Centers of Gravity: The Effect of Shared Leadership and Stability in Top Management Teams on Firm Growth and Industry Evolution[1]

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Abstract

We study the processes of firm growth in the evolution of the Japanese cotton spinning industry in the late 19th-early 20th century, the first episode of successful industrialization outside of Western Europe and the United Sates. By integrating strategy and historical approaches and utilizing rich quantitative firm-level data and detailed business histories, we examine the effect of top management teams' (TMT) shared and stable leadership in the emergence of "centers of gravity" for output and talent in the industry. Shared and stable TMT leadership enabled long term expansion, innovative product choices, and the accumulation of talent and physical assets. Additionally, a focus on value creation, in conjunction with talent recruitment and promotion enabled TMTs to weather discord related disruptions.

[1] This work was supported by the NSF grant No.1632833 (Braguinsky) and JSPS KAKENHI Grant No. 15KK0078 (Ohyama). We thank Tetsuji Okazaki and Takenobu Yuki for helpful advice and data sharing, as well as Hiroko Ohga, Tomohiro Hara, Kohei Yamagata, Jun Sakamoto, and Takao Takasago for great research assistance. 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 during parts of the work on this project. Ohyama also thanks Gakushikai (the Assocation of University Graduates) for the permission to use their restricted-use alumni lists. All interpretations and errors are ours.

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). In explaining firm growth and dominance, evolutionary scholars have largely focused on firm characteristics such as first mover advantage and pre-entry experience (Argyres and Mostafa, 2016; Bayus and Agarwal, 2007; Klepper and Simons, 2000), and scale economies and returns to innovation (Klepper, 1996). While employee entrepreneurship/mobility have been recognized (Klepper, 2016; Mostafa and Klepper, 2017), 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 examine the creation and evolution of entrepreneurial teams (Agarwal and Shah, 2014; Beckman and Burton, 2008; Shah, Agarwal and Echambadi, 2017), and the critical role of top management teams (TMT) in growth and strategic renewal (Adner and Helfat, 2003; Williams, Chen and Agarwal, 2017), even as they manage internal conflict arising from strategic or interpersonal differences (Boeker, 1992; Boeker and Karichalil, 2002; Eisenhardt and Bourgeios, 1988).

Our study answers calls for examining a firm's managerial talent as the microfoundation (Abell, Felin and Foss 2008; Coleman, 1990) of firm and industry evolution. We address the following questions: What characteristics of (founding) top management team determine which firms are likely to grow and dominate in an evolving industry? How do these characteristics impact the strategies undertaken by the firm, as they leverage opportunities or confront impediments to growth due to internal sources or external pressures?

We open the black box and answer the above questions by conducting a study at the intersection between history and 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, and consistent with a few studies which combine deep dives into phenomena over long periods with rigorous empirical methods (Braguinsky and Hounshell, 2016; Ingram, Rao, and Silverman, 2012), we integrate both approaches. We utilize the rich qualitative and historical information to inform the quantitative panel data analysis and adjudicate across plausible relationships that may be hypothesized for the 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 shared and stable 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/conflict induced departures within shared leadership teams. In addition to finding reduced growth rates during periods of single leadership, we find that 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.

These quantitative findings set the stage for an in-depth examination of the business histories. A comparison across early mover firms of similar size reveals salient ways in which stable and shared leadership enables long term growth strategies, and the factors which enable firms to recover from discord induced departures quickly and effectively. Specifically, a willingness to break from tradition and through glass ceilings to recruit/promote (engineering) talent enabled some firms to create TMTs with shared and stable leadership. Stable, shared leadership in turn permitted firms to pursue long term expansion strategies through expansion of scale (including acquisition of physical assets from less well managed firms), product varieties, and downstream integration. The business histories also reveal that it is not *absence* of stable, shared leadership per se that matters. Rather, a key hallmark distinguishing firms that became centers of gravity was their ability to recover from episodes of managerial discord through a focus on value creation and human capital strategies. Our findings provide contributions to several literature streams. To industry evolution studies (Jovanovic and MacDonald, 1994a, b; Klepper, 1996; Utterback and Abernathy, 1975) 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 (Beckman and Burton, 2008; Boeker and Karichalil, 2002; Bourgeois and Eisenhardt, 1988; Eisenhardt and Schoonhaven, 1990; Williams et al., 2017), we show similarities between entrepreneurial team formation processes, and TMT conflict management processes. Our contribution to the TMT literature (Adner and Helfat, 2003; Castanias and Helfat, 1991; Hambrick and Mason, 1984) 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 development of many Western countries during the industrial revolution is linked to the mechanization of cotton spinning, which was also key to Japan's status as the only developed country in the East during much of the 20th century (Fletcher, 1996; Landes, 1965; Saxonhouse, 1971; 1974). Emerging from autarky in the second half of the nineteenth century, 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 domestic cotton-spinning industry. Figures 1 and 2 represent the industry's evolution between inception in 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] [3] The first period is the dawn of the industry characterized by heavy government involvement, although the

[2] For information about sources through which the data have been compiled, please refer to Appendix A. Table 1 provides key variable definitions and their empirical operationalization for our study.
[3] Our focus in this paper is on the first complete observation of the industry life cycle. As is characteristic of industries observed over longer periods of time (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 scope of our study.

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," following on the heels of government withdrawal of industry support and the 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.[4] While the first two 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.[5] Figure 1 shows the leading firms evolved during this period from just over one-third to about two-thirds of the industry output (now reflecting the total market size of the industry). 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 are available only starting in period 3).

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[4] These seven firms are (in the order of their 1914 size): Kanegafuchi Spinning ("Kanebo"), Mie Spinning ("Mie"), Settsu Spinning ("Settsu"), Amagasaki Spinning ("Amabo"), Osaka Godo Spinning ("Godo"), Fuji Gasu Spinning ("Fujibo"), and Osaka Spinning ("Osaka"). Their success was neither accidental nor short-lived, some of them continue through current day. Osaka Spinning single-handedly jump-started the industry in the 1880s (Braguinsky and Hounshell, 2016) and remained at the top of the charts until 1895. By 1914 it slid to number 7 in terms of size, and later that year merged with Mie (No. 2 above) to form Toyo Cotton Spinning ("Toyobo"), which instantaneously became the largest textile company in Japan. Toyobo outlived the textile industry and is currently a global corporation producing films, functional polymers and industrial materials (http://www.toyobo-global.com). The No. 4 company on the list, Amabo, acquired Settsu (No. 3) in 1918 and temporarily displaced Toyobo at the top of the list (Toyobo regained its No. 1 position in 1931 after it absorbed Osaka Godo, No. 5 on the list). The company is also thriving today under the name of Unitika as a polymers/advanced materials producer (https://www.unitika.co.jp/e/index.html). Kanebo, which became the largest firm in 1897 and stayed as No. 1 through our sample, remained the close third even after the two mega-mergers above, and is today a leading Japanese producer of cosmetics (http://www.kanebo.com/aboutus/). Fujibo (No. 6) is also still alive and well, having expanded to IT, biotechnology and medical care industries (http://www.fujibo.co.jp/en/). The web sites of these corporations proudly trace their roots to the cotton spinning industry where they were first founded (see e.g., https://www.unitika.co.jp/e/company/history.html).

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

In Figure 2, we exploit the rare window of opportunity history affords us 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 7 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: the share of university educated engineers grew from approximately 45 percent to more than 75 percent, and the share of technical school educated engineers grew from approximately a third to almost 70 percent of the total talent pool in the industry.

[Figures 1 and 2, on the same page and one directly below the other, 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 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). The vast 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; Klepper, 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; Mostafa and Klepper, 2017); 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 which precludes a systematic understanding of the evolution of human capital in an industry. 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; Eisenhardt and Schoonhoven, 1990; Reuf Aldrich and Carter, 2003; Sine, Mitsuhashi and Kirsch, 2006; Stinchcombe, 1965); dynamic managerial capabilities (e.g. Adner and Helfat, 2003; Castanias and Helfat, 1991; Helfat and Martin, 2015; Penrose, 1959); 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 the development of 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 (1977; 1990)'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 study answers calls for examining a firm's managerial talent as the microfoundation (Abell et al. 2008; Coleman, 1990) of firm and industry evolution. We embark on an exploration of the following questions: What characteristics of (founding) top management team determines which firms are likely to grow and dominate in an evolving industry? How do these characteristics impact the strategies undertaken by the firm, as they leverage opportunities or confront impediments to growth due to internal or external pressures?

When addressing these questions, we note 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 top management teams 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 the 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. Such an approach increases the soundness of interpretations through the supplementation of the quantitative analysis (which establishes what relationships hold), with historical accounts about why and how these unfolded.

Specifically in our 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 (e.g. Agarwal, Sarkar and Echambadi, 2002; Klepper and Simons, 2000; Williams et al., 2017). 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

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. (Please see Appendix A for detailed information on data sources and the construction of key variables.) For industry, firm 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 were incorporated) and 1,192 firm-year observations, with a firm on average observed for 13.2 years. Eighty one firms (90 percent) 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.

QUANTITATIVE ANALYSIS

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 across entrepreneurship, managerial capabilities and upper echelons literature in our choice of variables. These include founding team/TMT size and diversity (Castanias and Helfat, 1991; Delmar and Shane, 2006; Eisenhardt and Schoonhoven, 1990; Hambrick and Mason, 1984), the centralization of power (Bourgeois and Eisenhardt, 1988; Eisenhardt and Bourgeois, 1988; Hambrick and

Mason, 1984), and stability/lack of discord (Eisenhardt, Kahwajy and Bourgeois, 1997). Table 1 summarizes the variable definitions and their empirical operationalization from rich qualitative and quantitative information on individuals who constituted the TMT, firm characteristics, and key performance metrics. 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.[6] Here, we briefly describe how other salient TMT characteristics are constructed from the data (a detailed description is in Appendix A).

[Table 1 about here]

Single vs. Shared Leadership: There is significant variation among firms and over time, notwithstanding TMT and firm size, on whether the strategic decision making and authority/power rests in one or more people. These time-varying variables capture whether the strategic leadership of the firm rests with a single person (*Single Leadership Dummy = 1)* or is shared by two or more key individuals (*Shared Leadership Dummy = 1)* in the firm in a given year. 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 episodes of shared leadership, an average firm had shared leadership in about 55 percent of their firm-year observations. This gives us rich variation in types of leadership (shared or single) both across and within firms.

TMT Stability: Table 1 defines various types of changes that occur in the TMTs of firms, and the periods in which such change is observed. Salient among these are variables which capture stability, or a lack of departures induced by discords causing TMT leaders to leave due to actions taken by shareholders or boards of directors. We code departures due to discord (*Discord induced Departure Dummy = 1),* departures for exogenous reasons such as death, or circumstances unrelated to the firm (*Exogenous Departure Dummy = 1),* and additions to the TMT (*Expansion of TMT Dummy = 1).* 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

[6] We do not include demographic characteristics of TMT members as all were male and ethnically Japanese. Most firms were startups, with few founders having pre-entry industry experience, or experience working together.

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 dummies (*Shared Leadership with Single Discord Induced Departure in Period = 1; Shared Leadership with Multiple Discord Induced Departures in Period = 1).* Finally, we interact the various types of TMT changes with shared leadership dummies to distinguish among shared leadership firms that experienced or didn't experience these changes (e.g. *Shared Leadership*Discord Induced Departure = 1; Shared Leadership*No Discord Induced Departure = 1).*

Results of Analysis

We regress 3- and 5- year moving average firm growth rates on TMT characteristics using a firm fixed effect specification[7] with robust standard errors and various time-varying controls for firm, industry and years. Controls for firm characteristics include firm age, and numbers of employees, educated engineers, technical school graduates, 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.). Following standard practice of growth estimations, we include the current level of output in our main estimating equation. Given firm exit, our estimation results are conditional on survival. 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. We further address reverse causality issues below in robustness checks, and in the qualitative analysis section.

Table 2 provides the effects of TMT characteristics on growth. In Specification I, the coefficient of *Shared Leadership* is 0.061 for 3-year growth rates and 0.097 for 5-year growth rates, and the 90-percent confidence interval is [-0.004, 0.125] and [0.027, 0.166], respectively. This implies that firms with shared leadership achieve 6.1 percent (9.7 percent) 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 a 20 percent output gap over the 10-year span, and 45 percent over the 20-year span. In Specification II, we

[7] Our choice of firm fixed-effects is premised, not as much on identification considerations (Skrondal and Rabe-Hesketh, 2004; Certo, Withers and Semadeni, 2017), but 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 structure within a firm affects the growth of that firm, rather than how differences in the TMT structure across firms influences their growth rates. We later discuss robustness checks with random-effects model, and dynamic panel estimation.

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.

[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 percent of the observations of firms with shared leadership.

[Table 3 about here]

We next explore the effects on growth rates of single and shared leadership and TMT changes. 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 5.4 percent with the 90 percent confidence interval [-0.132, 0.023]; in contrast, the 3-year growth rates for firms with shared leadership that experience no discord induced departure is higher by 6.6 percent with the 90 percent confidence interval [0.001, 0.131]. 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 0.001. Table 4 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 raises 3-year growth rates of output by about 12 percent. The estimation results remain qualitatively unchanged, and become stronger in statistical sense for 5-year growth rates.

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 examine potential endogeneity concerns stemming from joint determinants of growth prospects and TMT leadership departures. The point estimates in Column (II) (interaction terms of *Shared Leadership*Exogenous Departure* and *Shared Leadership*No Exogenous Departure*) are similar to Specification I, but limited number of observations result in high standard errors, and we cannot reject the null hypothesis that the coefficients on shared leadership with and without exogenous departures 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)*: there seems to be no appreciable 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 low and statistically insignificant coefficients of TMT size and functional diversity in Table 4, the results indicate that it is not TMT size and 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.

[Table 4 about here]

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. 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 0.44 and 0.43 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 14.7 % and 18.9% lower growth rates, with 90^{th} confidence intervals of [-0.269, -0.025] and [-0.354, -0.023], respectively, 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 0.0002 and 0.0001, respectively, for both 3 and 5 year growth rates.

[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 strategic 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*.[8] When shared leadership firms undergo a period of discord, the growth rates are 7.1 percent greater than single leadership firms, with the 90th percentile confidence interval [-0.02, 0.164], while shared leadership firms with *No Discord Period* have growth rates of 14.9 percent greater than single leadership firms, with the 90th percentile confidence interval [0.074, 0.223]. The null hypothesis of no significant difference in the two coefficients cannot be rejected (p value = 0.152). 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. 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 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 (not lower) than in periods prior to single departures. Together, the results across Table 5 and 6 suggest disagreement costs (in

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[8] 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.

