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Population Aging and Business Successions: A macroeconomic perspective[*]

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Abstract

This paper studies how population aging shapes firm dynamics and macroeconomic outcomes through business succession. Using large-scale Japanese firm-level panel data, we document systematic age transition patterns in successions, an inverted U-shape in performance with respect to managerial age, and the causal effects of succession on firm outcomes. Building on these facts, we develop a general equilibrium model with heterogeneous firms and life-cycle managerial ability. The model shows that declining population growth reduces succession but raises average managerial ability and strengthens firm selection. Quantitative analysis suggests that despite lower aggregate output, per capita output increases under demographic decline.

Keywords: Succession; managerial ability; entry and exit; macroeconomy
JEL classification: E22, L16, O31, O41

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1 Introduction

Top managers in Japan are aging, with the age distribution of managers in Japanese business enterprises shifting steadily rightward, as illustrated in Figure 1. According to a survey on the intention of business succession presented in the left panel of Figure 2, 35.9% of managers in their 60s and 28.5% of those in their 70s report that they have not yet decided about business succession. Such a sizable chunk of top managers who are expected to hand over their business in the near future but remain unprepared is likely to grow under population aging. As shown in the right panel of Figure 2, additionally, even among managers who have decided to pass on their businesses, 24.6% in 60s and 12.9% in 70s report that they have not yet found a successor. As such, business succession is becoming increasingly difficult under declining population growth accompanied by population aging and stagnated fertility rate.

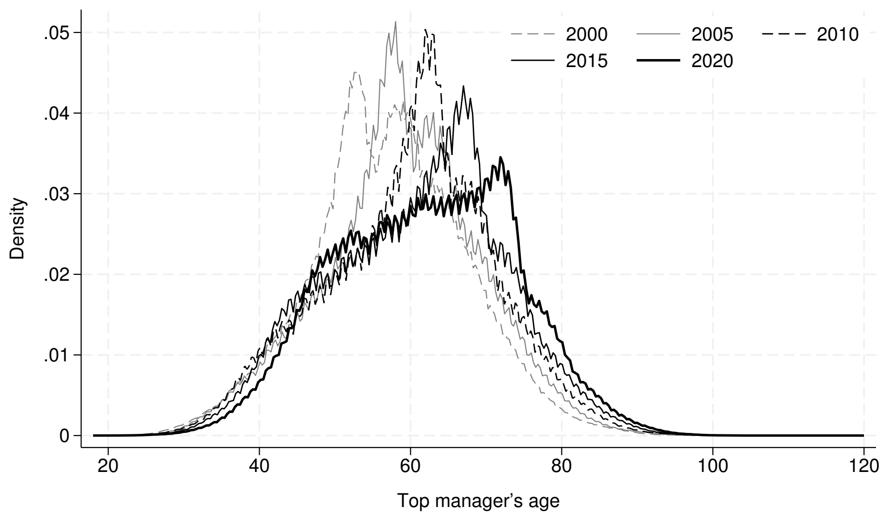

Figure 1: Top Managers' Age Distribution from 2000 to 2020

Source: Tokyo Shoko Research (TSR). We provide the detail of the TSR data in the data section.

The purpose of this paper is to theoretically examine and empirically quantify whether and how demographic changes affect aggregate outcomes in Japan, explicitly considering negative and positive aspects of business succession. Our empirical anal-

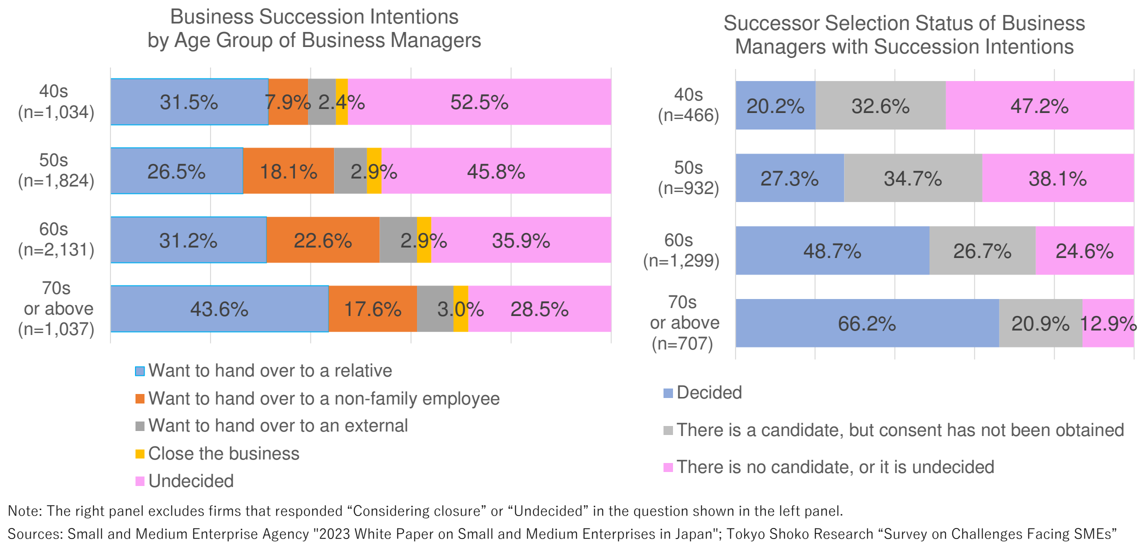

Figure 2: Status of Business Succession

Note: In the right panel, firms that responded "Want to hand over" in the question shown in the left panel are included.
Sources: Small and Medium Enterprise Agency "2023 White Paper on Small and Medium Enterprises in Japan"; Tokyo Shoko Research "Survey on Challenges Facing SMEs"

ysis investigates how managerial age and succession events affect firm performance in Japan. Using firm-level data covering a large number of enterprises over the past two decades, we document three key findings. First, we show typical age-pairing patterns between predecessors and successors at the time of succession, which illustrate the demographic structure underlying succession decisions. Second, we uncover an empirical relationship between manager age and firm outcomes: firm sales follow a clear inverted U-shape, peaking when managers are around age 60. Third, exploiting detailed succession records and applying propensity score matching to address endogeneity, we estimate the causal effect of succession on firm outcomes. The results indicate that performance temporarily declines immediately after succession but subsequently recovers and turns positive, suggesting that succession ultimately enhances firm performance. Together, these findings establish business succession as a central element of firm dynamics in aging societies and provide new evidence on how demographic change shapes corporate outcomes.

While these empirical findings highlight the role of succession in firm dynamics, they do not reveal how demographic change shapes the aggregate economy. To address this question, we develop a general equilibrium model in which firms use a span-of-control type production technology that specially uses managerial ability as an input (Lucas (1978); Bloom et al. (2013)). Firms are heterogeneous due to differences in firm-specific productivity and the managerial ability of top managers. Managerial ability follows a deterministic, hump-shaped life-cycle profile, similar to Atkeson and Kehoe (2005), leading managers to retire at some point during their tenure. Precisely, in each period, incumbent managers decide whether to continue operating the firm, search for a successor—incurring a cost—or close the business without succession. If a manager chooses to search, they are randomly matched with a worker who possesses a certain level of managerial ability while firm-specific productivity is unchanged through succession. A succession takes place if the firm value under the potential successor exceeds that under the incumbent. We embed this firm dynamics with occupational choice to a general equilibrium environment facing a constant population growth rate. We define the steady state equilibrium in per capita terms and examine the equilibrium corresponding to a specific population growth rate so that we can understand how demographic changes affect aggregate outcomes.

The model reveals that lower population growth exerts both negative and positive effects on aggregate productivity and per capita output. On the negative side, slower population growth reduces the pool of potential successors (i.e., current workers), while increasing the number of managers seeking succession. This imbalance lowers the probability of successful succession and, in turn, weakens the incentive to search, leading to more closures without succession. Consequently, fewer opportunities arise for managerial turnover that could otherwise allow firms to continue operating. On the positive side, lower population growth results in the larger proportion of aged (i.e., experienced) managers, whose ability is typically higher than younger counterparts up to some extent in their tenure, thereby raising the average managerial ability in the economy. Moreover, the difficulty of succession under population aging works as a selection mechanism among firms: high-productivity firms are able to secure successors, while closures without succession occur disproportionately among low-productivity firms. Additionally, labor scarcity pushes up wages, inducing exit among low-productivity firms and managers from the market. The relative sizes of those mechanisms determine how demographic changes affect macro variables through succession.

In the quantitative analysis with the calibrated model, we simulate the responses of various endogenously determined variables against the change in population growth rates. As natural consequences of lower population growth rates, the model predicts higher closure rates and lower succession rates. Nonetheless, aggregate productivity and per capita output increase under lower population growth rates. This result is due to firm selection and the improvement of managerial ability. The quantitative examination of our model suggests that the lower population growth rates could lead to higher per-capita output in Japan, despite a reduction in aggregate output.

Related Literature While our analysis focuses on Japan, the lessons extend to other advanced economies that are also experiencing declining population growth, as documented by Bloom et al. (2024). The consequences of declining population growth have been intensively examined from the viewpoints of shrinking labor supply (e.g., Ferrero (2010); Backus et al. (2014); Sasaki and Hoshida (2017)). Such a decrease in labor supply negatively affects a country's aggregate economy through a direct effect originating from the tightened resource constraint. Recent studies have further highlighted indirect effects of lower population growth on firm dynamics through, for example, smaller capital accumulation (Cooley et al. (2024)) as well as lower entrepreneurship and innovative activities (Engbom (2019); Peters and Walsh (2021); Hopenhayn et al. (2022); Jones (2022); Karahan et al. (2024); Inokuma and Sanchez (2024); Hoshi et al. (2025)). Engbom (2019) explores the effects of population aging on firm entry in the context of a search model similar in structure to ours, but with a key distinction: in his setting, workers search for better jobs, whereas in our model, incumbent managers search for suitable successors. However, to the best of our knowledge, no existing study analyzes population aging from the perspective of firm dynamics with business succession.

A related strand of the literature discusses misallocation of resources, including tangible assets (Hsieh and Klenow (2009)) and intangible assets (Andrews and de Serres (2012); Caggese and Perez-Orive (2022); Crouzet and Eberly (2023)). Misallocation may occur during managerial transitions. Top managers' managerial resources may not be efficiently allocated across firms due to frictions such as search and matching. These inefficiencies are particularly salient in the context of succession and may be further exacerbated by population decline. Carillo et al. (2019) examine successions in family and non-family firms during economic development although their model assumes a constant population size. Apart from the context of succession, Akcigit et al. (2021) study the macroeconomic implications of the limited delegation of managerial activities to outside managers. Their model highlights inefficiencies from delegation, while in our framework search costs play a similar role but can also generate positive selection effects.

On the empirical side, numerous studies have employed granular datasets to uncover the importance of top managers in firm performance, especially around periods of leadership transition (Johnson et al. (1985); Bertrand and Schoar (2003); Bennedsen et al. (2007); Kaplan et al. (2012); Bandiera et al. (2020); Dessein and Prat (2022)). Although the importance of top managers and their succession has been widely examined from a microeconomic perspective, the aggregate consequences of top manager turnover, especially as they relate to demographic trends, have received relatively little attention.

A substantial body of research has examined business successions among family-owned firms (e.g., Bertrand and Schoar (2003)). This literature frequently examines whether business successions within families enhance firm performance, often documenting negative effects (e.g., Burkart et al. (2003); Perez-Gonzalez (2006); Bennedsen et al. (2007); Caselli and Gennaioli (2013)). For example, Mehrotra et al. (2013) find that Japanese family firms perform well on average, especially those led by non-consanguineous heirs. Several empirical studies have also explored succession dynamics in Japan's aging society, including Saito (2008), Tsuruta (2020); Tsuruta (2021), Kodama et al. (2021), and Wongkaew and Saito (2023). Distinct from these studies, our analysis does not distinguish between family and non-family firms, and thus cannot speak directly to issues such as the shortage of intra-family successors. Nonetheless, as Mehrotra et al. (2013) highlight, business successions to non-consanguineous heirs were prevalent even during the post-war period of positive population growth in Japan. The difficulty in finding successors under demographic decline applies to both family and non-family firms, suggesting that our modeling approach remains broadly relevant.

