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Graduation of initial public offering firms from junior stock markets: Evidence from the Tokyo Stock Exchange*

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Abstract

For young and innovative firms, an initial public offering (IPO) is crucial for securing financing for research and development (R&D) investment. This study explores the post-IPO behavior and performance of firms listed on the two junior stock markets of the Tokyo Stock Exchange (TSE): Market of High-Growth and Emerging Stocks (MOTHERS) and JASDAQ. Using a sample of 943 non-financial firms listed on these markets from November 1999 to December 2019, we find that approximately 40% of IPO firms graduate to the TSE main markets, while more than 10% of IPO firms delist from the TSE junior markets. The results reveal that firms listed on the TSE junior markets increase financing cash flow by accessing public equity markets. Moreover, using a survival analysis approach, we examine the factors associated with the time to graduation to the TSE main markets. As a result, we find that young IPO firms and those with high R&D intensity are less likely to graduate from the TSE junior markets. In addition, firms with higher market capitalization are more likely to graduate to the TSE main markets. The results also reveal that listing regulations on graduation to the TSE main markets within 10 years, which were introduced only to MOTHERS, accelerate the graduation of IPO firms when the sample is restricted to firms listed before the announcement of the 10-year rule. Furthermore, we provide evidence that IPO firms that ultimately graduate to the TSE main markets show better post-IPO performance.

Keywords: graduation, initial public offering, junior stock market, listing regulation, young and innovative firm

JEL classification: G32, G38, M13

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1 Introduction

A promotion system (e.g. tenure track in universities) is often introduced to motivate the players in an organization. Under this system, a junior (i.e. lower) stage often provides young players with an opportunity to develop their knowledge and skills. Based on their performance in the junior stage, players can then obtain the opportunity to graduate from the junior stage to the main (i.e. upper) stage. In stock exchanges, junior stock markets play the role of fostering young and innovative firms by providing them with opportunities to access public equity markets through IPOs. For firms with an incentive to grow rapidly, an initial public offering (IPO) in junior stock markets is a preparation stage in firm growth. Such firms presumably seek the main markets after going public in junior stock markets.

From the perspective of economic growth, fast-growing firms are expected to stimulate product and financial markets (Bos and Stam 2014; Colombelli et al. 2014). Junior stock markets allow the shares of young firms to be publicly floated (Abbate and Sapio 2019). These markets are also introduced to promote the formation of new technology firms (Eberhart and Eesley 2018). Owing to these markets' less stringent listing requirements than established stock exchanges, IPOs in junior stock markets account for a large proportion in such countries as Japan and the United Kingdom (Granier et al. 2019). However, although active IPO markets are expected to boost economic growth, whether firms perform better by going public remains an open question. Indeed, it has been found that operating performance tends to decline after going public (Jain and Kini 1994; Mikkelson et al. 1997). Many firms may simply secure equity financing and rebalance their capital structures by going public. While young and innovative firms can acquire growth opportunities to expand their businesses by going public in junior stock markets, it is not certain that they necessarily show better post-IPO performance. In particular, it is unclear whether the promotion system helps fostering firms with growth potential, whereas junior stock markets are expected to play a role in providing equity financing to these firms. Therefore, research focusing on IPO firms in junior stock markets that wish to graduate to main stock markets could explain how to promote fast-growing firms in an economy.

This study explores the post-IPO behavior and performance of firms listed on the two junior stock markets of the Tokyo Stock Exchange (TSE): Market of High-Growth and Emerging Stocks (MOTHERS) and JASDAQ. The TSE is a unique case for two reasons: (1) it has two junior markets with different backgrounds because of the historical reorganization of stock exchanges in Japan and different listing rules and (2) listing regulations on graduation to the TSE main markets within 10 years were introduced only to MOTHERS but not to JASDAQ. Using a sample of 943 non-financial firms listed on these markets from November 1999 to December 2019, we

find that approximately 40% of IPO firms graduate to the TSE main markets (First and Second sections of the TSE), while more than 10% of IPO firms delist from the TSE junior markets. The results reveal that firms listed on the TSE junior markets increase financing cash flow through by accessing public equity markets. Moreover, using a survival analysis approach, we examine the factors associated with the time to graduation to the TSE main markets. We find that young IPO firms and those with high research and development (R&D) intensity are less likely to graduate from the TSE junior markets. Even if firms achieve an IPO in the TSE junior markets shortly after founding, they do not necessarily improve operating performance by going public. Moreover, IPO firms with high R&D intensity do not perform better, while they increase financing cash flow by going public. In addition, firms with higher market capitalization (market value of equity) are more likely to graduate to the TSE main markets. The results also reveal that listing regulations on graduation to the TSE main markets within 10 years, which were introduced only to MOTHERS, accelerate the graduation of IPO firms when the sample is restricted to firms listed before the announcement of the 10-year rule. Furthermore, we provide evidence that IPO firms that ultimately graduate to the TSE main markets show better post-IPO performance.

The contributions of this study are threefold. First, we provide novel insights into the behavior and performance of IPO firms in junior stock markets. Although the existing literature has examined the survival of IPO firms, especially in established stock exchanges (e.g. Jain and Kini 1999, 2000), little attention has been paid to the graduation of IPO firms from junior stock markets (Carpentier et al. 2010; Carpentier and Suret 2011). In this respect, our findings provide valuable evidence on the development of IPOs in junior stock markets. Second, we clarify whether young and innovative firms, which appear to be promising targets in junior stock markets, achieve rapid growth by going public. Whereas the growth of young and innovative firms through equity financing is useful to spur economic growth, there is scant evidence of the performance of young and innovative firms listed on junior stock markets. Third, we examine whether listing regulations on graduation within 10 years that apply only to IPOs on MOTHERS promote IPO firms to the TSE main markets. The desirability and efficacy of listing regulations in junior stock markets are still open and important questions (Carpentier and Suret 2011). The junior stock markets in Japan are a valuable case to investigate the impact of listing regulations through comparison tests because the delisting criteria differ between MOTHERS and JASDAQ; specifically, MOTHERS is a treatment group for the regulations, while JASDAQ is a control group (i.e. placebo). To the best of our knowledge, this is the first examination of listing regulations that differ between two junior stock markets in the same country.

The remainder of this paper is organized as follows. The following section introduces the

research background, including the literature review. In the fourth section, we discuss the methods used in this study. The fifth section explains the data used. The sixth section presents the estimation results. Finally, we present concluding remarks.

2 Research background

2.1 Financing and IPOs of young and innovative firms

Young and innovative firms, which tend to have the potential to grow through successful R&D, often have higher demand for financing to invest in R&D (Lee et al. 2015; Cowling et al. 2020). To compensate for their lack of internal financing for R&D, many firms seek external financing (Mina et al. 2013).[1] However, despite growth potential, young and innovative firms often face difficulties in acquiring external financing (Czarnitzki and Hottenrott 2011). It is plausible that young and innovative firms tend to have the high uncertainty of their business outcomes. These firms often lack the scale to invest in multiple projects (Freel 2007; Lee et al. 2015). Owing to this high risk, external suppliers of capital, such as banks and investors, are hesitant to provide funds to young and innovative firms.

Moreover, owing to few operating histories and track records on young and innovative firms, external suppliers of capital face difficulties in assessing the quality of the firms' projects (Colombo and Grilli 2007; Honjo 2020). In addition, collateral requirements often prevent young and innovative firms from raising funds through debt financing because these firms tend to have less collateral value (Colombo and Grilli 2007, 2010). Furthermore, young and innovative firms may be hesitant to provide external suppliers of capital with private information about their technologies to avoid the disclosure to competitors (Yosha 1995; Bah and Dumontier 2001). In these respects, the information asymmetries between entrepreneurs and external suppliers of capital are severe in young and innovative firms (Aslan and Kumar 2011; Cowling et al. 2020). Consequently, these firms are likely to face financial constraints when seeking funds to invest in R&D (Hall et al. 2016; Ferrucci et al. 2020).

For R&D investment, equity financing has several advantages over debt financing (Carpenter and Petersen 2002a; Hall 2002; Colombo and Grilli 2007; Müller and Zimmermann 2009). For instance, no collateral is required, the probability of financial distress is stable, and investors' upside returns are not bounded for equity financing (Carpenter and Petersen 2002a, Brown et al. 2012). Owing to their lack of collateralizable assets, young and innovative firms prefer equity

[1] According to a financing hierarchy, internal financing has more advantages for the cost of financing (Carpenter and Petersen 2002a, 2002b). Such a financing hierarchy may exist, especially for R&D of younger firms (Brown et al. 2009).

financing to debt financing. In addition, it is difficult for such firms to generate positive cash flow shortly after founding, meaning that the interest payments on debt financing become a burden (Honjo and Kato 2019; Honjo 2021). For these reasons, young and innovative firms favor equity financing.

To secure equity financing from public equity markets, young and innovative firms tend to pursue an IPO (Honjo 2020). An IPO is a critical stage in a firm's life cycle (He 2008; Filatotchev and Piesse 2009; Mumi et al. 2019). By going public, firms with higher demand for external finance can access public equity markets. As accessing public equity markets is important for young and innovative firms, a large proportion of these firms rely on public equity as a source of finance (Brown et al. 2009). Especially for innovative start-ups devoted to R&D, an IPO is crucial for securing financing for R&D investment (Honjo and Nagaoka 2018; Honjo 2020).

Firms' decision makers—mainly entrepreneurs, sometimes other shareholders, underwriters, and auditing firms—anticipate better performance by accessing public equity markets.[2] An IPO reinforces the benefits of advantages for firms facing difficulties in financing, as access to public equity markets leads to an opportunity for alternative financing. Especially for young and innovative firms with higher demand for R&D investment, an IPO may be necessary for maintaining their business activity. In this respect, access to public equity markets through an IPO helps these firms improve financing cash flow.