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]

Discord related Disruption and Resource Accumulation

To further probe mechanisms, we examine the impact on accumulation of productive resources, particularly human capital, 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 separately as the dependent variables in regressions.[9] 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 Table 4), we can infer that the university-educated part of the 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. Again, this may relate to the fungibility of financial capital, as opposed to physical capital and university educated workforce. In sum, our estimation results suggest TMT stability and shared leadership is indeed an important force explaining accumulation of important resources such as talent and capital.

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[9] The results remain unchanged qualitatively if we use 3-year growth rates.

[Table 7 about here]

Robustness Checks

While the quantitative estimations serve as a guide to the historical narratives and analysis in the next section which will provide the ultimate validation, we briefly discuss here the robustness of the results to potential concerns and limitations of the above analysis. Our use of fixed-effect model estimations was predicated by our quest for uncovering within-firm variation due to TMT shared leadership and stability. To assess robustness to other specifications, we conducted random-effect and Arellano-Bond-type estimations (see Table A3 in the appendix). Both estimations provide qualitatively similar results, though higher standard errors for some of the coefficients render them less statistically significant at conventional levels.

Another potential concern is reverse causality. Even though we estimated the relation between TMT member departure and future, not contemporaneous growth rates, one could argue that expectations of lower future growth rates can lead to a discord induced departure. The qualitative analysis in the next section leads us to believe that it was not the case at all. To examine this quantitatively, we estimated the probability of a discord induced departure of TMT leader, while controlling for various variables. The estimates in Table A4 of the Appendix indicate that lower profitability and past incidence of discord induced TMT departures have predictive power for the future discord TMT departures, but past output growth rate is not significant. Since our main dependent variable is output growth rates, reverse causality may not pose a serious issue.

Finally, we note that survivorship bias is another concern. We do not have enough observations to conduct dynamic panel analysis which would include firm exit, so our results should be interpreted as being conditional on survival. To the extent that failure is also associated with lower growth rates though, we expect the bias to result in conservative estimates. Rather than speculating on the issue, however, we explore differences in surviving and exiting firms in the qualitative analyses in the next section.

QUALITATIVE ANALYSES

The quantitative analyses of *all firms in the industry* produced three important results about medium-term (three- to five-years) growth rates of firms. One, shared leadership enabled higher growth rates than single leadership. Two, the advantages of shared leadership tended to dissipate in periods following discord related departure, and even became strongly negative due to repeated events. Three, accumulation of human capital (engineering) resources was facilitated by stable shared leadership and, in its turn, had an independent contribution to growth rates. Armed with these insights, we return to a deeper examination of the seven firms who emerged as "centers of gravity" in the Japanese cotton spinning industry, and in particular address the motivational question: At the early stages of the industry, how could someone have predicted which ones of the similarly-looking startups would grow and develop into "centers of gravity" and which would fizzle?

We begin by revisiting the output trends in Figure 1: The average output of the seven "centers of gravity" grew by 13.1 percent per year, compared to 8 percent 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 ultimate "centers of gravity" compared to all other firms. Five of the seven centers of gravity firms had entered by Period 2 (two others, Fujibo and Godo, were later entrants); they exhibited shared leadership in 74 percent of observations in that period, compared to just over 20 percent for other firms in the same period. The number of firm-year observations with shared leadership for the leading firms increases to almost 90 percent in the next period and stays high subsequently, relative to all other firms that never cross the 50-percent threshold. The dynamics of discord induced TMT departures in the total number of years firms spent 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 TMT departures approximately once every 5 years), TMTs in centers of gravity become much more stable over time.

[Figure 3 around here]

Figure 4 provides the evolution of the composition of TMT in the centers of gravity versus all other firms by three types of human capital represented; 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). Of important note is the historical fact that at the time, Japan was largely a traditionalist society, with "glass ceilings" in the business world against ascension for anyone not from a reputable merchant family, or without financial wealth. Under these circumstances, promoting a university-educated engineer or manager (who were generally not rich investors) to the TMT required breaking with strong cultural/traditional norms. In this light, the most striking aspect of Figure 4 is the big divergence, starting from period 3, between centers of gravity and other firms in terms of the fraction of TMT leaders with university education. This was the direct result of future centers of gravity adopting the merit-based promotion strategy regardless of wealth and family background.

[Figure 4 around here]

Figure 4 shows that early on, a much higher fraction of centers of gravity than other firms had at least one TMT leader with bank ties. Early bank ties helped raise money for larger initial size (even though most capital was raised through stock issues, many stocks were bought on money borrowed from banks). Future centers of gravity were three times larger than an average startup at founding; and more generally, startups with a banker on the founding team are 50 percent higher in initial size relative to startups who do not. The importance of bankers on TMTs, however, sharply declined with time and, in fact, they are largely absent as TMT leaders by the mid-1900s (Figure 4). This is not surprising; as centers of gravity accumulated resources, including internal financial resources, 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, over the whole industry evolution, but we see that having bank representatives as TMT leaders at the right time (early on) was still important. 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. As seen below, such ties, when coupled with stable shared leadership, were quite important for success of centers of gravity.

Figures 3 and 4 thus conform with the results of the quantitative analyses in the previous section; namely, we see that shared and stable leadership not only was a key determinant of higher growth rates, but is also salient for the emergence of the centers of gravity, which additionally broke with tradition by promoting engineering talent, also critical to growth. However, the question remains on *why* this is the case. In other words, what caused firms that had longer durations of shared and stable leadership to have higher growth rates, in terms of the strategies they could enact, or interim attributes or capabilities they could create? The rich historic, qualitative data within the individual business histories allow us to move beyond the above "impersonal" panel data analyses and address this question, as we do below.

Comparison Set of Similar Sized Startups

We undertake an in-depth examination of business histories of 15 startups[10], all of which entered the industry in Periods 1 and 2 (the early and firm take off periods, prior to large-scale entry in period 3).[11] Table 8 provides descriptive statistics for them, when grouped in three categories: Group 1 (the future Centers of Gravity) includes five firms: Kanebo, Mie, Settsu, Amabo, and Osaka. Group 2 (the Early Exiters) includes five firms who did not survive the first shakeout (1898-1902): Tenma, Naniwa, Hirano, Senshu, and Miike/Kyushu. Finally, group 3 consists of five firms that survived beyond the first shakeout but exited between 1905-1914: Nagoya, Okayama, Owari, Kanakin, and Tokyo. Where relevant, we append our analysis to include salient examples from business histories of firms not included in these three groups (e.g. later entrant center of gravity firm Godo Spinning as an exception to shared leadership).

[Table 8 around here]

Conditions at Founding and first 10 years of firm existence

All three groups were similar in their initial size of operations. Moreover, Group 2 firms largely kept pace with Group 1 firms, with their first 10-year growth rates at 196%; Group 3 firms lagged behind slightly at 165%. The founding and first 10 years of firms across all three groups reveal not much differences in TMT members with market knowledge (traders who were cotton yarn and garment merchants); additionally Group 1 and Group 2 were similar in terms of TMT members with financial knowledge (bankers).

In contrast, Group 1 was very different from the other two groups in terms of higher shared leadership at founding, and in the fraction of the first 10 years with shared leadership. The same holds for

[10] All the narratives and qualitative information about individual firms are gathered from a) dedicated chapters in Kinugawa (1964) and b) 100-year histories of Toyo Boseki (1986), Kanebo (1988), Unitika (1989), and Fuji Boseki (1998); these were verified whenever possible, through c) executives and white-collar employees lists in "Yakuinroku," and d) the information (including narratives) in shareholders' reports (Kokajo, 1883-1918).

[11] These startups were selected because of least 10 years of history; later startups often did not survive long enough or had outside-sample period histories. Also, post-1892 entrants could leverage technology refinements that occurred in the early 1890s upon entry, and their purchase of higher-quality machines at the onset implies significant differences in physical capital vintages for starting conditions. Of the 35 firms operating in the industry by 1892, we exclude 14 who were smaller former government-promoted mills and thus at a disadvantage right from the onset (Braguinsky, 2015). Six of the newer private startups could not muster enough resources to enter at the minimum efficient scale of 10,000 spindles either, so we exclude them also as not being on equal footing with larger startups in the qualitative sample.

TMT stability; only 10% of the shared leadership years are associated with discord related departures for Group1, while the comparable statistics for Group 2 and Group 3 are 40% and 30% respectively. The differences between Group 1 and the other two groups is also stark regarding the engineering talent employed by these firms. All startups in group 1 had university-educated engineers at the time of founding; recall that in periods 1 and 2, university-educated engineers were an extremely scarce resource. Even more striking is the 10 year change: four of five future "centers of gravity" had an 80% increase in the average number of university-educated engineers per firm. On the other hand, both Group 2 and Group 3 firms experienced 67% and 50% attrition in engineering talent, respectively.

University educated TMT Leaders at Helm

As is already becoming apparent from the above graphs and statistics, a key differentiator for firms in Group 1 was their approach to talent recruitment, retention and promotion—we turn to this issue in greater depth later when discussing strategies enacted by firms as they evolved. Here, we focus on the critical difference in the TMT which is both a correlate and a cause: an attention to merit and productive effort in the choice of TMT leaders. The most telling example is observed in the business histories of Hirano (Group 2), and Settsu and Amabo (Group 1). Hirano was the first among the three to enter the industry. Following the pioneering example of Osaka Spinning (Braguinsky and Hounshell, 2016), Hirano recruited a university-educated engineer, Kyozo Kikuchi, and immediately sent him to England to acquire knowledge of the state-of-the-art technology. Kikuchi turned out to be an exceptionally talented engineer. When Settsu and Amabo entered the industry, they negotiated his joint appointment as the chief engineer of their firms, alongside his primary job with Hirano.[12] Kikuchi was ambitious, and aspired to rise to managerial ranks rather than remain an engineer. When Hirano balked at promoting him because of its glass ceiling for engineers, Amabo gave Kikuchi a seat on its board of directors in 1894 and Settsu followed suit two years later. Kikuchi cut ties with Hirano in 1898; the company was never the same after that and failed in 1902.

All Group 1 firms were willing to promote their university-educated hired personnel to TMT leadership positions. Mie appointed its university-educated and England-trained chief engineer, Tsunezo

[12] Such sharing of scarce engineering talent was common in the early Japanese cotton spinning industry. See Hunter (1991) for an English-language description of Kikuchi's training in England and his career.

Saito, to become a TMT leader in 1891; this also marked the start of shared and stable leadership in the firm for the rest of the sample period. Amabo, as mentioned, promoted Kikuchi in 1894. The other three firms adopted the same strategy shortly thereafter: Osaka in 1895, and Settsu and Kanebo in 1896. Indeed, with the exception of Godo Spinning, all centers of gravity had university-educated TMT leaders throughout their lifecycle. In contrast, the fraction of other firms with a university-educated TMT leaders was well below 10 percent for almost the whole period, either because they were not able to recruit such personnel in the first place or because they could not break with the traditionalist thinking as was the case in Hirano. Apart from providing steady, professional management, university-educated TMT leaders signaled opportunity and helped attract and retain educated engineers from the market by providing them with confidence about their own career ascension potential in the firm, relative to competitors. This is perhaps a major reason why educated engineers flocked to the centers of gravity and increased their observed concentration of top engineering talent, even as the total supply of engineers exploded (Figure 2 above).

Strategies enabled by stable shared leadership

Stable shared Leadership enabled long-term expansion, including through acquisitions

Stable shared leadership was key to devising and implementing a long-term expansion strategy; this is best illustrated through a comparison of two initially very similar firms: Mie (Group 1) and Owari (Group 3). In 1890, both firms had almost equal size (15,000-16,000 spindles), and both firms employed a university-educated, top-notch engineer (Owari employed Shunichi Hattori, a graduate of the Imperial University and it had also sent him to study in England). Moreover, Owari was logistically located closer to the industry's market center. Nevertheless, 15 years later, Mie's capacity had quintupled in size to almost 81,000 spindles, while Owari merely doubled to just 30,000 spindles (Mie subsequently acquired Owari). This difference in outcomes can be traced to key TMT differences. Post the single TMT turnover in 1891; Mie was jointly run by two key leaders, the main founder, Denshichi Ito, and the already-mentioned chief engineer Saito. Mie was among the pioneers for a critical strategy for long term success in the industry, eventually adopted by many firms: downstream integration into garment production. Garment production, including for exports, was often more lucrative than yarn production; it also allowed in-house use of spun yarn to provide a cushion against market fluctuations. Creating and implementing this strategy was not easy, however, as it required careful attention to quality. Saito had to spend significant time and effort, traveling also to the U.S. and Europe to learn about the technology/various types of mechanical looms that may enable them to enter and compete successfully. Here, Ito's management of mills at the homefront was critical in Saito's absence.

Owari presents an almost diametrically opposite case. Founded by Masaka Okuda, the most prominent multi-profile businessman in the Nagoya region[13], Okuda had initially created a high-level of shared leadership in Owari, with Tomoemon Kondo, an experienced trader in charge of sales, the already-mentioned Hattori as the chief engineer, and Nobutaka Okada, an experienced manager with prior operational experience in charge of the mills. However, discord with the shareholders led to Kondo's departure in 1890, and Okada left to lead the industry association at the same time, leaving Hattori as the sole leader from 1891. Though Hattori was promoted to the board of directors in 1895 (so the glass ceiling was not an issue), the extremely frugal Owari's shareholders did not permit the appointment of additional TMT leaders and also voted to cut Hattori's salary by 20 percent and prohibit performance bonuses (Kinugawa, 1964, Vol. 3, Ch. 8). Despite this, Hattori did not quit (by his own admission, he loved the technology and didn't care much about money), but the inability to hire a capable supporting cast created significant managerial diseconomies: mill supervision suffered as he had to take on the other management tasks. The firm never grew, and downstream integration was not even a consideration as its performance went downhill.

As mentioned above, Owari exited in 1905 through acquisition by Mie. Stable shared leadership was also key to long term expansion through acquisitions, starting towards the end of period 3 above (1892-98) and continuing throughout our sample. Along with building new plants and purchasing new machines, centers of gravity took advantage of the fact that many new entrants were able to purchase the latest vintage machines from England but lacked necessary managerial (TMT) resources and skills to utilize them efficiently. Braguinsky et al. (2015) already noted that the acquisition of higher-productivity fixed assets by better managed firms resulted in higher capacity utilization and profitability. Indeed, all of the largest serial acquiring firms in Braguinsky et al. (2015) are the five group 1 firms in Table 8. Once again, Mie is a case in point. Among the eight independent firms in the industrial cluster of the Seo area (between Osaka and

[13] Okuda was nicknamed Nagoya's Shibusawa, in recognition of his similarity to Shibusawa Eiichi, the founder of Osaka Spinning, and the prolific Japanese industrialist known today as the "father of Japanese capitalism."

