little bit further.

Disagreement or Adjustment Costs?

Discord related departures can impact growth rates due to disagreement costs (incurred *prior* to the departure), or due to adjustment costs (incurred *after* the departure as the firm deals with the disruptions and adjusts to the loss of a prior leader). This issue is important because conflicts and disagreements among TMT members might hinder firm growth even before they trigger departures by taking important resources (e.g., time) away from productive uses. We examine this possibility through the effect of *Discord Period* on firm growth rates in Table 6, Column 1, relative to the effect of *No Discord Period*.[9] When shared leadership firms undergo a period of discord, the growth rates are 8.9% higher than single leadership firms, with the 90th percentile confidence interval [-0.013, 0.192], while shared leadership firms with *No Discord Period* have growth rates of 16% higher than single leadership firms, with the 90th percentile confidence interval [0.075, 0.246]; however, the null hypothesis of no significant difference in the two coefficients cannot be rejected (p value = 0.231). The results are thus not quite conclusive. On the one hand, shared leadership firms who are not at risk of imminent departures of leaders experience robustly stronger 3-year future growth rates than the baseline (single-leader firms). On the other hand, firms experiencing discord leading to key departures from TMTs in the near future seem to locate between single-leader firms and shared-leadership firms with no discord, with imprecisely estimated effects. Thus, there seem to be limits to what can be inferred from the quantitative analysis, and we revisit this issue in the qualitative section.

[9] When a firm experiences a TMT departure in year *t*, periods of discord are from year *t*-1 to *t*-3. We exclude 3-year growth rates measured at *t*-1 and *t*-2 from the analysis because it includes some periods after a TMT member departure.

In Column 2 of Table 6, we distinguish between *Discord Periods with Single Departures,* and *Discord Periods with Multiple Departures.* Interestingly, and in contrast to results in Table 5, there is no significant difference in growth rates in periods preceding single vs. multiple departures—if at all, the growth rates in periods prior to multiple departures are higher than in periods prior to single departures and similar to periods which did not precede any discords. This is what one would expect if events that triggered multiple departures and shared leadership unraveling happened suddenly and unexpectedly (we elaborate on this in the qualitative section). Together, the results across Table 5 and 6 suggest disagreement costs (in terms of distractions/conflict prior to departure) are not as important as the adjustment costs post departure, especially for repeated departures.

[Table 6 about here]

Resource Accumulation and Firm Growth

To further probe mechanisms, we examine the impact on accumulation of productive resources, particularly human capital, which is essential for a firm to become a center of gravity. Table 7 has 5-year growth rates of labor force (factory floor workers), educated engineers, and capital as the dependent variables (results are similar for 3-year growth rates). The results reveal significantly lower growth rates of labor force for firms with shared leadership and discord related departure (negative 11.8%) relative to both single leader firms, and shared leadership firms with no discord related departure (positive 5.6%); the null hypothesis of no significant difference with the latter can be rejected at a p-value of 0.004. Second, university-educated engineering workforce grows at much faster rates when a firm has shared leadership without discord related departures, relative to both single leadership (8.9% higher) and shared leadership with discord (8.9%-(-1.2%)=10.1%). The same is not true for technical school educated engineers, though this is perhaps not surprising as it was university-educated engineers who were most coveted and sought after scarce human-capital resources in the industry; and as a result were able to easily switch firms if dissatisfied with the TMT or firm performance. Given the significance of educated engineering workforce in firm growth (see Tables 2, 4, and 5), we can infer the university-educated engineering workforce was a particularly important driver of firm growth. In the next section, we elaborate through examples how TMT discords led to firms losing their top-notch engineers and suffering adverse consequences. Results for physical capital are similar: firms with shared leadership and no discord and single leadership firms have higher physical capital growth rates than firms with shared leadership and discord. Finally, the results for financial capital are similar to those of technical school educated workforce—there seem to be no discernable difference across the three types of firms in financial capital growth

rates. In sum, our estimation results suggest TMT stability and shared leadership are indeed important forces associated with accumulation especially of top talent and physical capital.

[Table 7 about here]

Diversification and Firm Growth

In accordance with Penrose's theory of firm growth (Penrose, 1959), diversification did accompany Japanese firms' growth. Such diversification consisted of expanding the number of product varieties[10] and integrating downstream into garments production by adding weaving divisions. Not all firms employed these strategies but the centers of gravity firms were at the forefront. In the qualitative section below, we describe how stable shared leadership (including that in the centers of gravity) enabled these strategies. As a precursor to that description, we tabulate in Table 8 the fraction of diversified firms and downstream integrated firms by single or shared leadership, and, for shared leadership, also by TMT stability (observations with no discord-induced departures, with single discord-induced departure, and with repeated discord-induced departures). Diversified firms are defined as those whose total output was comprised of the number of product varieties above the industry-year median. The downstream diversification is a zero-one dummy. Table 8 shows that both shared leadership and *stable* shared leadership are robustly associated with higher fractions of these diversification strategies.

[Table 8 about here]

Ownership Structure and TMT Characteristics

While our study's primary focus is on TMT characteristics, it is plausible that the underlying factor impacting firm growth could be ownership structure or corporate governance. In terms of ownership, as mentioned, the vast majority of cotton spinning firms from their inception were joint stock, limited liability corporations whose shares were frequently bought and sold, including but not limited to stock exchanges, and they had diffused and fluid ownership. Indeed, there were very few family-owned or privately held firms in this industry. As for corporate governance, in Table 9, we provide summary statistics for firms with single vs. shared, and stable, shared leadership on the total number of shareholders, the fraction of total shares owned by the top 5 shareholders, and the fraction of shares owned by board members (executives and auditors). Single leadership is not associated with high degree of ownership concentration. Relative to shared leadership, firms with

[10] Even though cotton yarn may seem to be a relatively homogenous product, it is produced in many varieties, distinguished by thickness ("count") and also by the degree of processing ("doubling," "gassing," and so on).

single leadership seem to have fewer total number of shareholders and slightly higher fractions of shares owned by the top 5 shareholders and board members than shared leadership. Nonetheless, even single leadership firms on average had 449 shareholders, and the fractions of shares owned by the top 5 of them and by board members were below 30%. Firms with stable shared leadership also had on average more shareholders than firms without stable shared leadership, while at the same time having a slightly higher concentration of ownership in the top 5 and board members. However, the differences across the last 3 columns of Table 9 are small and statistically not significant in the last two rows, so any association between corporate governance and the stability of shared leadership is quite weak.

[Table 9 about here]

QUALITATIVE ANALYSES OF FIRM BUSINESS HISTORIES

The quantitative analyses of *all firms in the industry* produced three important results about the connection between TMT characteristics and firm growth. One, shared leadership generally enabled higher growth than single leadership. Two, the advantages of shared leadership tended to dissipate in periods following discord related departure, and even became strongly negative in case of repeated such departures. Three, accumulation of human capital (engineering) resources was facilitated by stable shared leadership and, in its turn, had an independent contribution to firm growth. Armed with these insights, we turn to a deeper examination of the factors underlying firms who experienced such extreme high growth that they emerged as "centers of gravity" in the Japanese cotton spinning industry. Specifically, we address the motivational question: At the early stages of the industry, how could one have predicted which of the seemingly similar startups would grow and develop into "centers of gravity?"

We begin by revisiting the output trends in Figure 1: The average output of the seven ultimate "centers of gravity" grew by 13.1% per year, compared to 8% per year for all other (surviving) firms during 1893-1914. This resulted in almost tripling of the size gap between the two groups by 1914 (from 3.57 in 1893 to 9.13 in 1914). Figure 3, starting from period 2 (after the end of the government support measures), shows the dynamics of shared leadership and discord-induced TMT departures for the seven "centers of gravity" compared to other firms. Five of those had entered by Period 2 (in the order of size achieved by 1914 these are: Kanebo, Mie, Settsu, Amabo, and Osaka). The remaining two (Fujibo and Godo) were later entrants. Centers of gravity firms had shared leadership in 74% of observations in period 2, compared to just over 20% for other firms in the same period. The number of firm-year observations with shared leadership for these firms

increases on average to almost 90% in the next period and stays high, while other firms on average never cross the 50% threshold. The dynamics of discord-induced TMT departures in the total number of years under shared leadership (represented by bars in Figure 3) show that while there is not much difference between centers of gravity and other firms in the earliest period (both have discord–induced departures on average once every five years), TMTs in centers of gravity become more stable over time.

[Figures 3 and 4 around here]

Figure 4 provides the evolution of TMT composition in the centers of gravity versus other firms in three types of human capital: university-educated TMT leaders (including but not limited to university-educated engineers), "traders" (cotton yarn and garments merchants, both incorporated and large individual merchants), and "bankers" (bank executives). An important historical fact is that having recently emerged from feudalism, Japan still had a "glass ceiling" against ascension for anyone not from a reputable merchant family, or without financial wealth. Promoting a university-educated engineer or manager (who were generally not rich investors) to the TMT thus required breaking with strong cultural/traditional norms. In this light, the most striking aspect of Figure 4 is the big divergence, starting in period 3, between centers of gravity and other firms in terms of the fraction of TMT leaders with university education. In contrast, while a much higher fraction of centers of gravity than other firms had at least one TMT leader with bank ties initially (enabling them to enter with a larger size than other firms), the importance of bankers on TMTs sharply declined with time and they are largely absent as TMT leaders by the mid-1900s (Figure 4). This is also indicative of centers of gravity having accumulated resources, including internal finance, so they had less need for external ties to banks. Consistent with the above regression results, there is thus little association between ties to banks and firm growth on average as the industry evolved. Centers of gravity were also more likely to have at least one trader as a TMT leader at time of founding compared to other firms, although the gap was smaller than with respect to university-educated engineers or bankers. Also, both centers of gravity *and* other firms show increases in the number of traders as TMT leaders throughout the sample. The trends are almost parallel (Figure 4), which may be why the regression analysis did not pick the importance of market ties.

Lastly, Table 10 relates shared leadership and discord induced TMT departures in center of gravity firms (the large serial acquirers), their acquisition target firms, and all other acquiring firms. Relating Braguinsky et al.'s (2015) findings of acquisition of higher-productivity fixed assets by better managed firms, centers of gravity had shared leadership twice as often as the firms they

acquired. In contrast, discord induced TMT departures were 2.5 times more likely to occur in the future acquired firms than center of gravity firms. Strikingly, as the last row of Table 10 shows, other acquiring firms were not different from the target firms in these two dimensions, and almost half of them ended up eventually being acquired themselves.