2.2 IPOs in junior stock markets

Several countries, such as Canada and Japan, as well as European nations, have introduced junior stock markets (also called second-tier stock exchanges) since the mid-1990s, following National Association of Securities Dealers Automated Quotation (NASDAQ) in the United States, which would provide young and innovative firms with an opportunity to access public equity markets. Indeed, several countries have introduced junior stock markets, including Alternative Investment Market (AIM) (United Kingdom), Neuer Markt (Germany), Nouveau Marché (France), and Nuovo Mercato (Italy), and Toronto Stock Exchange Venture Exchange (TSXV) (Canada).

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[2] There are various reasons for going public, including diversification, the possibility of equity financing beyond the initial entrepreneurs' limited wealth, less costly access to the capital market, increased liquidity of the firms' share, some outside monitoring, enhanced company image and publicity, motivating management and employees, and cashing in (Zingales 1995; Röell 1996; Pagano et al. 1998). In addition, an IPO creates bargaining power against banks (Pagano et al. 1998). Moreover, Ritter and Welch (2002) emphasized the life cycle and market-timing theories in the decision to go public. Conversely, going public incurs additional costs, such as registration, underwriting, underpricing, and annual disclosure costs. Moreover, adverse selection, administrative expenses and fees, and a loss of confidentiality are regarded as other costs associated with going public (Pagano et al. 1998).

As young and small firms can find the listing requirements of established stock exchanges to be quite stringent, junior stock markets are designed to meet the needs of these firms (Ritter et al. 2013). However, some junior stock markets, especially those in European nations, became unviable because of the Internet bubble crush (Revest and Sapio 2012; Vismara et al. 2012). Indeed, Neuer Markt, Nouveau Marché, and Nuovo Mercato were reorganized or closed in the 2000s. Although the number of IPOs has decreased after the global financial crisis in these countries (Ritter et al. 2013; Akyol et al. 2014), an IPO is the most common sellout (exit) strategy in Japan (Granier et al. 2019; Honjo 2020). Hence, an IPO is still a significant avenue for raising capital for young and innovative firms in some countries.

Numerous studies have examined post-IPO performance using the cases of NASDAQ in the United States (e.g. Hensler et al. 1997; Bhattacharya et al. 2010; LiPuma 2012). Meanwhile, among the European junior stock markets, AIM in the United Kingdom has been relatively successful at attracting new IPOs (Revest and Sapio 2012; Granier et al. 2019). Indeed, many studies have examined IPOs on AIM (e.g. Gregory et al. 2010; Espenlaub et al. 2012; Nielsson 2013; Abbate and Sapio 2019; Revest and Sapio 2019). Additionally, the post-IPO performance of firms listed on TSXV in Canada has been examined (Carpentier et al. 2010; Carpentier and Suret 2011, 2018). However, there is a paucity of research on the IPOs in other junior stock markets, even though some markets, such as MOTHERS in Japan, continue to attract new IPOs (Granier et al. 2019).

Moreover, some scholars have focused on the performance of IPO firms in junior stock markets, compared to established stock exchanges with more stringent listing requirements (e.g. Gerakos et al. 2013; Nielsson 2013; Takahashi and Yamada 2015). However, to the best of our knowledge, few studies have examined the impact of listing regulations newly introduced to junior stock markets, in order to promote fast-growing firms, which would be useful to improve regulatory environments in junior stock markets.

2.3 Post-IPO behavior and performance

Traditionally, post-IPO performance has been explored in the literature (e.g. Ritter 1991; Jain and Kini 1994; Krishnan et al. 2011). Numerous studies have investigated IPO stock returns (Loughran and Ritter 1995). In particular, the high initial returns of IPOs—often called "underpricing"—have been highlighted (Ljungqvist 2007; Engelen and Van Essen 2010; Ekkayokkaya and Pengniti 2012).

Studies on post-IPO performance include three types of analytical approaches. First, pre- and post-IPO operating performance, such as profitability and cash flow, has been estimated, and

some studies have demonstrated a significant decline in operating performance after going public (e.g. Jain and Kini 1994; Mikkelson et al. 1997). Among studies of junior stock markets in Japan, Kutsuna et al. (2002) found sharply decreasing operating performance using firms listed on the over-the-counter (OTC) market (currently JASDAQ). Eberhart and Eesley (2018) found increased investment in new technology firms but decreased growth after the introduction of MOTHERS and other markets in 2000. Second, the time to delisting—conversely, IPO survival—has been estimated by employing a survival analysis approach (Jain and Kini 2000, 2008).[3] A substantial number of studies have examined IPO survival in established stock exchanges.[4] In addition, some have focused on it in junior stock markets (e.g. Gerakos et al. 2013; Pour and Lasfer 2013). Whereas junior stock markets are expected to create opportunities for providing risk capital for young and innovative firms, some scholars found that younger firms are less likely to survive in junior stock markets (e.g. Carpentier and Suret 2011; Espenlaub et al. 2012). Third, buy-and-hold abnormal returns (BHARs) and cumulative abnormal returns after going public have been estimated by using stock prices (Gregory et al. 2010; Gao and Jain 2011; Gerakos et al. 2013; Carpentier and Suret 2018). Vismara et al. (2012) found that IPOs in established stock exchanges (main markets) show better performance than those in junior stock markets.

Moreover, several scholars have focused on young IPO firms (e.g. Kroll et al. 2007; Walters et al. 2010; Le et al. 2013). Post-IPO performance in technology-oriented industries, such as the Internet (Jain et al. 2008; Wagner and Cockburn 2010) and biotechnology (Liu et al. 2012; Guo and Zhou 2016) has been examined. However, whether young firms devoted to the development of high-tech products are more likely to grow remains unclear. It is not evident that junior stock markets play a role in fostering young and innovative firms.

While most studies have investigated the survival probability (i.e. the time to failure), Carpentier et al. (2010) and Carpentier and Suret (2011) examined the success probability; specifically, they examined the time to graduation to the main stock market using IPOs on TSXV and found that innovative firms devoted to the development of high-tech products are more likely to graduate from TSXV. Their findings on the graduation of IPO firms could provide valuable

[3] Jain and Kini (1999) used binary and multinomial choice models to identify the determinants of three post-IPO states: survivor, non-survivor, and acquired.

[4] Many studies have examined IPO survival using data on IPOs in the United States (Chou et al. 2013; Gounopoulos and Pham 2018; Feng et al. 2020). Outside the United States, the post-IPO performance of firms listed on the Australian Stock Exchange (Chancharat et al. 2012), the Hong Kong Stock Exchange (Espenlaub et al. 2016b), the London Stock Exchange (Ahmad and Jelic 2014), the Milan Stock Exchange (Cirillo et al. 2017), the Shanghai and Shenzhen Stock Exchanges (Pour 2015), and the Taiwan Stock Exchange (Yang and Sheu 2006) has been examined. Espenlaub et al. (2016b) also examined the impact of legal institutions on IPO survival using data on IPOs in 32 economies.

evidence on the effects of initial listing requirements in junior stock markets. To the best of our knowledge, however, few studies examine the time to graduation from junior stock markets.[5] Further studies on graduation in other markets would be useful to better understand the role of junior stock markets in fostering IPO firms with growth potential.

2.4 Junior stock markets in Japan

By the early 2000s, junior stock markets for new ventures were founded in the Japanese stock exchanges: MOTEHRS (TSE), Ambitious (Sapporo Stock Exchange), Centrex (Nagoya Stock Exchange), Hercules (formerly NASDAQ Japan) (Osaka Stock Exchange; OSE), and Q-Board (Fukuoka Stock Exchange). Among the junior stock markets, MOTHERS is one of the leading junior stock markets for new ventures in Japan. MOTHERS was opened in the TSE in November 1999 to target young and small firms with growth potential at an early stage of their development. Further, JASDAQ was founded in December 2004 when the OTC market was renamed JASDAQ after NASDAQ in the United State and reorganized as a general stock exchange. NEO, a special market of JASDAQ for new ventures, was also founded in August 2007. Thereafter, the OSE acquired more than half of the shares of JASDAQ in December 2008, and JASDAQ was absorbed into the OSE in April 2010. JASDAQ and NEO, in addition to Hercules, were reorganized as the new JASDAQ in October 2010. Moreover, the TSE and OSE merged, and the Japan Exchange Group (JPX) emerged in July 2013. Eventually, both MOTHERS and JASDAQ became subsidiaries of the TSE hold by the JPX, and they are regarded as Japan's representative junior stock markets.[6]

The number of IPOs on MOTHERS and JASDAQ was almost 100 in 2005 and 2006. However, when the global financial crisis occurred in 2008, the number of IPOs on MOTHERS and JASDAQ decreased considerably. This fall in the number of IPOs may have partly occurred because IPOs become less attractive for privately held firms, compared with mergers and acquisitions (M&A) (Gao et al. 2013). However, M&A are much less common as a successful sellout strategy in Japan (Kubo and Saito 2012; Honjo and Nagaoka 2018). The number of IPOs on MOTHERS has gradually increased with the economic recovery to the point that they now account for a large proportion of IPOs in Japan. Fig. A1 in the Appendix illustrates the number of

[5] Some studies have examined transferring from NASDAQ to the American or New York Stock Exchanges (e.g. Dharan and Ikenberry 1995; Cheng 2005). Others have examined transferring between AIM and the London Stock Exchange (e.g. Vismara et al. 2012; Jenkinson and Ramadorai 2013).

[6] For more details on the histories of stock exchanges in Japan, see the following JPX website.
https://www.jpx.co.jp/english/corporate/about-jpx/history/index.html [accessed on January 14, 2021]

IPOs in the Japanese stock markets over time.