Tokyo) around the turn of the 20th century, Mie had the highest stable shared leadership: while shared leadership represented 83% (100% after 1891) of all of Mie's firm year observations, the other firms had such leadership in 53% of all observations. Mie had no discord induced TMT departures, while other firms had discords in about 10 percent of observations with shared leadership. Stable shared leadership enabled Mie to be the lead firm in the Seo industrial cluster, and was key to its acquisition of all but one of the area firms in the merger waves post period 3. Mie also acquired two other firms, one each in the Osaka and Tokyo areas.

In Table 9, we present summary statistics on shared leadership and discord induced TMT departures for Group 1 firms in Table 8 (the large serial acquirers), the firms that ended up being acquired by those serial acquirers, and all other acquiring firms (for comparison). Group 1 firms had shared leadership twice as often as the firms they acquired. In contrast, discord induced TMT departures (conditional on having shared leadership) were 2.5 times more likely to occur in the future acquired firms than in the serial acquirers. Strikingly, as the last row of Table 9 shows, all other acquiring firms were not different from the acquired firms along those two dimensions, and almost half of them ended up eventually being acquired themselves in later years. Coupled with the fact that serial acquirers also achieved by far the best post-acquisition performance of the acquired establishments (see Braguinsky et al., 2015), it seems clear that stable shared leadership was a major factor that enabled long-term successful expansion through acquisitions.

Stable shared leadership enabled superior product choice strategies

Stable shared leadership was also key to successful product choice strategies within the cotton spinning industry, as exemplified by Settsu and Amabo (Group 1). Settsu's stable shared leadership over a 20 year period consisted of company president, Chuemon Takeo, also founder and president of a large trading firm which exported cotton yarns, and Kyozo Kikuchi as its chief engineer and second TMT leader. The joint leverage of Kikuchi's technological leadership and Takeo' superior marketing prowess (Osaka Gaikoku Boeki Shirabe, 1900, p. 55) enabled Settsu to create superior product choice strategies and export two major products (16-count S- and 20-count Z-yarns) to become one of the most profitable firms in the industry, second only to Amabo. Amabo's case is even more spectacular. Kikuchi's promotion to the board in 1894 (as mentioned above) ushered in a new product strategy of penetrating the upscale 42-count doubled yarn market, entirely dominated by high-quality imports from England at the time. This was enabled because

Kikuchi and the new company president, Motonosuke Fukumoto (a banker) searched for and recruited Juemon Tashiro as a TMT leader of sales. Their joining of forces overcame various technological and marketing difficulties that could otherwise have derailed the firm (Unitika, 1989). For example, as Kikuchi experimented with various product varieties and developed the right technologies, also traveling abroad to England and the U.S., Fukumoto tended to business operations, and Tashiro went door to door with product samples to persuade Japanese merchants to switch to Amabo from the trusted British suppliers (who also paid generous commissions). In 1899, when the domestic output of 42-count doubled yarn finally exceeded imports, Amabo share constituted a whopping 70 percent, and was responsible for such an overtake of domestic output over imports. Largely through its dominance in this market niche, Amabo became the most profitable firm in the industry, and continued on an increasing profitability trajectory even during the shakeout period when profits of all other firms' profits (even those of other centers of gravity) nose-dived.

Amabo's success in penetrating the upscale 42-count doubled yarn stands in contrast with efforts by two other firms, Heian and Meiji that sought a foothold in this highly profitable niche at around the same time. Neither are included in Table 8 because they were later entrants who exited within the first industry shakeout. Heian did not have shared leadership when it entered the industry in 1896, and even 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 42-count doubled yarn production peaked at age 2 at 13% in 1897 and declined steadily thereafter till the firm went bankrupt in 1903. Meiji, run by a single leader throughout was able to peak its production of 42-count doubled yarn in 1899 at about 20 percent of total industry share, but also went out of business in 1902. Notable in their failure was their inability to recruit a university-educated engineer, placing them at a huge disadvantage compared to Amabo.

The cases above indicate that stable shared leadership's most important characteristic relative to single leadership was the enabling of division of labor, with each "best in class" leader being able to leverage their talents through smooth and stable coordination with the other talented leaders within the firm.[14][15]

[14] We cannot help notice parallels with shared leadership of Henry Ford and James Couzens in the success of Ford Motor Co. (see, e.g., Klepper, 2016, p. 28), and of Steve Jobs and Steve Wozniak in early Apple (Isaacson, 2011).

[15] While the historical, "remote sensing" nature of our study precludes the benefits of first hand interviews, documents from the era strongly support the importance of this factor. e.g. Sanji Muto, a TMT leader of Kanebo (more about him below), noted in his autobiography that he could freely concentrate on managing production as he was assured of shared

Other strategic limitations of single leadership relative to stable shared leadership

We examine additional factors by dwelling into strategic limitations resulting from single leadership. Firms with single leadership experienced difficulty in recruiting highly sought after educated engineers (especially university-educated ones), who eschewed such firms for others with perceived superior promotion prospects. Thus, single leadership within Tokyo Spinning (in Group 3) from 1889-1909 implied that it could only hire its first university-educated engineer in 1908 and the second one in 1912, even as it constructed a large, brand-new factory to produce high-end products. When Tokyo Spinning finally expanded the TMT in 1910, it was too little too late. In 1914, it had to exit through acquisition; given that its management structure was not able to fully leverage its state-of-the-art production facilities. Okayama Spinning (also in Group 3) was run by a single leader until it exited in 1907. While it managed to recruit a university-educated engineer twice (in 1896 and 1898), it was unable to retain them for more than three years.

Transitions from shared to single leadership are also illuminative: Kanakin (Group 3) lost a TMT leader to another firm in 1900, and the lack of immediate replacement resulted in the firm's single leadership after that year. Kanakin also lost its only university-educated engineer (who had been with the firm since founding). Even though the firm had been downstream integrated since inception, with strong positions in both cotton spinning and garment production, Kanakin never recovered from those departures and was subsequently acquired in 1906. Even centers of gravity were not immune from managerial diseconomies problems, once they transitioned to single leadership. Most notable is Osaka Spinning's decline from a strong pioneer leading the industry from inception to barely retaining its center of gravity position at number seven among them. Osaka's shared leadership was first disrupted in 1894, when TMT leader of sales, Rihei Kawamura, quit to found his own trading firm. Subsequent rifts occurred between the company president, Jutaro Matsumoto (a prominent member of the founding team and a rich investor) and its highly-respected chief engineer, Takeo Yamanobe (recruited at the founding and promoted to TMT in 1895). When Matsumoto's attempt to oust Yamanobe was thwarted by the firm founder (though no longer board member) Eiichi Shibusawa (credited, as noted, to be the father of Japanese capitalism), Matsumoto himself had to resign at the ensuing shareholders meeting. Yamanobe, though quite talented, could not attain the earlier

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leadership support which enabled, among other things, the financial backing of Mitsui (a large financial group).

growth rates as a single leader, and Osaka stagnated with the average growth rate of output of less than 1 percent per annum in 1898-1905. This period of single leadership also corresponds to loss of educated engineers (Figure A4 in the appendix), including an important university-educated engineer who had been with the firm since 1893.[16] When shared leadership was restored in 1906, the firm resumed growing in size and engineering talent (Figure A4 in the Appendix). Similarly, Fujibo (later entrant not included in Group 1) had been growing rapidly under shared leadership in the early 1900s, but lost momentum when it transitioned to single leadership due to TMT leaders' aging and retiring (Figure A7 in the Appendix).

Perhaps serving as an exception to the rule, Godo Spinning (later entrant and not in Group 1) is the only center of gravity firm with single leadership by Fusazo Taniguchi since its inception in 1900 and throughout our sample, and no university-educated engineer at founding. Taniguchi's ability to nonetheless lead the firm to great heights may be traced to his employee entrepreneurship: he is the only TMT leader among all center of gravity firms with prior industry experience. A yarn trader initially, he had served on the TMT of two cotton spinning firms, and also tried to create a new venture. Key to Taniguchi's success was this insider knowledge, and the strategy of expansion through acquisition of production facilities of failing firms: rather than rely on engineering talent necessary to create new production facilities in-house, Taniguchi grew Godo through superior management of acquired, under-performing mills.

Strategies enacted in the aftermath of discord induced TMT departures

Stability is important precisely because shared leadership increases the odds that leaders will develop disagreements and discords, both of strategic and inter-personal nature. Indeed, centers of gravity were not immune from these risks either. While the prior section focused on strategies enabled by stable, shared leadership, we now turn to strategies utilized by firms to recover from such discords. The evidence on the frequency of discord induced TMT departures over time in Figure 3 points to another salient feature of the centers of gravity: their ability to learn from early discord induced disruptions and to prevent them from happening in the future. They also seemed more successful in devising strategies to quickly and effectively fill in the leadership holes resulting from discord induced TMT departures, and reduce their disruption costs.

[16] The big one-time output decrease in 1893 (Figure A4) is not due to TMT discord but a devastating fire in a mill.

Strategies based on value creation to address disruptions from discord induced TMT departures

Our quantitative estimates of within-firm variation already showed that conditional on survival, the largest negative impact on growth was observed in periods of repeated discord induced departures (see Table 5 above). Across firms, inability to control repeated discord induced departures and their disruptions seemed to be fatal, as exemplified by Naniwa Spinning (Group 2). The first discord occurred in 1890 shortly after firm founding, due to the discovery of embezzlement by company president, Heihachiro Kobayashi for his own private business. Even in the reporting of the embezzlement to the shareholders, the just-elected new president, Masatoshi Murakami, chose to be a no-show, leaving another board member to take the heat. Things quickly went from bad to worse, with another embezzlement surfacing in the following year. Rather than dismissing the culprit—a political appointee from the Sumitomo financial group—Naniwa instead promoted him to the board of directors in 1893. The firm underwent six TMT changes and eventually went bankrupt after just 10 years in business. Settsu (Group 1)'s history stands in sharp contrast in its handling of a very similar situation. One of Settsu's founding board members, Jinbei Tanaka, also embezzled shareholders' money for private use right after company founding; moreover, the embezzled amount was several times larger than in Naniwa's case. But Settsu TMT nipped the problem in the bud: they honorably chose to issue 3,800 new shares to cover half the embezzled amount, and these shares were purchased entirely by the 6 remaining founding team members. The remainder was issued as a long-term loan to Tanaka, which he gradually repaid (and helped restore his reputation). The shareholders also elected a new TMT, which featured the already-mentioned Chuemon Takeo as a key leader responsible for the firm's subsequent success.

The manner in which the firms handled strategic disagreements induced departures is also important. Perhaps as a foil to the above examples of Amabo, Settsu and other centers of gravity successful division of labor and coordination, the business histories of several Group 2 and 3 firms reveal a failure to attain fruitful cooperation through frequent infighting. Several group 2 and group 3 firms in Table 8 fizzled because of such disruptions to their shared leadership. For example, Senshu's (Group 2) founding team comprised prominent cotton yarn merchants and investors with prior operational experience; a potentially powerful combination of market and technological competence. But in this (rather typical) case, a constantly shifting power balance between TMT members with different functional experience resulted in four discord-related TMT changes in ten years. In the process, Senshu lost the university-educated engineer employed at founding. The demise stories of Tenma and Miike/Kyushu (both in Group 2) are eerily similar. Nagoya Spinning (Group 3), a one-point contender to Mie and Owari, suffered from a major strategic discord in the early 1890s, when one of the key shareholders insisted on bringing in a new TMT member with government connections. The company president was forced out, and the firm performance deteriorated sharply. It was only in 1900, following several years of declining and even negative profits, that the former president's son managed to assume the rein and oust the usurping TMT by giving an impassionate speech at the shareholders meeting. But, this was too little, too late, and the firm eventually exited through acquisition in 1905.

Amabo's approach to strategic disagreements was very different. When Motonosuke Fukumoto proposed new plant construction for producing the 42-count doubled yarn, Chubei Kihara, the company president at the time strongly opposed the plan as too risky. Fukumoto called a shareholders meeting to garner support, leading to Kihara's resignation and Fukumoto becoming the new president of the firm.[17] Fukumoto also ensured Kikuchi's appointment to the board of directors in spite of opposition by making the forceful case that Kikuchi's engineering talent was an even more important resource for the firm than money. Fukumoto's focus on talent and productivity, rather than political connections, was again evidenced in his ensuring Kikuchi succeeded him as president when he had to resign for personal reasons in 1901, again in spite of significant opposition. Such visionary leadership in the face of disagreements proved critical to Amabo's success not only for reasons noted above, but also as underscored in the official company history which today proudly notes: "Kikuchi's promotion to the board of directors meant management by a professional, and was at the time a progressive, enlightening move toward modernization" (Unitika, 1989).

The above examples clarify that differences in TMTs (and shareholders) reactions to similar circumstances (fraud; strategic disagreements) determined whether the TMTs fell apart and dragged the firms down with them, or recovered and enabled continued growth under newly stabilized shared leadership. Notwithstanding the role of some quantifiable measures that could discern across these different reactions (e.g. shared leadership at founding, merit-based promotion policies), the differences in reactions also relate to

[17] In the spinout literature (Klepper and Thompson, 2010), Fukumoto who would have had to leave and start his own firm. The Amabo case shows new ideas can win also by changing the direction of existing firms through TMT changes.

the values and principles embodied in the TMTs: their sense of honor, and their commitment to productive value creation. Shared leadership and merit based promotion strategies are also ultimately related to these values, rather than orthogonal or exogenously given to the firms. Accordingly, a key differentiator of centers of gravity from similar-looking firms seems to be value creation-based strategic leadership.

Human capital based strategies to cope with discord induced TMT departures

Ensuring swift and effective replacement of TMT leadership, whether by external professional managers or internal promotion also seems key to centers of gravity's enduring success. The above examples of promotion of university-educated engineers by Mie, Amabo, Settsu and Osaka (Group 1) show the importance of recruiting and retaining talent during periods of shared and stable leadership, and additional examples elucidate the importance of human capital based strategies in creation and recovery from discord. Kanebo's experience, both early in its history, and in the face of a later, major crisis is a case in point regarding a firm who faced several disruptions, but endured and thrived nonetheless (see Figure A6 in the Appendix). The firm teetered on the verge of bankruptcy following its less than successful launch in the late 1880s. When the leadership turned to Mitsui group (a prominent financial groups) for help, Mitsui initiated two discord induced TMT changes in 1891 and 1893, replacing two holdover TMT leaders by their own prominent university-educated managers, Hikojiro Nakamigawa and Eiji Asabuki. While Kanebo became stable, Nakamigawa and Asabuki realized their prior experience was in finance, and even more specialized management resources were needed for an industrial firm. In 1894 they hired two young university graduates who had also studied in the U.S: Toyoji Wada to manage the main Tokyo mill, and Sanji Muto to manage the newly established Hyogo mill (in the Osaka area). Attempts to resolve rivalry between these two ambitious young men proved unsuccessful, so in 1900, Kanebo's leadership removed Wada and gave Muto authority over both firm branches. Muto spearheaded the technological renewal of the outdated Tokyo mill, and orchestrated several acquisitions where he restructured underutilized production facilities and integrated them into Kanebo's organizational hierarchy (Kuwahara, 2004), resulting in phenomenal growth over the next decade. Later in 1906, when Kanebo's owners sold their controlling block of shares, the firm ended up in the hands of a speculator, Hisagoro Suzuki. Suzuki had sharp disagreements with Muto, leading to the resignation of both Muto and executive director Eiji Asabuki. Long-term Kanebo investors, however, rallied in Muto's support, and the newly elected TMT in early 1907 requested Muto to stay in the advising capacity with Kanebo. When the stock market crash in late 1907 resulted in the seizure of Suzuki's shares of Kanebo by the creditor bank, the earlier thoughtful intervention of Kanebo's investors allowed for Muto's triumphant return as the new executive director, and the firm getting right back on track (visible in Figure A6 in the Appendix).