Figures 3 and 4 thus conform with the results of the quantitative analyses in the previous section. We see how stable shared leadership not only was a key determinant of higher growth rates, but was also salient for the emergence of the centers of gravity, who additionally broke with tradition by promoting educated talent, and were serial acquirers of other firms for physical assets. However, the question remains on *how* and *why* this is the case, which we turn to next.

Qualitative Comparison of Seemingly Similar Startups

To delve more deeply into how factors identified in the quantitative analysis played into the emergence of the "centers of gravity," we undertake an in-depth examination of business histories. While we draw upon information on all firms as is relevant, to ensure an appropriate comparison set of initially similar startups, we focus our attention on early entrants (prior to 1892; the year of firm take-off in the industry), who achieved the minimum efficient scale of at least 10,000 spindles either at or shortly after entry (and prior to 1892), and had survived in the industry for at least 10 years. Sixteen of 35 firms that entered the industry prior to 1892 meet these criteria—in addition to the five centers of gravity firms mentioned above (Kanebo, Mie, Settsu, Amabo, and Osaka), the other 11 firms are: Tenma Spinning (Tenma), Naniwa Spinning (Naniwa), Hirano Spinning (Hirano), Senshu Spinning (Sensu), Miike Spinning (Miike), Nagoya Spinning (Nagoya), Okayama Spinning (Okayama), Owari Spinning (Owari), Kanakin (Calico) Spinning and Weaving (Calico), Tamashima Spininng (Tamashima), and Tokyo Spinning (Tokyo).[11]

The insights from our qualitative comparisons, and their connection to the explanatory variables highlighted from the quantitative analysis above, are summarized in Table 11 and Figure 5, and discussed in greater detail in the subsequent sub-sections. In Table 11, we group the 16 startups in our comparison set by explanatory variables used in the quantitative analysis: (i) shared leadership at founding, (ii) the stability of shared leadership, and (iii) presence of a university-educated engineer at founding.[12] The table depicts differences in outcomes as a function of each of the explanatory

[11] We excluded post-period 3 entrants, because they could leverage technology refinements from the early 1890s upon entry; this created significant differences in starting conditions. Of the 35 "candidate" firms with pre-period 3 entry, we excluded 13 smaller former government-promoted mills and six newer private startups who could not muster enough resources to enter at the minimum efficient scale of 10,000 spindles.

[12] Criteria (i) and (iii) are zero-one, while in criterion (ii) we separate the sample based on being above or below the

variables (i)-(iii). In Figure 5, we provide a depiction of the evolutionary paths of the 16 firms from the initial starting conditions through their ultimate fate by 1914; while all five firms who became centers of gravity experienced high growth, the other 11 had all exited by 1914 (six during the first shakeout in period 4). The boxes in Figure 5 elaborate on the explanatory variables identified in the quantitative analysis (single vs. shared leadership; stability vs. discord-induced departure), and additionally illustrate the post-discord governance changes, and their implications for growth outcomes. Importantly, the qualitative comparisons reveal that the business histories of the 16 firms can be grouped into *four* distinct evolutionary paths.

[Table 11 and Figure 5 around here]

Initial Single vs. Shared Leadership

As detailed in Appendix A, the Commercial Code in Japan at the time required commitment by multiple investors to begin the process of chartering a limited liability corporation. Since this was how an overwhelming majority of firms in the industry originated, it created the potential for shared leadership from the onset. All 16 startups in Table 11 were incorporated at founding, or (in cases of Mie, Okayama, Nagoya, and Tamashima who had small former government-promoted mills as their precursors) re-born through this process during period 2 (in these 4 cases, we consider the incorporation year to be the entry year).

For all 16 startups, many founders-investors had other primary businesses, and did not dedicate themselves full-time to governing cotton spinning firms. Such founders refrained from active management, although they may have remained board members or auditors to exercise control. Recall that we empirically identify single or shared leadership by individuals who were actually in charge of strategic decision making or/and managing the firm; therefore, individuals who held TMT positions in title only are not included in TMT leadership. Table 11 shows that among the 16 startups, nine (56%) had shared leadership at entry. Also, having shared leadership at entry seems to be positively associated with the likelihood of becoming a center of gravity. However, by itself, shared leadership was not associated either with higher growth rates, or increases in employment of educated engineers in the first ten years. The lack of a clear-cut relationship between shared leadership and firm growth in Table 11 is in large part due to shared leadership being not stable. Once TMT stability is taken into account, the difference becomes very clear. The second row in

median of the TMT stability over 10 years, measured as the ratio of the number of discord related departures, divided by the number of years under shared leadership during that 10-year period. The two firms that were under single leadership throughout are dropped from this sample and discussed separately below.

Table 11 shows the eight firms with shared leadership with above median TMT stability grew twice as fast as the six other firms. They also increased their employment of educated engineers by 43% over the first ten years, in contrast to firms with unstable shared leadership who lost a third of their initial educated engineers.

Smooth TMT Transition to Stable Shared Leadership

Smooth transition to stable shared leadership (Path 1 in Figure 5) enabled pursuit of growth strategies by leveraging complementarities in human capital of the TMT leaders, to eventually become a center of gravity. Among the 16 startups, only one firm, Mie, was able to follow Path 1, so it is the exception rather than the rule, and an exemplar showcasing the advantages of stable shared leadership.

Mie was founded in 1882, and "re-born" when it was chartered in 1886 in the city of Yokkaichi in the Mie prefecture in Central Japan; among the three board members, two were mere investors and the firm had a single leader, founder Denshichi Ito.[13] In the year of incorporation, Ito recruited Tsunezo Saito, a university-educated engineer, and enabled his travel to England to acquire technical and operational skills. As the third row in Table 11 demonstrates, all future centers of gravity employed a university educated engineer at founding, which is associated with robustly higher growth in the first 10 years. For Mie, Saito's hiring proved to be critical. In 1891, he was elected to replace a board member who left due to personal circumstances. Saito's promotion to TMT was the first case where an engineer became a TMT leader.

The smooth transition from single to shared leadership between Ito (with entrepreneurial vision and managerial talent) and Saito (with engineering skills) was stable throughout our sample period. Not only did the two of them complement each other's knowledge, they also exhibited complementarities, i.e. they were best-in-class talent within their expertise domains.[14] As with other center of gravity firms discussed later, Mie's stable shared leadership served as the "planetary core" around which the center of gravity forms. Mie exemplifies how the "human element" of TMT leadership enabled the pursuit of growth strategies: talent acquisition, scale acquisition, product

[13] The firm's origins trace to a small 2,000-spindle government-promoted mill, located in a remote mountainous area. As all government-promoted mills in that era (Braguinsky, 2015), it suffered from small scale, bad location (dictated by use of hydro power instead of steam engine), and lack of managerial, engineering, and skilled labor resources. Upon government withdrawal of subsidies, Ito sought advice from Eiichi Shibusawa, founder of Osaka Spinning, who helped Ito raise capital to build the 10,000+-spindle mill in Yokkaichi.

[14] Company history describes their complementarity: "Once the new Yokkaichi mill started operating … Ito moved into a newly built dorm on the factory premises, and lived there with the staff in charge of sales and administration. Technology-related staff, meanwhile, moved into Saito's home and lived there while working and learning technology together with Saito." (Toyo Boseki, 1986. p. 171).

expansion and downstream integration.

As mentioned above, educated engineers and managerial cadres were a very scarce resource, especially until about 1907. Mie, as the only center of gravity located away from the bustling central cities of Osaka and Tokyo, suffered a location disadvantage in recruiting talent. Nevertheless, Saito leveraged his (alumni) network, and Mie was a leading recruiter of educated personnel, especially engineers, even among centers of gravity, and the number of educated engineers it employed over the years was second only to Kanebo. As the firm grew larger, Mie expanded its stable shared leadership through promotion of professional managers and engineers (such as Shunichi Hattori mentioned below), in supporting roles.

Mie also added scale through acquisitions. Table 10 shows the five center of gravity firms were the largest serial acquiring firms, and Mie, under Ito and Saito's stable shared leadership, was the most prolific among them with nine acquisitions, seven of which were in the surrounding Seo region. Of note here is Nagoya and Owari could have been arguably stronger candidates to lead the Seo region consolidation, but neither had Mie's stable shared leadership.

Mie's stable shared leadership also enabled downstream integration into garment production. Cotton garment producers—the primary consumers of cotton yarn—still remained largely non-mechanized until the early 20th century. Diversifying downstream, while a lucrative opportunity, was not easy, as it required exploring and implementing different technologies and marketing channels. For example, an important technology choice related to power looms vs. automatic (Northrop) looms. When Mie embarked on garment production in 1896, it first equipped its weaving division with the then standard power looms. Automatic looms were invented and first marketed in the U.S. in 1894, and in 1900, Saito engaged in an extensive, long term overseas travel, first to the U.S., and then also to Europe, so he could learn about the newest technology. Ito's management of mills at the home-front was critical in Saito's absence. As a result, Mie was the first Japanese firm to implement automatic looms (Toyo Boseki, 1986, p. 175-76). By 1906, almost 40% of Mie's cotton yarn was being consumed in-house.

Product diversification in Mie was coupled with garment production for export. In contrast to Amabo and Kanebo described below, Mie did not venture into high-end products until much later. That said, by the 1910s, it produced 20 different product varieties, compared to the industry average of eight. Here too, the complementarities in shared leadership are evident. Early on, Ito invested significant effort in demand development, traveling to Shanghai to learn about market conditions there, while Saito remained in charge at the mills. Later, as Mie's garment exports became

integral to its growth, Ito undertook a comprehensive study of the Chinese market, and gauged potential demand in Manchuria and Korea.

Together, these growth strategies enabled by Ito and Saito's stable shared leadership resulted in Mie emerging, in spite of initial disadvantages of inferior technologies and location, as a key center of gravity accounting for 13% of industry output alone by 1914, the end of our sample period.

Single Leadership in TMT

Single leadership throughout a firm's history represented another pathway for the 16 startups in our comparison set, one which led to limited growth and ultimate exit (Path 4). Only two firms, Okayama and Tokyo, followed Path 4, and their histories serve as contrasts to Mie above. Okayama in Western Japan also started as a 2,000-spindle government-promoted mill in 1881, and was chartered sometime before 1890 (the year of the first surviving shareholders report). It remained under single leadership of the company president, Tastsumi Tanigawa from 1887 through its exit 20 years later. Tokyo was chartered in 1887 in Tokyo by a group of cotton merchants, and was under single leadership of its founder and president, Rishichi Tamura, until 1910. Although it transitioned to shared leadership then, this occurred very late in its history and just prior to its exit through a hostile acquisition in 1914. We consider it a Path 4 firm because this timeline did not permit any benefits of shared leadership on strategies or performance outcomes.