One main difference between MOTHERS and JASDAQ is related to their regulations. The TSE announced the revision of delisting criteria for firms listed for more than 10 years on MOTHERS ("10-year rule" hereafter) in March 2011, and the 10-year rule was applied to firms listed on MOTHERS in March 2014. The delisting criteria of the 10-year rule contain the number of shareholders, tradable shares, and market capitalization. Firms listed on MOTHERS, unlike JASDAQ, must overcome these delisting criteria within 10 years after going public.[7] In addition, firms listed for more than 10 years on MOTHERS are required to choose to either remain listed on MOTHERS or alter their listing to the Second Section of the TSE. If a firm chooses to remain listed on MOTHERS, it makes its next choice five years later. By contrast, the 10-year rule has not been introduced to JASDAQ.

Whereas some studies have examined listing regulations on stock exchanges (e.g. Gerakos et al. 2013; Akyol et al. 2014; Cattaneo et al. 2015), research on the effect of changes in listing rules in junior stock markets globally is scarce. In particular, it is unclear whether the listing regulations of junior stock markets help foster firms with growth potential. As discussed, the Japanese junior stock markets are a valuable case to examine the impact of listing regulations through comparison tests because the delisting criteria differ between MOTHERS and JASDAQ.

2.5. Hypothesis development

Gaining access to a source of financing alternative to banks is one benefit of an IPO (Pagano et al. 1998). As firms expect to raise more capital through an IPO, they increase financing cash flow after going public. In addition, young and innovative firms, which can be assumed to have higher demand for investment in R&D, have more incentive to access public equity markets by going public (Honjo 2020). Young firms devoted to R&D may seek access to public equity markets in countries where private equity capital, including venture capital (VC), is underdeveloped. Moreover, access to public equity markets helps some firms acquire bridge financing, partly because VC seeks to recover their investment, especially in Japan, where VC tends to invest in firms in their early stages (Honjo and Nagaoka 2018). Thus, we test the following hypothesis:

H1: IPO firms, including young and innovative firms, are more likely to increase financing cash flow by going public.

[7] For more details on the delisting criteria for firms listed on MOTHERS, see the following JPX website. https://www.jpx.co.jp/english/equities/listing/criteria/mothers/index.html [accessed on August 18, 2020]

The ultimate goal of junior stock markets is to transfer high-performing firms to main stock markets (Carpentier et al. 2010). Firms with an incentive to grow rapidly may seek the next stage after going public in junior stock markets. In addition to financing cash flow, young and innovative firms that have gone public are expected to improve operating performance and cash flow by securing access to public equity markets, which serves to lower their financial constraints. If young and innovative firms in junior stock markets perform better through access to public equity markets, they may seek to graduate to main stock markets. However, firms can overstate pre-IPO operating performance by window-dressing (Jain and Kini 1994). In addition, poor operating performance after going public may be prominent in small and young firms (Mikkelson et al. 1997). Whereas young and innovative firms have more incentive to access public equity markets, they are less likely to improve operating performance by overstating it before going public. Moreover, the success of projects undertaken by young and innovative firms is highly uncertain, even if they achieve an IPO in junior stock markets. Without successful projects, it would be difficult to graduate to main stock markets. Thus, we test the following hypothesis:

H2: Young and innovative firms are less likely to graduate from junior stock markets.

As noted above, firms with growth opportunities have more incentive to graduate to main stock markets (Carpentier et al. 2010). In the literature, growth opportunities are often captured by market capitalization (e.g. Kogan and Papanikolaou 2014). Moreover, according to the undervaluation hypothesis, firms go private when share prices are undervalued in relation to the true potential of firms (Renneboog et al. 2007; He et al. 2010). This indicates that firms with lower market capitalization have more incentive to delist from junior stock markets. By contrast, it is likely that firms with higher market capitalization have more incentive to graduate to main stock markets. Thus, we test the following hypothesis:

H3: Firms with higher market capitalization are more likely to graduate to main stock markets.

The promotion system in junior stock markets may encourage IPO firms to graduate from the markets. Such promotion system may lead to an increase in the likelihood of graduation from junior stock markets. As already mentioned, listing regulations on graduation within 10 years were introduced only to MOTHERS but not to JASDAQ. However, it is unclear whether the intended effects of regulatory reforms are amplified for IPOs on MOTHERS. To clarify the impact of listing regulations on the likelihood of graduation from junior markets, we test the following

hypothesis:

H4: Firms listed on MOTHERS are more likely to graduate to main stock markets than those listed on JASDAQ.

Several listing requirements must be fulfilled to graduate to main stock markets. These requirements for the TSE include criteria related to the number of shareholders, tradable shares, trading volume, market capitalization, net assets, and net profits. These requirements reflect firms' growth potential in main stock markets. Among the requirements, market capitalization seems to be more binding for IPO firms in junior stock markets.[8] Moreover, IPO firms that seek the next stage after going public in junior stock markets have a growth orientation. Such firms may be highly evaluated in main stock markets because higher listing requirements provide a signaling effect (Johan 2010). However, Carpentier et al. (2010) using IPOs on TSXV found that firms graduating to the main market are followed by a negative but insignificant. To identify post-graduated performance, we test the following hypothesis:

H5: Firms that graduate from junior stock markets to main stock markets perform better.

3 Method

3.1 Operating performance before and after going public

To assess operating and financing performance before and after going public, we measure profitability (operating profit ratio), operating and financing cash flow, and sales. The performance measures are then compared with those before the IPO. Specifically, we provide the means and medians of the operating and financing performance measures in years $T-1$, T, and $T+1$ where T is the accounting year after the IPO. In addition, we present the mean and median of market capitalization after going public.

3.2. Time to graduation: cumulative hazard estimates

We describe the time to graduation to the TSE main markets using the cumulative hazard function proposed by Nelson (1972) and Aalen (1978). Let T_i denote the time to firm i's graduation to a main stock market, where the starting point is set to firm i's IPO date (month) in a junior stock

[8] Other listing requirements, such as tradable shares, trading volume, and net profits, may also become determinants of graduation to main stock markets. However, these requirements are related to market capitalization. To avoid multicollinearity, this study examines the impact of market capitalization on graduation to main stock markets.

market. However, many firms remain in the junior stock market after an IPO; in this case, T_i is not observable during the observation window. Let C_i denote the censoring time, which depends on the duration of the observation window, and T_i is observed if $T_i \leq C_i$. Suppose that T_i is observed for n firms in the sample and $T_1 \leq T_2 \leq \ldots \leq T_n$. In this case, the cumulative hazard function proposed by Nelson (1972) and Aalen (1978) is given by

$$\widehat{H}(t) = \sum_{j|T_j<t}^{n} \frac{d_j}{n_j}. \quad (1)$$

where d_j is the number of firms that have graduated to the main stock market at time T_j, and n_j is the number of firms that remain until T_j. Following Eq. (1), we obtain the cumulative hazard estimate of graduation to the main stock market.

We calculate the cumulative hazard estimates of the graduation of IPO firms for MOTHERS and JASDAQ, as well as before and after the announcement of the 10-year rule in March 2011. Moreover, we examine the graduation of young (IPO) firms, defined as those conducting an IPO within six years after founding, and (IPO) firms with high R&D intensity, defined as those with a ratio of R&D expenditures to sales of 1% or more.

3.3. Time to graduation: regression estimation

To describe the determinants of graduation, we estimate a regression equation for graduation to main stock markets among IPO firms. For this purpose, a binary logit or probit model has often been used. However, we use the proportional hazards model ("PH model" hereafter) proposed by Cox (1972) to take into account the time to an event (i.e., the time from the IPO to graduation to the main stock market). Hence, we examine how quickly firms graduate to the main stock market. Generally, the hazard function, $h_i(t; x_i)$, is written as follows:

$$h_i(t; x_i) = h_0(t)\exp(x_i'\gamma), \quad (2)$$

where x_i is a vector of the covariates affecting the graduation, γ is a vector of the parameters to be estimated, and $h_0(t)$ is the baseline hazard.

To test H2 and H3, we include the covariates of firm age (young), R&D intensity, and market capitalization in the regression model. In addition, to control for other firm-specific characteristics, we add the covariates of fixed assets, leverage (debt ratio), and the industry dummies to the model. Moreover, to clarify the differences in listing regulations—specifically, the 10-year rule—

between MOTHERS and JASDAQ, we include the dummies for MOTHERS and the 10-year rule. More importantly, to identify the impact of listing regulations on graduation to main stock markets, we include the cross-terms of the MOTHERS and 10-year rule dummies, following the analytical framework of difference-in-difference approach. We present the definitions of the variables in Table A1 in the Appendix.

Moreover, we employ a competing-risks regression model ("CR model" hereafter) to take into account the different types of events other than graduation. This is because the presence of competing events—specifically, delisting from junior stock markets—may impede the event of interest, which is graduation from junior stock markets in this study. Indeed, as shown later, more than 10% of the 943 IPOs in the TSE junior markets delist from the markets up to January 2020. In the Appendix, we further provide the estimation results of graduation to the TSE main markets using a parametric survival model, often called an accelerated failure-time (AFT) model, used in previous studies (e.g. Ahmad and Jelic 2014; Espenlaub et al. 2016a, 2016b).

3.4. Post-IPO performance

Following studies that have employed BHARs to assess post-IPO performance (e.g. Gao and Jain 2011; Gao et al. 2013), we measure the BHARs of firms that graduate to main stock markets.[9] We calculate the BHARs of firm i in month τ after graduation ($BHAR_{i\tau}$) as follows:

$$BHAR_{i\tau} = \prod_{t=1}^{\tau}(1 + R_{it}) - \prod_{t=1}^{\tau}\big(1 + E(R_{it})\big) \tag{3}$$

where R_{it} is the return of firm i's market value in month t, and $E(R_{it})$ is the benchmark return, which has often been measured by market indices, such as the Tokyo Stock Price Index (TOPIX).