Fujibo (center of gravity firm not included in Group 1) was also close to bankruptcy when it started operations. When its first attempt of hiring a professional manager from another company (Kanakin) was unsuccessful, the firm entrusted Heizaemon Hibiya, a prominent trader and respected investor with a reputation for turning around failing companies. Hibiya enlisted the above-mentioned Toyoji Wada, who had just been passed over by Kanebo, as a professional manager. The shared leadership between Hibiya, Wada, and Fujibo's executive chairman and major shareholder Kichiemon Hamaguchi, led the firm to stability and steady growth (on average by 20% per year from 1902-1914, see Figure A7 in the Appendix).

In sum, the elucidation of the actual mechanisms that both trigged discord induced TMT departures, and allowed firms to recover from discord induced departures reveal managerial talent at the heart of both dampened growth rates, and the containment of the effects on growth, independent of any shocks to the production function or the demand faced by the firm. Thus, the ultimate factor behind both success and failure of shared leadership was the human element, both in cases where firms turned their fortunes around by enacting the appropriate strategies, and where the firms failed to take such action and fell apart.

DISCUSSION AND CONCLUSION

By digging deep into microfoundations of firm and industry evolution through the integration of history and strategy research, our study shows that contrasted with similar sized peers at the onset, firms that grew to become centers of gravity had disproportionately greater periods of shared and stable leadership as well as focus on value creation through recruiting and promoting superior human capital. These factors enabled firms to both grow in periods of stability because of increased managerial span of control, division of labor, and smooth coordination processes, and also recover more quickly from discord induced departure, through the foundation of value-based focus on human capital strategies. By applying the methodological approach at the intersection of history and strategy research—quantitative analysis of associations between shared and stable leadership and growth rates for *all* firms in the Japanese cotton spinning industry, and qualitative analysis of business histories—we could uncover the strategies enabled by shared and stable leadership, and strategies to minimize disruptions due to discord induced departures.

The insights of our study hark back to the classics' focus on entrepreneurial/managerial *embodiment* of firm capabilities and resources (Lucas, 1978; Penrose, 1959; Schumpeter, 1949[1911]). 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. TMTs themselves do not smoothly transition from founding teams or grow linearly; shared leadership brings with it increased risks of power struggles and discord; the management of which is critical to whether the firm will survive and grow, or wither and die. Prevention of such disruptions and capability to contain their impact if and when they nevertheless happen appear to be key factors that separated "centers of gravity" from other firms that "also ran." Our study shows that the ability to keep high-quality TMTs working 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's founding principles are based on value creation. When the Meiji era ushered open markets in Japan, enterprising individuals created new ventures. Among these new entrants, 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, such as capital, labor, etc.) 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). Firms emerged to become the centers of gravity, whose 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 (Agarwal et al., 2004; Klepper and Thompson, 2010), 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.

These insights permit us to integrate across and contribute to several literature streams. While existing industry evolution studies place primacy on market selection processes and product/process innovation (Jovanovic and MacDonald, 1994a, b; Klepper, 1996; Utterback and Abernathy, 1975), our study highlights the role of managerial talent, and uncovers the key role played by TMT evolution in firm and industry evolution. We contribute to the literature at the intersection of entrepreneurship and strategy (Beckman and Burton, 2008; Boeker and Karichalil, 2002; Bourgeois and Eisenhardt, 1988; Eisenhardt and Schoonhaven, 1990; Williams et al., 2017). By utilizing a unique methodological approach of qualitative and quantitative analysis grounded in historical narratives of *all* firms in an industry, we examine the transition of founding teams to top management teams, and highlight the importance of characteristics such as shared leadership and stability, over and above TMT size and functional diversity. Our findings show similarities in two seemingly separate processes—entrepreneurial team formation processes, and TMT conflict management processes: Founding teams which focus on best-in-class talent and value creation (Shah et al., 2017) become TMT of the more successful firms, and such focus enables the creation of shared and stable leadership, and speedier recovery in instances where discord does occur (Eisenhardt, Kahwajy and Bourgeois, 1997). In doing so, we provide empirical evidence of Penrose's theoretical insights: firms grow based on talent attracting more talent and when the entrepreneurial TMT can build on both operational excellence with innovative experimentation through stable and shared leadership. Finally, our contribution to the TMT literature (Adner and Helfat, 2003; Castanias and Helfat, 1991; Hambrick and Mason, 1984) is in examining TMT composition and turnover and their performance effects over the entire firm lifecycle and over the census of firms within an industry: we show that even high growth firms experience instances of TMT discord. However, sustained disagreements within TMT, results in significantly lower growth rates, and even exit of the firm. Taken together, these contributions highlight the evolutionary processes that permit some firms to become "centers of gravity," implicates managerial talent at the core, and provides comprehensive qualitative and quantitative evidence for the micro-foundations of firm and industry evolutionary trajectories.

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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 unita adjusted by thread count weights to account for varying thickness of different product varieties.
B. TMT Characteristic Variables	
TMT members	TMT members by title, including but not limited to TMT leaders
TMT leaders	TMT members who actually run the firm and made strategic decisions (not nominal heads)
Singe Leadership dummy	Equals 1 if a firm was led by a single TMT leader, 0 otherwise
Shared Leadership dummy	Equals 1 if a firm was led by two or more TMT leaders, 0 otherwise
Number of TMT leaders	The number of TMT leaders
Number of TMT members	The number of TMT members
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 left the firm as a result of the action taken by shareholders or boards of directors, 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
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
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	0.061	0.097	0.095	0.126
	(0.039)	(0.042)	(0.045)	(0.064)
Number of TMT Leaders			-0.028	-0.018
			(0.026)	(0.045)
Number of TMT members	0.006	0.013		
	(0.024)	(0.024)		
Functional diversity of TMT	-0.019	0.009	-0.015	0.013
	(0.048)	(0.055)	(0.047)	(0.056)
Firm age	0.086	0.086	0.082	0.086
	(0.024)	(0.026)	(0.023)	(0.026)
Number of workers	0.527	0.443	0.529	0.446
	(0.043)	(0.045)	(0.043)	(0.045)
Current output	-0.988	-1.051	-0.989	-1.052
	(0.029)	(0.031)	(0.029)	(0.031)
Constant	4.849	6.494	4.862	6.527
	(0.238)	(0.261)	(0.235)	(0.261)
Observations	822	672	822	672
R-squared	0.830	0.881	0.831	0.881

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	-0.054 (0.047)	-0.046 (0.052)	0.060 (0.059)	0.040 (0.057)	0.101 (0.058)	0.049 (0.072)
Shared leadership without TMT change	0.066 (0.040)	0.118 (0.042)	0.077 (0.032)	0.075 (0.036)	0.077 (0.032)	0.073 (0.035)
Number of TMT members	0.021 (0.023)	0.022 (0.023)	0.010 (0.023)	0.028 (0.023)	0.008 (0.024)	0.030 (0.023)
Functional diversity of TMT	0.010 (0.049)	0.037 (0.056)	-0.001 (0.049)	0.016 (0.057)	0.000 (0.049)	0.020 (0.057)
Number of engineers r	0.127 (0.027)	0.114 (0.033)	0.134 (0.027)	0.119 (0.034)	0.135 (0.027)	0.122 (0.033)
Market knowledge index	0.008 (0.041)	0.025 (0.046)	0.014 (0.042)	0.042 (0.046)	0.015 (0.042)	0.040 (0.047)
Financial knowledge index	0.054 (0.048)	0.008 (0.056)	0.050 (0.048)	0.013 (0.058)	0.050 (0.048)	0.009 (0.058)
Firm age	0.090 (0.024)	0.092 (0.028)	0.091 (0.023)	0.094 (0.023)	0.092 (0.023)	0.092 (0.024)
Number of workers	0.502 (0.042)	0.428 (0.044)	0.498 (0.042)	0.423 (0.045)	0.499 (0.042)	0.422 (0.045)
Logged current output	-1.006 (0.028)	-1.069 (0.028)	-1.000 (0.028)	-1.061 (0.030)	-1.001 (0.028)	-1.060 (0.030)
Constant	4.968 (0.229)	6.601 (0.254)	4.956 (0.230)	6.568 (0.251)	4.961 (0.229)	6.557 (0.254)
P-value for test 1	0.011	0.002	0.755	0.487	0.643	0.712
Observations	822	672	822	672	822	672
R-squared	0.837	0.886	0.836	0.884	0.836	0.884

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

VARIABLES	DV: Output growth rates 3 year	5 year
Shared Leadership with Single Discord Induced departure	0.085	0.108
	(0.056)	(0.056)
Shared Leadership with Multiple Discord Induced departures	-0.147	-0.189
	(0.074)	(0.100)
Shared leadership without Discord Induced Departures	0.122	0.151
	(0.043)	(0.046)
Number of TMT members	0.016	0.026
	(0.026)	(0.023)
Logged number of engineers	0.121	0.091
	(0.028)	(0.032)
P-value for test 1	0.445	0.434
P-value for test 2	0.0002	0.001
Observations	790	646
R-squared	0.815	0.877

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, Number of workers, Logged current output, and the constant term are included but coefficients not reported. See Table A5 in the appendix for full results.

Table 6: Firm Growth in Discord Periods (Periods Preceding Discord Induced Departures)

	DV: 3-year output growth rates	
Discord period	0.071	
	(0.057)	
Single Discord period		0.046
		(0.070)
Multiple Discord Period		0.110
		(0.086)
No Discord Period	0.149	0.148
	(0.045)	(0.045)
Number of TMT members	-0.006	-0.007
	(0.026)	(0.026)
Constant	4.861	4.891
	(0.246)	(0.246)
P-value for test 1	0.152	0.152
P-value for test 2		0.640
Observations	730	730
R-squared	0.853	0.853

Note: (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, Number of workers, Logged current output, and the constant term are included but coefficients not reported. See Table A6 in the appendix for full results.

Table 7: Discord Induced Departures and Resource Accumulation

VARIABLES	DV: 5-year growth rates of: I. Workers	II. Engineers University	II. Engineers Technical school	III. Capital Physical	III. Capital 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 A7 for full results.

Table 8. Comparisons across similar-sized early startups

	Group 1	Group 2	Group 3
Initial size (# of spindles installed)	16,993	11,726	11,627
Size (# of spindles installed) in year 10	53,244	34,720	30,834
Ten-year change rate in size	213%	196%	165%
Founding conditions:			
Shared leadership at founding	**0.80**	**0.40**	**0.40**
University-educated engineer at founding	**1.00**	**0.60**	**0.40**
Trader in TMT at founding	0.60	0.60	0.40
Banker in TMT at founding	0.80	0.60	0.00
10-year dynamics:			
Shared Leadership years in the first 10 years (a)	**8.40**	**6.00**	**2.00**
Number of Discord Induced Departures in the first 10 years (b)	**0.80**	**2.40**	**0.60**
Ratio: (b)/(a)	**0.10**	**0.40**	**0.30**
Years with traders in TMT in the first 10 years	5.00	3.80	2.20
Years with bankers in TMT in the first 10 years	6.80	6.67	0.00
Number of university-educated engineers in year 10	1.80	0.20	0.20
Ten-year change rate in university-educated engineers	**80%**	**-67%**	**-50%**
Average # of product varieties in the first 10 years	**9.78**	**6.49**	**6.31**

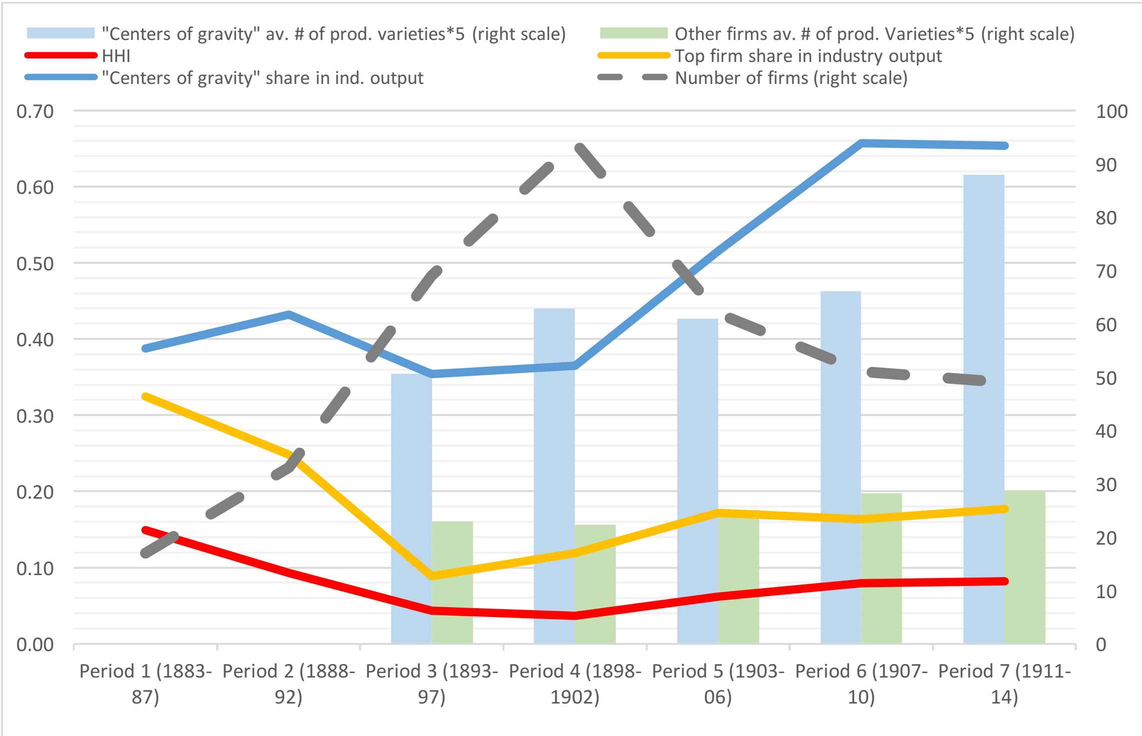
Group 1 is 5 future "centers of gravity." Group 2 is 5 firms that did not survive the first shakeout (1898-1902). Group 3 is 5 firms that exited between 1905 and 1914. Source: our data described in the main text and the appendix.