The single leaders of both Okayama and Tokyo were competent, but nonetheless, each firm grew at a much more constrained rate than Mie. The limits to their growth can be traced to an inability to aggressively pursue above mentioned strategies. In terms of talent recruitment, neither firm had an educated engineer at the helm, and while they made several efforts to recruit, they were unable to retain engineers, university educated or technical school graduates. For example, both university-educated engineers recruited by Okayama (in 1896 and 1898 respectively), and the technical school graduates recruited by Tokyo (in 1891-1900) had left each firm by 1901. Given high demand for their services within and outside cotton spinning, these personnel were able to pursue better career opportunities than offered by slow-growing, one man-led firms. Similarly, both firms lagged in scale expansion and acquisitions. While Mie's capacity was already over 16,000 spindles around 1890, Okayama and Tokyo each had only about 10,000 spindles. By 1906, (the year prior to Okayama's exit), Mie had expanded to 187,656 spindles (more than a ten-fold increase in scale) while both of these firms, remarkably, were stuck at a similar size of 36,500 spindles. While Mie had acquired six other firms by 1906, Okayama had acquired only one and Tokyo had made no

acquisitions. In terms of product diversification, while Mie was producing 14 different product varieties in 1906, Okayama was able to produce only eight different product varieties, though Tokyo came close with 12 different product varieties. Similarly, in stark contrast to Mie's spectacularly successful downstream integration through leverage of stable shared leadership above, Okayama's efforts at downstream integration resulted in the fraction of in-house yarn consumption at only 13.5% in 1906, and Tokyo had not even attempted downstream integration.

Indeed, Tokyo's late experience is also illuminating. In 1908, still under Tamura's single leadership, the firm began new plant construction, expanding its total capacity to over 100,000 spindles by 1910. The number of its product varieties increased to 24, and it also embarked on downstream integration. The firm also finally added a new TMT leader, Seijiro Miyajima, who was Tamura's son-in-law and a recent graduate of the prestigious law department of the Imperial University. But this transition to shared leadership came too late and, notably, did not precede the expansion strategy (as in Mie above) but followed up on it. The new management structure was not able to fully leverage its new state-of-the-art production facilities and it succumbed to a hostile acquisition bid from Amabo in 1914.

Firms in Path 4 thus represent able, but not *shared* leadership, and experienced managerial diseconomies of scale. A notable exception to this rule is Godo (a later spinout entrant and not in our comparison set), the only center of gravity firm spearheaded by a single leader, Fusazo Taniguchi, from inception through the sample period end. Taniguchi's ability to lead Godo single handedly may be due to employee entrepreneurship: Hailing from a yarn-trading background, Taniguchi acquired industry experience by serving on two cotton spinning firms' boards, and had attempted a new venture creation prior to Godo. These experiences provided Taniguchi a "within-person" integration of market and operational knowledge, a substitute for shared leadership. He leveraged this knowledge successfully by following an expansion through acquisition strategy: rather than relying on engineering talent necessary to create new in-house production facilities, Taniguchi grew Godo through superior management of acquired, under-performing mills.

Shared Leadership with Discord-induced Departures

Thirteen of the 16 startups in our comparison set, and thus the majority of the firms, either started or transitioned to shared leadership and experienced at least one discord-induced departure. Accordingly, they represent both Path 2 (eventual establishment of stable shared leadership) and Path 3 (lack of stable shared leadership) in Figure 5. Their business histories (see Appendix E for the timeline of each firm) provide rich detail regarding the underlying reasons for the discord-induced

departure. We categorize these reasons in three types: strategic, interpersonal, and ethical.

Strategic Discord-induced Departures

Discord-induced departures stemming from strategic disagreements between TMT leaders and/or board members are observed in many business histories. In Amabo (1893), an early discord-induced departure occurred due to a disagreement between company president Chubei Kihara and actively engaged board member Motonosuke Fukumoto who (with the help from chief engineer Kyozo Kikuchi), proposed a pioneering plan for new plant construction for entry into the high-end 42s count doubled yarn. Fukumoto called a shareholders meeting to garner support, which resulted in Kihara's resignation and Fukumoto becoming the president. Similar disagreements over expansion plans within TMT leadership and among shareholders also led to discord-induced departures in Tamashima (1898-99) and Naniwa (1895-96).

Kanebo experienced several discord-induced departures (in 1891-93; 1900 and 1907). Shortly after the firm was launched, and as a result of several miscalculations by the shared TMT leadership, Kanebo found itself on the verge of bankruptcy, leading to the general manager's forced resignation in 1891. The leadership then sought financial help from Mitsui (a prominent financial group) and had to surrender the controlling block of shares. Mitsui then implemented two more TMT leadership changes (1892 and 1893) to replace holdover TMT leaders with university-educated managers, Hikojiro Nakamigawa and Eiji Asabuki. Later on, Kanebo experienced another discord-induced departure in 1900 in their second tier of expanded TMT shared leadership: Toyoji Wada (the general manager) and Sanji Muto (who managed the newly established Hyogo mill in the Osaka area) held conflicting views about how to technologically upgrade the older Tokyo mill. After failing to resolve their conflict, the senior leadership in 1900 decided to remove Wada and give Muto authority over both firm branches. A final strategic discord-induced departure occurred in 1907. Muto and a stock market speculator, Hisagoro Suzuki, who obtained a controlling block of shares in the previous year, sharply disagreed about the company's strategy going forward, and this led to the resignations by both Muto and Asabuki (Nakamigawa had passed away a few years earlier). Similar to Kanebo, Tenma (1895) experienced mismanagement early on, and a strategic discord-induced departure followed on the heels of a labor strike that deteriorated into violence (still a very rare occasion in Japan at that time), prompting government inquiry into the firm's management practices. Tenma experienced 2 more discord-induced TMT departures in 1899-1900 that were directly related to the 1894-95 shakeup.

Strategic disagreements in shared leadership resulted in spinouts too: both Osaka (1894) and

Calico (1899) lost a TMT leader to employee entrepreneurship. In Osaka's case, Rihei Kawamura, a highly touted professional manager and TMT leader in charge of marketing and sales, left to found his own venture. In Calico's case, another professional manager and TMT leader, Masahiro Tamura, left to join the TMT of newly founded Fujibo (a later entrant center of gravity not in our comparison set, described briefly below).

Interpersonal Discord-induced Departures

While often morphed with strategic differences (Amason, 1996; Eisenhardt and Bourgeios, 1988), we describe below five discord-induced departures primarily driven by interpersonal differences. Interpersonal differences in attitudes towards engineers were at the root of Hirano (1893) and Osaka (1898). While the discord-induced departure in Amabo (1893) above was mostly about strategy, Hirano (1893) serves as a great foil, if only because the same individual, Kyozo Kikuchi, was involved. Hirano (who entered two years prior to Amabo) was the first to recruit Kikuchi right after his graduation from Imperial University, and had sponsored his trip to England to acquire state-of-the-art technological knowledge, in the same year as Mie sent Saito. When Settsu and Amabo entered the industry, they negotiated his joint appointment as the chief engineer of their firms, alongside his primary job at Hirano.[15] Kikuchi aspired to rise to leadership ranks, and in 1893, he seemed to have some support from the just-installed shared TMT leadership in Hirano. However, the company president vetoed Kikuchi's promotion because of his engineering background. The discord led to the departure of the other TMT leaders, and shelving of Kikuchi's promotion. Similarly, Osaka's (1898) interpersonal discord-induced departure occurred three years after Kawamura's departure above. The company had restored shared leadership by promoting its educated chief engineer, Takeo Yamanobe to a TMT leader, but the lack of Kawamura's superior marketing knowledge was hampering firm growth. "New" and "old school" differences resulted in "blame-games" and interpersonal rifts between Yamanobe and the company's president Jutaro Matsumoto. In 1897, Matsumoto wanted to remove Yamanobe from TMT, but firm founder Eiichi Shibusawa supported Yamanobe (whom he had personally recruited), and Matsumoto himself had to resign instead in the ensuing shareholders meeting.

In Nagoya's (1893) case, interpersonal discord occurred when Jubei Sofue, a major shareholder, financier and wholesale trader, pushed through the election of a new TMT leader with government ties. This leader, in his turn, hired mid-level managerial personnel from the prefectural

[15] Such sharing of scarce engineering talent was common in the early Japanese cotton spinning industry.

government. Their arrogant behavior, when coupled with little industry knowledge, disrupted Nagoya's management. Unable to work with the new team, the incumbent TMT leader and long-serving company president resigned. Similar discords erupted in the case of Owari in 1891 (see below for details). In Senshu's case, interpersonal fighting for firm control between competing investor/directors groups led to repeated discord-induced departures (and comebacks by previously ousted leaders) over 1893-95, as we also describe in some detail below.

Ethical Discord-induced Departures

Ethical discord-induced departures is a final category, consisting of financial fraud or misappropriation. Two firms, Settsu and Naniwa developed very similar ethical discords in 1889, shortly after their founding. The company president (in Naniwa's case) and a founding board member (in Settsu's case) misappropriated shareholders money for their own private businesses and were dismissed. The ethical discord-induced departure in Tamashima in 1897 was also following misappropriation of company money for private use by the firm's general manager. In two additional cases—Senshu, 1900, and Miike, 1901 (re-named Kyushu following acquisitions of two other firms in 1899)—mid-level managers who were protégés of shared TMT leadership members gambled with company money and lost. These events led to the resignations of the TMT leaders responsible for the mid-managers' supervision.

Post Discord-induced Departure Transition to Stable Shared Leadership

Regardless of reasons underlying discord-induced departure, some firms transitioned into stable shared leadership (Path 2). The extent to which their history demonstrates sustained periods of stable shared leadership is directly related to their pursuit of growth strategies. Among the 13 firms who experienced at least one discord-induced departure, four firms followed this pathway to eventually become a center of gravity; our examination of their business histories revealed these firms (in contrast to the other nine) focused on different underlying *principles* when undertaking governance changes after the discord-induced departure.