Moreover, we construct an original index ("new IPO index" hereafter) to capture the benchmark return more precisely. Practically, market indices include older firms with a long history in established stock exchanges. However, it may be inappropriate to include older firms when we evaluate post-IPO performance in junior stock markets in which younger firms tend to go public. Thus, our new IPO index consists of firms directly conducting an IPO in the TSE main markets after the emergence of the TSE junior markets. Specifically, we select non-financial firms

[9] Other scholars used buy-and-hold returns without controlling for average changes in the markets (e.g. Gerakos et al. 2013).

that directly conducted an IPO in the TSE main markets (First and Second sections of the TSE) after December 1999 when the first IPO was launched on MOTHERS. This index is based on the market capitalization of these firms directly listed on the TSE main markets. Furthermore, we present the post-IPO performance of the following groups: (1) young firms (young), (2) firms with high R&D intensity (R&D intensity), and (3) early graduated firms (early graduation), defined as those that graduated to the TSE main markets within two years of going public in the TSE junior markets.

4 Data

4.1 Data sources

We construct a list of IPOs on MOTHERS and JASDAQ (including NEO) using *Kabushiki Kokai Hakusho* (White Paper on IPOs) edited by Pronexus, Inc. We also use the Nikkei Needs Financial Quest database compiled by Nikkei to include data on the annual financial statements and monthly market capitalization of the sample firms. Hence, the sample excludes IPOs on senior stock exchanges (i.e., TSE, Sapporo Stock Exchange, Nagoya Stock Exchange, OSE, and Fukuoka Stock Exchange) and junior stock markets other than MOTHERS and JASDAQ (i.e. Ambitious, Centrex, Hercules, and Q-board).[10] In addition, the sample excludes firms listed on the OTC market and NASDAQ Japan (subsequently Hercules).[11] Among IPOs on MOTHERS and JASDAQ, 27 financial firms were excluded from the sample. In addition, eight firms were excluded as outliers.[12] As a result, the sample consists of 943 non-financial firms: 631 IPO firms on MOTHERS from November 1999 to the end of December 2019 and 314 IPO firms on JASDAQ from December 2004 to the end of December 2019. We observe the time to IPO firms'

[10] In this study, we ignore listing experience in the Tokyo Pro Market (formerly Tokyo AIM), a special market that offers new investment opportunities to professional investors. In practice, two firms (Ci Medical and Global Bridge Holdings) were listed on the Tokyo Pro Market before going public on JASDAQ and MOTHERS, respectively. These firms are regarded as IPOs on MOTHERS and JASDAQ, respectively.

[11] One firm (Precision System Science) that was listed on NASDAQ Japan and graduated to JASDAQ in October 2010 is not included in the sample.

[12] Originally, we obtained a list of 980 IPO firms from *Kabushiki Kokai Hakusho*. Among these 980 firms, some financial firms are excluded from the sample. In addition, two firms (Kyotaru and SDS Biotech) listed on JASDAQ are excluded from the sample because they have experience in listing and delisting from the TSE and OTC market, respectively. Five firms are excluded from the sample because these firms are regarded as the group of foreign firms by Nikkei. Moreover, one firm (Global Kids Company) is excluded because it was reorganized as a holding company and went public within one year, and one firm (Total Medical Service) is excluded because we cannot obtain positive market capitalization from the Nikkei Needs Financial Quest.

graduation and delisting from these markets up to January 2020. In other words, the time to graduation and delisting is right censored.

4.2 Sample

Table 1 provides the distribution of IPO firms for graduation and delisting (demotion) in the sample. Among the 943 IPOs in the TSE junior markets, 48% graduate to the TSE main markets up to January 2020. Of the 631 IPOs on MOTHERS, 41% graduate to the TSE main markets, compared with 35% of the 314 IPOs on JASDAQ. By contrast, 12% delist from MOTHERS, and 17% delist from JASDAQ. Hence, 47% and 48% retain their status on MOTHERS and JASDAQ, respectively.

Considering the purpose of junior stock markets to provide funds to young and innovative firms, we examine whether such firms are more likely to graduate to the TSE main markets. Table 1 provides the distributions of IPO firms that graduate and delist. As shown in Table 1, we find no evidence that young and innovative firms are more likely to graduate to the TSE main markets. Rather, innovative firms—more precisely, firms with high R&D intensity—tend to remain in the TSE junior markets. Hence, these firms do not aim higher, even though they need to secure more funds for R&D investment. Using the subsample of firms that went public after the announcement of the 10-year rule in March 2011, we find that the proportion of retentions on MOTHERS and JASDAQ is higher because the observation window in the subsample is shorter than that in the entire sample. Further, the proportion of firms graduating from MOTHERS is slightly below that of those graduating from JASDAQ, which is different from the result in the entire sample.

Table 2 presents the time to graduation and delisting from the TSE junior markets. The mean times to graduation from MOTHERS and JASDAQ are 60 and 51 months (approximately less than or equal to five years), respectively. In addition, the median times to graduation from MOTHERS and JASDAQ are 32 and 30 months (approximately less than three years), respectively. As the minimum times indicate, few firms graduate to the TSE main markets within a year.

4.3 Operating performance and market capitalization

Table 3 presents the operating performance of IPO firms on MOTHERS and JASDAQ, based on their operating profits, operating cash flow, and financing cash flow in the pre- and post-IPO years in MOTHERS and JASDAQ, respectively. These are divided by total assets; in other words, we calculate the operating profit ratio (return on assets), the operating cash flow ratio, and the financing cash flow ratio. Table 3 also includes mean and median sales.

As shown in Table 3, the mean and median operating profit and operating cash flow ratios in the post-IPO years (T and $T+1$) are below those in the pre-IPO year ($T-1$). These results are consistent with those of previous studies (e.g. Jain and Kini 1994; Mikkelson et al. 1997). The results indicate that firms do not improve their operating performance by going public in the TSE junior markets. By contrast, the mean and median financing cash flow ratios in the post-IPO year (T) are considerably above those in the pre-IPO year ($T-1$), indicating that firms increase financing cash flow by going public. In addition, IPO firms increase sales after going public in the TSE junior markets. On the reasons why firms go public, some scholars have emphasized financial expansion (e.g. Jain and Kini 1994; Mikkelson et al. 1997), and others have suggested rebalancing after high investment and growth (e.g. Pagano et al. 1998). Our results suggest that firms listed on the TSE junior markets require more funds to assist their financial expansion and rebalancing.

As shown in Table 3, the mean and median financing cash flow ratios for young IPO firms and those with high R&D intensity in the post-IPO year (T) are also above those in the pre-IPO year ($T-1$), indicating that these firms raise more capital through an IPO in the TSE junior markets. The results provide strong support for H1. We thus provide evidence that young IPO firms and those with high R&D intensity are more likely to increase financing cash flow by going public. However, the mean and median operating profit and operating cash flow ratios for young IPO firms and those with high R&D intensity in the subsequent year ($T+1$) are below those in the pre-IPO year ($T-1$). Hence, we find no evidence that young and innovative firms increase operating profits and operating cash flow.

Table 4 presents the market capitalization of IPO firms, as well as the market-to-book ratio, measured by the ratio of market capitalization to the book value of equity. The mean market capitalization is approximately JPY 18 billion in the post-IPO year (T) on MOTHERS above that on JASDAQ. Further, market capitalization does not increase between the post-IPO year (T) and the subsequent year ($T+1$). The mean market-to-book ratio is over six and its median is over four in the post-IPO year. However, firms listed on the TSE junior markets are more likely to decrease the market-to-book ratio from T to $T+1$. Moreover, young and innovative firms tend to decrease their market-to-book ratios over time.

5 Results

5.1 Cumulative hazard estimates

Fig. 1(a) illustrates the cumulative hazard estimates of graduation to the TSE main markets. Fig. 1(b) shows those estimates when the sample is restricted to IPOs in or after December 2004. The

cumulative hazard estimate of graduation from MOTHERS is above that from JASDAQ. These results reveal that IPO firms on MOTHERS are more likely to graduate to the TSE main markets than those on JASDAQ.

Fig. 2(a) illustrates the cumulative hazard estimates of graduation of IPO firms on MOTHERS before and after the announcement of the 10-year rule (IPOs before March 2011). Fig. 2(b) show those estimates of graduation of IPO firms on JASDAQ. The cumulative hazard estimate of graduation after the announcement of the 10-year rule both on MOTHERS and on JASDAQ is above that before it. These results reveal that IPO firms are more likely to graduate from both MOTHERS and JASDAQ after the announcement of the 10-year rule. The cumulative hazard estimates are similar for the samples of IPOs on MOTHERS and JASDAQ. Although the number of IPOs on MOTEHRS increased after the global financial crisis (see Fig. A1) and announcement of the 10-year rule, the ratio of firms graduating from MOTHERS is not necessarily higher than that of those from JASDAQ.

5.2 Determinants of the time to graduation

Table 5 presents the estimation results for graduation from the TSE junior markets using the survival analysis approach. While we estimate the hazard ratios in columns (i) and (ii) using the PH model, we estimate the sub-hazard ratios in columns (iii) and (iv) using the CR model where delisting is a competing event. The cross-term of the MOTHERS and 10-year rule dummies is included in columns (ii) and (iv).

