**Appendix to Centers of Gravity**

1. **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]](#footnote-1) The first part of the database consists 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 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*) (*Tokyo Koto Kogyo Gakko Ichiran*, *Kyoto Koto Kogei Gakko Ichiran*, *Osaka Koto Kogyo Gakko Ichiran*, *Nagoya Koto Kogyo Gakko Ichiran*, *Kumamoto Koto Kogyo Gakko Ichiran*, and *Sendai Koto Kogyo Gakko Ichiran*––see references list at the end of this Appendix), which 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 seven, according to the 1893 Commercial Code) investors had to come up with startup funds, and then four 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.*
2. **Kanakin (Calico) Spinning and Weaving**. This company was founded by merchants from Ohmi region, to the east of the ancient capital of Kyoto, and governed mostly (although not exclusively) by members of the extended Abe family. 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 manage 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).
3. **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).
4. **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.
5. *Examples where TMT leaders with no formal titles were included.*
6. **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 leader). In 1891-93 (prior to the Commercial Code implementation) Ito was called “iin ken shihainin” (“member and general manager”) while Saito was called “iin kensa-gakari ken gishicho” (“member in charge of audit and chief engineer”). After 1894 their titles became just “torishimariyaku” (director) and only in a two year period (1896-97) they both had the titles of “jomu torishimariyaku” (“full-time, or executive director”) (Yakuinroku, 1896 and 1897). There were no changes to their actual positions in the shared leadership either from before 1896 to after 1897, and, 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.
7. **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.
8. **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 1894, with the titles of “general manager” and “Hyogo branch manager,” respectively, but they were not made board directors. 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 general manager of the whole firm in 1900, 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 the 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]](#footnote-2)

1. **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 |
| 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. Current level of output | -0.252 | 0.005 | 0.301 | 0.306 | -0.050 | 0.659 | 0.336 | 0.095 | 0.169 | 1 |

1. **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 | -0.018 | 0.047 | -0.029 | 0.049 |
| 　 | (0.068) | (0.082) | (0.023) | (0.028) |
| Shared leadership without TMT change | 0.070 | 0.121 | 0.021 | 0.052 |
| 　 | (0.062) | (0.068) | (0.028) | (0.025) |
| Number of TMT members | 0.059\* | 0.073 | -0.017 | -0.022 |
|  | (0.032) | (0.038) | (0.009) | (0.013) |
| Functional diversity of TMT | 0.047 | 0.087 | 0.068 | 0.042 |
|  | (0.090) | (0.118) | (0.030) | (0.036) |
| Logged (1+number of) engineers (Technical level) | 0.221 | 0.237 | 0.046 | -0.022 |
|  | (0.052) | (0.067) | (0.022) | (0.022) |
| Market knowledge index | 0.018 | 0.082 | -0.002 | 0.011 |
|  | (0.069) | (0.088) | (0.033) | (0.031) |
| Financial knowledge index | 0.089 | 0.137 | 0.032 | -0.050 |
|  | (0.074) | (0.123) | (0.040) | (0.040) |
| Firm age | -0.027 | -0.035 | 0.004 | 0.008 |
|  | (0.013) | (0.016) | (0.018) | (0.017) |
| Logged current output | -0.539 | -0.571 | -1.074 | -1.025 |
|  | (0.042) | (0.046) | (0.023) | (0.025) |
| P-value for test 1 | 0.216 | 0.389 | 0.056 | 0.891 |
| P-value for AR1 test | 　 | 　 | 0.005 | 0.070 |
| P-value for AR2 test | 　 | 　 | 0.847 | 0.148 |
| Observations | 831 | 679 | 665 | 528 |