Strategic Alignment on Value Creation (for strategic and interpersonal discords)

In Amabo, the only instance of discord-induced departure in 1893 was resolved based on the potential for value creation in Fukumoto's long term expansion strategy. Once elected, Fukumoto immediately proposed promoting the company's university-educated chief engineer, Kyozo Kikuchi, to a TMT leader position. Similar to Hirano above, this was initially met with opposition from more conservative, traditionalist board members and shareholders given glass ceilings against engineers. However, in contrast to Hirano, Fukumoto prevailed against them and this discord *did not* lead to

another TMT departure. The role of strategic alignment here is brought home by the fact that the shareholders had already approved Fukumoto's ambitious and potentially risky expansion plan. The necessary capital was to be raised through issue of new shares, allocated to incumbent shareholders in proportion to the existing shareholdings (a practice consistently employed by firms when raising new capital for large-scale expansions, including for acquisitions). The commitment ensured the shareholders' subsequent agreement with Fukumoto, who noted to them that Kikuchi's professional knowledge and talent were more important for the company success than money. As the firm history proudly notes, this paved the way for the modernization of management and amounted to "a progressive, enlightened decision for that time." (Unitika, 1989, p. 12). Thus, notwithstanding a short-term cost to growth from Kihara's discord-induced departure (as Figure A2 in Appendix D shows, robust growth in 1891-92 was followed by two years of almost no growth in 1893-94), Amabo experienced spectacularly high long term growth from a long period of stable shared leadership in the aftermath.

In Kanebo too, the post-discord departure resolution in each case was swift and made in consideration of long term value-creation. This started with the early leadership's willingness to surrender controlling block of shares to Mitsui (a financial group), putting the company's long-term survival and prosperity ahead of short-term self-interest, given that all of them were eventually replaced by Mitsui.[16] In turn, new TMT leaders, Nakamigawa and Asabuki, who originated within Mitsui with a finance background realized they lacked the specialized management resources for an industrial firm. In 1894, they expanded to a second tier of management by hiring two young university graduates with U.S. based education, Toyoji Wada and Sanji Muto. As noted above, the second round of discord-induced departure in 1900 between Wada and Muto was resolved with a focus on modernization under Muto's leadership. The final discord-induced departure of Muto and Asabuki in 1907, precipitated by strategic disagreement with Suzuki, who in 1906 acquired the controlling interest (though less than 50% of Kanebo's shares), was contained in the very same shareholder meeting which ratified the resignations. Other shareholders, concerned about the company's future, created a strategic coalition that ensured Suzuki was not elected to the board, and instead helped elect a new, independent TMT leadership, including Heizaemon Hibiya (a respected

[16] Although this may seem like an obvious thing to do, things, of course, can easily get sidetracked. An example is provided by Enshu Spinning (not in the comparison set because it never grew). The firm, an early chartered corporation on the basis of a small government-promoted mill, suffered from the same problems as Mie did but in 1889 had an opportunity to raise capital and construct a new 10,000+-spindles mill much in the same way as Mie did. Afraid of losing control because of inflow of new investors, incumbent shareholders killed the plan. The firm exited three years later.

investor with company turnaround experience) and Narazo Takatsuji, a university-educated engineer, with prior industry experience. The new TMT leadership kept Muto in an advisory role. Later that year, a stock market crash led to seizure of Susuki's Kanebo shares by a creditor bank, and in January 1908, Muto triumphantly returned to (re-)join the shared TMT leadership as the new executive director. Appendix D Figure A6 shows that the immediate post-disruption years were characterized by slower growth, but robust growth resumed shortly thereafter. [17]

Finally, Osaka was able to restore shared leadership swiftly after the first discord-induced departure in 1894, and followed Path 2. As noted above, it promoted its educated chief engineer Yamanobe to a TMT leader position; however, the stability lasted only a few years till 1898. As we discuss below, Osaka was in Path 3 until shared leadership was restored through the acquisition of Calico in 1906, when Calico's university-educated manager (a non-engineer) was retained to complement Yamanobe.

Honorable Resolution of Ethical Conflict

Among the five ethical discord-induced departure cases in Figure 5, only Settsu's (1890) case was resolved honorably and with long term value creation in mind. The TMT leadership elected to take both personal and financial responsibility for the malfeasance by one of its own. A special shareholders meeting was called and approved their proposal to issue new shares to cover half the misappropriated amount, to be purchased entirely by the remaining founding TMT members. The rest was construed as a long-term loan to Tanaka (the embezzler), which he subsequently repaid gradually. A new TMT leadership was also elected, with Heibei Hirano and Chuemon Takeo at the helm. The shared leadership in Settsu continued after Hirano passed away in 1896, when chief engineer, Kyozo Kikuchi, was promoted to replace him. This smooth transition ensured Settsu maintained Path 2 to become a center of gravity.

[17] A worthwhile mention here is Fujibo (a late entrant not part of our comparison set), another center of gravity. Similar to Kanebo, Fujibo also started on a large scale and found itself on the verge of bankruptcy, in this case because the single leader at the helm in the first three years, Tetsunosuke Tomita, lacked professional knowledge in cotton spinning (Fuji Boseki, 1998, p. 32). In 1899, the shareholders recruited Masahiro Tamura, who had been successful in shared leadership at Calico. However, Tamura did not fit in and had to resign after just 10 months in office (Fuji Boseki, 1998, p. 33-34). The shareholders then elected Heizaemon Hibiya (already mentioned above in his role in the post-discord resolution at Kanebo in 1907) to the board of directors in late 1900. Hibiya instantly assumed a leadership role despite not having an executive title and proposed a new senior executive director, Toyoji Wada, a university-educated manager who had just been let go by Kanebo. The shared leadership of Hibiya, Wada, and Fujibo's new executive chairman Kichiemon Hamaguchi (who replaced Tomita) finally stabilized the firm and led it to steady growth (on average by 20% per year from 1902-1914, see Figure A7 in Appendix D) and on the path to becoming a center of gravity.

Growth Strategies Enabled by Value-Creating Post-Discord Resolution and Transition to Stable Shared Leadership

While Path 2, followed by four of the five center of gravity firms, was not as smooth as Path 1 above for Mie, these cases reinforce what was depicted in Figure 4; while discord-induced departures were more frequent in the early years of these firms, their (often) swift resolution in favor of value creation both reduced the potential for follow-on departures, and ensured longer periods of stable shared leadership. In turn, similar to Mie, all four firms were able to pursue one or more growth strategies when under stable shared leadership.

Figure 2 already depicts the disproportionate acquisition of talented university educated engineers by the center of gravity firms. In all cases, the presence of educated (engineer) managers in the stable shared leadership (Kikuchi in Amabo and Settsu; Yamanobe in Osaka, Muto—the only non-engineer—in Kanebo) was critical to their ability to attract talent. Similar to Saito in Mie, each of these TMT leaders not only recruited through their alumni network, but also served as beacons of future potential to the engineering graduates. These graduates were also able to realize more successful careers in center of gravity firms, through their growth from scale expansion (and acquisitions), downstream integration and product diversification.

Indeed, complementarity in TMT human capital within all four firms enabled them to grow through both acquisition of later entering firms with superior physical assets but under-performing management (see Table 10), and through new plant construction. In addition to Mie above, a striking example of how stable shared leadership enabled acquisitions is Kanebo, which consummated eight acquisitions over the period from 1898-1911 (second to Mie in terms of numbers, but greater in terms of added scale). Muto recalled the benefits of complementarity in shared leadership, noting his ability to focus on consummating acquisitions and managing the production process complexities across multiple plants was predicated on his reliance on Asabuki's able management of company finances (Kanebo, 1988). Upon Muto's return to TMT leadership in 1907, the later shared leadership team embarked on an even more ambitious expansion plan, involving a new big plant construction in Tokyo to produce state-of-the-art high end profitable yarn (e.g. 42s doubled yarn, and even higher end gassed yarn of 60s-100s counts). The successful execution over the next 5 years, doubled the firm total capacity (Appendix D Figure A6). Combined with a tripling of engineering talent, this enabled Kanebo's rise by 1914 as the largest center of gravity.

Scale expansion enabled product diversification in Amabo and Settsu, (with Kikuchi as part of the stable shared leadership in both firms), and later downstream integration in Amabo.

Implementing Amabo's product diversification strategy required not just Fukumoto's entrepreneurial vision and Kikuchi's engineering talent but also a marketing champion. Fukumoto and Kikuchi jointly searched for and recruited Juemon Tashiro as a TMT leader for sales; the three of them then established an effective division of labor (Unitika, 1989), very similar to the division of labor between Ito and Saito in Mie. As Kikuchi developed the right technologies, traveling also long-term to the U.S. and England, Fukumoto tended to business operations, and Tashiro went door to door with product samples to persuade Japanese merchants to switch from the trusted British suppliers (who also paid generous commissions). By 1899, these dedicated efforts had borne fruit: the domestic output of 42s count doubled yarn exceeded imports for the first time, with Amabo producing 70 % of this lucrative segment and establishing dominance for years to come.[18] The value-creating strategic alignment was so strong that when Fukumoto had to resign as company president in 1901 due to personal circumstances, Kikuchi seamlessly replaced him (thus becoming the first non-investor president of a major spinning company), while Tashiro became the senior executive director. Amabo became the most profitable firm in the industry; its profits kept increasing even during the shakeout when profits of other firms (even those of other centers of gravity) nose-dived (Figure A3 in Appendix D). When other firms (especially Kanebo as above) started to catch up in the higher-end market, Kikuchi and Tashiro (together with Fukumoto who rejoined the firm as a director in 1912) steered Amabo towards more product diversification and downstream integration, adding scale by new construction and the above-mentioned acquisition of Tokyo in 1914. Similarly, within Settsu, Kikuchi shared TMT leadership with Takeo (also a founder and president of a large import-export firm). They leveraged their complementary human capital to implement a growth strategy focused on scale expansion through acquisitions, and targeting product varieties for exports.

Osaka represents a unique case among the center of gravity firms, inasmuch as its business history reveals both Path 2 and Path 3. Osaka was the industry pioneer, created through Shibusawa's entrepreneurial energy and with shared leadership which included Osaka business community

[18] Amabo's success stands in contrast with two firms, Heian and Meiji (both later entrants and not in our comparison set) who also sought a foothold in this highly profitable niche at around the same time. Heian entered with single leadership in 1896, and its transition to shared leadership in 1899 was pockmarked by power struggles, leading to two discord induced TMT turnovers in 1900 and 1902. Its share of industry-wide 42s count doubled yarn production peaked at 13% in 1897 and declined steadily thereafter till the firm went bankrupt in 1903. Meiji, under single leadership throughout, was able to peak its production of 42s count doubled yarn in 1899 at about 20% of total industry production, but also went out of business in 1902. Notable in these failures was their inability to recruit a university-educated engineer, and lack of a true sales champion.

leaders Denzaburo Fujita and Matsumoto, as well as Rihei Kawamura for procurement/sales, and Yamanobe for technology. The initial stable shared leadership enabled Osaka to expand its scale 6-fold in the first seven years and to engage in many pioneering experiments. For example, Kawamura was key to initiating cotton imports from India, while Yamanobe integrated it into the production technology. Together, they reconfigured Osaka's capabilities, enabling increased efficiency and expansion into higher-grade product varieties and propelling not just Osaka, but the entire industry to high growth. While it languished with lackluster growth after the 1898 discord-induced departure under single leadership through 1905 (discussed below), Osaka regained stable shared leadership after acquiring Calico in 1906. This enabled Osaka to acquire another firm in 1907 and invest in big expansion of both acquired facilities to triple its overall capacity by 1914.