As shown in Table 5, the hazard ratios of firm age are above one, and its coefficients are significant at the 1% level. This indicates that young firms listed on the TSE junior markets are less likely to graduate from the TSE junior markets. Rather, such firms tend to remain in the TSE junior markets. In addition, the hazard ratios of R&D intensity are above one, and its coefficients are significant at the 1% level. This indicates that firms devoted to R&D are less likely to graduate from the TSE junior markets. These results provide supportive evidence for H2. Although young and innovative firms acquire financing cash flow by going public, it is typically difficult for them to graduate from junior stock markets by achieving successful outcomes.

The hazard ratios of fixed assets are below one, indicating that firms with more fixed assets are less likely to graduate from the TSE junior markets. In addition, the hazard ratios of leverage are above one, indicating that firms with high leverage are more likely to graduate to the TSE main markets. However, their coefficients are not sufficiently significant. Moreover, the hazard ratios of market capitalization are above one, and its coefficients are significant at the 1% level. We find that firms with higher market capitalization are more likely to graduate to the TSE main

markets.[13] These results provide support for H3, and firms highly evaluated in junior stock markets tend to graduate to main stock markets. Among the industry dummies, the hazard ratios of ICT and infrastructure and energy industries are above one, and their coefficients are significant. The results indicate that firms in ICT, infrastructure, and energy sectors are more likely to graduate to the TSE main markets.

In Table 5, the hazard ratios of the dummy for MOTHERS are above one, indicating that IPO firms on MOTHERS are more likely to graduate to the TSE main markets than those on JASDAQ. This is consistent with the differences in the cumulative hazard ratios in Fig. 1, although its coefficients are insignificant in columns (ii) and (iv). The hazard ratios of the dummy for the 10-year rule is above one, indicating that firms in the TSE junior markets are more likely to graduate to the TSE main markets after the announcement of the 10-year rule. However, the hazard ratios of the cross-term of the MOTHERS 10-year rule dummies are not significant in columns (ii) and (iv). We find no evidence that the time to graduation from MOTHERS to the TSE main markets increases after the announcement of the 10-year rule, compared with the time to graduation from JASDAQ. These results do not support H4. The finding suggests that the announcement of the 10-year rule does not increase graduation from MOTHERS.

However, if IPO firms' decisions to select MOTHERS and JASDAQ are affected by the announcement of the 10-year rule, the selection of the TSE junior market occurs in and after its accouchement. To account for this selection, we estimate the regression equation for graduation from the TSE junior markets when the sample is restricted to IPOs before March 2011. Similar to Table 5, Table 6 presents the estimation results. In Table 6, we find that the cross-term of the MOTEHRS and 10-year rule dummies, in addition to each dummy, are above one, and these coefficients are significant in column (iv). The results indicate that the time to graduation from MOTHERS to the TSE main markets increase after the announcement of the 10-year rule, compared with the time to graduation from JASDAQ, which supports H4. This finding suggests that IPO firms before the announcement of the 10-year rule have more incentives to graduation from MOTHERS. From the results shown in Tables 5 and 6, we can infer that IPO firms that seek graduation from the TSE junior markets are less likely to select MOTHERS introduced listing regulations in and after the announcement of the 10-year rule. This finding also suggests that the promotion system introduced to MOTHERS motivates IPO firms to aim higher, especially when they went public without being aware of listing regulations on graduation to the TSE main markets.

[13] We also estimated the regression model using the covariate of market indices (TOPIX), instead of the covariate of market capitalization and 10-year rule, and found that the hazard ratio for graduation from the TSE junior markets is above one, suggesting that firms are more likely to graduate to main stock markets as the markets recover.

5.3 Post-IPO performance of graduated firms

Table 7 presents the post-IPO performance of firms that graduate to the TSE main markets (up to January 2020). Using the TOPIX and new IPO index, we calculate the BHARs of graduated firms. For IPO firms on the TSE junior market from December 1999 to December 2019, we calculate their BHARs up to December 2020. Fig. A2 in the Appendix displays the trend of the new IPO index. Table 7 presents the mean and median BHARs of graduated firms, with the observation windows of 3, 6, 12, 24, and 36 months. In addition, we provide the mean and median BHARs on MOTHERS and JASDAQ. As shown in Table 7, the mean BHARs of firms that graduated from MOTHERS and JASDAQ are positive for all the observation windows, while the median BHARs are partially negative. In particular, the mean BHARs are significant at the 1% level when we calculate them using the TOPIX, indicating that graduated firms show better post-IPO performance than firms remaining in the TSE main markets, supporting H5. Our findings suggest that IPO firms that aim higher perform better by graduating to main stock markets. Meanwhile, the mean BHARs are significant only in the 12-, 24-, and 36-month observation windows when we calculate the BHARs using the new IPO index. These results indicate that firms that graduate to the TSE main markets are highly evaluated over a certain period. Conversely, we can infer that such firms are not highly evaluated within one year, compared to those directly having an IPO in the TSE main markets after the emergence of the TSE junior markets.

Furthermore, Table 8 presents the post-IPO performance of (1) young firms (young), (2) firms with high R&D intensity (R&D intensity), and (3) early graduated firms (early graduation). In this study, early graduated firms are defined as those that graduate to the TSE main markets within two years (24 months) after going public in the TSE junior markets. As shown in Table 8, the mean BHARs of young, R&D-intensive, and early graduated firms are positive are significant at the 1% level when we calculate the BHARs using the TOPIX. This indicates that junior stock markets provide young and innovative firms with risk capital and they show better post-IPO performance than firms listed on the TSE main markets. However, we find no evidence that the mean BHARs of young, R&D-intensive, and early graduated firms are insignificant using the new IPO index, indicating that these firms do not show better post-IPO performance than those directly having an IPO in the TSE main markets. Our findings suggest that young and innovative firms do not necessarily exhibit significant performance via junior stock markets, even though junior stock markets provide them with risk capital.

Finally, Tables 9 and 10 present the BHARs of firms that graduate to the TSE main markets (up to January 2020), in addition to young firms (young), (2) firms with high R&D intensity (R&D

intensity), and (3) early graduated firms (early graduation), when the sample is restricted to IPOs before March 2011. We find that the mean BHARs are significant at the 1% level when calculating them using the TOPIX. We also find that the mean BHARs are positive but insignificant only in the 36-month observation window when calculating them using the new IPO index. As shown in Table 9, these results are almost similar to those shown in Table 7, and they are robust when we account for the selection due to the announce of the 10-year rule. Moreover, as shown in Table 10, the results for young firms, firms with high R&D, and early graduated firms are similar to those shown in Table 8 when we calculate the BHARs using the TOPIX. However, the results for graduated firms in Table 10 show that the mean BHARs are negative and partially significant when we calculate the BHARs using the new IPO index. This finding indicate that early graduated firms show worse post-IPO performance, compared to firms directly having an IPO in the TSE main markets.

6 Conclusions

6.1 Summary

This study explored the post-IPO behavior and performance of firms listed on the two TSE junior markets: MOTHERS and JASDAQ. In our sample, approximately 40% of IPO firms graduate to the TSE main markets, while more than 10% of IPO firms delist from the TSE junior markets. The results also revealed that firms listed on the TSE junior markets increase financing cash flow by accessing public equity markets. Moreover, using a survival analysis approach, we examined the factors associated with the time to graduation to the TSE main markets. As a result, we found that young IPO firms and those with high R&D intensity are less likely to graduate from the TSE junior markets. The results indicate that even if firms achieve an IPO in junior stock markets shortly after founding, they do not necessarily improve operating performance by going public. Moreover, IPO firms with high R&D intensity do not perform better, despite improving their financing cash flow considerably, suggesting that many, but not all, innovative firms simply secure external financing for R&D by going public. The results indicate that these firms in the TSE junior markets simply increase financing cash flow by accessing public equity markets. In addition, firms with higher market capitalization are more likely to graduate to the TSE main markets. The results also revealed that listing regulations on graduation to the TSE main markets within 10 years that apply only to IPOs on MOTHERS accelerate the graduation of IPO firms when the sample is restricted to firms listed before the announcement of the 10-year rule. Furthermore, we provided evidence that IPO firms that ultimately graduate to the TSE main markets show better post-IPO performance.

The findings of this study provide valuable insights into firms' behavior and performance after going public. While the existing literature tends to focus on the survival of IPO firms in established stock markets (e.g. Jain and Kini 1999, 2000), our findings provide novel evidence of their development in junior stock markets. IPO firms should aim higher—specifically, they should quickly seek to climb to main stock markets—to raise performance. Whether IPO firms can graduate from junior stock markets leads to the true value of these firms to materialize. However, the results of this study indicate that young and innovative firms do not necessarily graduate to the TSE main markets. Although junior stock markets aim to provide equity financing to young and innovative firms with growth potential, these firms do not necessarily aim higher after their IPOs. Our findings suggest that IPOs in junior stock markets are not sufficient conditions for young and innovative firms to expand. Some firms investing heavily in R&D simply go public to maintain R&D activity by accessing public equity markets, and thus they may become complacent.

6.2 Limitations and implications

This study has the following limitations. First, a change in corporate ownership and management, which may create additional value for an IPO firm, may follow an IPO (Kim et al. 2004; Bruton et al. 2010). The top management team may also affect post-IPO performance (Kroll et al. 2007; Walters et al. 2010; Le et al. 2013).[14] However, we did not examine the impact of corporate ownership and management on post-IPO performance. Second, young and innovative firms could growth by entering into M&A, even though these markets are underdeveloped in Japan (Honjo 2020). However, we did not include a discussion on M&A. Third, we did not take into account the selection of foreign markets. Further investigation into these limitations is warranted.