The remainder of the paper is organized as follows. Section 2 presents the empirical analysis on business succession in the Japanese economy. Section 3 develops the model linking succession to the aggregate economy. Section 4 presents quantitative results. Section 5 concludes.

2 Empirical Investigations

In this section, we examine firm dynamics surrounding business succession using firm-level data covering a large number of Japanese firms over the past two decades. We provide some stylized facts on business successions such as age-transition patterns at successions, the effect of succession events on firm performance, and the role of managerial age in firm outcomes. These findings demonstrate that succession is a systematic factor in firm dynamics and motivate the theoretical framework developed in the next section.

2.1 Data

We use firm-level panel data provided by Tokyo Shoko Research (TSR), one of the largest credit rating agencies in Japan. TSR is a counterpart to the Dun & Bradstreet in the United States that is the world largest credit rating agency and the provider of business enterprise data. The TSR dataset includes information on firm sales from 2001 to 2019, with approximately 0.8 to 0.9 million firm observations per year. According to the Economic Census of 2016, the total number of firms in Japan is 3.9 million; thus, the TSR data cover more than 20% of all firms in Japan. Regarding the representativeness of the TSR data in terms of sales and the number of employees, Ito and Miyakawa (forthcoming), for example, document that, for the year of 2016, 74% of all sales and 45% of all employees in Japan are covered by the TSR data.[1]

A key advantage of this dataset is its inclusion of both listed and unlisted firms, which is essential for studying business succession, as more than 99.9% of operating firms in Japan are private. Succession in these firms represents a critical economic event (e.g., Carillo et al. (2019)). We take advantage of the access to the dataset, that has been intensively used in academic research (e.g., Bernard et al. (2019); Carvalho et al. (2021); Miyauchi (2024)) and covers a large share of the firms and its employees. A further novelty of the dataset is that it contains detailed information on each firm's top manager, including his/her name and date of birth—key variables for analyzing succession dynamics.

Despite such an advantage of the TSR data, one major caveat is its limited coverage of very small firms. As discussed in Miyakawa et al. (2024), who compare the TSR data with the universe of Japanese business enterprises using corporate tax filing data, the firms included in TSR are substantially larger, on average, than those

[1]Hong et al. (2020) show that the TSR data resemble the Census data in terms of geographic coverage and firm size.

not covered by TSR. Given smaller firms tend to be less productive (cf. van Ark and Monnikhof (1996)), omitting those very small firms may bias our evaluation of aggregate implications of population aging. In particular, very small firms are often the first to stop looking for successors as the population ages. This suggests that our estimates may understate the overall impact of population aging on firm dynamics. Therefore, the quantitative implications of managerial resources obtained in our empirical analysis should be regarded as conservative.

2.2 Age Transition Pattern of Predecessors and Successors

Table 1 reports the transition probabilities from predecessors to successors by age. The most common age pairing is between predecessors in their 70s and successors in their 40s, accounting for 12.8%, reflecting family firm successions with an age gap about 30 years. Another common pattern is when both predecessors and successors are in their 50s to 60s (e.g., 11.3% from 60s to 60s), which is more typical of non-family firm successions.

Table 1: Succession Transition Matrix (Data)

	Predecessor age							
Successor age	20s	30s	40s	50s	60s	70s	80s	90s
20s	0.0	0.0	0.1	0.5	0.3	0.1	0.0	0.0
30s	0.0	0.5	0.5	1.8	8.7	2.1	0.2	0.0
40s	0.0	0.4	1.9	2.6	8.9	12.8	1.1	0.2
50s	0.1	0.3	1.3	6.9	11.9	6.0	3.9	0.5
60s	0.0	0.5	0.7	2.6	11.3	4.3	1.5	0.1
70s	0.0	0.1	0.6	0.5	1.0	1.4	0.5	0.0
80s	0.0	0.0	0.1	0.2	0.2	0.1	0.2	0.0
90s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: The values indicate transition probabilities (in percent) from predecessors (columns) to successors (rows) by age. The total sum of all probabilities equals 100%.

2.3 Manager Age

The transition patterns observed above suggest that the age of managers plays a central role in succession decisions. To further explore the implications of aging for firm performance, we next examine how manager age relates to firm outcomes.

Specifically, we estimate the following equation to describe the relationship between the firm size dynamics and top managers' age:

$$\begin{aligned}\log\left(\text{sales}_{f,m,t}\right) &= \sum_{k}\beta_k \mathbb{1}\left(\text{Age}_{m,t}=k\right) + \sum_{\tau=-5}^{5}\delta_\tau \mathbb{1}\left(\text{Succession}_{f,t+\tau}\right) \\ &\quad + \alpha_{f\times m} + \alpha_{\text{IND}(f)\times t} + \varepsilon_{j,t}, \end{aligned} \tag{1}$$

where f, m, and t represents firms, managers, and years, respectively. Terms $\alpha_{f\times m}$ and $\alpha_{\text{IND}(f)\times t}$ control for the firm-manager fixed effects and industry-year fixed effects, respectively, where IND(f) denotes the main industry to which firm f belongs to. The variable $\text{Age}_{m,t}$ denotes the age of manager m in year t, and is grouped into five-year bins indexed by k, such as 20–24, 25–29, $\cdots$, 95–100. Th term $\mathbb{1}\left(\text{Succession}_{f,t+\tau}\right)$ is a dummy variable that takes the value of one if firm f experiences succession at τ years from year t, and zero otherwise. For $\tau < 0$, this indicates that the succession occurred $|\tau|$ years prior to year t. We include both the firm-manager fixed effects and industry-year fixed effects to control for various unobservable factors affecting the dependent variables and are correlated with the independent variables so that we can avoid the omitted variable biases associated with estimated β_k and δ_τ. The standard errors are clustered at the firm level.

Figure 3 presents the estimated coefficients $\hat{\beta}_k$ on age fixed effects, with the age group 55–59 used as the reference category. The figure reveals a clear inverted U-shape, with the peak occurring around age 60. In other words, conditional on firm-specific productivity, sales are highest when managers are around age 60. This pattern suggests that assigning firms to managers around age 60 may be desirable. The figure also indicates that the decline in the coefficient for managers older than 60 is steeper than the improvement for those younger than 60. This implies that delaying succession can substantially deteriorate firm performance, thereby motivating managers to search for successors.

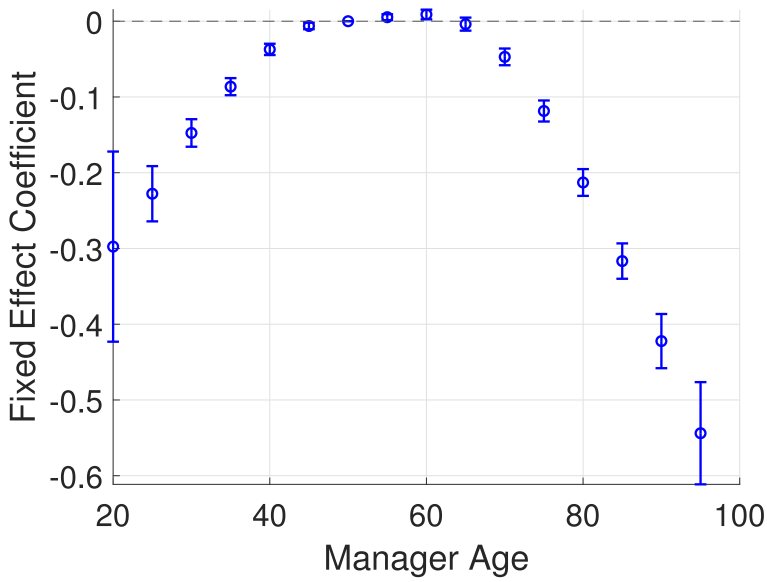

Figure 3: Changes in Managerial Ability by Age

2.4 Firm Size Dynamics around Succession

To examine the causal impact of succession on firm dynamics, we estimate the following equation:

$$\log\left(\text{sales}_{f,t}\right) = \sum_{\tau=-10}^{5} \delta_\tau \mathbb{1}\left(\text{Succession}_{f,t+\tau}\right) + \boldsymbol{x}_{f,t-1}\boldsymbol{\gamma} + \alpha_{\text{IND}(f)} + \alpha_t + \varepsilon_{j,t}, \tag{2}$$

where $\mathbb{1}\left(\text{Succession}_{f,t+\tau}\right)$ is a dummy variable defined in the same way as in equation (1). We control for a set of lagged firm characteristics $\boldsymbol{x}_{f,t-1}$ that include firm age, top manager age, log sales, a dummy variable for positive profit, the number of industries the firm is active in (up to three), and the number of products and services it provides (up to six), the owner duration, and the number of employees. We include $\alpha_{\text{IND}(f)}$

and α_t that account for the industry fixed effects and year fixed effects, respectively.

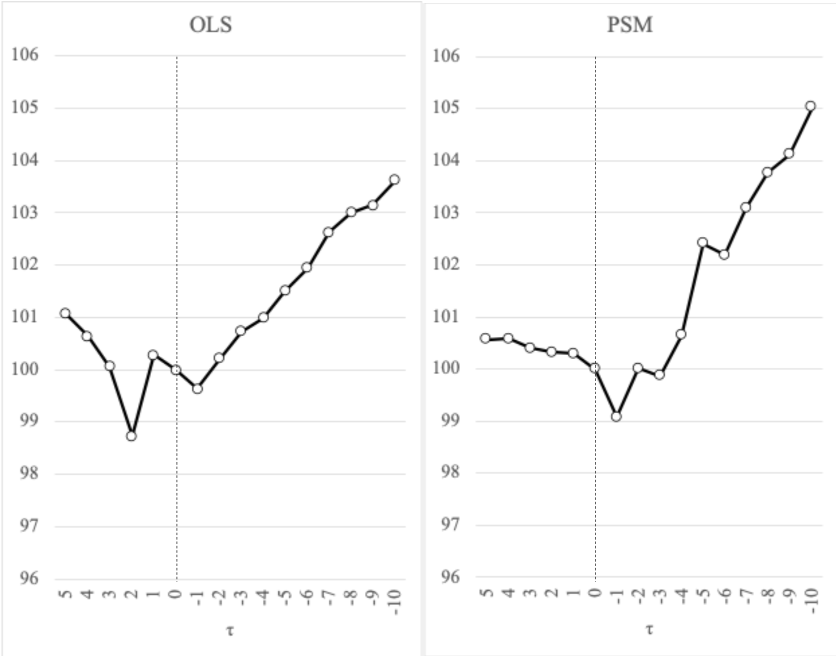

Figure 4: Firm Dynamics over Succession δ_τ (Data)

Note: The figure shows coefficient δ_τ. The left panel shows the results based on OLS estimation, while the right panel shows those based on propensity score matching (PSM), which controls for sales growth from the second to fourth lags.

First, we run a simple OLS regression, and the resulting coefficients δ_τ are plotted in the left panel of Figure 4, with sales at the time of succession normalized to 100. The figure reveals a U-shaped pattern in firm sales around the time of succession, with a trough occurring two years prior to the succession event. Although we control for firm characteristics up to some extent, this regression captures only correlations, and not necessarily causal effects. Succession is endogenous, as it is more likely to occur in firms with favorable characteristics, while some firms undergo turnover because of deteriorating performance. These different factors are mixed together and not fully controlled for, which likely explains the large fluctuations observed in the pre-succession period.

To address this endogeneity, we estimate the causal effect of succession using propensity score matching. Specifically, we compute each firm's propensity score for succession based on the same firm characteristics used in the OLS estimation, along with sales growth from the second to fourth lags. We include the lagged growth rates to improve the quality of the control groups. Using these scores, we estimate the average treatment effect of succession on firm sales.

The right panel of Figure 4 presents the results. It shows no significant pre-trend in sales prior to succession, supporting the parallel trend assumption. Following succession, firm sales experience a temporary decline in the first year,[2] but subsequently recover and exhibit a positive growth trend, suggesting a causal improvement in performance. In Section 4, we refer these empirical facts to discuss the validity of our theoretical model constructed in the following section.

3 Model

We develop a general equilibrium model that links demographic changes, such as population decline and aging, to macroeconomic performance through firm dynamics—specifically, entry, closure, and succession. Firm heterogeneity arises from two components: one is the firm type, $z_j \in \{z_1, z_2, ..., z_J\}$, which is fixed over time, and the other is managerial ability x, which evolves exogenously over the individual's lifecycle. This framework makes individual occupational choices and firms' decisions age-dependent, shaping the impact of demographic changes on aggregate output.