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: Full Results of Table 5

|  |  |
| --- | --- |
|  | DV: Output growth rates |
| VARIABLES | 3 year | 5 year |
| Shared leadership with one-time TMT discord-related departure | 0.083 | 0.106 |
|  | (0.063) | (0.058) |
| Shared leadership with multiple-time TMT discord-related departure | -0.167 | -0.226 |
|  | (0.086) | (0.101) |
| Shared leadership without TMT departure | 0.098 | 0.134 |
|  | (0.048) | (0.047) |
| Number of TMT members | 0.035 | 0.040 |
|  | (0.027) | (0.023) |
| Functional diversity of TMT | 0.081 | 0.071 |
|  | (0.057) | (0.059) |
| Number of engineers  | 0.172 | 0.133 |
|  | (0.032) | (0.036) |
| Market knowledge index | -0.045 | -0.040 |
|  | (0.049) | (0.048) |
| Financial knowledge index | 0.005 | -0.078 |
|  | (0.053) | (0.059) |
| Firm age | 0.053 | 0.065 |
|  | (0.021) | (0.027) |
| Current output | -0.673 | -0.818 |
|  | (0.039) | (0.033) |
| Constant | 5.944 | 7.668 |
|  | (0.354) | (0.369) |
| P-value for test 1 | 0.795 | 0.629 |
| P-value for test 2 | 0.002 | 0.001 |
| Observations | 799 | 653 |
| R-squared | 0.808 | 0.878 |

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 A5: Full Results of Table 6

|  |  |
| --- | --- |
|  | DV: 3-year output growth rates |
| Disagreement period  | 0.089 |  |
|  | (0.062) |  |
| One time disagreement periods |  | 0.070 |
|  |  | (0.079) |
| Multiple time disagreement periods |  | 0.120 |
|  |  | (0.092) |
| No disagreement periods | 0.160 | 0.160 |
|  | (0.052) | (0.052) |
| Number of TMT members | 0.017 | 0.017 |
|  | (0.030) | (0.030) |
| Functional diversity of TMT | 0.055 | 0.054 |
|  | (0.065) | (0.064) |
| Number of engineers | 0.205 | 0.206 |
|  | (0.035) | (0.035) |
| Market knowledge index | -0.035 | -0.033 |
|  | (0.051) | (0.050) |
| Financial knowledge index | -0.031 | -0.027 |
|  | (0.059) | (0.058) |
| Firm age | 0.035 | 0.040 |
|  | (0.023) | (0.026) |
| Current output | -0.723 | -0.723 |
|  | (0.033) | (0.033) |
| Constant | 5.839 | 5.864 |
| 　 | (0.379) | (0.379) |
| P-value for test 1 | 0.231 | 0.245 |
| P-value for test 2 | 　 | 0.655 |
| Observations | 738 | 738 |
| R-squared | 0.838 | 0.838 |

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 A6: 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.

1. **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.

1. **Founding circumstances and TMT timelines of Path 2 and Path 3 firms in Figure 5.**

### Path 2 firms

*Osaka* was chartered in 1882 in Osaka on the initiative of Eiichi Shibusawa, the most prolific serial entrepreneur in Japan’s history, dubbed “the father of Japanese capitalism” (See, e.g., Braguinsky and Hounshell, 2016.) and recruited Takeo Yamanobe, the most important top manager in the company history. It had been under shared leadership of its founding investors until 1893 but went through a discord induced departure in 1894, followed by new shared leadership in 1896-97, another discord induced departure in 1898, followed by 6 years of single leadership until 1906 when it added another TMT leader as a result of an acquisition. By 1914 Osaka was a center of gravity but it was the last among them (including also two later entrants, Fujibo and Godo described below) in terms of its size.

*Kanebo* was chartered in Tokyo in 1887, founded by several groups of Tokyo cotton merchants who formed its initial shared leadership. It was the first large-scale cotton spinning firm to be created in Tokyo, and it started on an ambitiously large scale (30,000 spindles, three times more than the minimum efficiency scale from which most other startups in Table 10 started). It went through several discord induced departures (in 1891-93, 1900, and 1907) but it grew to become a center of gravity.

*Settsu* was chartered in 1889 in Osaka, founded by several investor groups whose representatives formed its board of directors, and three of which formed its shared TMT leadership at founding. It went through one big discord and TMT departure triggered by it in 1890 (detailed below) but was under stable shared leadership ever since growing into a center of gravity.