Table 9.

	Shared Leadership (a)	Discord Induced TMT Departures (b)	Ratio: (b)/(a)
Serial acquirers (from Braguinsky et al, 2015; group 1 firms in Table 8)	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

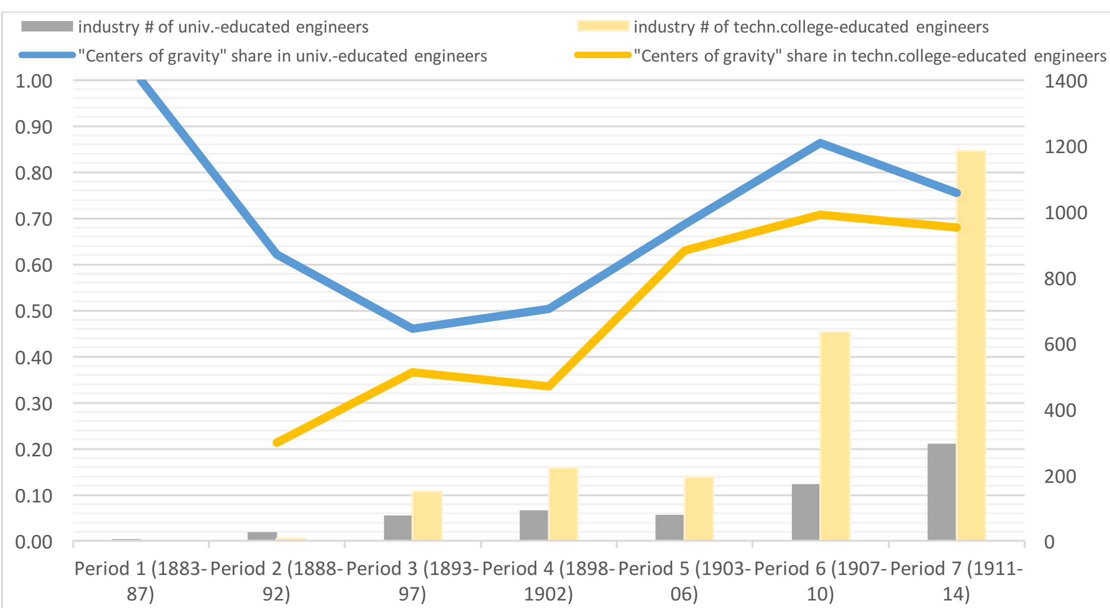
Figure 1.

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



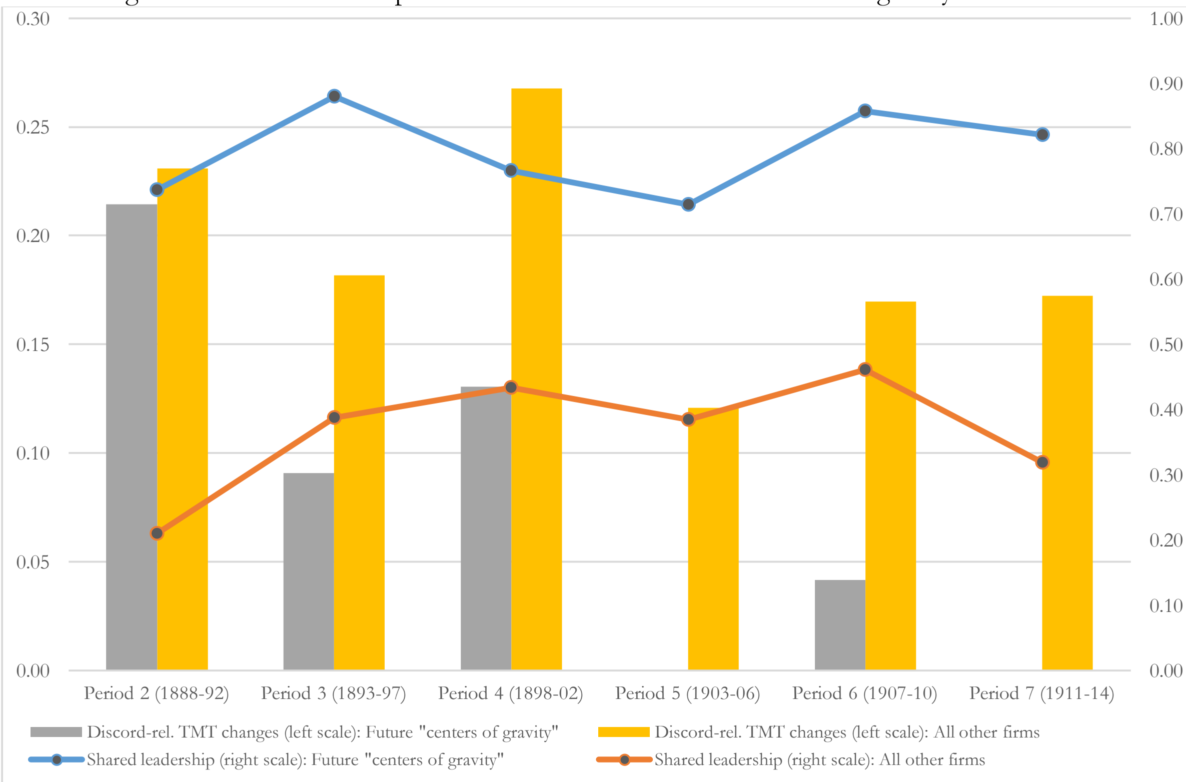
Source: our data, described in the text and in the appendix. The number of product varieties has been multiplied by 5 to fit the right scale.

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



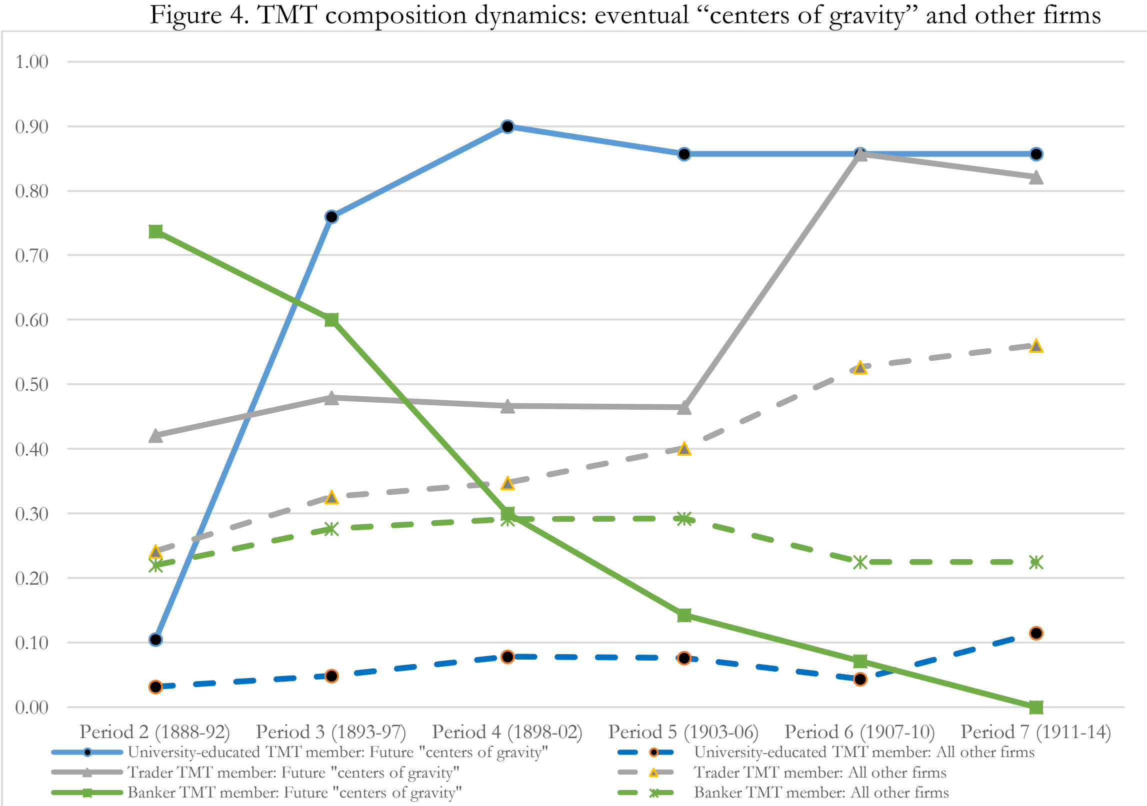
Source: our data, described in the text and in the appendix.

Figure 3. Shared leadership and TMT discords: eventual "centers of gravity" and other firms



Source: our data, described in the text and in the appendix.

Figure 4. TMT composition dynamics: eventual "centers of gravity" and other firms



Source: our data, described in the text and in the appendix.

Centers of Gravity: The Effect of Shared Leadership and Stability in Top Management Teams on Firm Growth and Industry Evolution

Online Appendix

A. Data description and variables construction

Output, product variety and financial data

We have compiled a comprehensive database covering the universe of firms that participated in the All-Japan Cotton Spinners' Association (hereafter "Boren" for short, using its Japanese acronym) which were *all* the firms meaningfully engaged in mechanized cotton yarn spinning at any point in time.[1] The first part of the database consist of firm-level monthly data on inputs and outputs in physical units published (since July 1889) in Boren's bulletins (hereafter, "Geppo"). The data for 1883-June 1889 have been coded from the "Official Gazette" ("Kampo") which uses the same data reporting format, and the two time series were combined together. The data actually used in the paper are annualized monthly data from these two sources.

Starting on May 1893, Geppo also published monthly data about different product varieties (such as 16-count weft yarn, 20-count twist yarn, 42-count doubled yarn, 80-count gassed yarn and so on) produced by each firm. These data were coded and annualized to calculate the number of product varieties produced by each firm in a given year.

The second part of the database is comprised of financial information from firms' balance sheets and income statements contained in semi-annual shareholders' reports. For missing years and privately held companies, basic financial data were also published in Boren's monthly bulletins ("Geppo") and its semi-annual reports on all companies ("Sankosho"), which we integrated into the database.

Engineers data

The information about university-educated engineers was coded from restricted-use membership lists, *Gakushikai Meibo* compiled by Gakushikai (The University Graduates' Society), the association of the alumni of Imperial Universities, containing information about addresses and workplaces of the graduates. Until 1897 Tokyo Imperial University was the only one. In 1897 Kyoto Imperial University was founded and its first cohort graduated in 1901. Two more Imperial Universities were founded in 1907 and 1911 but there were no graduates of the last one available to the industry at the end of our sample (1914) as yet.

The above information was verified and supplemented, especially for earlier years, from chapters dedicated to the history of each firm in Kinugawa (1964) and from published company histories (Kanebo, 1988; Unitika, 1989; Toyobo, 1986; Fujibo, 1998, Shikibo, 1968, Kurabo, 1953). Engineers educated in British universities, in particular, were identified from these industry history sources and added to the list of graduates of Japanese Imperial Universities. We also used *Keio Gijuku Shusshin Meiryu Retsuden* (*Biographies of*

[1] We gratefully acknowledge the collaboration from Tetsuji Okazaki and Takenobu Yuki who helped build and code parts of the database and also provided invaluable advice, while absolving them of any responsibility for the data processing process and our inferences and interpretations below.

Celebrity Alumni of Keio Gijuku) published in 1909 to identify graduates of Keio Gijuku, the predecessor of Keio University, the oldest private university in Japan, who worked in the industry.

For technical school graduates, we used annual *Ichiran* (*Catalogs*) which also contain the lists of alumni with their current workplaces and picked up all graduates of mechanical engineering and dyeing departments who worked in one of the firms in our sample in any given year. The first technical school was established in Tokyo in 1881, the second one in Osaka, in 1896. By the end of our sample there was the total of 6 technical schools that already had alumni working in the industry; all those alumni data were coded and added to the database of educated engineers employed by cotton spinning firms.

TMT data and the identification of TMT leaders and their backgrounds

General background on Japan's corporations

As mentioned in the main text, 86% (77 out of 90) of the firms in our sample were public (incorporated, chartered) firms. The Commercial Code, unifying the legal framework governing such firms, was enacted only in 1893; prior to that (which is when almost half of all the firms in our sample were founded), approval of charters of incorporation was left largely to the discretion of regional (prefectural) authorities. Regardless, the basic procedures were the same (and remained so after the enactment of the Commercial Code). First, to establish a limited liability corporation, multiple (at least 7, according to the 1893 Commercial Code) investors had to come up with startup funds, and then 4 representatives of the founding team had to submit the business plan and draft charter for approval. Although it was only in 1899 that the approval requirement was eliminated and replaced by registration in courts, in practice the approvals were granted liberally and did not deter free entry; for example, among 310 charters submitted for preliminary approval to the Ministry of Agriculture, Trade, and Industry (one of the ministries in charge) between July 1893-September 1895 only 13 were denied (Takamura, 1996, p. 175).

After the preliminary approval, the firm was allowed to start raising capital. Once all the shareholders had been identified, it had to hold the general shareholders' meeting and formally adopt the charter while also electing the board of directors and auditors. The final approval and court registration happened after that, and also after 25% of the pledged capital had been actually paid up (shares could be traded freely after the first 25% of the capital had been paid up but not before that). The important point for our purposes here is that the number of directors and auditors was specified in the charter (although it could be changed by shareholders meetings later on) and all their names and addresses had to be registered in courts. They were also published in annual issues of "Yakuinroku" (the first issue of which came out in 1893) and in semi-annual companies' shareholder reports (which also contained the names, addresses, and the number of shares of all shareholders). Yakuinroku also has data on the TMTs of privately held firms, although not all of them and not for all years. This constitutes our primary source of TMT data. The histories of firms that had been founded prior to 1893 are described in detail in dedicated chapters of the seven-volume history of the industry written in the 1930s by the Japanese historian Taiichi Kinugawa (Kinugawa, 1964). In particular, he provides invaluable, detailed information about the founding teams and their early evolution, which we used to supplement the available shareholders' reports for years prior to 1893.

Board members panel data

We started by coding and reconciling the information on the members of the boards across "Yakuinroku" and all available shareholder reports (there were a few discrepancies due to turnover during a given year and we resolved those discrepancies through the narrative parts of the shareholders reports). Obviously, the names in the sources are in Japanese characters; moreover, those are old-style characters that allow variations in the way the names are written. While this represents a unique difficulty of working with Japanese archival data, we also faced the problems familiar to all data coders, such as misspelled names. In addition, it was common in Japan at the time for sons to assume the same names as their fathers when succession happened, and the generation numbers were not always added, so we had to be careful to make sure that we code individuals with the same last and first name as different persons as long as they belonged to different generations. The work of matching names across several data sources and assigning unique IDs to distinct individuals was conducted by a dedicated RA team comprised of several doctoral students across two universities, working under one of the author's supervision. In particular, after all computer code methods of matching the names were exhausted, the team manually checked each and every individual ID before finalizing the panel.