Lack of Stable Shared Leadership

Firms that followed Path 3 to limited growth and eventual exit are diverse in their circumstances, but a unifying theme across these is their *lack* of transition to stable shared leadership. In four instances, this was due to focus on (broadly defined) value appropriation, while in the remaining (including Osaka, a center of gravity firm), the reversion to single leadership limited growth due to managerial diseconomies.

Politics and Power Struggles Leading to Firm Exit

Lack of strategic alignment over expansion proposals similar to that of Amabo (1893) within TMT leaders and among the shareholders caused discord-induced departures in Tamashima (1898-99) and Naniwa (1895-96). In Tamashima's case, two of three TMT leaders wanted to double the firm's capacity in 1897, in spite of strong opposition from the third. Rather than creating alignment and ensuring shareholder buy-in, the two TMT leaders pursued the highly risky strategy of financing the expansion through new capital raised through corporate bonds and bank borrowing. In the midst of financial uncertainty, both sides focused on their own interests, rather than on long-term growth and survival, causing the firm to become insolvent. When creditors sued Tamashima, all three TMT leaders resigned and replaced themselves with dummy figures in an attempt to avoid legal responsibility. Tamashima's path to self-destruction was additionally marked by the ethical breach discussed above, and it exited less than three years from the first discord. In Naniwa, the ethical discord-induced departure due to financial misappropriation was handled in stark contrast to Settsu. The newly elected president, Masatoshi Murakami, chose to skip the shareholders meeting called to discuss the issue altogether, and things quickly went from bad to worse, with another embezzlement surfacing in the following year. Rather than being dismissed, the culprit (a political

appointee from the Sumitomo financial group) was instead promoted to the board of directors in 1893. The TMT then proposed an expansion plan similar to Tamashima, and also resorted to bank borrowing and issuing corporate bonds when the TMT could not garner shareholders' commitment to pay in new capital. The firm underwent six TMT changes and went bankrupt after just ten years in business.

Politics and power struggles also plagued Senshu, where TMT leaders pursued their individual interests and positions in quests for power. The firm went through four discord-induced TMT departures as a result of this political infighting in the first ten years of its existence. In the process, Senshu lost the university-educated engineer it employed at founding. The lack of TMT stability also led to an ethical breach, as mentioned above, which triggered even more TMT departures, and the firm exited in late 1902. Tenma's case following labor unrest-related TMT shakeup noted above was similar, and also created an exodus of engineering talent, causing the firm to become bankrupt in 1900.

Reversion to Single Leadership Leading to Limited Growth

We being with Osaka's post-1898 reversion to single leadership for eight years, because it illustrates that even centers of gravity were not immune from managerial diseconomies problems when they transitioned to single leadership, similar to firms in Path 4. Yamanobe, the new company president had both engineering talent and high professional skills, and deserves credit for leading Osaka singlehandedly through 1905, which largely overlapped with the difficult (shakeout) years in the industry. However, while other centers of gravity, especially Mie and Kanebo, took full advantage of industry shakeout through acquisition-related expansion, Osaka was unable to make a single acquisition, and stagnated with the average growth rate of output of less than 1% per annum, and also lost part of its engineering talent during this period (Appendix D Figure A4). While it regained growth momentum post 1906 in Path 2 under stable shared leadership after acquiring Calico, its extended Path 3 experience was damaging to its eventual position. Starting as the pioneering industry leader who accounted for almost 50% of all industry output in the 1880s, Osaka was barely able to retain its center of gravity position as the smallest of the seven in 1914, with just over 6% of industry output.

Calico history post-1899 and before it was acquired in 1906 also illuminates the diseconomies of scale from single leadership. Upon losing TMT leader, Masahiro Tamura, to Fujibo in 1899, Calico could have promoted its university-educated chief engineer, Narazo Takatsuji. This was not done; and Takatsuji also left the firm. That he could have been a suitable person is proven

by his subsequent rise to TMT leadership in the much larger Kanebo. Calico's transition to single leadership resulted in stagnation over the next five years, in contrast to the tripling of capacity during the earlier 1890-1899 period. As Tamura returned in December 1904, Calico added new capacity through acquisition in the next year. But, similar to Tokyo in Path 4, this was too little too late, and the firm was acquired by Osaka in 1906, as noted above.

Owari represents another stark example of the limits to growth when a firm with shared leadership reverts to single leadership. With almost the same size as Mie in 1890, it initially had shared leadership comprised of Tomoemon Kondo, an experienced trader in charge of sales, Nobutaka Okada, a manager with prior experience at a government "model" mill, and a top-notch, university-educated chief engineer, Shunichi Hattori (who had very similar background to Saito in Mie). However, interpersonal discord with shareholders led to Kondo's and Okada's departure in 1890, leaving Hattori as the sole de facto leader from 1891. Though he was subsequently promoted to the board of directors to formalize his role (so the glass ceiling was not an issue), the Owari shareholders focused on value appropriation through dividends, refused to appoint additional TMT leaders to complement Hattori's engineering talent, and even voted to reduce his salary by 20% and prohibit performance bonuses. By his own admission, Hattori didn't care much about money, so he stayed with the firm, but the lack of a complementary marketing and management leaders constrained Owari's growth. The firm could not implement either product diversification or downstream integration strategies. In terms of scale, by 1904, while Mie's capacity had more than quintupled in size, Owari's was merely doubled. Owari was subsequently acquired by Mie in 1905.[19]

Shared leadership was short-lived also in Nagoya, Miike and Hirano. As mentioned, in the Nagoya (1893) case, the incumbent TMT leader quit within a year after the promotion of a former prefectural government bureaucrat into shared leadership position. Even though the history is silent on the motive behind this promotion, we conjecture that it had something to do with the sponsoring major shareholder (Sofue)'s outside business interests. The institutional environment in which the industry itself operated, however, was unforgiving; any possible benefits Sofue derived from his government connections did not and could not benefit Nagoya. The firm exited in 1905 after years of subpar performance, with no ability to grow through either downstream integration or product diversification. At Miike, coordination problems in an expanded leadership team due to two

[19] When Mie acquired Owari in 1905, Hattori was offered a position on the board. He declined, feeling responsibility for failing his previous firm. Instead, he reset his career by joining Mie as a rank-and-file engineer. He was subsequently elected to Mie's shared TMT leadership in 1912.

acquisitions in 1899 were exacerbated by transition costs of a non-discord departure, during which time the ethical breach not only had financial ramifications, but also resulted in resignations of several leaders. The firm reverted to single leadership in 1901 and was later acquired by Kanebo. In Hirano, following the unwillingness to promote Kikuchi and the falling apart of the shared TMT leadership in 1893, Jinsaku Kanazawa, (the company president's brother-in-law) who had started his career in the firm as Kikuchi's subordinate, emerged as the single TMT leader. Kikuchi first retreated to an advisory role, and then cut ties completely in 1898. Subsequently, Hirano had difficulty retaining its other engineers (high technical school graduates) . An attempt to gain scale by acquiring another firm in 1898 backfired, given single leadership and instability in the engineering pool. In the irony not lost on Kikuchi, it was Settsu that acquired Hirano's mills in 1902, putting him in charge of his former employer, after all.

DISCUSSION AND CONCLUSION

The fact that industries tend to become dominated by just a handful of leading firms as they mature has long fascinated industry evolution scholars. We dug deep into micro- ("nano-") foundations of firm and industry evolution in the historical context of Japan's cotton spinning industry, and carefully triangulated across quantitative and qualitative data through the integration of history and economics/strategy

Our study has produced the following stylized findings. First, industry leaders or "centers of gravity" in terms of scale and scope rose to dominance first and foremost through their accumulation of superior talent, and acquisition of underperforming tangible assets. Second, firms who became centers of gravity had at their core, top management teams who exhibited stable shared leadership. Harking back to Penrose, firms with single leadership (either throughout their business history or during episodic periods) often had able leaders. All but one (Godo) were nonetheless constrained because they "simply don't have the necessary number of men of the required caliber around" (Penrose, 1959, p. 63). Complementarities in managerial talent across expertise domains through stable shared leadership at the helm enabled firms to grow by pursuing talent and scale acquisition, product expansion and downstream integration. Third, smooth transition to long-term stability of shared leadership was the exception, not the rule. Only one firm (Mie) among over a hundred that entered cotton spinning during out time frame was able to do so. Rather, for the overwhelming majority of firms, TMTs under shared leadership evolved through distinct alternative paths resulting from discord-induced departures. Thus, *maintaining* stable shared leadership was a difficult endeavor.

Contrasts among initial peers reveal the following principles were used more consistently by center of gravity firms, for disproportionately greater periods of stable shared leadership. Their TMT leadership and shareholders strategically aligned themselves on long-term development of their firms through a) joint buy-in of new growth strategies while accepting inevitable short-term costs, b) adoption of merit-based promotion system in defiance of prevalent cultural norms, c) sharing of power within TMT leadership to enable efficient division of labor among them, and d) honorable resolution of conflicts and ethical breaches. These factors enabled firms to both grow in periods of stability because of increased managerial span of control, division of labor, and successful talent recruitment and retention, and recover more quickly from discord induced departures, through the foundation of value-based focus on human capital strategies.

It is perhaps not surprising that few firms had TMT leaderships that could do most or all of the above. In the majority of cases, TMT leadership and/or major shareholders engaged in politics and power struggles, prioritizing short-term value appropriation over long-term value creation. These firms had repeated discords and discord-induced departures, putting them on path for the worst growth records and early exit. Other firms reverted to single leadership, limiting growth and precluding development into centers of gravity.