Our model is motivated by the empirical patterns documented in Section 2, which highlight systematic features of succession in the Japanese economy. Importantly, the framework does not restrict attention to specific forms of succession, such as family inheritance or internal promotion, but abstracts from these institutional details to construct a generalized model. The model is deliberately kept simple, incorporating

[2] This drop likely reflects adjustment costs associated with managerial turnover, such as the new manager's learning process, the disruption of established customer relationships, or coordination frictions within the firm. A "big bath" effect, where losses are concentrated immediately after the turnover, may also contribute to this temporary dip (cf. Bornemann et al. (2015)).

only minimal frictions, apart from search costs.

3.1 Demographic and Production Setting

Let N_t be the total population in period t, which consists of birth-year cohorts, $N_{\tau,t}$, where τ is the period of birth. The size of each cohort is shrinking over time by death. We assume the death rate depends on age, $a = t - \tau$, such that $d_a \leq d_{a+1}$ for any $a \geq 0$, and $\lim_{a\to\infty} d_a = 1$,[3] which yields

$$N_t = \sum_{\tau=-\infty}^{t} N_{\tau,t} = \sum_{\tau=-\infty}^{t} N_{\tau,\tau} \prod_{a=0}^{t-\tau-1} (1 - d_a).$$

The population growth rate, ν, is defined as $N_{t+1,t+1} = (1+\nu) N_{t,t}$, where $\nu < 0$ implies population decline accompanied by a declining birth rate and an aging population.

We introduce heterogeneous managerial ability for each agent (Bloom et al. (2013)). Let $x_{i,\tau,a}$ be the managerial ability of agent i, born in τ, at the age of a. The initial $x_{i,\tau,0}$ is a random draw at birth from a log-normal distribution, $\mathcal{LN}\left(\ln \bar{x} - \frac{\sigma^2}{2}, \sigma^2\right)$, with $\mathbb{E}[x_{i,\tau,0}] = \bar{x}$ for any i and τ. Managerial ability $x_{i,\tau,a}$ evolves deterministically, following

$$x_{i,\tau,a+1} = x_{i,\tau,a} h_{a+1}, \qquad \text{for } a = 0, 1, 2, \ldots, \quad \forall \tau$$

where $h_a > 0$ for all a, and

$$h_a \begin{cases} \geq 1 & \text{for } a \leq \bar{a}, \\ < 1 & \text{for } a > \bar{a}. \end{cases} \tag{3}$$

Define $H_a \equiv \prod_{a'=1}^{a} h_{a'}$ so that $x_{i,\tau,a} = x_{i,\tau,0} H_a$. This setting is similar to Atkeson and Kehoe (2005) except that we assume the agents face randomness only when they are

[3] We describe the model under the assumption of infinite age for notational simplicity. In simulations, we set $d_a = 1$ for finite a to prevent infinite age. There is no essential difference as long as the measure of the unrealistically aged individuals is negligible in the current model.

born. In addition, we assume that $h_{a+1} \leq h_a$ for $a > \bar{a}$ and $\lim_{a\to\infty} H_a = 0$.[4]

There are two occupations: managers and workers, whose measures are represented by M_t and L_t, respectively ($N_t = M_t + L_t$). Each manager runs a single firm that hires workers. We assume that worker's wage, w_t, is independent of managerial ability. The managerial ability affects firm productivity in the form of span-of-control model developed by Lucas (1978). If an agent with ability x becomes a manager, the firm's production function is given by

$$y = (zx)^{\mu} \left[k^{\alpha} l^{1-\alpha}\right]^{1-\mu} \qquad \alpha, \mu \in (0,1), \tag{4}$$

where z is the firm-specific productivity, y is output, k is capital, and l is employment. Assuming perfect competition, the flow profit of the firm is

$$\pi_t(z,x) = \max_{k,l}\ (zx)^{\mu} \left[k^{\alpha} l^{1-\alpha}\right]^{1-\mu} - (r_t + \delta)k - w_t l,$$

for given factor prices. Then, the size of the firm is linear in x such that

$$k_t(z,x) = \bar{k}_t zx, \qquad \text{where } \bar{k}_t \equiv \left(\frac{\alpha(1-\mu)}{r_t+\delta}\right)^{\frac{1}{\mu}} \left(\frac{1-\alpha}{\alpha}\frac{r_t+\delta}{w_t}\right)^{\frac{(1-\alpha)(1-\mu)}{\mu}}, \tag{5}$$

$$l_t(z,x) = \bar{l}_t zx, \qquad \text{where } \bar{l}_t \equiv \left(\frac{\alpha(1-\mu)}{r_t+\delta}\right)^{\frac{1}{\mu}} \left(\frac{1-\alpha}{\alpha}\frac{r_t+\delta}{w_t}\right)^{\frac{(1-\alpha)(1-\mu)}{\mu}+1}, \tag{6}$$

$$y_t(z,x) = \bar{y}_t zx, \qquad \text{where } \bar{y}_t \equiv \left(\frac{\alpha(1-\mu)}{r_t+\delta}\right)^{\frac{1-\mu}{\mu}} \left(\frac{1-\alpha}{\alpha}\frac{r_t+\delta}{w_t}\right)^{\frac{(1-\alpha)(1-\mu)}{\mu}}. \tag{7}$$

And the profit is also linear in x as

$$\pi_t(z,x) = \mu \bar{y}_t zx. \tag{8}$$

[4]Regarding the evolution of managerial ability, for example, Van Reenen et al. (2025) distinguish the firm-level exogenous factors following Markov process and the affiliated plant-level endogenous factors. In our model, we abstract the structure of endogenous evolution of managerial ability and assume the hump shaped deterministic evolution so that we can focus on the implication of population aging.

3.2 Occupational Choice

All agents are workers when they are born and they can switch their occupation to managers in two ways: succession or entry. Let $V_{\tau,t}(z,x)$ denote the value of a manager of a type-z firm who is born at τ and has ability x in period t. Similarly, $W_{\tau,t}(x)$ is the values of a worker who is born at τ and has ability x in period t. For later convenience, we also define the gap in those values as

$$G_{\tau,t}(z,x) \equiv V_{\tau,t}(z,x) - W_{\tau,t}(x). \tag{9}$$

3.2.1 Successor Search

A manager can search for a successor by incurring a cost of κ each period. A searching manager randomly meets a worker from the current pool of workers. We assume that the measure of searching managers is sufficiently small compared to the measure of workers, ensuring that each searching manager can meet one worker and that the probability of two or more managers meeting the same worker is negligible. For a worker to succeed to an existing business, they must make a transfer of q to the preceding manager. The transfer is determined by a take-it-or-leave-it offer made by the predecessor. Thus, all excess value from being a manager is transferred to the predecessor. If a worker in cohort τ with ability x succeeds to a firm, the worker pays

$$q = G_{\tau,t+1}(z, xh_{t-\tau+1}), \tag{10}$$

at the beginning of the next period. Firm type z is unchanged upon succession.

Business succession realizes when it is accepted by both sides. For clarity, we denote (x^s, τ^s) as the managerial ability and cohort of a successor candidate, and (x^p, τ^p) as those of a searching predecessor. If a searching manager of type-z firm

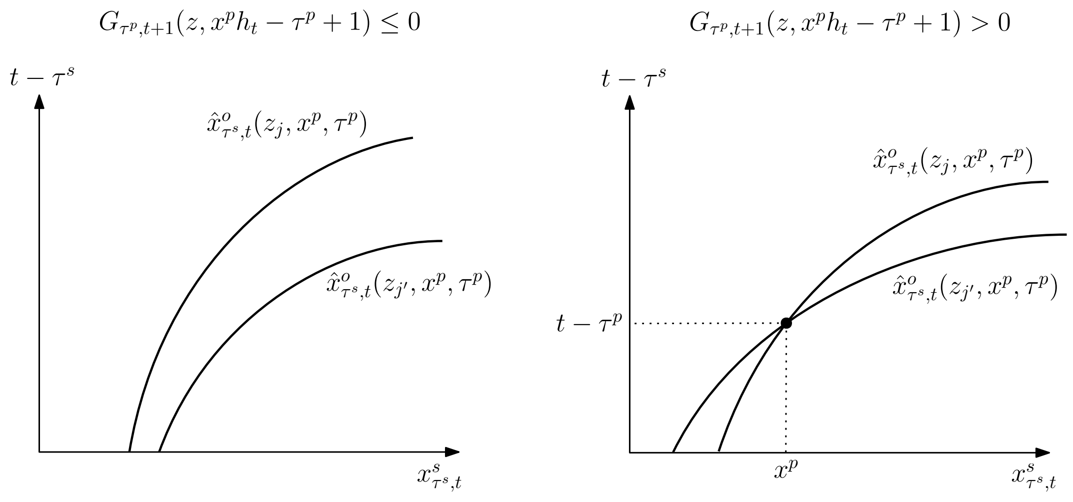

Figure 5: Threshold Curves for Successful Successor Search, $\hat{x}^o_{\tau^s,t}(z, x^p, a^p)$.
Note: Succession occurs if $x^s_{\tau^s,t}$ is greater than $\hat{x}^o_{\tau^s,t}$. We assume $z_j > z_{j'}$.

accepts a candidate (x^s, τ^s) at t, the next period value for the predecessor is

$$W_{\tau^p,t+1}\left(x^p h_{t-\tau^p+1}\right) + q_{\tau^s,t}(z, x^s),$$

conditional on the survival of the matched successor, where $q_{\tau^s,t}(z, x^s) = G_{\tau^s,t+1}\left(z, x^s h_{t-\tau^s+1}\right)$.

In contrast, if the manager rejects the successor candidate, the next period value is $V_{\tau^p,t+1}\left(z, x^p h_{t-\tau^p+1}\right)$. Hence, the successor candidate is accepted by the predecessor if

$$\begin{aligned} &W_{\tau^p,t+1}\left(x^p h_{t-\tau^p+1}\right) + q_{\tau^s,t}(z, x^s) \geq V_{\tau^p,t+1}\left(z, x^p h_{t-\tau^p+1}\right) \\ &\qquad\Leftrightarrow \quad G_{\tau^s,t+1}\left(z, x^s h_{t-\tau^s+1}\right) \geq G_{\tau^p,t+1}\left(z, x^p h_{t-\tau^p+1}\right). \end{aligned}$$

From the successor's perspective, being the manager of the type-z firm should generate positive gap value, or $G_{\tau^s,t+1}\left(z, x^s h_{t-\tau^s+1}\right) \geq 0$. There exists the threshold function $\hat{x}^o_{\tau^s,t}\left(z, x^p, \tau^p\right)$, above which matching is successful:

$$G_{\tau^s,t+1}\left(z, \hat{x}^o_{\tau^s,t} h_{t-\tau^s+1}\right) = \max\left\{0, G_{\tau^p,t+1}\left(z, x^p h_{t-\tau^p+1}\right)\right\}. \tag{11}$$

Figure 5 illustrates the thresholds for successful search for two firm types, $z_j > z_{j'}$. A match is accepted by both parties if successor's $(x^s, t-\tau^s)$ lies below each curve. The left panel depicts the case in which the successor's condition is binding, that is, when the predecessor's continuation value is nonpositive, $G_{\tau^p,t+1}(z, x^p h_{t-\tau^p+1}) \leq 0$, for both firm types. In this case, the threshold $\hat{x}^o_{\tau^s,t}$ is independent of the predecessor's ability and cohort, and the threshold curves are described by the equation $G_{\tau^s,t+1}(z, x^s h_{t-\tau^s+1}) = 0$. As the acceptance region for $z_{j'}$ is included in that of z_j, high-type firms are more likely to be succeeded to, leading to the selection of higher-type firms through succession. The right panel depicts the case in which predecessor's condition is binding, meaning that the predecessor's value for continuing the business is positive: $G_{\tau^p,t+1}(z, x^p h_{t-\tau^p+1}) > 0$. In this case, the threshold curves for different firm types of z cross at a certain point $(x^p, t-\tau^p)$. Moreover, the slope is steeper for firms with higher z because the sensitivity of manager values to managerial ability is greater as z is larger. Intuitively, a manager of a superior firm is more selective—preferring to continue managing the firm themselves rather than transferring it to a lower-ability successor. As managers age, their own continuation value decreases, and the situation gradually shifts from the right panel scenario (where the predecessor's condition binds) to the left panel scenario (where the successor's condition binds).