We then added information on founding and early top management teams from Kinugawa (1964), company business histories (Toyo Boseki, 1986, Kanebo, 1988, Unitika, 1989, Fujibo, 1998, Shikibo, 1968, Kurabo, 1953), and the study of several startups on the island of Kyushu by Okamoto, 1993. Information on directors' turnovers from Geppo was also consulted in case of doubt about the exact timing of a particular executive's appointment or departure.

The most common Japanese term for a board of director member was (and still is as of today) "torishimariyaku." At that time, however, not all companies adhered to this terminology. For example, Mie Spinning (one of our centers of gravity) had adopted the term "iin" ("member") for the first 8 years of its existence (until the implementation of the Commercial Code). We have unified and reconciled all such cases. The result of this work is a comprehensive panel data on all members of the boards of directors of the firms in our sample, comprised of 5,958 observations on 879 uniquely identified distinct directors.

Identifying TMTs

Directors (members of company boards) did not necessarily belong to the TMT. As pointed out by the prominent Japanese historian, Naosuke Takamura, the responsibilities of the directors were not clearly stated in most charters, as opposed to the responsibilities of top executives. Top executives (presidents, vice-presidents, and executive directors—see immediately below for how we identified them in the data) were typically elected by the board of directors from within its members, but they could also be elected directly at the shareholder meetings (and occasionally would be delegated by the shareholders the right to choose directors to fill in the board). (Takamura, 1996, p. 65.)

The differences in title names used by different companies for their top executives are even larger than those in naming members of the board of directors. Even the company president could be called either "shacho," or "todori," or "torishimariyaku shacho," and so on (all these are translated into English as "president"). In addition, there were titles like "kaicho" ("chairman"), "torishimariyaku kaicho" ("executive chairman"), "fukushacho" ("vice-president"), "torishimariyaku fukushacho" ("executive vice-president"), "senmu torishimariyaku" ("executive director"), "jomu torishimariyaku" ("full-time/executive director"), "torishimariyaku shihainin" ("director-manager"), "mochinushi" ("owner," in privately held companies), "gyomu tanto shain" (which, in privately held companies, was the equivalent of the tile of the executive director in chartered corporations), and so on. We have considered each of the naming that came up in each of the firms, consulting with their business histories and narrative parts of the shareholders reports to understand which titles were associated with TMT membership in different firms and at different points in time. There were also cases where firms would simply list all of its "torishimariyaku" (directors) in the shareholders reports (and in Yakuinroku) and not identify any of them as the top executive; yet the narrative part will mention some specific directors as performing the functions of executive directors (corroborated also by the ordering in which directors were listed). After reconciling all these differences, we came up with the panel data comprised of TMT members only (based on the title classification) in our sample. The data are comprised of 3,138 observations on 328 uniquely identified distinct TMT members.

Identifying TMT leaders

Using TMT members identified from the titles of their positions was not satisfactory for the purpose of our analyses. First, as we read business histories, we repeatedly came across evidence that some top TMT members (presidents, chairmen, etc.) were company heads just nominally but did not really participate either in the strategic decision making or in managing the firm. (See below for examples, listing the sources.) These TMT members in name only do not fit into our definition of shared leadership and, therefore, needed to be excluded from TMT leadership.

We also saw opposite cases, where individuals not formally bestowed with a TMT title were actually very much in charge of the firm, including strategic decision making. We added such individuals in charge of strategic decision making, and/or managing the firm to the list of TMT leaders. Again, we present and discuss examples, together with data sources on which our discerning of TMT leaders without formal titles was based below. As a result, the panel of TMT leaders presents a partially overlapping set with the panel TMT members identified through titles only and consists of 2,101 observations on 304 distinct TMT leaders (of which 242 are TMT leaders also with formal title, while 62 are TMT leaders with no formal TMT title).

TMT turnover

TMT turnover events and TMT leader turnover events are identified from the panel data described immediately above. Kinugawa (1964), firm histories, and narrative parts of shareholders' reports provide information about the reasons, which were utilized in the paper to separate involuntary (discord induced) departures from those due to natural causes or personal reasons. For each year *t* we also counted the number of TMT departures in a given firm in the years from *t*-1 to *t*+1, and then created dummy variables for a one-time TMT member departure (if the total count is 1) and for a multiple-time TMT member departures (if the total count is 2 or 3). (We got qualitatively the same results when we counted the number of the TMT departures in years between *t*-2 and *t*.)

Examples of how we discerned TMT leaders

1) *Examples where TMT members by title were excluded from TMT leaders.*

(a) **Kanakin Spinning and Weaving**. This company was founded and run by the Abe family, a prominent merchant family from Ohmi region, to the east of the ancient capital of Kyoto. They chose the location in the city of Osaka, about 100 kilometers to the West. The firm's president ("shacho") at the time of founding (1890) was Ichirobei Abe VII, the seventh generation head of the family but he was overseeing the whole family business and did not manager the firm. The firm did not have the formal title of president for several years after that, but in 1896 it appointed Ichitaro Abe III, the second son of Ichirobei Abe VII's younger brother (Ichitaro Abe II) to become the president by title, and he stayed in this position until 1904. This president was not involved in running this particular company either. From 1890-1899, the company's TMT leaders were Masahiro Tamura and Shukichi Abe (the latter the adopted son of the third Abe brother, Rihei Abe). They both held the title of "executive director," one rank below "president" but they actually resided in Osaka with the firm and were the TMT leaders in charge (Sources: Kinugawa, 1964, Vol. 4, Ch. 5; Denda, 1993).

(b) **Ichinomiya Spinning**. This firm that entered relatively late (in 1897) hoping to take advantage of the booming industry had a bunch of TMT members in name only. Toichiro Mori who was the president until 1901 was a politician and a member of Diet (Japanese parliament). He had no interest in cotton spinning and was selected only for political reasons. He never showed up at the firm itself. Mokichiro Matsuoka who held the title of the executive director from 1897-1903 looked after his own vegetable oil business and had no interest in the company either. (Source: Kinugawa, 1964, Vol. 7, Ch. 7). At the November 24, 1903, shareholder meeting, the shareholders finally voted out the previous TMT in name only, and pointedly added the word "full-time" to the title of the president, Sinichiro Saburi, who was thus listed as "jomu shacho," the title never seen in any other company and underlying the urgency felt by the shareholders to have someone really in charge rather in name only (Ichinomiya Spinning, Company report No. 16, pp. 2 and 17).

(c) **Mie Spinning**. Mie (one of our centers of gravity) had three TMT members through most of its history but one of those, Monshichi Kuki VIII whose formal title was "torishimariyaku kaicho" (“executive chairman”) inherited the position from his father, Monshichi Kuki VII who was one of the company’s founders but passed away in 1890. Kuki VIII developed his father’s business in many directions, and he also became a politician, a member of Diet (Japanese parliament) but all company history sources (Toyo Boseki, 1986; Kinugawa (1964, Vol. 2, Ch. 13) agree that he did not participate in running the firm or strategic decision making, so we do not include him in the list of TMT leaders.

2) *Examples where TMT leaders with no formal titles were included.*

(a) **Mie Spinning**. In the main text we identified two TMT leaders, the company founder, Denshichi Ito, and the chief engineer, Tsunezo Saito. Together, they managed the company for 25 years, from 1891-1914, and turned it into the second largest firm in the industry. Yet, over this period of time, both underwent changes in the formal titles and for most part they were not bestowed with the titles indicating a top executive position (in contrast to the executive chairman, Monshichi Kuki VIII who, as mentioned above, was a name-only TMT member). In 1891-93 (prior to the Commercial Code implementation) Ito was called “iin ken shihainin” (“member and manager”) while Saito was called “iin kensa-gakari ken gishicho” (“member in charge of audit and chief engineer”). After 1894 their titles are just “torishimariyaku” (director) and only in a two years (1896-97) they both have the title of “jomu torishimariyaku” (“full-time, or executive director”) (Yakuinroku, 1896 and 1897). Formal titles notwithstanding, the company history (Toyo Boseki, 1986) and Kinugawa (1964, Vol. 2, Ch. 13) both agree that Ito and Saito had managed the firm all along and jointly made all the strategic decisions. We also confirmed this in an interview with Yoshinori Murakami, the now retired head of the company history division in Toyobo.

(b) **Takaoka Spinning**. The firm, which survived in the industry from its entry in 1894 and until 1914 nearly collapsed following the death of its founding president and TMT leader, Denemon Sugano in late 1900. His long-term partner, Shozo Arai became the new president but he was also deeply involved in the political world and could not spend a lot of time at the firm. In 1902 he summoned his adopted son, Kenzo, from Tokyo where the latter was studying at a university. Kenzo Arai was initially given the title of “jimucho” (“chief of staff”) which was not a board position but he took charge of the firm and contributed to its revival (Kinugawa, 1964, Vol. 5, Ch. 11). He was officially promoted to a TMT position of “executive director” in 1908 (Yakuinroku, 1908) but we count him as a TMT leader and thus consider Takaoka Spinning to be under shared leadership since he first arrived in December 1902.

(c) **Kanebo**. The story of this firm, described in detail in the main text represents another example of our judgment-based assignment of TMT leadership. As mentioned, the firm underwent TMT transformation in 1891-93, after which it had two undisputed TMT leaders sent in by Mitsui, in Hikojiro Nakamigawa and Eiji Asabuki. As also mentioned, two hired managers, Toyoji Wada and Sanji Muto were put in charge of Tokyo and Hyogo mills, respectively, in 1896, with the titles of "managers" (not board members). We considered adding them to TMT leadership already at that point but did not do so because at that time each of them only oversaw one of the two mills, and not yet the whole company. However, once Wada was let go and Muto assumed the position of the manager of the whole firm in 1901, he was already definitely a TMT leader even though he was not given the formal title of executive director until 1908, following the ownership upheaval described in the main text. The very fact that his role in the company came into such spotlight during the 1906-07 crisis tells us how important his TMT leadership role already had been before that, despite not having the formal board member title.

To sum up, we believe that they way we discerned TMT leadership, making use of qualitative, business histories data and not just relying on formal titles, has provided us with a unique and significant advantage over studies that cannot do this. Basically, what we accomplish is a considerable reduction in noise for the purposes of quantitative analysis, an important consideration especially in relatively small data sets that usually come up in historical studies aimed at elucidating issues of strategic management.[2]

[2] In the quantitative analysis, we also looked specifically at borderline cases where we ourselves were on the fence as to whether to classify the firm as shared or single leadership and we conducted robustness checks with the shared leadership dummy turned on and off for such cases. The overall results were not affected.

B. Summary statistics and correlation matrix

Table A1: Summary Statistics

	Mean	Std Dev	Observations
A. Growth rates			
3 year output Growth Rates	0.423	0.022	889
5 year output growth rate	0.518	0.027	454
5 year employment growth rate	0.299	0.024	454
5 year university-educated engineer growth rate	0.131	0.018	454
5 year high technical school educated engineers growth rate	0.396	0.033	454
5 year physical capital growth rate	0.470	0.025	454
5 year financial capital growth rate	0.396	0.019	454
B. TMT Characteristic Variables			
Shared leadership dummy	0.430	0.014	1,182
Number of key TMT members	1.517	0.025	1,182
Number of TMT members	1.911	0.028	1,182
Functional diversity of TMT	0.414	0.010	1,182
C. TMT Turnover Variables			
Discord-related departure of TMT members	0.085	0.008	1,144
No discord-related departure of TMT members	0.324	0.014	1,144
Involuntary departure of TMT members	0.031	0.005	1,144
No involuntary departure of TMT members	0.408	0.015	1,144
Expansion	0.032	0.005	1,144
No Expansion	0.406	0.015	1,144
Shared leadership with one-time TMT discord-related departure	0.094	0.009	1,144
Shared leadership with multiple-time TMT discord-related departure	0.038	0.006	1,144
Disagreement period	0.170	0.011	1,144
One time disagreement period	0.103	0.009	1,144
Multiple time disagreement period	0.067	0.007	1,144
D. Firm Characteristics			
Firm age	11.271	0.214	1,195
Logged value of the number of workers	6.366	0.037	1,195
Logged value of the number of Engineers	0.614	0.026	1,195
Market knowledge	0.252	0.013	1,195
Financial knowledge	0.198	0.010	1,195

Table A2: Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11
1. 3 year output growth rate	1.000										
2. Shared leadership with TMT change	0.012	1									
3. Shared leadership without TMT change	0.053	-0.224	1								
4. Number of TMT	0.073	0.216	0.495	1							
5. Functional diversity of TMT	0.006	0.048	-0.083	0.011	1						
6. Engineers	-0.019	-0.011	0.300	0.292	-0.127	1					
7. Market knowledge	0.002	0.012	0.234	0.128	-0.061	0.320	1				
8. Financial knowledge	0.118	0.019	0.121	0.198	-0.018	0.039	0.154	1			
9. Firm age	-0.285	-0.062	-0.004	-0.071	-0.048	0.244	0.044	-0.139	1		
10. Number of workers	-0.066	0.028	0.299	0.341	-0.030	0.682	0.340	0.132	0.103	1	
11. Current level of output	-0.252	0.005	0.301	0.306	-0.050	0.659	0.336	0.095	0.169	0.949	1

C. Robustness Checks

Table A3: Results from Other Panel Data Estimations

	DV: Output Growth Rates			
	I. Discord departure		II. Discord departure	
	Random Effect		Arellano-Bond	
VARIABLES	3 year	5 year	3 year	5 year
Shared leadership with TMT change	-0.031	0.019	-0.026	0.054*
	(0.057)	(0.075)	(0.023)	(0.028)
Shared leadership without TMT change	0.080	0.132*	0.024	0.054**
	(0.057)	(0.073)	(0.027)	(0.024)
Number of TMT members	0.030	0.035	-0.018**	-0.025*
	(0.031)	(0.042)	(0.009)	(0.014)
Functional diversity of TMT	0.005	0.049	0.067**	0.052
	(0.083)	(0.121)	(0.030)	(0.034)
Logged (1+number of) engineers (Technical	0.126***	0.136***	0.041*	-0.026
	(0.039)	(0.052)	(0.022)	(0.022)
Market knowledge index	0.045	0.087	-0.002	0.016
	(0.066)	(0.088)	(0.034)	(0.032)
Financial knowledge index	0.111	0.144	0.030	-0.055
	(0.069)	(0.114)	(0.041)	(0.044)
Firm age	-0.024**	-0.031**	0.018	0.002
	(0.011)	(0.013)	(0.015)	(0.030)
Logged number of workers	0.638***	0.678***	-0.037	0.052
	(0.052)	(0.066)	(0.036)	(0.042)
Logged current output	-0.939***	-0.978***	-1.072***	-1.077***
	(0.038)	(0.047)	(0.036)	(0.056)
P-value for test 1	0.047	0.115	0.058	0.999
P-value for AR1 test	0.002	0.056	0.002	0.056
P-value for AR2 test	0.767	0.103	0.767	0.103
Observations	822	672	649	514

Note: (i) Robust standard errors in parentheses.
(ii) Test 1 tests the null hypothesis that Multiple leaders with TMT change = Multiple leaders without TMT change.