Our study has several limitations; in addition to generalizability concerns from a single industry study, others relate to historical, archival nature of the data. In particular, we lack systematic evidence about discords that did not result in TMT leaders' departures (although we can infer from company histories that such episodes definitely took place), nor could we conduct interviews with the individuals involved to gain deeper insights into their thinking and systems of values. We hope, however, that future research finds the regularities we uncovered useful for qualitative studies dealing with more contemporaneous data. Also, although we have the universe of all firms in the industry, our quantitative examination was still constrained by relatively few observations because of one industry over a limited period of time. This did not allow us, in particular, to garner enough statistical power to examine econometrically how different *types* of discord-induced departures and post-discord resolutions affected firm growth. That said, given that only a few firms grow to become centers of gravity, and we uncover the critical importance of the human element as the factor of this growth, our study also strikes a note of caution about interpreting results obtained from large-scale panel data analyses which look at an "average" firm. Finally, our focus on the first complete industry life-cycle precludes follow on evolution through subsequent life cycles in the 1920s and 1930s, and then again after World War II. These new cycles not only resulted in mergers between centers of

gravity examined here (see the online Appendix F), and their diversification in other industries, but also the emergence of new firms. An examination of such growth opportunities, and the manner in which the firms evolved their internal organizational structure, is a task we leave for future research.

Our study contributes to the literature motivated in the introduction, and importantly, harks back to the classics' focus on entrepreneurial/managerial *embodiment* of firm capabilities and resources (Schumpeter, 1949[1911]; Penrose, 1959; Lucas, 1978). The history of the Japanese cotton spinning industry shows the capacity of the TMT and its growth are indeed the key factors behind accumulation of talent and physical capital accumulation, and thus the growth of the firm. The ability to keep high-quality TMTs together as a Penrosian "working unit" is by itself a scarce resource capable of generating Marshallian quasi-rents. Schumpeter (1987 [1943]) emphasized how such quasi-rents induce entry and lead to industry growth. We emphasize here another important aspect of this phenomenon: quasi-rents generated by successful entrepreneurial firms attract talented people *into* these firms, but only if the firm was aligned on value creation. When the Meiji era ushered in open markets, enterprising individuals created new ventures. Among these, those whose focus was on talent and value creation became the best incumbent firms: the "centers of gravity" that attracted more and more talent (and other complementary resources) into their orbit, in a process that can be likened to that of planet formation (with industry organization being similar to the organization of a planetary system). Their leadership represented (and recruited) the "best in class" talent, with a focus on enterprise and experience rather than political connections and inherited riches, and had willingness to break with tradition in the face of opposition.

While industry evolution scholars have studied the role of strategic disagreements and knowledge spillovers in existing firms as spurring entrepreneurial entry, the growth effects of cohesion and internal capitalization of opportunities have been understudied. Stable and shared leadership, and the resultant accumulation of talent and physical capital created a virtuous cycle: by recruiting and expanding the overall pool of talent available to them, firms overcame the limitations of managerial span of control and grew the Lucas x factor even more effectively. Not just Schumpeterian entrepreneurial entry, but also Penrosian managerial entrepreneurship are critical to firm and industry evolution, and thus economic growth. Most of all, this study presents an opportunity to showcase the human element in the forefront of firm growth and industry evolution studies, as the underlying factor enabling other, more conventional ones, such as first-mover advantage, experience, general resource accumulation and economies of scale.

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Table 1: Research Variables

	Definitions
A. Main dependent variable	
Output Growth Rates	The growth rate of cotton yarns produced in physical units, measured as the difference between logged output at time *t*+1 and that at time *t*. Weight units adjusted by thread count weights to account for varying thickness of different product varieties.
B. TMT Characteristics Variables	
Singe Leadership dummy	Equals 1 if a firm was led by a single TMT leader (defined as a TMT member who actually runs the firm and made strategic decisions (not nominal heads) , 0 otherwise
Shared Leadership dummy	Equals 1 if a firm was led by two or more TMT leaders, 0 otherwise
Number of TMT members	The number of TMT members by title, including but not limited to TMT leaders
Number of TMT leaders	The number of TMT leaders
Functional diversity of TMT	Each TMT member is classified as a cotton yarn trader, a banker, ex-politician/bureaucrat, or entrepreneur in other business area. The share of each class filled by TMT members is calculated. The variable is 1 minus the sum of squared shares of these classes.
C. TMT Turnover Variables	
Discord-induced departure Dummy	Equals 1 if a TMT member resigned or was ousted from the firm for reasons other than death, illness or personal circumstances unrelated to the firm, 0 otherwise
Shared Leadership with Single Discord-induced departure in Period	Equals 1 if a discord-induced departure occurred only once in three consecutive years, 0 otherwise
Shared Leadership with Multiple Discord-induced departures in Period	Equals 1 if a discord-induced departure occurred more than once in three consecutive years, 0 otherwise
Discord period	Equals 1 in the three year period preceding the year of a discord-induced departure, 0 otherwise
Single Discord Period	Equals 1 in the three year period preceding a single discord-induced departure, 0 otherwise
Multiple Discord Period	Equals 1 in the three year period preceding consecutive three years with multiple discord-induced departures, 0 otherwise
No Discord Period	Equals 1 if there is no discord in the next three years, 0 otherwise
Exogenous Departure Dummy	Equals 1 if a TMT member departed for exogenous reasons, such as death, illness, or personal circumstances, 0 otherwise
Expansion of TMT Dummy	Equals 1 if a new TMT member is added while no member was removed, 0 otherwise
D. Firm Characteristics	
Firm age	The age of the firm since it was founded
Number of workers	Logged value of the number of floor workers employed
Number of Engineers	Logged value of 1 plus the number of university educated and technical school educated engineers
Market knowledge	Logged value of the number of trading company executives and auditors or cotton traders who were also cotton spinning firms' board members in a given year
Financial knowledge	Logged value of the number of bankers

Table 2: Relationship between the Size of TMT and Firm Growth

	DV: Output Growth Rates			
	I		II	
VARIABLES	3 year	5 year	3 year	5 year
Shared leadership dummy	0.058	0.087	0.105	0.125
	(0.044)	(0.042)	(0.049)	(0.066)
Number of TMT Leaders			-0.022	-0.010
			(0.026)	(0.049)
Number of TMT members	0.030	0.038		
	(0.027)	(0.024)		
Functional diversity of TMT	0.023	0.039	0.028	0.042
	(0.056)	(0.057)	(0.056)	(0.058)
Firm age	0.075	0.076	0.070	0.077
	(0.023)	(0.022)	(0.024)	(0.023)
Number of engineers	0.193	0.165	0.193	0.164
	(0.032)	(0.037)	(0.032)	(0.036)
Market knowledge index	-0.039	0.006	-0.042	0.006
	(0.048)	(0.047)	(0.048)	(0.047)
Financial knowledge index	-0.003	0.005	-0.033	-0.023
	(0.053)	(0.053)	(0.048)	(0.061)
Current output	-0.707	-0.706	-0.837	-0.836
	(0.033)	(0.034)	(0.031)	(0.031)
Constant	5.972	7.527	6.010	7.597
	(0.373)	(0.381)	(0.378)	(0.389)
Observations	831	679	831	679
R-squared	0.819	0.881	0.818	0.880

Note: (i) The omitted category is Single Leadership. (ii) Robust standard errors in parentheses.

Table 3A: Frequency of TMT Discord-Related Departure (Firm level observations)

Number of TMT discord-related departures	Frequency	Percent
0	15	22.73
1	23	34.85
2	15	22.73
3	4	6.06
4	6	9.09
5	1	1.52
6	2	3.03
Total	66	

Table 3B: Frequency of TMT Discord-Related Departure (Firm-Year level observations)

	TMT discord-related departure	No TMT departure
Single Leadership	NA	765
Shared Leadership	106	425

Table 4: Relationship between TMT Departures and Growth Rates

	DV: Output growth rates					
	I. Discord-induced departure		II. Exogenous Departure		III. TMT Expansion	
VARIABLES	3 year	5 year	3 year	5 year	3 year	5 year
Shared leadership with TMT change	-0.057	-0.042	0.062	0.044	0.065	0.015
	(0.056)	(0.054)	(0.066)	(0.064)	(0.065)	(0.071)
Shared leadership without TMT change	0.046	0.103	0.070	0.069	0.071	0.070
	(0.045)	(0.043)	(0.039)	(0.039)	(0.039)	(0.038)
Number of TMT members	0.044	0.044	0.031	0.048	0.031	0.054
	(0.026)	(0.023)	(0.026)	(0.023)	(0.027)	(0.023)
Functional diversity of TMT	0.035	0.053	0.028	0.035	0.029	0.040
	(0.057)	(0.057)	(0.056)	(0.058)	(0.056)	(0.058)
Number of engineers	0.188	0.162	0.195	0.167	0.196	0.169
	(0.032)	(0.037)	(0.032)	(0.037)	(0.032)	(0.037)
Market knowledge index	-0.043	-0.010	-0.039	0.005	-0.039	0.002
	(0.048)	(0.048)	(0.048)	(0.047)	(0.048)	(0.047)
Financial knowledge index	-0.001	-0.037	-0.004	-0.033	-0.005	-0.038
	(0.052)	(0.060)	(0.053)	(0.061)	(0.053)	(0.062)
Firm age	0.078	0.080	0.077	0.082	0.077	0.078
	(0.022)	(0.026)	(0.022)	(0.022)	(0.022)	(0.022)
Logged current output	-0.709	-0.840	-0.706	-0.836	-0.706	-0.835
	(0.034)	(0.031)	(0.033)	(0.031)	(0.033)	(0.031)
Constant	5.968	7.546	5.945	7.507	5.942	7.478
	(0.369)	(0.378)	(0.377)	(0.384)	(0.378)	(0.384)
P-value for test 1	0.068	0.010	0.893	0.660	0.915	0.403
Observations	831	679	831	679	831	679
R-squared	0.820	0.882	0.819	0.881	0.819	0.881

Note: (i) The omitted category is Single Leadership. (ii) Robust standard errors in parentheses. (iii) Test 1 tests the null hypothesis that Shared Leadership with TMT change = Shared Leadership without TMT change.

Table 5: Single Discord-induced departures vs. Multiple Discord-induced departures

	DV: Output growth rates	
VARIABLES	3 year	5 year
Shared Leadership with Single Discord-induced departure	0.083	0.106
	(0.063)	(0.058)
Shared Leadership with Multiple Discord-induced departures	-0.167	-0.226
	(0.086)	(0.101)
Shared leadership without Discord-induced departures	0.098	0.134
	(0.048)	(0.047)
Number of TMT members	0.035	0.040
	(0.027)	(0.023)
Logged number of engineers	0.172	0.133
	(0.032)	(0.036)
P-value for test 1	0.803	0.629
P-value for test 2	0.002	0.001
Observations	799	653
R-squared	0.808	0.878

Note: (i) The omitted category is Single Leadership. (ii) Robust standard errors in parentheses. (iii) Test 1 tests the null hypothesis that Shared leadership with single discord-induced departure = Shared leadership without Discord-induced departures. (iv) Test 2 tests the null hypothesis that Shared leadership with multiple discord-induced departures = Shared leadership without Discord-induced departures. (iv) Functional diversity of TMT, Market knowledge index, Financial knowledge index, Firm age, Logged current output, and the constant term are included but coefficients not reported. See Table A4 in Appendix C for full results.