The probability of successful matching is the probability that the matched worker has (x^s, τ^s) satisfying $x^s \geq \hat{x}^o_{\tau^s,t}(z, x^p, \tau^p)$ and they survive in the next period, that is,

$$p_{\tau^p,t}(z, x^p) = \sum_{\tau^s=-\infty}^{t} \frac{(1-d_{t-\tau^s}) L_{\tau^s,t}}{L_t} \int_{\hat{x}^o_{\tau^s,t}(z,x^p,\tau^p)}^{\infty} dF^L_{\tau^s,t}, \tag{12}$$

where $F^L_{\tau,t}(x)$ represents the distribution of managerial ability among workers in cohort τ at period t. The expected transfer, conditional on success in search, is

$$\bar{q}_{\tau^p,t}(z, x^p) = \frac{1}{p_{\tau^p,t}(z, x^p)} \sum_{\tau^s=-\infty}^{t} \frac{L_{\tau^s,t}}{L_t} \int_{\hat{x}^o_{\tau^s,t}(z,x^p,\tau^p)}^{\infty} G_{\tau^s,t+1}(z, x^s h_{t-\tau^s+1})\, dF^L_{\tau^s,t}. \tag{13}$$

3.2.2 Firm Entry

Workers receive entry opportunities with probability of η, which is assumed sufficiently small such that the probability of a single worker receiving both succession offer and entry opportunity is negligible. We assume that firm type is revealed after entry, so that their entry decisions are based on the expected value of $V_{\tau,t}(z,x)$. Let $\bar{\theta}_j \in (0,1)$ be the probability of z_j. A τ-cohort worker with managerial ability of x takes the entry opportunity if

$$\bar{G}_{\tau,t+1}\left(xh_{t-\tau+1}\right) \equiv \sum_{j=1}^{J} \bar{\theta}_j G_{\tau,t+1}\left(z_j, xh_{t-\tau+1}\right) \geq 0.$$

We denote $\hat{x}^e_{\tau,t}$ as the threshold of x for a worker born in τ above which they take the entry chance, that is,

$$\bar{G}_{\tau,t+1}\left(\hat{x}^e_{\tau,t} h_{t-\tau+1}\right) = 0. \tag{14}$$

This entry setting creates an environment where workers with high managerial ability remain available due to the lack of business ideas, thereby providing incumbent managers with sufficient incentives to search for successors among these workers.

3.2.3 Value Functions and Thresholds for Closure and Successor Search

We formulate the value functions for managers and workers and analyze how their occupational choices and successor search decisions depend on those values.

Worker Value From the argument in the previous subsection, the worker value is represented by

$$W_{\tau,t}(x) = w_t + \frac{1-d_{t-\tau}}{1+r}\left[\eta \max\left\{0, \bar{G}_{\tau,t+1}\left(xh_{t-\tau+1}\right)\right\} + W_{\tau,t+1}\left(xh_{t-\tau+1}\right)\right], \tag{15}$$

where the first term in the big parenthesis is the expected value from entry. Succession does not matter in the worker value because all the values gained by succession is transferred to the predecessor through bargaining.

Manager Value and Threshold for Closure The manager value depends on three phases: business closure, successor search (on operation), and continuation of business. First, if a manager closes their business at the end of period t, they become a worker in $t+1$. In this case, the manager's value satisfies

$$V_{\tau,t}(z,x) = \pi_t(z,x) + \frac{1-d_{t-\tau}}{1+r_t} W_{\tau,t+1}\left(xh_{t-\tau+1}\right). \tag{16}$$

Second, we consider the phase of successor search. Let $\kappa > 0$ be the search cost. The search phase exists when the expected return from successor search is greater than the search cost, or

$$p_{\tau,t}(z,x)\bar{q}_{\tau,t}\left(z,x\right) \geq \tilde{\kappa}_{\tau,t} \equiv \frac{1+r_t}{1-d_{t-\tau}}\kappa. \tag{17}$$

Note that the effective search cost, $\tilde{\kappa}_{\tau,t}$, is greater for older agents due to the increase in death rates. Suppose that inequality (17) holds. If a manager does not close the business immediately and conducts a search for successor, the value function satisfies

$$\begin{aligned} V_{\tau,t}(z,x) = {} & \pi_t(z,x) - \kappa \\ & + \frac{1-d_{t-\tau}}{1+r_t}\left[V_{\tau,t+1}\left(z,xh_{t-\tau+1}\right) + p_{\tau,t}(z,x)\left(\bar{q}_{\tau,t}(z,x) - G_{\tau,t+1}\left(z,xh_{t-\tau+1}\right)\right)\right]. \end{aligned} \tag{18}$$

Comparing equations (16) and (18), a manager closes their business instead of searching a successor if

$$G_{\tau,t+1}\left(z,xh_{t+1-\tau}\right) < \frac{\tilde{\kappa}_{\tau,t} - p_{\tau,t}(z,x)\bar{q}_{\tau,t}(z,x)}{1-p_{\tau,t}(z,x)}. \tag{19}$$

Because a higher x yields a greater profit flows for given τ and z, $G_{\tau,t+1}\left(z,xh_{t+1-\tau}\right)$ is strictly increasing in x. Inequality (19) implicitly determines the unique threshold for managerial ability x conditional on $p_{\tau,t}(z,x)\bar{q}_{\tau,t}(z,x) \geq \tilde{\kappa}_{\tau,t}$. Note that the right-hand side of inequality (19) is negative, implying that the prospective succession delays closure.

If inequality (17) does not hold, indicating that the expected return of search is less than the effective cost, managers dismiss the option of succession. Since the manager value committing to continue their business is given by

$$V_{\tau,t}(z,x) = \pi_t(z,x) + \frac{1-d_{t-\tau}}{1+r_t} V_{\tau,t+1}(z, xh_{t+1-\tau}), \tag{20}$$

a manager closes its business if $G_{\tau,t+1}(z, xh_{t+1-\tau}) < 0$. In sum, the threshold for closure, $\hat{x}^c_{\tau,t}(z)$, is implicitly determined by

$$G_{\tau,t+1}\left(z, \hat{x}^c_{\tau,t}(z)h_{t+1-\tau}\right) = \begin{cases} \frac{\tilde{\kappa}_{\tau,t} - p_{\tau,t}(z,x)\bar{q}_{\tau,t}(z,x)}{1-p_{\tau,t}(z,x)} & \text{if } p_{\tau,t}(z,x)\bar{q}_{\tau,t}(z,x) \geq \tilde{\kappa}_{\tau,t}, \\ 0 & \text{otherwise.} \end{cases} \tag{21}$$

Manager Value and Threshold for Successor Search Managers also face a threshold for successor search, which is defined only if $p_{\tau,t}(z,x)\bar{q}_{\tau,t}(z,x) \geq \tilde{\kappa}_{\tau,t}$. In this case, the search phase exists; otherwise, no search phase arises. Comparing equations (18) and (20), a manager continues business without search if

$$G_{\tau,t+1}(z, xh_{t+1-\tau}) \geq \bar{q}_{\tau,t}(z,x) - \frac{\tilde{\kappa}_{\tau,t}}{p_{\tau,t}(z,x)},$$

implying that there exists a unique threshold for search, $\hat{x}^s_{\tau,t}(z)$, above which they continue their business without search for successors, for each τ and z, such that

$$G_{\tau,t+1}\left(z, \hat{x}^s_{\tau,t}(z)h_{t+1-\tau}\right) = \bar{q}_{\tau,t}(z,x) - \frac{\tilde{\kappa}_{\tau,t}}{p_{\tau,t}(z,x)}. \tag{22}$$

Figure 6 summarizes the threshold conditions that govern a manager's decision-making. In the upper panel of the figure, where the effective search cost is relatively

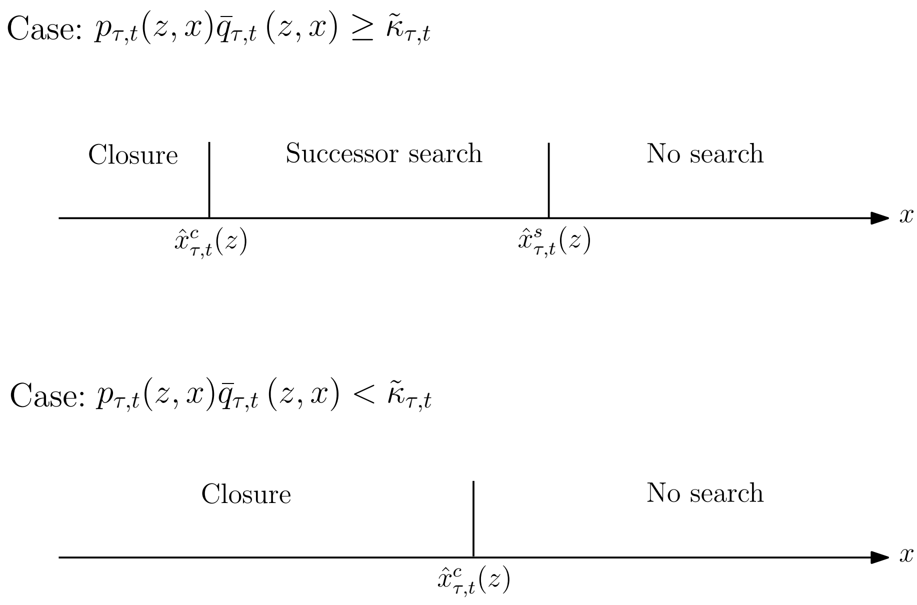

Figure 6: Thresholds for Succession Search and Closure

small, managers have three phases: closure, search, and continuation without search, according to their managerial ability x. By contrast, when the effective search cost is relatively high, as shown in the lower panel, they forgo the option of successor search.[5] The lower-panel case is more likely to occur when the prospective return from succession is small or when the effective search cost increases due to higher death rates.

3.3 Aggregation and Steady State Equilibrium

3.3.1 Households

We assume a simple household setting to focus on the impact of business succession. There is a unit mass of homogeneous households that consist of N_t members. Each household has the identical age structure and manager/worker shares to the aggregate economy. It pools all incomes obtained by household members and maximize

[5] As the expected transfer approaches the effective search cost, namely $p_{\tau,t}(z,x)\bar{q}_{\tau,t}(z,x) \to \tilde{\kappa}_{\tau,t}$, the search threshold $\hat{x}^s_{\tau,t}(z)$ converges to the closure threshold $\hat{x}^c_{\tau,t}(z)$.

household utility function:

$$\max U_{t_0} = \sum_{t=t_0}^{\infty} e^{-\rho(t-t_0)} \ln c_t$$
$$\text{s.t. } c_t + (1+\nu)b_{t+1} = \frac{1}{N_t}\left(\int \pi_{it} di + w_t L_t\right) + (1+r_t)b_t \qquad \forall t \geq t_0,$$

where b_t is the risk-free assets. Thus, we have $\frac{c_{t+1}}{c_t} = e^{-\rho}\frac{1+r_{t+1}}{1+\nu}$, leading to $r_t \simeq \rho + \nu$ in the steady state of consumption per capita.