Despite these limitations, we provide valuable insights into post-IPO performance using the case of the TSE junior markets in Japan, principally that young and innovative firms do not necessarily perform better by going public, whereas IPO firms that aim higher by graduating to the TSE main markets do raise their performance. Carpenter and Rondi (2006) argued that going public does not guarantee faster growth or more jobs and that policies that simply increase access to public equity markets are ineffective unless the policies incentivize firms' decision makers to use new capital for growth. Their results indicate that firms do not improve performance without having a growth orientation, even if they overcome financial constraints through an IPO. Moreover, no improvement of post-IPO performance of young and innovative firms may be due to window-dressing in the IPO process (Jain and Kini 1994; Klein and Li 2009). Hence, we should

[14] Gao and Jain (2012) investigated the impact of founder-CEOs on post-IPO performance.

recognize that an IPO in junior stock markets is simply a way to secure access to public equity markets and restructure management and control.

Young and innovative firms with growth potential often attract policymakers because they are expected to stimulate the stagnant economy (Honjo 2020). In this respect, junior stock markets play a role by providing equity financing for these firms, thereby promoting economic growth through entrepreneurship. Our novel findings on the impact of listing regulations on the behavior and performance of IPO firms in junior stock markets—specifically listing regulations on graduation within 10 years, which were introduced only to MOTHERS—suggest that firms listed on junior stock markets with listing regulations are more likely to graduate to main stock market, thus leading to the creation of fast-growing firms. Such regulations may provide incentives for IPO firms to aim higher. The promotion system introduced to MOTHERS motivates IPO firms to aim higher, especially when they went public without being aware of listing regulations on graduation to the TSE main markets. These findings improve our understanding of the consequences of regulatory reforms in junior stock markets, which would be helpful in the TSE's market restructuring scheduled in April 2022.

Appendix

Table A1 presents the definitions of the variables used in this study. Table A2 presents the mean and median operating performance, market capitalization, and market-to-book ratio of IPO firms on MOHERS and JASDAQ in terms of graduation, retention, and delisting. To check the robustness of our results, Table A3 presents the estimation results of the time to graduation to the TSE main markets for the subsample of firms that went public in or after December 2004. Table A4 also presents those of the time to graduation using the AFT model: the exponential, Weibull, log-normal, log-logistic, and generalized gamma distributions. It is important to note that Table A4 provides the estimated coefficients of the covariates, while Tables 5 and A3 provides the estimated hazards and sub-hazards. These findings in Tables A3 and A4 are consistent with those reported in Table 5. Fig. A1 displays the number of IPOs in the Japanese stock markets over time. Fig. A2 displays the trend of the TOPIX, in addition to the new IPO index proposed in this study.

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Table 1 Distribution of IPO firms for graduation and delisting from the TSE junior markets (MOTHERS and JASDAQ).

	IPO	(%)	Graduation	(%)	Retention	(%)	Delisting	(%)
All	943	(100)	370	(39)	448	(48)	125	(13)
MOTHERS	630	(100)	261	(41)	296	(47)	73	(12)
JASDAQ	313	(100)	109	(35)	152	(49)	52	(17)
Young	186	(100)	72	(39)	72	(39)	42	(23)
R&D intensity (pre-IPO)	215	(100)	59	(27)	124	(58)	32	(15)
(10-year rule)								
All	495	(100)	172	(35)	317	(64)	6	(1)
MOTHERS	385	(100)	128	(33)	253	(66)	4	(1)
JASDAQ	110	(100)	44	(40)	64	(58)	2	(2)
Young	72	(100)	22	(31)	48	(67)	2	(3)
R&D intensity (pre-IPO)	94	(100)	20	(21)	74	(78)	0	(0)

The sample consists of IPO firms that have gone public in MOTHERS and JASDAQ until the end of December 2019. Retention, graduation, and delisting are measured in January 2020. “Young” is defined as a firm conducting an IPO within six years after founding. “R&D intensity (pre)” is defined as a firm with 1% and more of the ratio of R&D expenditures to sales in pre-IPO accounting year. “10-year rule” targets those that have gone public after the announcement of the 10-year rule (in or after March 2011). Figures in parentheses are the percentages of frequencies by row in each column.

Table 2 Time to graduation to the TSE main markets.

Market	Mean	SD	Min	25%	Median	75%	Max	*N*
MOTHERS	60.3	52.5	7	17	32	125	178	261
JASDAQ	50.9	40.3	6	18	30	84	150	109

This table presents the descriptive statistics of the time to IPO firms' graduation to the TSE main markets. All figures are measured by the number of months. The sample consists of IPO firms on MOTHERS from November 1999 to December 2019 and those on JASDAQ from December 2004 to December 2019. SD indicates standard deviation. *N* indicates the number of firms.

Table 3 Mean and median of operating performance of IPO firms.

	All			MOTHERS			JASDAQ			Young			R&D intensity (pre-IPO)		
	Mean	Median	*N*	Mean	Median	*N*	Mean	Median	*N*	Mean	Median	*N*	Mean	Median	*N*
Operating profit ratio															
$T-1$	0.128	0.121	942	0.138	0.142	630	0.108	0.098	312	0.149	0.135	186	0.080	0.109	215
T	0.113	0.114	913	0.120	0.126	603	0.100	0.095	310	0.112	0.119	183	0.074	0.097	208
(vs. $T-1$)	[0.001]	[0.000]	912	[0.002]	[0.000]	603	[0.047]	[0.008]	309	[0.026]	[0.000]	183	[0.392]	[0.086]	208
$T+1$	0.069	0.082	830	0.070	0.088	536	0.068	0.076	294	0.051	0.068	164	–0.020	0.031	191
(vs. $T-1$)	[0.000]	[0.000]	829	[0.000]	[0.000]	536	[0.000]	[0.000]	293	[0.000]	[0.000]	164	[0.000]	[0.000]	191
Operating cash flow ratio															
$T-1$	0.091	0.102	927	0.104	0.124	616	0.065	0.078	311	0.084	0.099	178	0.048	0.084	212
T	0.069	0.083	913	0.076	0.094	603	0.056	0.063	310	0.060	0.076	183	0.035	0.048	208
(vs. $T-1$)	[0.003]	[0.000]	897	[0.005]	[0.000]	589	[0.280]	[0.007]	308	[0.454]	[0.027]	175	[0.268]	[0.077]	205
$T+1$	0.031	0.057	830	0.024	0.050	536	0.043	0.063	294	–0.010	0.024	164	–0.036	0.014	191
(vs. $T-1$)	[0.000]	[0.000]	815	[0.000]	[0.000]	523	[0.057]	[0.002]	292	[0.001]	[0.000]	156	[0.000]	[0.000]	188
Financing cash flow ratio															
$T-1$	0.076	0.006	889	0.103	0.026	581	0.024	–0.011	308	0.180	0.068	170	0.126	0.028	201
T	0.240	0.195	913	0.312	0.277	603	0.101	0.073	310	0.364	0.336	183	0.338	0.279	208
(vs. $T-1$)	[0.000]	[0.000]	860	[0.000]	[0.000]	555	[0.000]	[0.000]	305	[0.000]	[0.000]	167	[0.000]	[0.000]	195
$T+1$	0.063	0.003	825	0.094	0.010	532	0.006	–0.013	293	0.127	0.018	162	0.088	0.005	188
(vs. $T-1$)	[0.293]	[0.846]	780	[0.690]	[0.747]	491	[0.096]	[0.929]	289	[0.139]	[0.365]	149	[0.226]	[0.299]	177
Sales (million JPY)															
$T-1$	7,549	3,229	943	4,220	2,023	630	14,251	7,470	313	3,960	1,815	186	4,346	1,725	215
T	9,209	4,119	911	5,595	2,870	602	16,250	8,459	309	5,842	2,883	182	5,147	2,221	206
(vs. $T-1$)	[0.000]	[0.000]	911	[0.000]	[0.000]	602	[0.000]	[0.000]	309	[0.000]	[0.000]	182	[0.000]	[0.000]	206
$T+1$	10,939	5,080	831	6,983	3,537	536	18,126	9,296	295	8,031	3,613	163	5,487	2,453	189
(vs. $T-1$)	[0.000]	[0.000]	831	[0.000]	[0.000]	536	[0.000]	[0.000]	295	[0.000]	[0.000]	163	[0.000]	[0.000]	189

log Sales															
$T-1$	8.091	8.080	943	7.691	7.612	630	8.896	8.919	313	7.550	7.504	186	7.520	7.453	215
T	8.351	8.323	911	8.000	7.962	602	9.035	9.043	309	8.023	7.966	182	7.732	7.706	206
(vs. $T-1$)	[0.000]	[0.000]	911	[0.000]	[0.000]	602	[0.000]	[0.000]	309	[0.000]	[0.000]	182	[0.000]	[0.000]	206
$T+1$	8.509	8.533	831	8.187	8.171	536	9.093	9.137	295	8.238	8.192	163	7.760	7.805	189
(vs. $T-1$)	[0.000]	[0.000]	831	[0.000]	[0.000]	536	[0.000]	[0.000]	295	[0.000]	[0.000]	163	[0.001]	[0.000]	189

This table presents the mean and median of market capitalization and market-to-book ratio of firms listed on MOHERS and JASDAQ. *N* indicates the number of firms. Figures in brackets in rows (vs. $T-1$) and (vs. T), and columns "Mean" are p-values for the paired t tests. Figures in brackets in rows (vs. $T-1$) and (vs. T), and columns "Median" are p-values for Wilcoxon signed-rank test.

Table 4 Mean and median of market capitalization and market-to-book ratio of IPO firms.