Table 6: Firm Growth in Discord Periods (Periods Preceding Discord-induced departures)

VARIABLES	DV: 3-year output growth rates	
Discord period	0.089 (0.062)	
Single Discord period		0.070 (0.079)
Multiple Discord Period		0.120 (0.092)
No Discord Period	0.160 (0.052)	0.160 (0.052)
Number of TMT members	0.017 (0.030)	0.017 (0.030)
Constant	5.839 (0.379)	5.864 (0.379)
P-value for test 1	0.231	0.245
P-value for test 2		0.655
Observations	738	738
R-squared	0.838	0.838

Notes: (i) The omitted category is Single Leadership. (ii) Robust standard errors in parentheses. (iii) Test 1 tests the null hypothesis that (Single) Discord period= No Discord Period. (iv) Test 2 tests the null hypothesis that Multiple Discord Period = No Discord Period. (v) Functional diversity of TMT, Market knowledge index, Financial knowledge index, Firm age, Logged current output, and the constant term are included but coefficients not reported. See Table A5 in Appendix C for full results.

Table 7: Discord-induced departures and Resource Accumulation

	DV: 5-year growth rates of:				
	I. Workers	II. Engineers		III. Capital	
VARIABLES		University	Technical school	Physical	Financial
Shared Leadership with Discord-induced departure	-0.118 (0.057)	-0.012 (0.038)	0.038 (0.069)	-0.129 (0.064)	0.001 (0.043)
Shared Leadership without Discord-induced departure	0.056 (0.044)	0.089 (0.031)	0.062 (0.064)	0.039 (0.052)	0.046 (0.034)
Number of TMT members	0.012 (0.023)	-0.036 (0.025)	-0.052 (0.039)	0.019 (0.024)	-0.017 (0.017)
P-value for test 1	0.004	0.016	0.723	0.0031	0.2442
Observations	672	693	693	672	451
R-squared	0.792	0.774	0.696	0.855	0.803

Notes: (i) The omitted category is Single Leadership. (ii) Robust standard errors in parentheses. (iii) Test 1 tests the null hypothesis Shared Leadership with Discord-induced departure = Shared Leadership without Discord-induced departure . (iv) functional diversity of TMT, market and financial knowledge, firm age, logged current level of dependent variable, and the constant term are included but coefficients not reported. See Table A6 for full results.

Table 8: TMT Leadership and Diversification

VARIABLES Fractions of:		Single Leadership	Shared Leadership	Shared leadership of which:		
				No discord departure	Discord-induced departure	Repeated discord-induced departures
Diversified firms	Mean	0.518	0.664	0.674	0.613	0.622
	St.Err.	0.021	0.022	0.024	0.055	0.081
Downstream integrated firms	Mean	0.082	0.281	0.300	0.191	0.116
	St.Err.	0.010	0.020	0.022	0.042	0.049

Notes: Diversified firms have number of product varieties above the industry-year median. Export and downstream integrated firms have non-zero exports and in-house consumption of cotton yarn in a given year, respectively.

Table 9: Ownership and Governance Structure and TMT Leadership

VARIABLES		Single Leadership	Shared Leadership	Shared leadership of which:		
				No discord departure	Discord-induced departure	Repeated discord-induced departures
Total # of shareholders	Mean	449	708	727	592	505
	St.Err.	28	54	59	121	137
Fraction of shares of top 5	Mean	0.290	0.248	0.249	0.241	0.230
	St.Err.	0.012	0.007	0.007	0.024	0.034
Fraction of shares of board members	Mean	0.232	0.202	0.204	0.187	0.198
	St.Err.	0.012	0.008	0.008	0.027	0.043

Note: data on incorporated companies, based on shareholders reports.

Table 10 Shared Leadership and Acquisitions

	Shared Leadership (a)	Discord Induced TMT Departures (b)	Ratio: (b)/(a)
Serial acquirers (from Braguinsky et al, 2015; Centers of Gravity in Table 11)	0.852	0.049	0.058
Firms acquired by serial acquirers	0.424	0.062	0.146
Other acquiring firms	0.380	0.055	0.144

Source: Braguinsky et al. (2015), matched with our data, described in the text and in Appendix A.

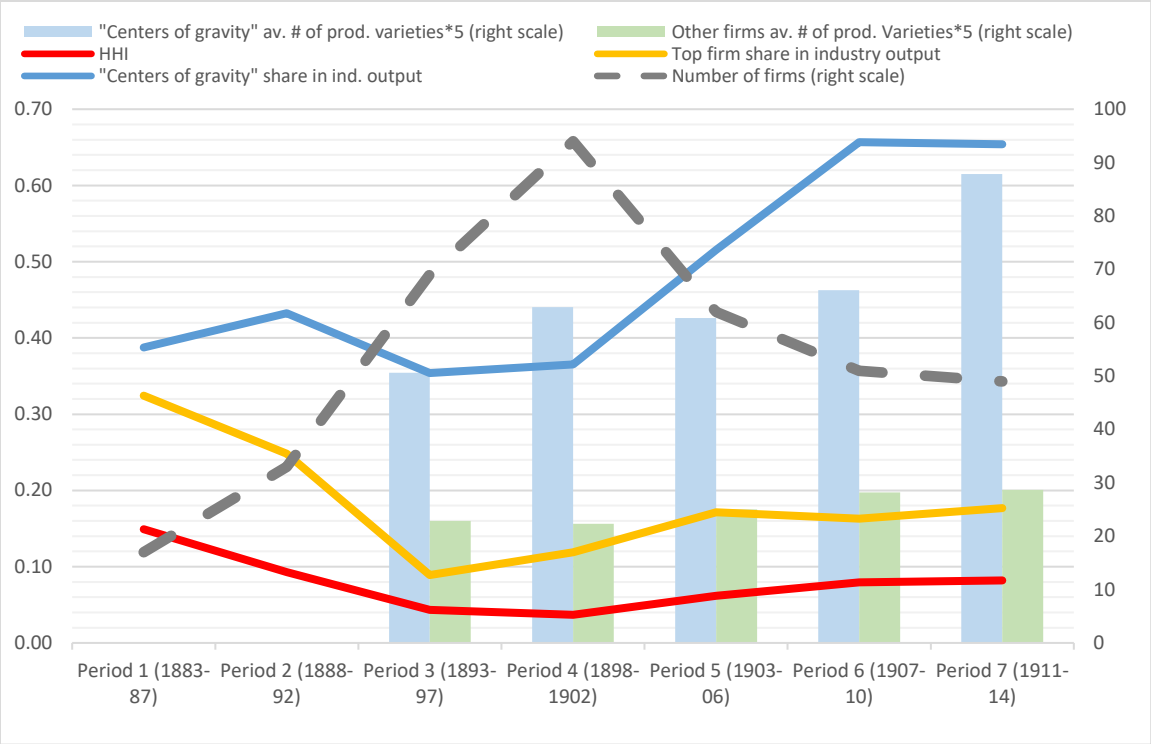
Table 11: Comparisons across similar-sized 16 early startups

Explanatory variables		# in each category	Initial size (# of spindles)	10-year capacity growth rate	# to become Centers of Gravity	10-year change in # of educated engineers
Shared leadership at entry	Yes	9	15,702	163%	4	13%
	No	7	11,371	191%	1	50%
TMT stability at or above median	Yes	8	15,276	206%	5	43%
	No	6	13,811	103%	0	-33%
University-educated engineer at entry	Yes	10	15,426	183%	5	10%
	No	6	11,622	139%	0	

Centers of Gravity: Kanebo, Mie, Settsu, Amabo, Osaka. Other startups: Tenma, Naniwa, Hirano, Senshu, Miike, Nagoya, Okayama, Owari, Calico, Tokyo, Tamashima. Source: our data described in the main text and Appendix A.

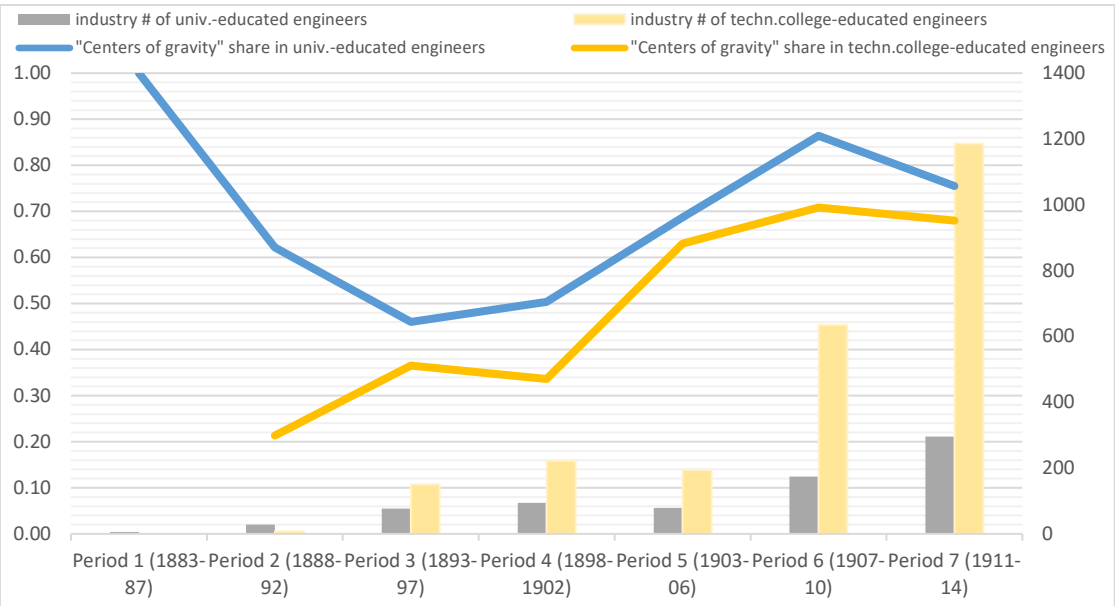
Figure 1.