Table A4: The Probability of TMT Member Departure Due to Discord

VARIABLES	DV: TMT discord departure
Average profit rates over past 3 year	-5.810**
	(2.903)
Average output growth rates over past 3 year	-1.713
	(2.833)
Previous period discord departure dummy	1.578**
	(0.732)
Number of TMT	-0.344
	(0.310)
Functional diversity of TMT	-0.449
	(0.829)
Engineers (Technical level)	-0.117
	(0.447)
Market knowledge	-0.983
	(0.819)
Financial knowledge	0.637
	(0.800)
Firm age	-0.048
	(0.044)
Number of workers	0.032
	(0.339)
Constant	2.458
	(2.038)
Observations	187

Note: (i) Robust standard errors in parentheses.
(ii) The dependent variable is a dummy variable for a TMT member departure due to discord.

Table A5: Full Results of Table 5

	DV: Output growth rates	
VARIABLES	3 year	5 year
Shared leadership with one-time TMT discord-related departure	0.085	0.108*
	(0.056)	(0.056)
Shared leadership with multiple-time TMT discord-related departure	-0.147**	-0.189*
	(0.074)	(0.100)
Shared leadership without TMT departure	0.122***	0.151***
	(0.043)	(0.046)
Number of TMT members	0.016	0.026
	(0.026)	(0.023)
Functional diversity of TMT	0.047	0.044
	(0.051)	(0.059)
Number of engineers	0.121***	0.091***
	(0.028)	(0.032)
Market knowledge index	-0.019	-0.028
	(0.042)	(0.046)
Financial knowledge index	0.065	-0.025
	(0.049)	(0.057)
Firm age	0.067***	0.076***
	(0.021)	(0.028)
Number of workers	0.488***	0.423***
	(0.047)	(0.048)
Current output	-0.998***	-1.076***
	(0.034)	(0.032)
Constant	4.997***	6.720***
	(0.222)	(0.255)
P-value for test 1	0.445	0.434
P-value for test 2	0.0002	0.001
Observations	790	646
R-squared	0.815	0.877

Note: (i) Robust standard errors in parentheses.
(ii) Test 1 tests the null hypothesis that Multiple leaders with one-time TMT discord departure = Multiple leaders without TMT departure.
(iii) T Test 2 tests the null hypothesis that Multiple leaders with multiple-time TMT discord departure = Multiple leaders without TMT departure.

Table A6: Full Results of Table 6

	DV: 3-year output growth rates	
Disagreement period	0.071 (0.057)	
One time disagreement periods		0.046 (0.070)
Multiple time disagreement periods		0.110 (0.086)
No disagreement periods	0.149*** (0.045)	0.148*** (0.045)
Number of TMT members	-0.006 (0.026)	-0.007 (0.026)
Functional diversity of TMT	0.032 (0.057)	0.031 (0.056)
Number of engineers	0.142*** (0.030)	0.144*** (0.030)
Market knowledge index	0.007 (0.043)	0.010 (0.043)
Financial knowledge index	0.056 (0.052)	0.061 (0.052)
Firm age	0.049** (0.022)	0.055** (0.025)
Number of workers	0.474*** (0.045)	0.474*** (0.045)
Current output	-0.994*** (0.028)	-0.994*** (0.028)
Constant	4.861*** (0.246)	4.891*** (0.246)
P-value for test 1	0.152	0.152
P-value for test 2		0.640
Observations	730	730
R-squared	0.853	0.853

Note: (i) Robust standard errors in parentheses.
(ii) Test 1 tests the null hypothesis that Period with (one time) disagreement = Period without disagreement.
(iii) Test 2 tests the null hypothesis that Period with multiple time disagreement = Period without disagreement.

Table A7: Full Results of Table 7

	DV: 5-year growth rates of:				
	I. Workers	II. Engineers		III. Capital	
VARIABLES		University	High technical school	Physical	Financial
Shared leadership with TMT discord departure	-0.118**	-0.012	0.038	-0.129**	0.001
	(0.057)	(0.038)	(0.069)	(0.064)	(0.043)
Shared leadership without TMT departure	0.056	0.089***	0.062	0.039	0.046
	(0.044)	(0.031)	(0.064)	(0.052)	(0.034)
Number of TMT members	0.012	-0.036	-0.052	0.019	-0.017
	(0.023)	(0.025)	(0.039)	(0.024)	(0.017)
Functional diversity of TMT	0.056	-0.051	0.127	-0.042	0.145***
	(0.055)	(0.042)	(0.080)	(0.059)	(0.045)
Firm age	0.067***	0.025	0.139***	0.035***	0.068
	(0.021)	(0.033)	(0.029)	(0.005)	(0.046)
Number of workers	-0.656***				
	(0.034)				
Number of university educated engineers		-0.567***			
		(0.071)			
Number of high technical school educated engineers			-0.736***		
			(0.057)		
Physical capital				-1.021***	
				(0.030)	
Financial capital					-0.860***
					(0.041)
Constant	4.780***	0.210	0.951***	16.480***	10.901***
	(0.212)	(0.190)	(0.168)	(0.430)	(0.499)
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

Note: (i) Robust standard errors in parentheses.
(ii) Test 1 tests the null hypothesis that Multiple leaders with TMT discord departure = Multiple leaders without TMT departure.

D. Individual centers of gravity, 1883-1914.

Figure A1. Evolution of output, number of engineers and number of product varieties in Settsu

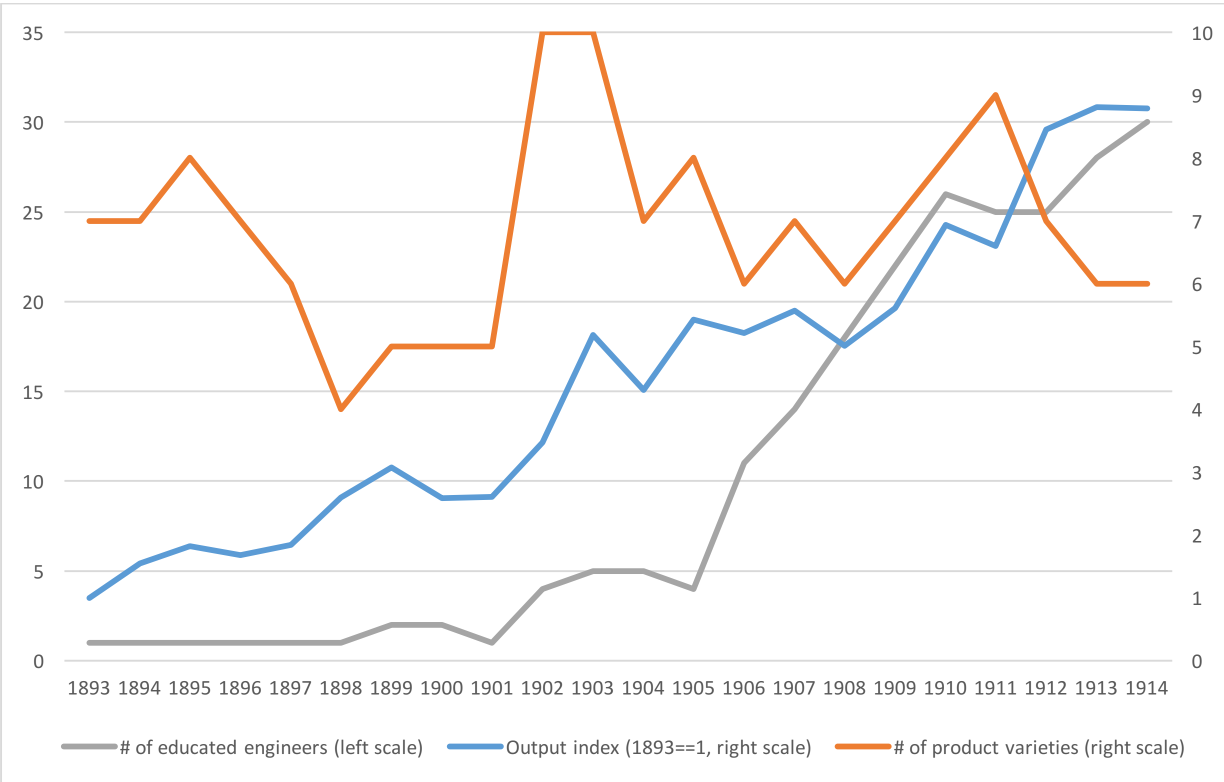


Figure A2. Evolution of output, number of engineers and number of product varieties in Amabo.

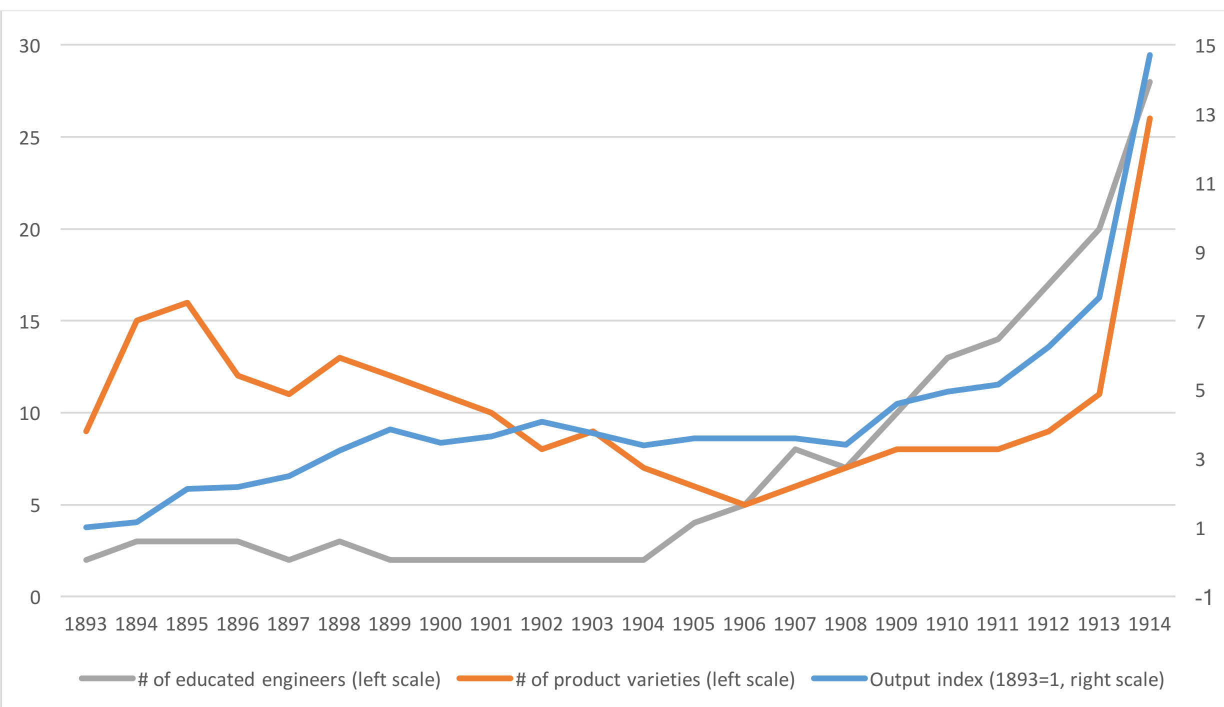


Figure A3. Amabo output of 42-count doubled yarn and profitability

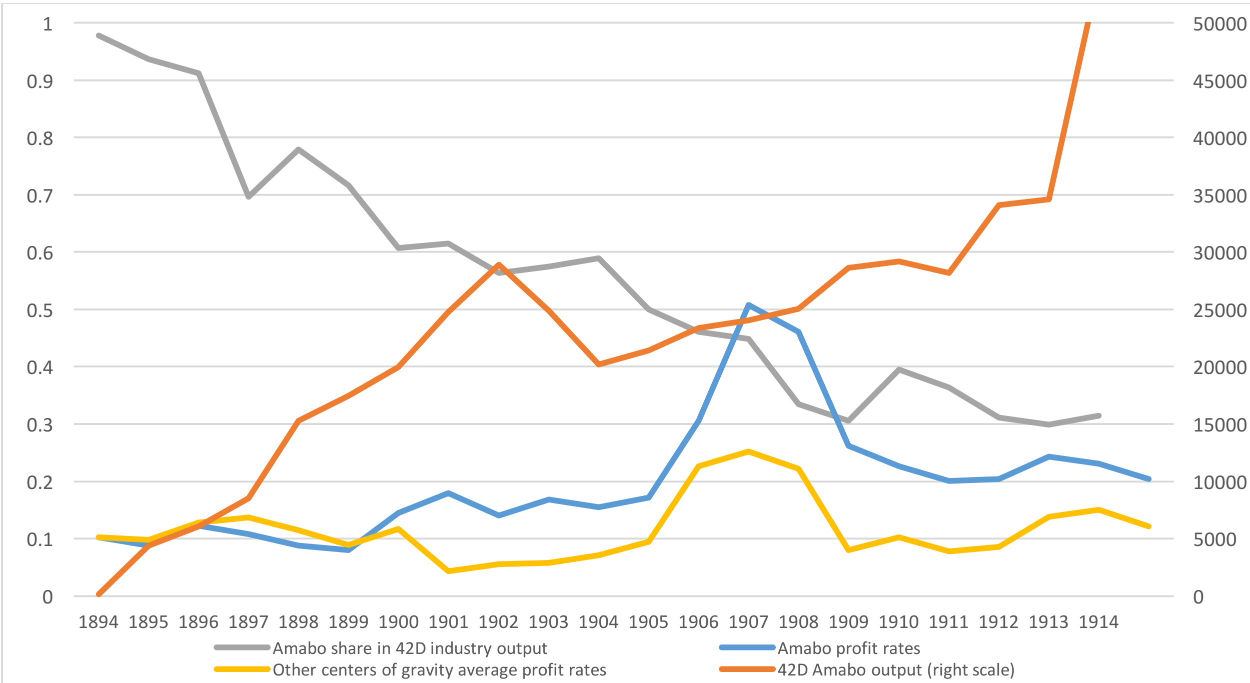


Figure A4. Evolution of shared leadership, output, number of engineers and number of product varieties in Osaka Spinning.