	All			MOTHERS			JASDAQ			Young			R&D intensity (pre-IPO)		
	Mean	Median	*N*	Mean	Median	*N*	Mean	Median	*N*	Mean	Median	*N*	Mean	Median	*N*
Market capitalization (million JPY)															
T	18,413	8,333	915	21,447	10,433	605	12,492	4,921	310	32,582	15,387	183	21,802	10,684	208
$T+1$	17,196	6,545	836	21,226	9,229	538	9,921	3,916	298	31,279	11,106	164	17,636	6,302	191
(vs. T)	[0.042]	[0.000]	836	[0.516]	[0.016]	538	[0.000]	[0.000]	298	[0.325]	[0.001]	164	[0.033]	[0.000]	191
log Market capitalization															
T	9.106	9.028	915	9.327	9.253	605	8.674	8.501	310	9.624	9.641	183	9.306	9.276	208
$T+1$	8.903	8.786	836	9.180	9.130	538	8.404	8.273	298	9.397	9.315	164	8.918	8.749	191
(vs. T)	[0.000]	[0.000]	836	[0.000]	[0.000]	538	[0.000]	[0.000]	298	[0.000]	[0.000]	164	[0.000]	[0.000]	191
Market-to-book ratio															
T	6.722	4.233	913	8.637	5.794	604	2.981	1.847	309	10.434	6.293	182	8.000	4.308	208
$T+1$	4.900	2.895	831	6.470	4.501	535	2.063	1.297	296	6.015	4.326	162	5.138	2.624	191
(vs. T)	[0.000]	[0.000]	831	[0.000]	[0.000]	535	[0.000]	[0.000]	296	[0.000]	[0.000]	162	[0.001]	[0.000]	191

This table presents the mean and median of market capitalization and market-to-book ratio of firms listed on MOHERS and JASDAQ. *N* indicates the number of firms. Figures in brackets in row (vs. T) and columns "Mean" are p-values for the paired t tests. Figures in brackets in row (vs. T) and columns "Median" are p-values for Wilcoxon signed-rank test.

Table 5 Estimation results (hazard ratios) for graduation to the TSE main markets.

	PH	PH	CR	CR
Covariate	(i)	(ii)	(iii)	(iv)
Firm age	1.489***	1.483***	1.601***	1.591***
	(0.192)	(0.192)	(0.208)	(0.207)
R&D intensity	0.512***	0.512***	0.547***	0.547***
	(0.084)	(0.085)	(0.089)	(0.089)
Fixed assets	0.735	0.735	0.739	0.740
	(0.222)	(0.222)	(0.242)	(0.243)
Leverage	1.240	1.236	1.157	1.154
	(0.203)	(0.204)	(0.162)	(0.163)
Market capitalization	1.697***	1.696***	1.649***	1.649***
	(0.088)	(0.088)	(0.090)	(0.090)
Manufacturing	0.714	0.714	0.767	0.767
	(0.159)	(0.159)	(0.169)	(0.170)
ICT	1.321*	1.321*	1.299*	1.299*
	(0.197)	(0.197)	(0.196)	(0.196)
Infra & energy	2.077***	2.078***	2.180***	2.176***
	(0.452)	(0.453)	(0.458)	(0.460)
Whole & retail	1.113	1.114	1.137	1.138
	(0.192)	(0.193)	(0.195)	(0.195)
Real estate	1.178	1.181	1.061	1.066
	(0.287)	(0.288)	(0.280)	(0.281)
MOTHERS	1.374*	1.267	1.580**	1.396
	(0.226)	(0.376)	(0.281)	(0.424)
10-year rule	3.455***	3.235***	3.763***	3.405***
	(0.518)	(0.844)	(0.562)	(0.884)
MOTHERS×10-year rule		1.101		1.158
		(0.332)		(0.356)
# observations	63,180	63,180	63,180	63,180
# subjects	943	943	943	943
# events	370	370	370	370
# competing events			125	125
Wald χ^2	307***	308***	306***	311***

This table presents the hazard ratios for the graduation to the TSE main markets in columns (i) and (ii) and the sub-hazard ratios in columns (iii) and (iv). PH indicates the proportional hazards model. CR indicates the competing-risks regression. Figures in parentheses are robust estimates of standard errors. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively. The covariates of firm age, market capitalization, and 10-year rule are time-variant (monthly). The covariates of R&D intensity, fixed assets, and leverage are also time-variant (yearly).

Table 6 Estimation results (hazard ratios) for graduation to the TSE main markets (IPOs before March 2011)

	PH	PH	CR	CR
Covariate	(i)	(ii)	(iii)	(iv)
Firm age	2.009***	1.918***	2.344***	2.235***
	(0.366)	(0.357)	(0.420)	(0.408)
R&D intensity	0.502***	0.501***	0.548***	0.546***
	(0.106)	(0.108)	(0.116)	(0.117)
Fixed assets	0.566	0.553	0.549	0.546
	(0.225)	(0.222)	(0.224)	(0.223)
Leverage	1.335*	1.327*	1.201	1.200
	(0.209)	(0.212)	(0.156)	(0.155)
Market capitalization	1.667***	1.668***	1.642***	1.653***
	(0.108)	(0.111)	(0.105)	(0.108)
Manufacturing	0.814	0.819	0.844	0.845
	(0.220)	(0.224)	(0.225)	(0.228)
ICT	1.448*	1.454	1.382	1.388
	(0.324)	(0.332)	(0.316)	(0.324)
Infra & energy	1.938*	1.914*	2.195**	2.114**
	(0.666)	(0.672)	(0.678)	(0.692)
Whole & retail	1.472*	1.482*	1.481*	1.483*
	(0.334)	(0.338)	(0.330)	(0.333)
Real estate	0.966	0.981	0.785	0.803
	(0.338)	(0.343)	(0.309)	(0.310)
MOTHERS	2.758***	1.682	3.540***	2.030**
	(0.604)	(0.549)	(0.825)	(0.679)
10-year rule	3.772***	2.422**	5.230***	3.205***
	(1.061)	(0.906)	(1.210)	(1.066)
MOTHERS×10-year rule		1.892*		2.047**
		(0.628)		(0.698)
# observations	47,237	47,237	47,237	47,237
# subjects	444	444	444	444
# events	197	197	197	197
# competing events			117	117
Wald χ^2	149***	152***	184***	195***

This table presents the hazard ratios for the graduation to the TSE main markets in columns (i) and (ii) and the sub-hazard ratios in columns (iii) and (iv). PH indicates the proportional hazards model. CR indicates the competing-risks regression. Figures in parentheses are robust estimates of standard errors. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively. The covariates of firm age, market capitalization, and 10-year rule are time-variant (monthly). The covariates of R&D intensity, fixed assets, and leverage are also time-variant (yearly).

Table 7 BHARs of IPO firms that graduate to the TSE main markets

TOPIX		3 months	6 months	12 months	24 months	36 months
All	Mean	1.025	1.070	1.149	1.399	1.644
	Median	0.986	0.972	1.004	1.051	1.204
	SD	0.322	0.475	0.712	1.363	1.562
	N	370	370	369	331	283
	$\|t\|$	61.2***	43.3***	31.0***	18.7***	17.7***
MOTHERS	Mean	1.027	1.075	1.141	1.405	1.589
	Median	0.989	0.953	0.983	1.022	1.131
	SD	0.359	0.526	0.749	1.522	1.659
	N	261	261	260	231	198
	$\|t\|$	46.2***	33.0***	24.5***	14.0***	13.5***
JASDAQ	Mean	1.021	1.056	1.170	1.385	1.773
	Median	0.985	0.993	1.112	1.192	1.468
	SD	0.212	0.325	0.618	0.903	1.306
	N	109	109	109	100	85
	$\|t\|$	50.2***	34.0***	19.8***	15.3***	12.5***
New IPO index		3 months	6 months	12 months	24 months	36 months
All	Mean	0.012	0.032	0.072	0.208	0.317
	Median	–0.030	–0.066	–0.067	–0.086	–0.091
	SD	0.328	0.474	0.683	1.331	1.502
	N	370	370	369	331	283
	$\|t\|$	0.70	1.31	2.04**	2.84***	3.55***
MOTHERS	Mean	0.011	0.038	0.060	0.227	0.306
	Median	–0.039	–0.077	–0.094	–0.119	–0.099
	SD	0.371	0.529	0.731	1.504	1.606
	N	261	261	260	231	198
	$\|t\|$	0.48	1.16	1.33	2.30**	2.69***
JASDAQ	Mean	0.014	0.019	0.101	0.162	0.340
	Median	–0.022	–0.041	–0.045	–0.058	–0.053
	SD	0.193	0.304	0.552	0.805	1.233
	N	109	109	109	100	85
	$\|t\|$	0.76	0.64	1.91*	2.01**	2.54**

This table presents the descriptive statistics of BHARs for firms that graduate to the TSE main markets. To calculate BHARs, we use two benchmarks: TOPIX and the new IPO index (see the main text). SD indicates standard deviation. *N* indicates the number of firms. $|t|$ indicates a test statistic for the null hypothesis that BHAR equals zero. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table 8 BHARs of IPO firms that graduate to the TSE main markets: young, R&D intensity, and early graduated firms