Number of Firms and Output Concentration in the Japanese Cotton Spinning Industry 1883-1914



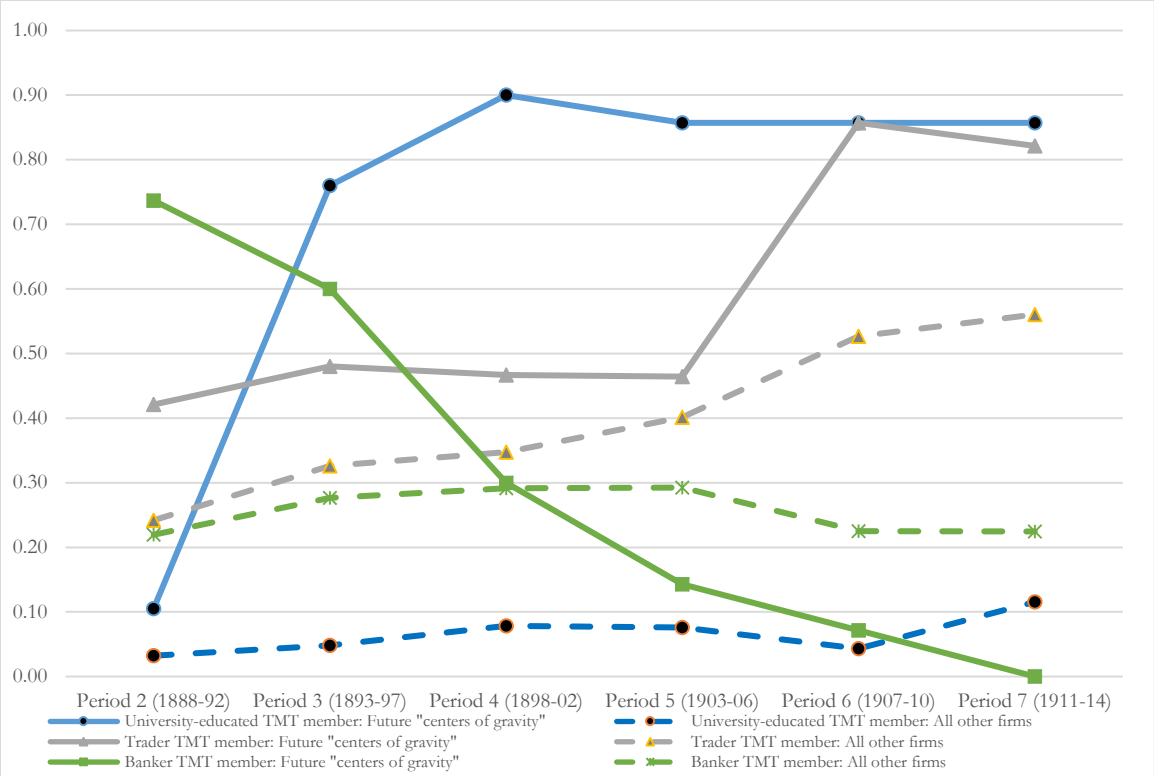
Source: our data, described in the text and in Appendix A. The number of product varieties has been multiplied by 5 to fit the right scale.

Figure 2. "Ultimate Centers of Gravity" Shares in Engineering Talent, 1883-1914



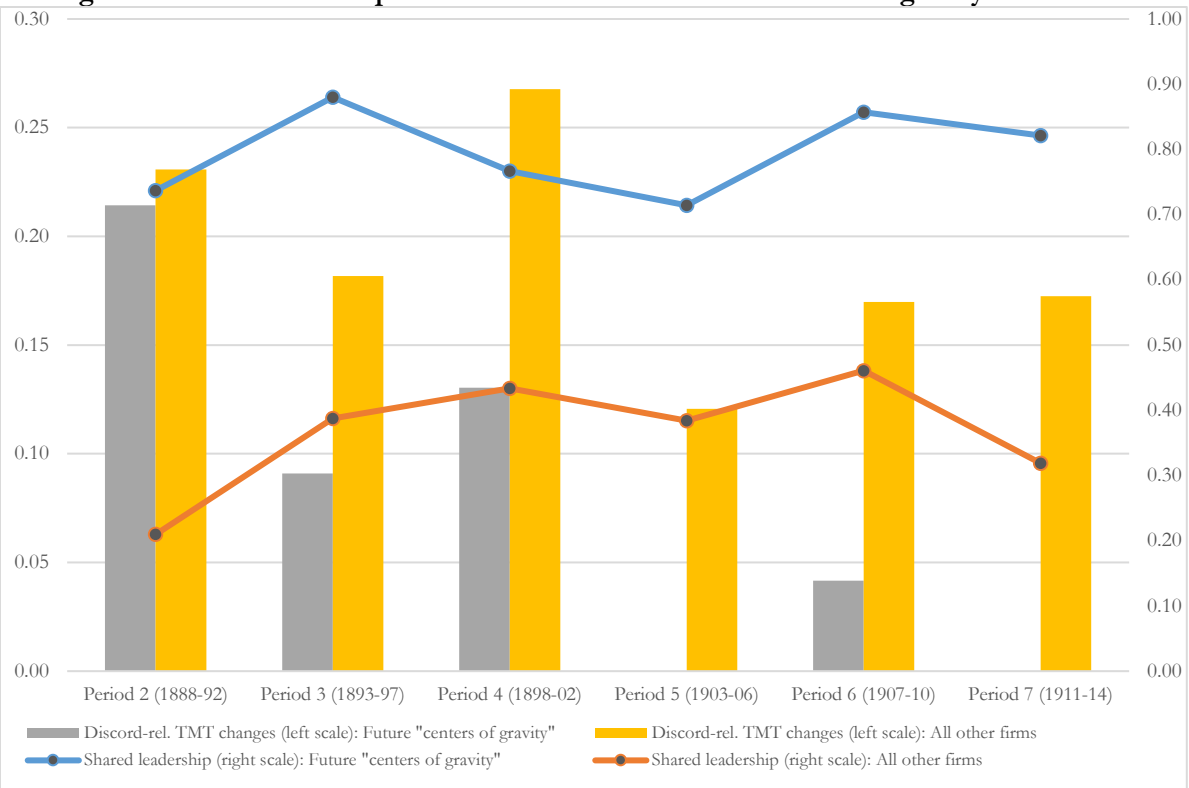
Source: our data, described in the text and in Appendix A.

Figure 3. TMT composition dynamics: eventual "centers of gravity" and other firms



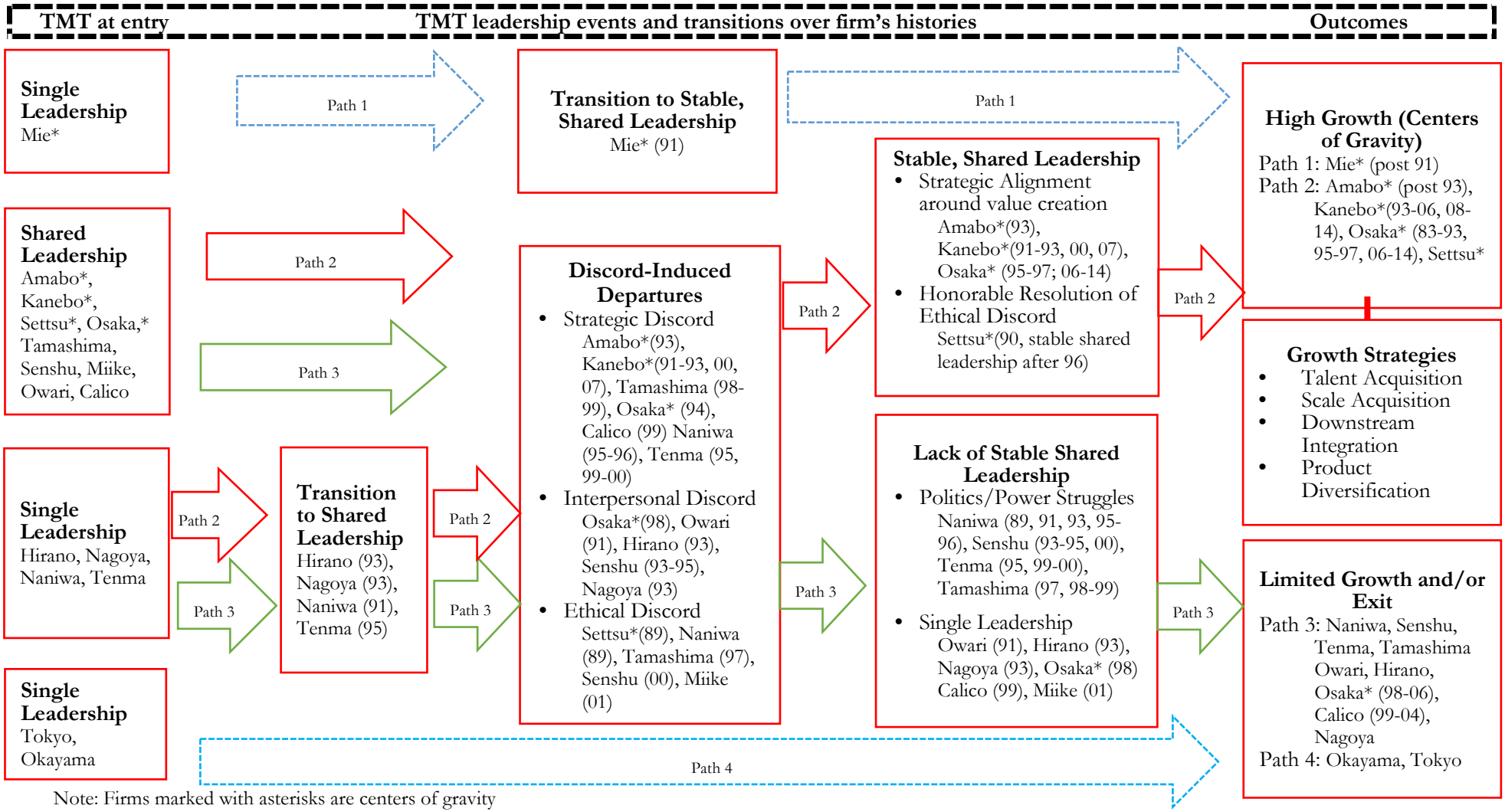
Source: our data, described in the text and in Appendix A.

Figure 4. Shared leadership and TMT discords: eventual "centers of gravity" and other firms



Source: our data, described in the text and in Appendix A.

Figure 5. Evolutionary paths of 16 startups from entry to 1914



Note: Firms marked with asterisks are centers of gravity