3.3.2 Aggregate Production and the Labor Market

We define the managerial ability distributions of managers of type-z firms and workers in cohort τ in period t as $F_{\tau,t}^M(x|z)$ and $F_{\tau,t}^L(x)$, respectively. Let $M_{\tau,t}(z)$ be the measure of type-z firms among managers in cohort τ in period t. Denoting the aggregate productivity and aggregate capital as

$$A_t \equiv \left[\frac{1}{M_t}\sum_{j=1}^{J} z_j \sum_{\tau=-\infty}^{t} M_{\tau,t}(z_j) \int_0^{\infty} x F_{\tau,t}^M(dx|z_j)\right]^{\mu},$$
$$K_t \equiv \sum_{j=1}^{J} M_t(z_j) \int k_t(z_j, x) F_t^M(dx|z_j),$$

respectively, the aggregate output is given by

$$Y_t = A_t M_t^{\mu} \left(K_t^{\alpha} L_t^{1-\alpha}\right)^{1-\mu}. \tag{23}$$

The demand for workers in the aggregate economy is $L_t^D = \bar{l}_t M_t A_t^{\frac{1}{\mu}}$. The labor market clearing condition in each period is given by $L_t = L_t^D$, or

$$L_t = \bar{l}_t M_t A_t^{\frac{1}{\mu}}. \tag{24}$$

3.3.3 Steady State Equilibrium

The steady state equilibrium of the current economy exists in per-capita terms, characterized by the Euler equation, the labor market clearing condition (24), optimal decisions by agents regarding production, entry, closure, and succession, a constant measure of firms per capita, constant shares of firm types, as well as stationary age compositions and ability distributions of managers and workers. In this steady state, all cohort-dependent variables depend on age and are independent of both cohort and calendar time. Accordingly, we denote the managerial ability thresholds between phases as $\hat{x}_a^c(z)$, $\hat{x}_a^s(z)$, and $\hat{x}_a^e$, where subscript $a = t - \tau$ represents age, rather than $\hat{x}_{\tau,t}^c(z)$ and so on. Similarly, the ability distributions are expressed as F_a^M and F_a^L, instead of $F_{\tau,t}^M$ and $F_{\tau,t}^L$.

We summarize the key properties of the equilibrium to understand what happens under a declining population. In the present model, per-capita variables, such as the manager share and the aggregate output, are not neutral to the population growth rate through the decisions regarding occupational change and succession.

The probability of successful matching in the steady state, $p_a(z, x)$, and the expected transfer conditional on success in search, $\bar{q}_a(z, x)$ are given by

$$p_a(z, x) = \sum_{a^s=0}^{\infty} \frac{(1 - d_{a^s})\ell_{a^s}}{\ell} \left[1 - F_{a^s}^L\left(\hat{x}_{a^s}^o(z, x, a)\right)\right],$$

$$p_a(z, x)\bar{q}_a(z, x) = \sum_{a^s=0}^{\infty} \frac{\ell_{a^s}}{\ell} \int_{\hat{x}_{a^s}^o(z,x,a)}^{\infty} G_{a^s+1}\left(z, x^s h_{a^s+1}\right) F_{a^s}^L\left(dx^s\right).$$

From equations (15), (16), (18), and (20), the steady state gap values are obtained as

$$G_a(z,x) = \begin{cases} \pi(z,x) - w - \frac{1-d_a}{1+r}\eta \max\left\{0, \bar{G}_{a+1}(xh_{a+1})\right\} & \text{for } x < \hat{x}^c_a(z), \\ \pi(z,x) - w - \kappa + \frac{1-d_a}{1+r}\Big[p_a(z,x)\bar{q}_a(z,x) & \\ \qquad + (1-p_a(z,x))\, G_{a+1}(z, xh_{a+1}) & \\ \qquad -\eta \max\left\{0, \bar{G}_{a+1}(xh_{a+1})\right\}\Big] & \text{for } \hat{x}^c_a(z) \le x < \hat{x}^s_a(z), \\ \pi(z,x) - w + \frac{1-d_a}{1+r}\left[G_{a+1}(z, xh_{a+1})\right. & \\ \qquad \left. -\eta \max\left\{0, \bar{G}_{a+1}(xh_{a+1})\right\}\right] & \text{for } x \ge \max\left\{\hat{x}^c_a(z), \hat{x}^s_a(z)\right\}. \end{cases} \tag{25}$$

From equations (23) and (24), the aggregate output per capita in the steady state is determined by

$$y = mA^{\frac{1}{\mu}}\bar{y}, \tag{26}$$

where $y \equiv Y_t/N_t$ and $m \equiv M_t/N_t$ in the steady state, and $\bar{y}$ is general equilibrium effect through factor prices, which is given by equation (7). The aggregate productivity term, which is the sum of zx across firms, is given by

$$mA^{\frac{1}{\mu}} = m \sum_{a=1}^{\infty} \frac{m_a}{m} \sum_{j=1}^{J} \theta_{j,a} z_j \, \mathbb{E}^M_a\left[x|z_j\right], \tag{27}$$

where $\mathbb{E}^M_a[x|z] = \int_0^\infty x F^M_a(dx|z)$, $m_a \equiv \frac{M_{a,t}}{M_t}$, and $\theta_{j,a}$ is the share of type-j firms among managers with age a.

3.3.4 Reallocation through Business Succession

Succession affects the aggregate economy. Without succession, firms exit as managers age—through closure or death—so the firm measure is constrained by the entry rate, η, and the distribution of firm types deviates from the initial condition $\left\{\bar{\theta}_j\right\}$ only via endogenous closures, with lower-type firms exiting earlier. Once succession is introduced, firms can survive beyond the tenure of the original manger. As a result, the current measure of firms becomes less dependent on the entry rate. Moreover, since predecessors accept successors who generate greater value—typically due to higher managerial ability or younger age—manager turnover becomes an endogenous channel of productivity improvement. This manager turnover process is one key benefit of succession, as it contributes to aggregate productivity.

Succession also affects the composition of surviving firms. As discussed earlier, higher-type firms are more likely to be succeeded, since they generate higher profits, making them attractive to a broader range of potential successors and justifying the associated search costs. Consequently, in equilibrium, the share of high-type firms exceeds its original share at entry. This firm selection process also positively contributes to the aggregate productivity.

These effects are closely tied to the presence of search costs, which constitute the source of inefficiency in our model. The manager turnover effect is dampened by search costs: it operates most strongly when the search cost is zero, as all firms then engage in successor search, and firms are transferred to better managers whenever such candidates are available. By contrast, the firm selection effect is amplified by search costs, since a strictly positive search cost discourages low-productivity firms from searching. This filtering role of search cost strengthens firm selection and raise aggregate productivity by increasing the share of high-productivity firms in the market.[6]

It is important to note that there is no systematic sorting (i.e., positive or negative assortative matching) between firm type and managerial ability. While high-ability managers tend to choose higher-ability successors (see the right panel of Figure 5), implying positive assortative matching between predecessors and successors, this does

[6]Beyond the mechanisms analyzed here, other sources of inefficiency could also be considered. For instance, information asymmetries about managerial ability, search externalities in the matching process, or alternative bargaining structures might distort succession outcomes. Our model deliberately abstracts from these complications in order to highlight the fundamental selection effects of business succession within a simple framework.

not translate into a clear sorting pattern between managers and firms. There are two reasons for this. First, successors have no incentive to sort because of the take-it-or-leave-it structure of succession offers. Second, as illustrated in the left panel of Figure 5, the acceptance region for high-type firms tends to be larger, which can lead to negative assortative matching between firm type and managerial ability. These mechanisms generate a certain degree of mismatch between firms and managers. In our framework, however, such mismatch is treated as a technological feature of random matching rather than as a source of inefficiency. Nevertheless, we do not disregard its quantitative relevance. Section 4.3 explicitly incorporates the effect of mismatch in the decomposition analysis.

These channels evolve under population aging, as shifts in the age and ability distributions of managers and workers alter succession incentives and outcomes. The precise impact, however, depends on the demographic environment. In the next section, we conduct a quantitative evaluation of the aggregate impacts of population aging and decompose the contribution of these channels.

4 Quantitative Investigations

We simulate the model introduced in the previous section to quantitatively investigate how a declining population affects the economy through the channel of business succession. A time unit is five years. Agents live for a maximum of 16 periods, assuming that agents work or run businesses from ages 20 to 99. We discretize the state space using 200 grid points for initial managerial ability, 16 for age, and 5 for firm-specific productivity.

4.1 Calibration

We calibrate the model as follows, which is summarized in Table 2. Discount rate ρ is 0.05, the span of control μ is 0.2, and capital share α is 0.3, which indicates the labor share of 0.56. Initial managerial ability $\bar{x}$ and firm-specific productivity z are assumed to follow log-normal distributions with unit mean (i.e., their logarithms are zero-mean). Population growth rate ν is set at -0.025, because the average total population growth rate from 2021 to 2024 in Japan is -0.5% annually. The age profile of managerial ability is taken from Figure 3, which is based on the estimated coefficients from equation (1). From this estimation, we also obtain the standard deviations of x_0 (initial managerial ability) and z. Specifically, we calculate the standard deviation of z using the estimated firm fixed effects, derived by grouping managers within each firm from the estimated firm×manager fixed effect $\alpha_{f\times m}$. The standard deviation of $\bar{x}$ is then inferred as the residual component, i.e., the variation in firm×manager fixed effects not explained by firm fixed effects. The death rate is nondecreasing and $d_{16} = 1$. Specifically, we set $d_a = 0.04$ for $a \leq 4$, $d_a = 0.027$ for $5 \leq a \leq 9$, $d_a = 0.264$ for $10 \leq a \leq 14$, $d_a = 0.714$ for $a = 15$. These values are based on average male mortality rates by age group, drawn from the 1995 and 2020 life tables published by the Ministry of Health, Labour and Welfare of Japan, with males representing the majority of managers. The fixed cost of succession search is κ and the probability of obtaining entry opportunities η are calibrated to match the empirical succession and closure rates observed in the TSR data, which are 0.020 and 0.012 annually, respectively (defined as the fraction of firms that undergo succession or voluntary closure out of all firms). Converting these rates to a five-year frequency yields 0.096 for succession and 0.059 for closure. These targets imply $\kappa = 20$ and $\eta = 0.003$.

4.2 Numerical Results on Firm Distribution and Dynamics

Figure 7 presents the distribution of firms by manager's age a, initial managerial ability x_0, firm-specific productivity z, and combined productivity zx (not zx_0). Except for age, all horizontal axes are log-scaled. The top-left panel shows that the distribution of managers peaks around age 50. The bottom-left panel indicates positive selection in firm-specific productivity, with a larger share of firms exhibiting high z.

Table 2: Calibration

Parameters	Descriptions	Values	Targets
ν	population growth	-0.025	population data
σ_x	S.D. of x_0	0.36	eq. (1)
σ_z	S.D. of z	1.51	eq. (1)
d_a	death rate	$d_a = 0.04$ for $a \leq 4$ $d_a = 0.027$ for $5 \leq a \leq 9$, $d_a = 0.264$ for $10 \leq a \leq 14$ $d_a = 0.714$ for $a = 15$ $d_a = 1$ for $a = 16$	population data
H_a or h_a	x on age	Figure 3	eq. (1)
κ	search cost	20	succession rate 0.020 (annual)
η	entry chance	0.003	closure rate 0.012 (annual)

By contrast, the distribution of initial managerial ability x_0 is relatively symmetric and not heavily skewed to the right.

To investigate how managers and firms are matched, we present Figure 8, which further decomposes the firm distribution by firm-specific productivity z. While high-z firms are more densely represented (bottom-left panel in the previous Figure 7), the left panel shows that the distribution of manager ability x is non-monotonic across z. On the one hand, low-z firms are operated by managers with high ability x, since only highly capable managers can sustain firms with low productivity; otherwise such firms exit and their managers revert to being workers. On the other hand, the highest-z firms tend to be matched with somewhat higher-x managers, reflecting positive assortative matching. As we explore this mechanism in Figure 6, the complementarity between z and x drives high-z firms to search intensively for high-x managers. As a result, the relationship between x and z becomes U-shaped. Although low-z firms are paired with high-x managers, the combined productivity zx increases monotonically with z, as shown in the right panel.