*Amabo* was chartered in 1889 in the city of Amagasaki near Osaka, founded by several investor groups from Amagasaki and Osaka, whose representatives formed its initial board of directors and its shared TMT leadership. In 1893 it went through a discord and TMT departure detailed below, but was under stable shared leadership ever since growing into a center of gravity.

### Path 3 firms

*Tamashima* was founded as a government-promoted 2,000-spinde mill in 1881 in Okayama prefecture in Western Japan. It incorporated early (in 1882) and had shared TMT leadership throughout. After the death in 1895 of its long-term president, the new shared leadership went through several discord induced departures detailed below, and the firm went bankrupt in 1898.

*Nagoya* was chartered in 1885 in Nagoya (Seo region) in Central Japan, based on a 4,000-spinlde former government-sponsored mill. It was run by a single leader until 1893 when it transitioned to shared leadership. The shared leadership did not last and the firm went back to single leadership (by a different leader) in the following year. The firm then remained under single leadership until its exit in 1905.

*Owari* was chartered in 1887, also in the Seo region and close to Nagoya. It was founded on the initiative of Masaka Okuda, a prolific serial entrepreneur who earned himself the nickname of “Nagoya’s Shibusawa” (a reference to Eiichi Shibusawa––see *Osaka* above). Initially, it had shared leadership but transitioned to single leadership following discord induced departures in 1891. The firm remained under single leadership until its exit in 1905.

*Tenma* was chartered in Osaka in 1887, founded by several investor groups from the area. It was under single TMT leadership until 1895 when it transitioned to a shared leadership following labor unrest. It went through 2 discord induced departures under shared leadership and exited in 1900.

*Hirano* was chartered in 1887 in Osaka by several investor groups from the area. It was under single TMT leadership until 1893 when it transitioned to shared leadership, following more than doubling of the firm capacity. The shared leadership did not last and the firm went back to single leadership (by a different leader) in the following year. It exited in 1902.

*Naniwa* was chartered in Osaka in 1888, founded by several investor groups from the area the representatives of which formed its shared leadership. The firm went through 6 discord induced departures in the first 10 years. It went bankrupt in 1899.

*Kanakin (Calico)* was chartered in 1888 in Ohmi province in Western Japan where its founders were based (the mill itself, however, was located in Osaka). It had shared TMT leadership until 1899 at which point its general manager quit and the firm transitioned to single leadership. Calico remained under single leadership until December 1904 (when the manager who left in 1899 came back). It exited in 1906.

*Miike* was chartered in 1889 in Miike district (currently Fukuoka prefecture) on the norther tip of the island of Kyushu. Its founders consisted of local investors and the Mitsui business group. The firm had been under shared leadership throughout most of its history but faced a discord induced departure in 1901 that led to the collapse of shared leadership and exit in 1902.

*Senshu* was chartered in the city of Sakai, a suburb of Osaka in 1889, founded by a merchant group from Sakai, an investor group from Osaka, and the founder and owner of a separate small former government-promoted mill. It had shared leadership throughout but went through several discord induced departures detailed below and exited in 1902.

**F. Centers of gravity beyond the periods of this study**

The success of the center of gravity firms described in this study was neither accidental nor short-lived; some continue through current day. Mie Spinning merged with Osaka Spinning to form Toyo Cotton Spinning (Toyobo), which instantaneously became the largest textile company in Japan. Toyobo then acquired another of our centers of gravity, Osaka Godo Spinning in 1931 and subsequently diversified to become a current global corporation producing films, functional polymers and industrial materials (<http://www.toyobo-global.com>). In another mega-merger of the center of gravity firms, Amabo acquired Settsu in 1918 to form Dai-Nihon Spinning. The company also thrives today under the name of Unitika as a polymers/advanced materials producer (<https://www.unitika.co.jp/e/index.html>). Kanebo eventually became a leading Japanese producer of cosmetic products ([http://www.kanebo.com/aboutus/)](http://www.kanebo.com/aboutus/%29). Fujibo 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 found their first success.

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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. [↑](#footnote-ref-2)