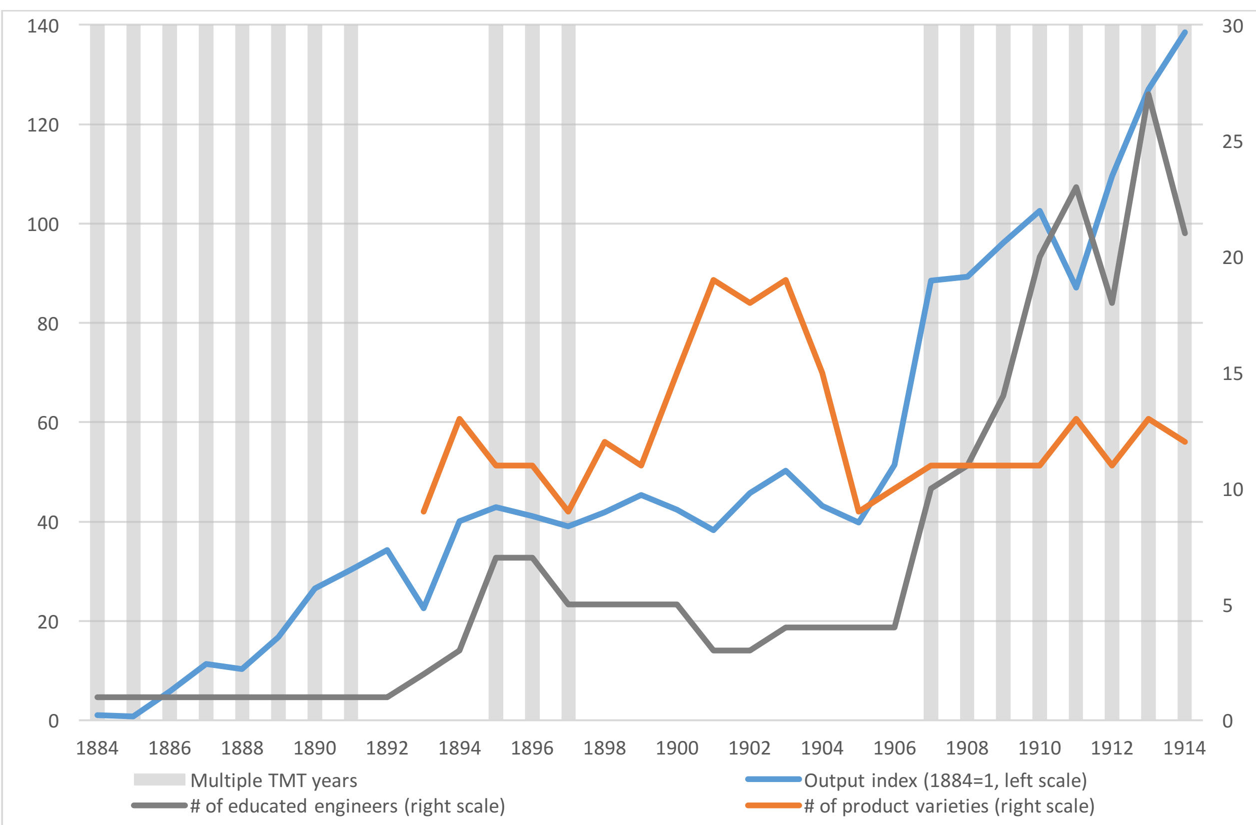


Figure A5. Evolution of output, number of engineers and number of product varieties in Mie.

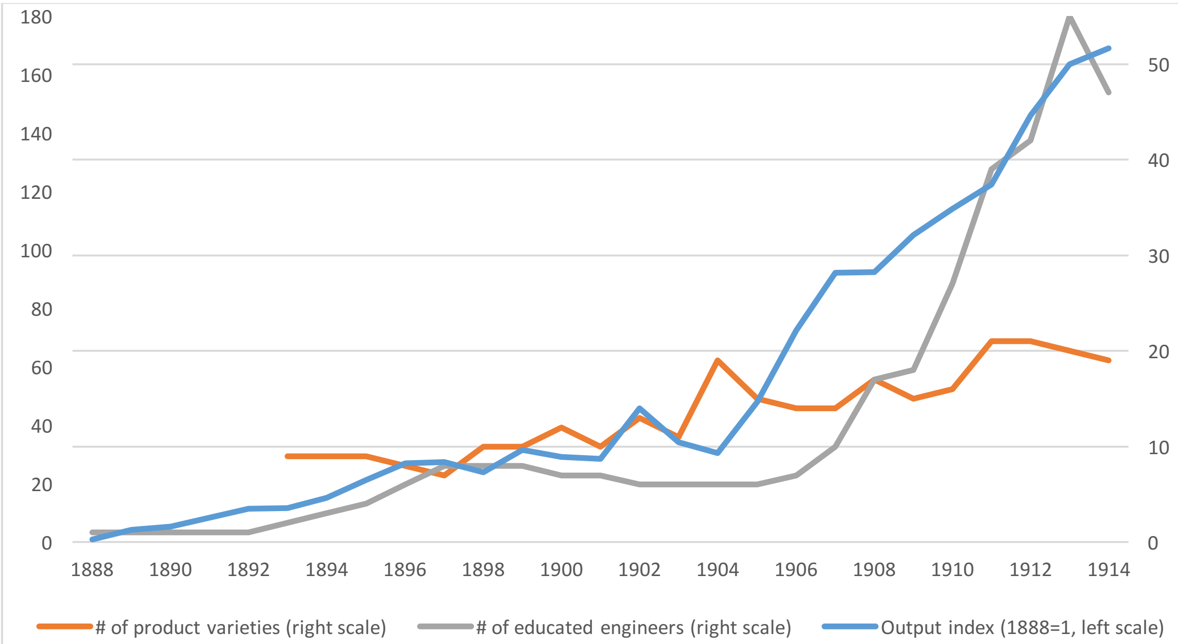


Figure A6. Evolution of shared leadership, discord induced TMT departures, output, number of engineers and number of product varieties in Kanebo.

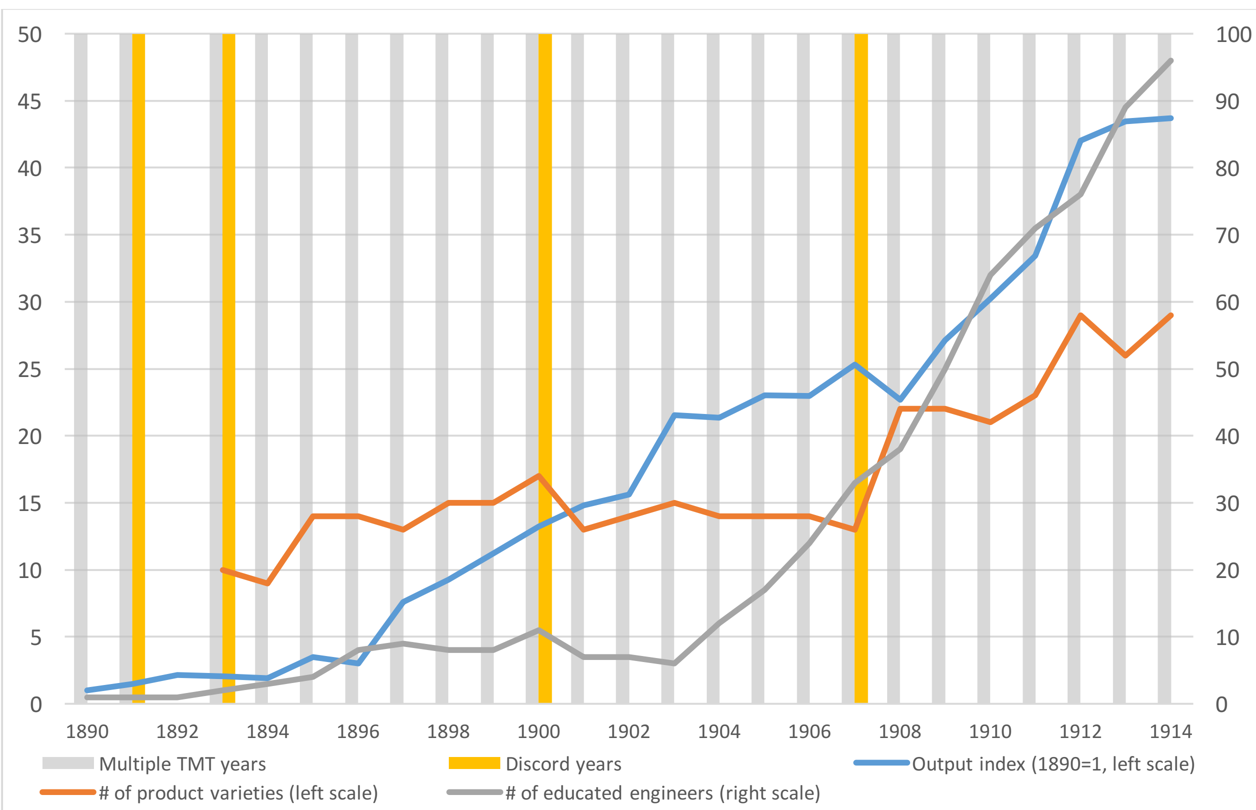


Figure A7. Evolution of shared leadership, discord induced TMT departures, output, number of engineers and number of product varieties in Fujibo.

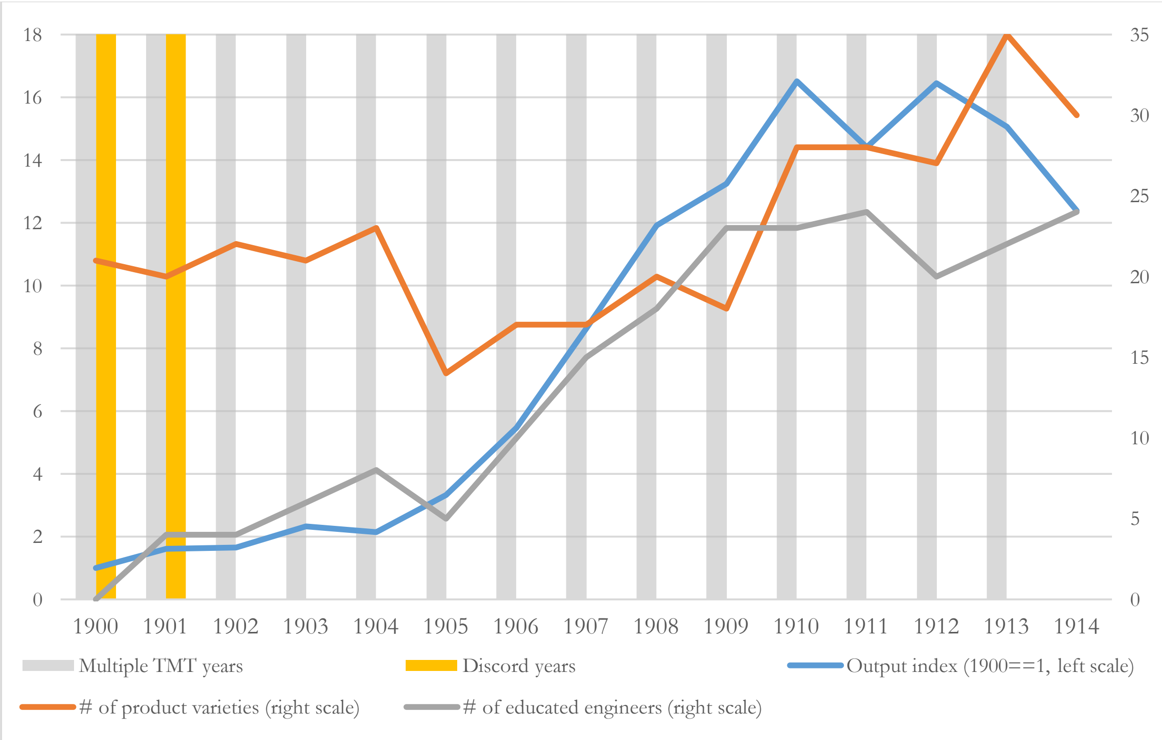
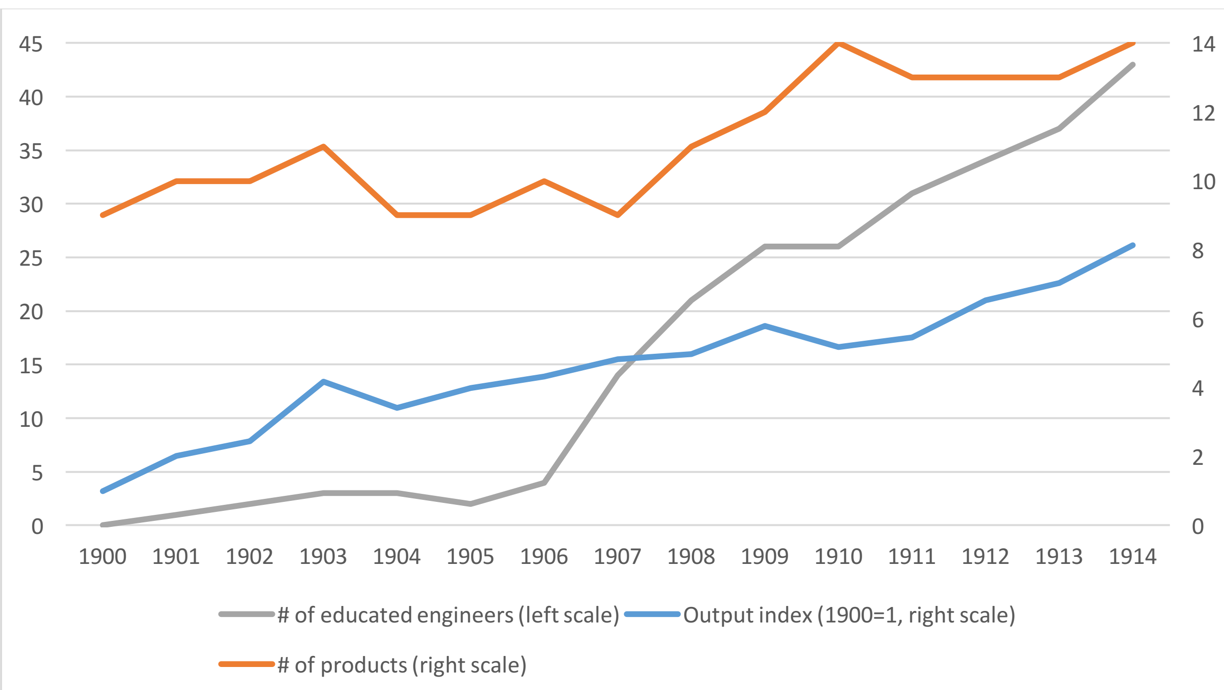


Figure A8. Evolution of output, number of engineers and number of product varieties in Godo Spinning.



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