Figure 9 plots three types of firm age distributions. The red dashed line represents the total population distribution (including both workers and managers), which is

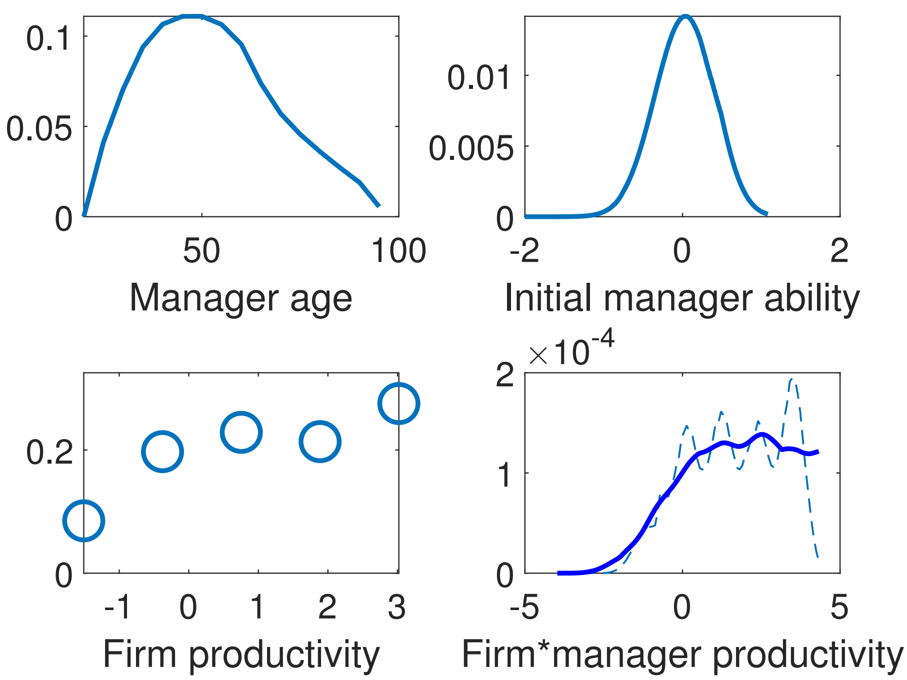

Figure 7: Firm Distribution

simulated under the model's steady state. Starting from this population distribution, the model endogenously generates the manager age distribution, depicted by the blue solid line with circles. Because managerial ability improves with age until around 60, the model predicts a manager distribution that is more concentrated around that age compared to the population distribution. However, the actual data show an even sharper concentration around age 60 and a greater share of elderly managers, as indicated by the black dashed line.

This discrepancy highlights both the limits and implications of our framework. The model is intentionally kept simple, incorporating minimal frictions apart from search costs, so the deviation from the data suggests the presence of additional factors, such as institutional or social barriers that deter younger managers even when succession to younger managers would enhance productivity, or endogenous selection that biases the data toward more capable incumbents.[7] We will investigate this is-

[7]We attempt to improve the model's fit by introducing age-dependent search costs for κ. Specifically, we assume higher values of κ for managers under age 50 and negligible values for those in

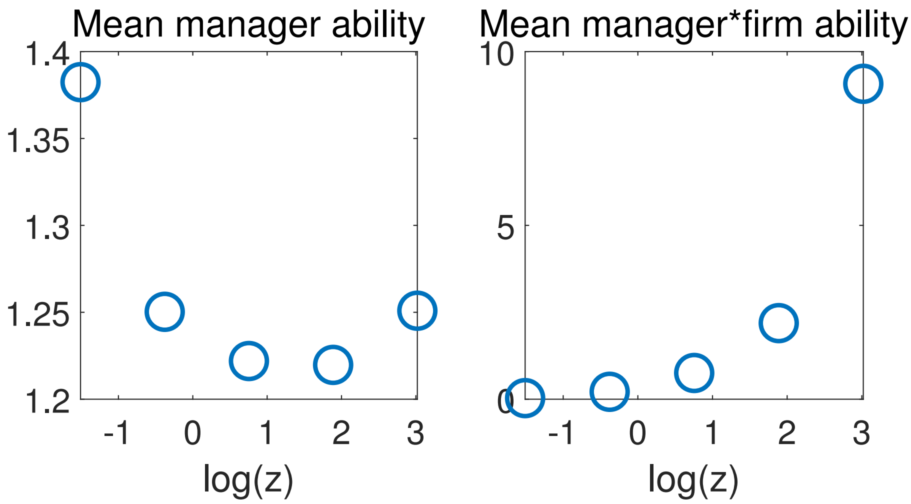

Figure 8: Firm Distribution: Matching of Firms and Managers

sue in Section 4.4 in more detail. Moreover, our simulations assume a stationary population age structure, whereas Japan's actual demographics are transitional, with declining fertility and a rising elderly share. These considerations underscore the need to extend the model to incorporate transitional dynamics and richer frictions, which we leave for future work.

Table 3 presents the transition matrix of model-generated age pairs, with predecessor ages shown in columns and successor ages in rows. We compute this by simulating hypothetical data for 10,000 firms over 20 periods using the model. The peak transitions occur from predecessors in their 50s to successors in their 30s. Compared with the actual data, the model predicts transitions concentrated at younger ages. Furthermore, the model's transition matrix exhibits a single mode, in contrast to the empirical matrix, which displays two distinct modes—one of which corresponds to transitions from managers in their 60s to successors also in their 60s.

We estimate the counterpart of equation (2) and reproduce Figure 4 using data simulated from the model. The estimation results are presented in Figure 10, where

their 60s and 70s. This adjustment shifts the managerial age distribution to the right, bringing it closer to the empirical distribution. Nevertheless, the model continues to overpredict the number of young managers in their 30s and 40s compared to the data.

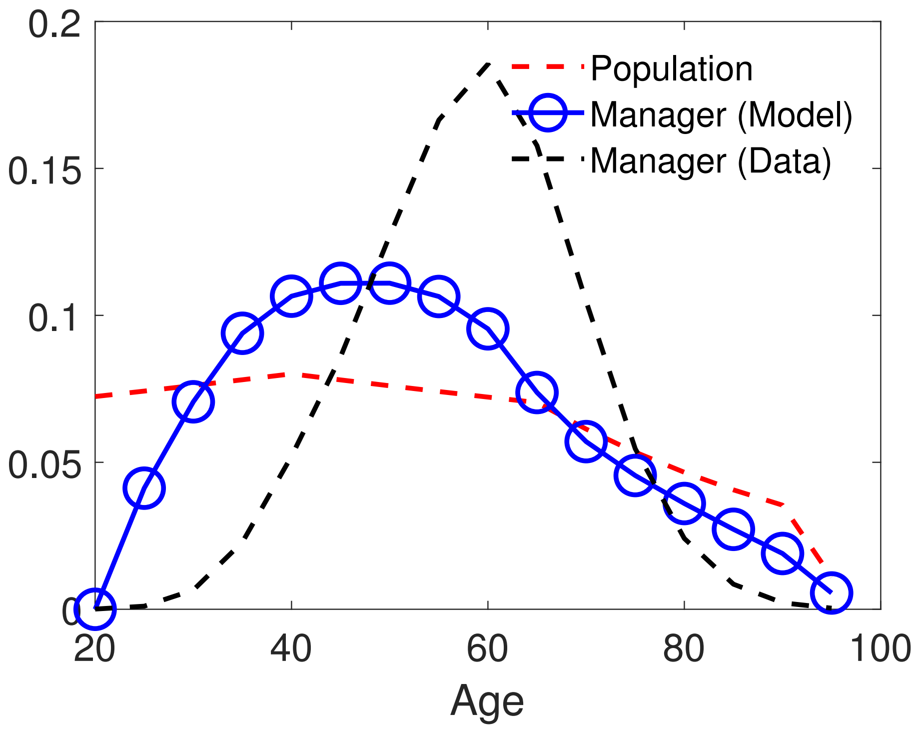

Figure 9: Firm Distribution

one period corresponds to five years. The left panel shows results without addressing endogeneity—that is, using the full sample of firms. The right panel addresses endogeneity partially, mimicking the actual empirical strategy: we restrict the sample to firms actively searching for successors and include firm-specific productivity z as a control.

The simulated data reveal firm dynamics around successions that closely resemble those observed in the TSR data. Specifically, firm sales tend to decline around the time of succession and subsequently recover. Notably, the right panel shows that the sales trough occurs one period after succession, consistent with the empirical results in Figure 4. This pattern arises because predecessor managers make succession decisions based not on the successor's current managerial ability, but on the expected present discounted value of future firm performance. Hence, firms are often handed over with the expectation that the successor's ability will improve over time.

Table 3: Succession Transition Matrix (Model)

	Predecessor age							
Successor age	20s	30s	40s	50s	60s	70s	80s	90s
20s	0.5	2.6	4.1	4.5	3.2	0.7	0.2	0.0
30s	0.9	4.6	7.1	8.2	6.3	1.5	0.6	0.1
40s	0.7	3.2	5.7	7.1	5.9	1.5	0.5	0.1
50s	0.4	1.9	3.7	5.0	5.0	1.3	0.5	0.1
60s	0.1	0.6	1.4	2.2	3.5	1.0	0.4	0.1
70s	0.0	0.1	0.2	0.4	0.8	0.4	0.2	0.0
80s	0.0	0.1	0.1	0.1	0.3	0.1	0.1	0.0
90s	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0

Note: The values indicate transition probabilities (in percent) from predecessors (columns) to successors (rows) by age. The total sum of all probabilities equals 100%.

4.3 Effects of Population Growth Changes

Figure 11 demonstrates the numerical comparative statics for aggregate per-capita variables across various population growth rates ν. As the population growth rate declines (which moves to the left in each panel of the figure), the economy exhibits a lower succession rate but a higher closure rate. Interestingly, output per capita increases. The average manager age increases under a declining population. Although the maturity of managers contributes to average firm productivity, a portion of its increase under declining population growth is attributable to positive firm selection effects. Furthermore, a declining population leads to an increase in the wage rate due to labor shortages. This wage effect further enhances firm productivity by raising the minimum productivity required for survival, thereby strengthening the selection among managers and firms.

While Figure 11 summarizes the aggregate effects of population aging, it remains unclear which mechanisms are most responsible for these changes. To shed light on

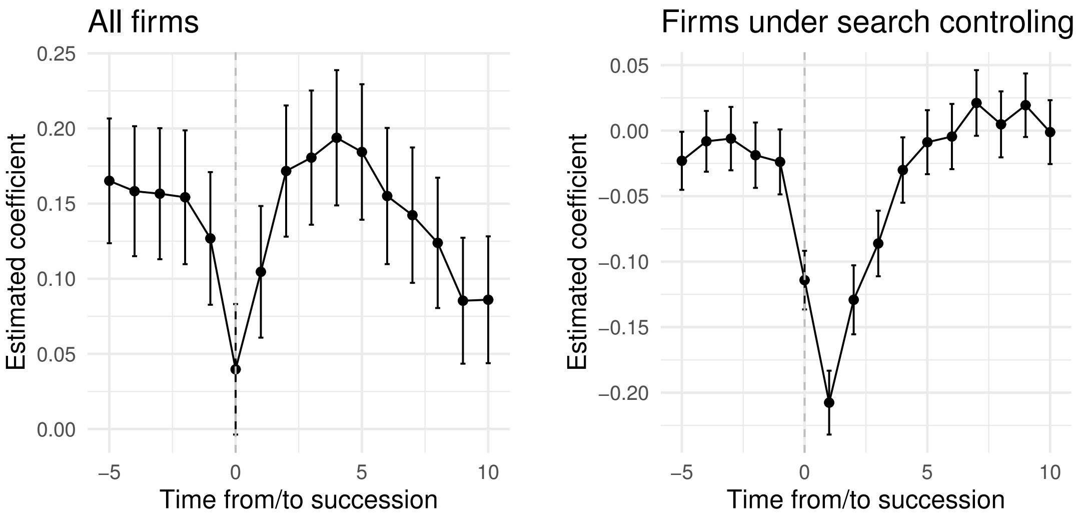

Figure 10: Firm Dynamics over Succession δ_τ (Model)

Note: The figure shows coefficient δ_τ without taking care of the selection mechanism of the succession

this, we decompose aggregate productivity $mA^{1/\mu}$ in equation (27) as follows:

$$
\begin{aligned}
mA^{\frac{1}{\mu}} = & \underbrace{\sum_j \bar{\theta}_j z_j \sum_a m_a^0 \, \mathbb{E}_a^M [x]}_{\text{baseline productivity}} + \underbrace{\sum_j \bar{\theta}_j z_j \sum_a \left(m_a - m_a^0\right) \mathbb{E}_a^M [x]}_{\text{maturity effect}} \\
& + \underbrace{\sum_a m_a^0 \, \mathbb{E}_a^M [x] \sum_j \left(\theta_{j,a} - \bar{\theta}_j\right) z_j}_{\text{firm type selection}} + \underbrace{\sum_a m_a^0 \sum_j \bar{\theta}_j z_j \left(\mathbb{E}_a^M [x|z_j] - \mathbb{E}_a^M [x]\right)}_{\text{matching}} + \text{Cov},
\end{aligned}
\tag{28}
$$

where m_a^0 denotes the steady state share of age-a managers in the total population, $\frac{M_{a,t}}{N_t}$, when $\nu = 0$, which provides the baseline aggregate productivity (the first term in the equation). The second term is the change in the aggregate managerial ability relative to the steady state with constant population, reflecting the effect of manager turnover. We refer to this as the maturity effect since the age distribution is skewed toward older individuals whose managerial ability is higher according to the ability lifecycle. The third term represents the firm selection effect. Under population ag-

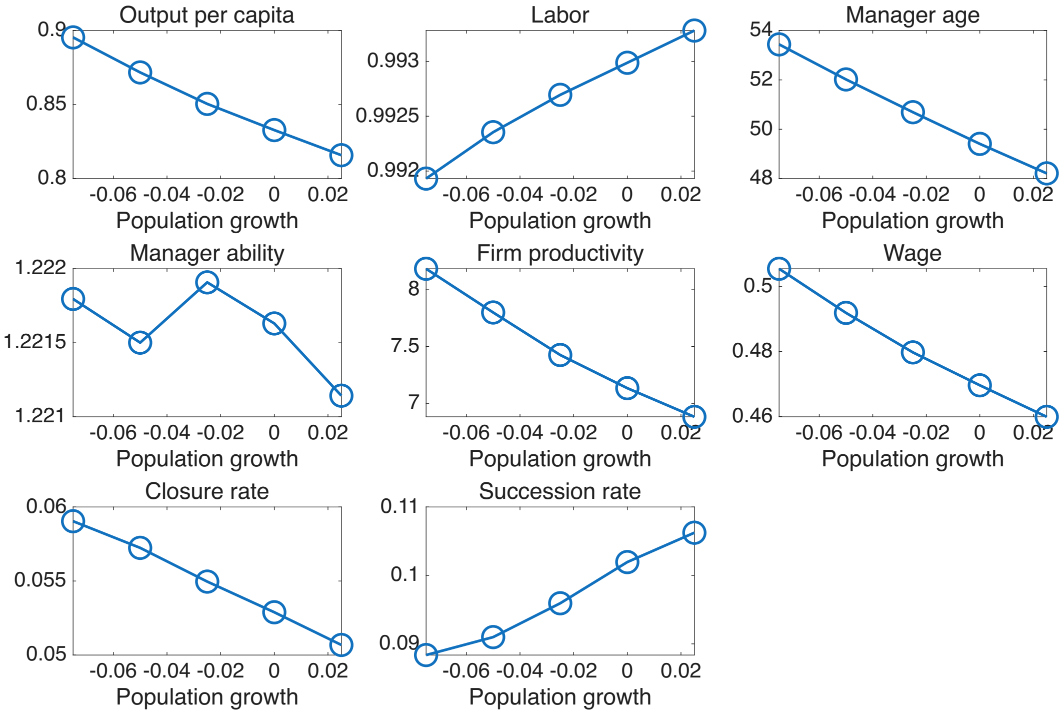

Figure 11: Comparative Statics

ing, the probability of successful succession declines, so managers of low-productivity firms are more likely to abandon succession search, increasing the relative share of high-productivity firms. The fourth term reflects the effect of matching: positive assortative matching contributes to aggregate productivity The last term, Cov, collects all the covariance components.

Figure 12 presents the decomposition result, where the baseline productivity term in equation (28), which is held constant across different population growth rates, is incorporated into the maturity effect. The figure shows that the improvement in aggregate productivity as population growth declines is primarily driven by firm type selection, namely, a higher share of firms with greater firm-specific productivity z. The maturity effect also contributes positively, reflecting the increasing share of more experienced managers with higher managerial ability. The direct contribution of matching, defined as the allocation of managerial ability conditional on z, appears relatively modest. However, the residual component increases with lower population

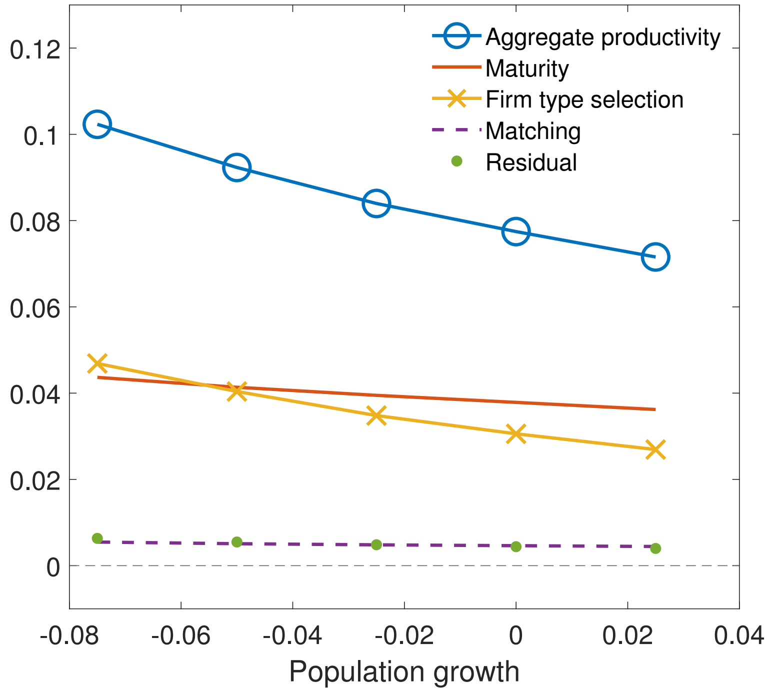

Figure 12: Decomposition of Aggregate Productivity

growth. This suggests that complementarities between managerial ability and firm-specific productivity play a growing role, underscoring the importance of matching in driving productivity dynamics.

4.4 Discussions: Increasing Longevity and Internal Promotion

In this subsection, we present two simulation experiments based on the benchmark calibrated model: (i) increasing longevity through declines in death rates and (ii) internal promotion by restricting the pool of successor candidates.

Increasing Longevity So far, we examined the impact of population aging driven only by declining birth rates. However, aging can also arise from improvements of longevity. In particular, falling death rates among older individuals shift the age distribution further toward elderly cohorts. In Figure 13, we simulate the model

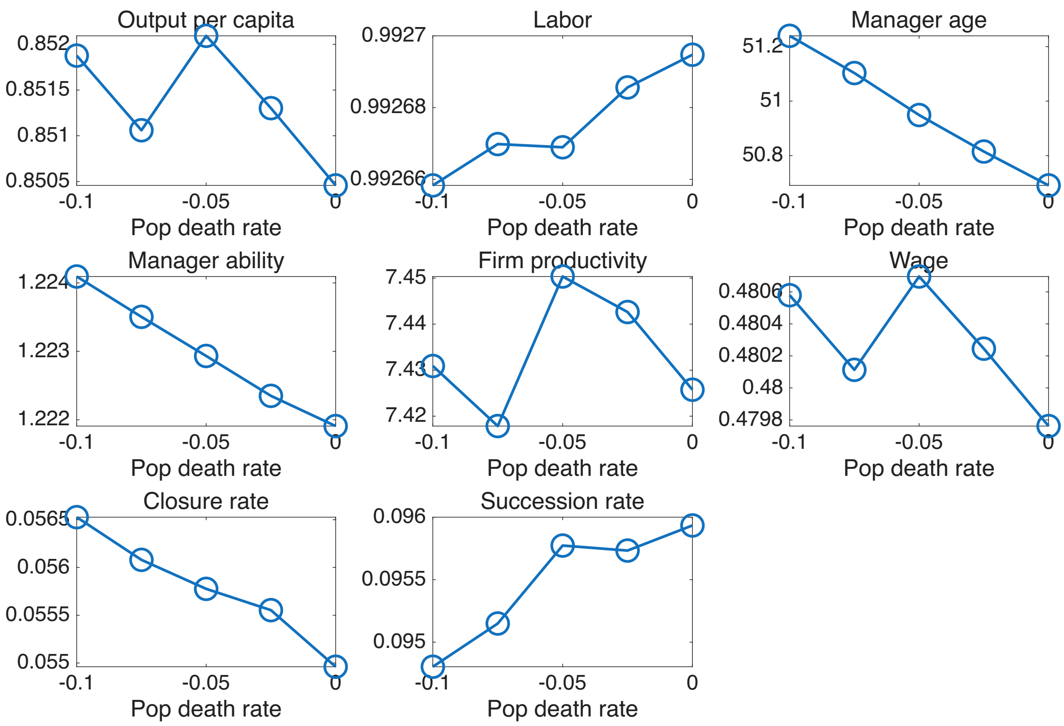

Figure 13: Comparative Statics: Lower Death Rates for 50s and older.

under alternative death rates for individuals aged 50 or above. Specifically, the death rates are reduced between 0% and 10% relative to the benchmark while the population growth rate is constant. Compared with Figure 11, the impact of population aging is very small while the basic tendency is similar to the benchmark simulation.

Succession through internal promotion In the benchmark model, searching managers are assumed to meet successor candidates at random, regardless of their ages. In the second experiment, we restrict the pool of potential successors to individuals in their 50s and 60s. This modification reflects empirical evidence showing that successions most frequently occur in these age groups (as presented in Table 1), which is a pattern not captured in the benchmark simulation. Such successions are typically interpreted as cases of internal promotions rather than intergenerational succession from a parent to a child. Figure 14 presents the simulation result for the aggregate outcomes. The impact of declining population growth is basically the same as in the benchmark model, except that the succession rate increases with population decline under the restriction for the successor pool. This is because successor searches are more likely to succeed, given that managerial ability peaks around ages 50–60, as shown in Figure 3.

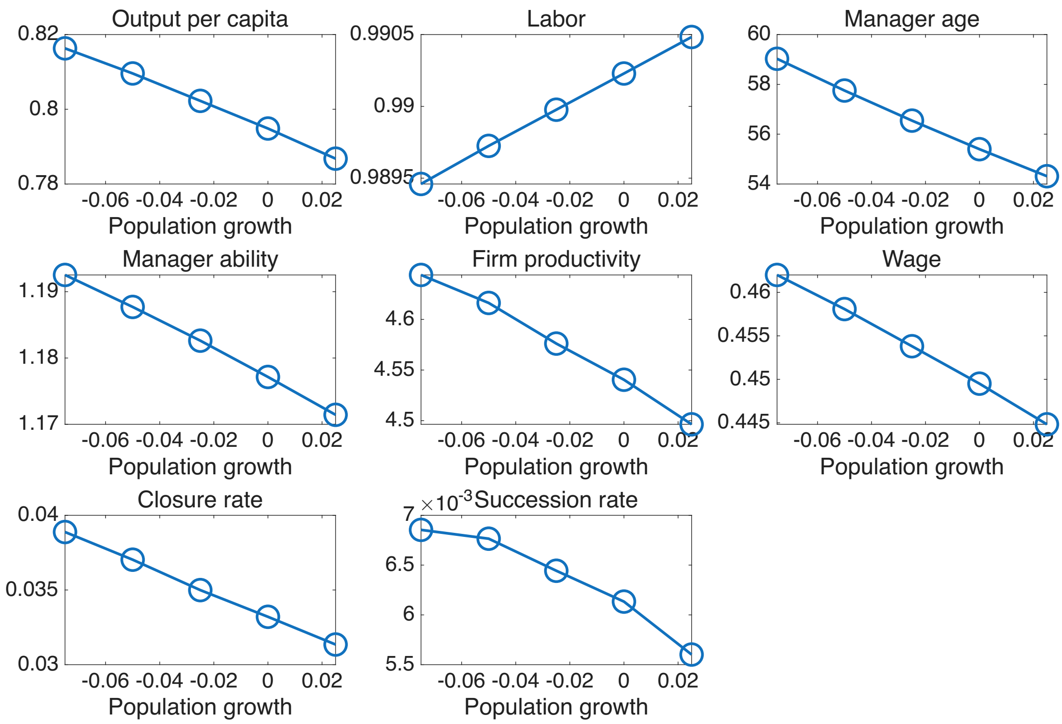

Figure 14: Comparative Statics: Searching only 50s or 60s.

The left panel of Figure 15 shows the distribution of managers by age in this experiment. Because the successor ages are restricted to the 50s and 60s, the resulting distribution is concentrated around these ages, making it closer to the empirical manager age distribution (black dashed line). Younger managers appear only through new entry, while older managers engage in successor searches more rapidly. It is worth noting that, although managerial ability becomes higher than in the benchmark case due to the restricted successor pool, the firm selection effect is weakened compared with our benchmark result (i.e., lower and flatter), as illustrated in the right panel. Even low-type firms can survive longer when they are operated by mature managers, which in turn leads to lower average firm productivity and per-capita output compared with the benchmark.

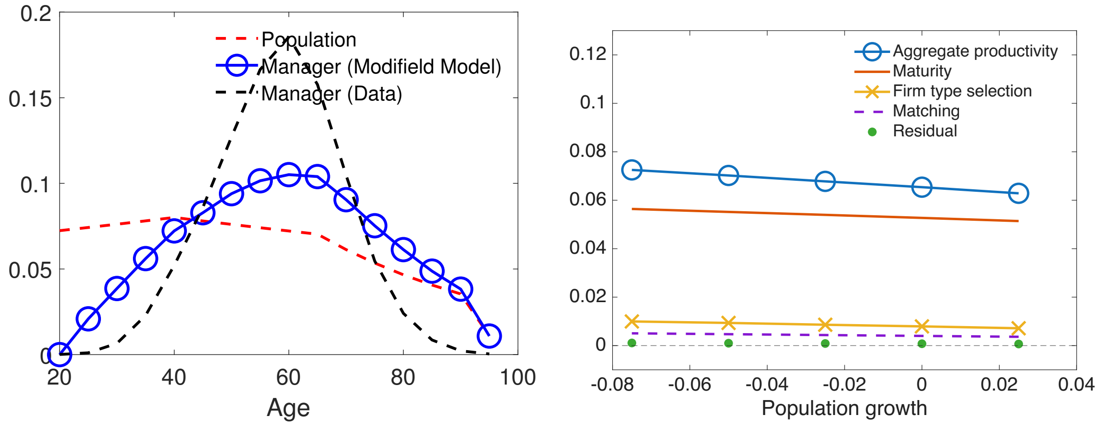

Figure 15: Manager Age Distribution and Decomposition: Searching only 50s or 60s.

5 Concluding Remarks

In this study, we develop a general equilibrium model incorporating business succession, that is modeled as the occupation choices of managers and workers. The quantitative investigations based on the calibrated model reveal that, on top of the the natural consequences of lower population growth (i.e., high exit rates, low entry, and low succession rates), aggregate productivity and per capita output could in fact become higher thanks to the selection of firms and the maturity effect of aging through the succession process. The present paper contributes to highlighting such a novel channel through which population dynamics affects the macroeconomy.

There are several important directions for future research. First, a promising avenue is to incorporate heterogeneous succession modes, such as family transfers, internal promotions, and external recruitment. While the present model deliberately abstracts from these distinctions to provide a general theoretical framework, each mode has attracted substantial empirical and theoretical interests. Extending the analysis to explicitly account for these modes would enrich the interpretation of succession dynamics, although we have already provided a limited analysis of internal promotion within the main text.

Second, it is important to analyze transition dynamics when demographic parameters change. Because it takes a long time for the population age distribution to converge to a steady state, what is observed in practice is more likely to be the transitional path. Incorporating such dynamics would provide a more realistic assessment of the macroeconomic consequences of demographic change.

Finally, the analysis should be extended to welfare implications that account for retirees and unemployment associated with firm closures. Our results suggest that population aging raises output per capita, which in the model also implies higher consumption per capita because all agents are assumed to participate in production as managers or workers. In reality, however, aging increases the share of retirees, and more frequent closures due to fewer successions may raise the frictional unemployment rate among the young. These groups consume but do not contribute to production. In such a case, output per active agent may rise even as per-capita consumption falls, implying a potential welfare loss. Incorporating non-working retirees and the unemployed into the framework is therefore essential for welfare analysis.

References

Akcigit, Ufuk, Harun Alp, and Michael Peters, "Lack of Selection and Limits to Delegation: Firm Dynamics in Developing Countries," *American Economic Review*, 2021, *111* (1), 231–275.

Andrews, Dan and Alain de Serres, "Intangible Assets, Resource Allocation and Growth: A FRAMEWORK FOR ANALYSIS," *OECD Economic Department Working Papers*, 2012, (989).

Atkeson, Andrew and Patrick J. Kehoe, "Modeling and Measuring Organization Capital," *Journal of Political Economy*, 2005, *113* (5), 1026–1053.

Backus, David, Thomas Cooley, and Espen Henriksen, "Demography and low-frequency capital flows," *Journal of International Economics*, 2014, *92* (1), S94–S102.

Bandiera, Oriana, Andrea Prat, Stephen Hansen, and Raffaella Sadun, "CEO Behavior and Firm Performance," *Journal of Political Economy*, 2020, *128* (4), 1325–1369.

Bennedsen, Morten, Kasper Meisner Nielsen, Francisco Perez-Gonzalez, and Daniel Wolfenzon, "Inside the Family Firm: The Role of Families in Succession Decisions and Performance," *Quarterly Journal of Economics*, 2007, *122* (2), 647–691.

Bernard, Andrew B., Andreas Moxnes, and Yukiko U. Saito, "Production Networks, Geography, and Firm Performance," *Journal of Political Economy*, 2019, *127* (2), 639–688.

Bertrand, Marianne and Antoinette Schoar, "Managing with Style: The Effect of Managers on Firm Policies," *Quarterly Journal of Economics*, 2003, *118* (4), 1169–1208.

Bloom, David E, Michael Kuhn, and Klaus Prettner, "Fertility in High-Income Countries: Trends, Patterns, Determinants, and Consequences," *Annual Review of Economics*, 2024, *16* (1), 159–184.

Bloom, Nicholas, Benn Eifert, Aprajit Mahajan, David McKenzie, and John Roberts, "Does Management Matter? Evidence from India," *Quarterly Journal of Economics*, 2013, *128* (1), 1–51.

Bornemann, Sven, Thomas Kick, Andreas Pfingsten, and Andrea Schertler, "Earnings baths by CEOs during turnovers: empirical evidence from German savings banks," *Journal of banking & finance*, 2015, *53*, 188–201.

Burkart, Mike, Fausto Panunzi, and Andrei Shleifer, "Family Firms," *Journal of Finance*, 2003, *58* (5), 2167–2201.

Caggese, Andrea and Ander Perez-Orive, "How stimulative are low real interest rates for intangible capital?," *European Economic Review*, 2022, *142*, 103987–.

Carillo, Maria Rosaria, Vincenzo Lombardo, and Alberto Zazzaro, "The rise and fall of family firms in the process of development," *Journal of Economic Growth*, 2019, *24* (1), 43–78.

Carvalho, Vasco M, Makoto Nirei, Yukiko U Saito, and Alireza Tahbaz-Salehi, "Supply Chain Disruptions: Evidence from the Great East Japan Earthquake," *Quarterly Journal of Economics*, 2021, *136* (2), 1255–1321.

Caselli, Francesco and Nicola Gennaioli, "Dynastic Management," *Economic Inquiry*, 2013, *51* (1), 971–996.

Cooley, Thomas F., Espen Henriksen, and Charlie Nusbaum, "Demographic obstacles to European growth," *European Economic Review*, 2024, *169*, 1–29.

Crouzet, NICOLAS and JANICE Eberly, "Rents and Intangible Capital: A Q+ Framework," *Journal of Finance*, 2023, *78* (4), 1873–1916.

Dessein, Wouter and Andrea Prat, "Organizational Capital, Corporate Leadership, and Firm Dynamics," *Journal of Political Economy*, 2022, *130* (6), 1477–1536.

Engbom, Niklas, *Firm and Worker Dynamics in an Aging Labor Market*, Federal Reserve Bank of Minneapolis, 2019.

Ferrero, Andrea, "A structural decomposition of the U.S. trade balance: Productivity, demographics and fiscal policy," *Journal of Monetary Economics*, 2010, *57* (4), 478–490.

Hong, Gee Hee, Arata Ito, Yukiko Saito, and Thi-Ngoc Anh Nguyen, "Structural Changes in Japanese SMEs: Business Dynamism in Aging Society and Inter-Firm Transaction Network," Policy Discussion Papers 20003, Research Institute of Economy, Trade and Industry (RIETI) 2020.

Hopenhayn, Hugo, Julian Neira, and Rish Singhania, "From Population Growth to Firm Demographics: Implications for Concentration, Entrepreneurship and the Labor Share," *Econometrica*, 2022, *90* (4), 1879–1914.

Hoshi, Takeo, Naomi Kodama, and Li Huiyu, "The Effect of Aging on Entrepreneurship and Aggregate Productivity," Discussion papers, SSRN 2025.

Hsieh, Chang-Tai and Peter J. Klenow, "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics*, 2009, *124* (4), 1403–1448.

Inokuma, Hiroshi and Juan M. Sanchez, "From Population Growth to TFP Growth," *IMES Discussion Paper Series*, 2024, (24-E-09).

Ito, Yojiro and Daisuke Miyakawa, "The Impact of Mergers on Aggregate Productivity: An Empirical Analysis Using Productivity Decomposition," *Industrial and Corporate Change*, forthcoming.

Johnson, W. Bruce, Robert P. Magee, Nandu J. Nagarajan, and Harry A. Newman, "An analysis of the stock price reaction to sudden executive deaths: Implications for the managerial labor market," *Journal of Accounting & Economics*, 1985, *7* (1), 151–174.

Jones, Charles I., "The End of Economic Growth? Unintended Consequences of a Declining Population," *American Economic Review*, 2022, *112* (11), 3489–3527.

Jr., Robert E. Lucas, "On the Size Distribution of Business Firms," *Bell Journal of Economics*, 1978, *9* (2), 508–523.

Kaplan, Steven N., Mark M. Klebanov, and Morten Sorensen, "Which CEO Characteristics and Abilities Matter?," *Journal of Finance*, 2012, *67* (3), 973–1007.

Karahan, Fatih, Benjamin Pugsley, and Aysegul Sahin, "Demographic Origins of the Start-up Deficit," *American Economic Review*, 2024, *114* (7), 1986–2023.

Kodama, Naomi, Yoshiaki Murakami, and Mari Tanaka, "No Successor, No Success? Impact of a Little Son on Business Performance," *Journal of the Japanese and International Economies*, 2021, *62* (C).

Mehrotra, Vikas, Randall Morck, Jungwook Shim, and Yupana Wiwattanakantang, "Adoptive expectations: Rising sons in Japanese family firms," *Journal of Financial Economics*, 2013, *108* (3), 840–854.

Miyakawa, Daisuke, Miho Takizawa, and Tatsushi Furuya, "Using Corporate Tax Filing Data to Measure Business Dynamism," NTC Joint Research Discussion Paper Series 2024.

Miyauchi, Yuhei, "Matching and Agglomeration: Theory and Evidence From Japanese Firm-to-Firm Trade," *Econometrica*, 2024, *92* (6), 1869–1905.

Perez-Gonzalez, Francisco, "Inherited Control and Firm Performance," *American Economic Review*, 2006, *96* (5), 1559–1588.

Peters, Michael and Conor Walsh, "Population Growth and Firm Dynamics," *NBER Working Paper Series*, 2021.

Reenen, John Van, Raffaella Sadun, Jonathan S Hartley, Rachel J Schuh, and Nicholas Bloom, "Management and Firm Dynamism," *NBER Working Paper Series*, 2025.

Saito, Takuji, "Family firms and firm performance: Evidence from Japan," *Journal of the Japanese and International Economies*, 2008, *22* (4), 620–646.

Sasaki, Hiroaki and Keisuke Hoshida, "The Effects of Negative Population Growth: An Analysis using a Semiendogenous R&D Growth Model," *Macroeconomic Dynamics*, 2017, *21* (7), 1545–1560.

Tsuruta, Daisuke, "Japan's elderly small business managers: Performance and succession," *Journal of Asian Economics*, 2020, *66* (C).

_ , "Lack of successors, firm default, and the performance of small businesses," *Japan and the World Economy*, 2021, *57* (C).

van Ark, Bart and Erik Monnikhof, "Size Distribution of Output and Employment: A Data Set for Manufacturing Industries in Five OECD Countries, 1960s-1990," OECD Economics Department Working Papers 166, OECD Publishing Jan 1996.

Wongkaew, Kongphop and Yukiko Saito, "CEO Age, Firm Exit and Zombification amidst the COVID-19 Pandemic," Discussion papers 23080, Research Institute of Economy, Trade and Industry (RIETI) 2023.