TOPIX		3 months	6 months	12 months	24 months	36 months
Young	Mean	1.007	1.105	1.150	1.431	1.556
	Median	0.984	0.943	0.943	0.906	0.923
	SD	0.200	0.611	0.930	1.936	1.886
	N	72	72	72	66	58
	$\|t\|$	42.7***	15.3***	10.5***	6.00***	6.28***
R&D intensity	Mean	1.014	1.081	1.108	1.384	1.686
(pre-IPO)	Median	0.989	1.012	1.018	0.999	1.307
	SD	0.199	0.599	0.919	1.869	1.786
	N	59	59	59	50	44
	$\|t\|$	39.1***	13.9***	9.26***	5.24***	6.26***
Early	Mean	1.005	1.036	1.118	1.239	1.429
	Median	0.975	0.954	0.930	0.912	0.930
	SD	0.218	0.408	0.645	0.936	1.324
	N	138	138	138	123	104
	$\|t\|$	54.2***	29.8***	20.4***	14.7***	11.0***
New IPO index		3 months	6 months	12 months	24 months	36 months
Young	Mean	–0.010	0.048	0.046	0.195	0.221
	Median	–0.044	–0.094	–0.170	–0.208	–0.227
	SD	0.193	0.597	0.888	1.918	1.805
	N	72	72	72	66	58
	$\|t\|$	0.435	0.683	0.442	0.825	0.931
R&D intensity	Mean	–0.015	0.037	0.020	0.182	0.297
(pre-IPO)	Median	–0.036	–0.040	–0.091	–0.178	–0.091
	SD	0.218	0.610	0.895	1.855	1.765
	N	59	59	59	50	44
	$\|t\|$	0.543	0.463	0.175	0.694	1.12
Early	Mean	–0.019	0.003	0.052	0.086	0.185
	Median	–0.047	–0.091	–0.107	–0.107	–0.193
	SD	0.229	0.393	0.608	0.922	1.241
	N	138	138	138	123	104
	$\|t\|$	0.959	0.0860	1.01	1.03	1.52

This table presents the descriptive statistics of BHARs for firms that graduate to the TSE main markets. To calculate BHARs, we use two benchmarks: TOPIX and the new IPO index (see the main text). SD indicates standard deviation. *N* indicates the number of firms. $|t|$ indicates a test statistic for the null hypothesis that BHAR equals zero. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table 9 BHARs of IPO firms that graduate to the TSE main markets (IPOs before March 2011)

TOPIX		3 months	6 months	12 months	24 months	36 months
All	Mean	1.043	1.079	1.149	1.372	1.703
	Median	0.993	0.974	1.020	1.033	1.325
	SD	0.387	0.530	0.800	1.513	1.704
	N	197	197	196	187	176
	$\|t\|$	37.8***	28.6***	20.1***	12.4***	13.3***
MOTHERS	Mean	1.051	1.103	1.137	1.378	1.694
	Median	0.993	0.965	0.969	0.991	1.193
	SD	0.450	0.611	0.882	1.725	1.850
	N	133	133	132	128	118
	$\|t\|$	26.9***	20.8***	14.8***	9.04***	9.94***
JASDAQ	Mean	1.026	1.028	1.173	1.360	1.722
	Median	0.988	0.990	1.138	1.221	1.449
	SD	0.203	0.297	0.599	0.909	1.372
	N	64	64	109	59	58
	$\|t\|$	40.5***	27.6***	15.7***	11.5***	9.56***
New IPO index		3 months	6 months	12 months	24 months	36 months
All	Mean	0.028	0.030	0.059	0.156	0.350
	Median	–0.022	–0.066	–0.079	–0.134	–0.074
	SD	0.394	0.532	0.763	1.440	1.635
	N	197	197	196	187	176
	$\|t\|$	1.00	0.785	1.09	1.48	2.84***
MOTHERS	Mean	0.032	0.046	0.038	0.178	0.375
	Median	–0.023	–0.077	–0.115	–0.161	–0.064
	SD	0.463	0.620	0.858	1.660	1.785
	N	133	133	132	128	118
	$\|t\|$	0.802	0.849	0.510	1.22	2.28**
JASDAQ	Mean	0.020	–0.003	0.103	0.107	0.300
	Median	–0.019	–0.047	0.000	–0.078	–0.148
	SD	0.185	0.271	0.520	0.783	1.289
	N	64	64	64	59	58
	$\|t\|$	0.854	–0.0956	1.59	1.05	1.77*

Table 10 BHARs of IPO firms that graduate to the TSE main markets: young, R&D intensity, and early graduated firms (IPOs before March 2011)

TOPIX		3 months	6 months	12 months	24 months	36 months
Young	Mean	1.019	1.126	1.144	1.421	1.733
	Median	0.999	0.960	0.981	0.907	1.105
	SD	0.189	0.666	1.011	2.026	2.081
	N	50	50	50	47	44
	$\|t\|$	38.1***	12.0***	8.00***	4.81***	5.52***
R&D intensity	Mean	0.987	1.089	1.117	1.438	1.684
(pre-IPO)	Median	0.983	0.980	0.950	0.936	1.385
	SD	0.170	0.707	1.083	2.153	1.917
	N	39	39	39	37	34
	$\|t\|$	36.2***	9.62***	6.44***	4.06***	5.12***
Early	Mean	0.998	0.855	0.762	0.707	0.772
	Median	0.968	0.916	0.695	0.627	0.593
	SD	0.173	0.251	0.437	0.597	0.804
	N	27	27	27	25	24
	$\|t\|$	30.1***	17.7***	9.06***	5.92***	4.71***
New IPO index		3 months	6 months	12 months	24 months	36 months
Young	Mean	0.005	0.074	0.059	0.217	0.438
	Median	–0.015	–0.073	–0.145	–0.183	–0.172
	SD	0.193	0.662	0.980	1.961	1.931
	N	50	50	50	47	44
	$\|t\|$	0.189	0.786	0.424	0.759	1.50
R&D intensity	Mean	–0.048	0.013	–0.003	0.224	0.281
(pre-IPO)	Median	–0.042	–0.069	–0.145	–0.189	–0.091
	SD	0.200	0.713	1.048	2.131	1.933
	N	39	39	39	37	34
	$\|t\|$	–1.51	0.112	–0.0155	0.638	0.847
Early	Mean	–0.016	–0.132	–0.162	–0.209	–0.226
	Median	–0.047	–0.152	–0.189	–0.190	–0.252
	SD	0.188	0.227	0.381	0.469	0.639
	N	27	27	27	25	24
	$\|t\|$	–0.449	–3.03***	–2.20**	–2.23**	–1.73*

Table A1 Definitions of variables used in this study.

Variable		Definition
MOTHERS		If the firm goes public on MOTHERS.
JASDAQ		If the firm goes public on JASDAQ.
Graduation		If the firm graduates to the TSE main markets (First and Second sections of the TSE) up to January 2020.
Early graduation		If the firm graduates to the TSE main markets within two years (24 months) after going public in the TSE junior markets (MOTHERS and JASDAQ) up to January 2020.
Time to graduation		Number of months from IPO to graduation to the TSE main markets.
Retention		If the firm remains in the TSE junior markets in January 2020, and (= 0) otherwise.
Delisting		If the firm delists from the TSE junior markets up to January 2020.
Young		If the firm goes public within six years after founding.
R&D intensity (pre-IPO)		If a ratio of R&D expenditures to sales in pre-IPO accounting year is 1% or more.
Operating profit ratio		Ratio of operating profits to total assets
Operating cash flow ratio		Ratio of operating cash flow to total assets.
Financing cash flow ratio		Ratio of financing cash flow to total assets.
Sales		Net sales (total operating revenue) (million JPY).
Market capitalization		Market value of shareholders' equity (million JPY).
log Market capitalization		Logarithm of market capitalization.
Market-to-book ratio		Ratio of market capitalization to book value of shareholders' equity.
log Sales		Logarithm of sales.
IPO after the 10-year rule		If the firm goes public in the TSE junior markets after the announcement of the 10-year rule (March 2011).
Covariates in regressions	**Time**	**Definition**
Firm age	Monthly	Logarithm of the number of months from founding to the time.
R&D intensity	Yearly	(= 1) if a ratio of R&D expenditures to sales is 1% or more, and (= 0) otherwise.
Fixed assets	Yearly	Ratio of fixed assets to total assets.
Leverage	Yearly	Ratio of total debt to total assets.
Market capitalization	Monthly	Logarithm of the market value of shareholder's equity (million JPY).
Industry dummies	(Invariant)	Dummies for (i) manufacturing, (ii) ICT, (iii) infrastructure and energy, (iv) wholesale and retail, (v) real estate, and the others (reference).
MOTHERS	(Invariant)	(= 1) if the firm goes public in MOTHERS, and (= 0) if the firm goes public in JASDAQ.
10-year rule	Monthly	(= 1) if the time is after the announcement of the 10-year rule (March 2011), and (= 0) otherwise.

This tables reports the definitions of the variables used in this study. The observation window for graduation and delisting is from the firm's IPO to January 2020. Covariates in regressions show those used in Tables 5, 6, A3, and A4. Time indicates that the covariate is a monthly, yearly or time-invariant (invariant) variable.

Table A2 Mean and median of operating performance and market capitalization of IPO firms.

	All			MOTHERS			JASDAQ		
Year *T*	Mean	Median	*N*	Mean	Median	*N*	Mean	Median	*N*
Operating profit ratio									
Graduation	0.140	0.129	370	0.147	0.144	261	0.124	0.113	109
Retention	0.095	0.104	420	0.103	0.118	271	0.081	0.087	149
Delisting	0.093	0.094	123	0.084	0.085	71	0.105	0.100	52
Operating cash flow ratio									
Graduation	0.085	0.094	370	0.091	0.102	261	0.070	0.075	109
Retention	0.062	0.081	420	0.074	0.095	271	0.039	0.059	149
Delisting	0.046	0.050	123	0.025	0.043	71	0.075	0.056	52
Financing cash flow ratio									
Graduation	0.220	0.187	370	0.276	0.254	261	0.087	0.074	109
Retention	0.253	0.195	420	0.325	0.283	271	0.123	0.077	149
Delisting	0.258	0.217	123	0.394	0.355	71	0.071	0.058	52
Sales									
Graduation	10,663	4,925	370	6,920	3,518	261	19,627	9,480	109
Retention	6,609	3,427	418	4,488	2,303	270	10,479	5,779	148
Delisting	13,672	5,002	123	4,938	2,541	71	25,597	13,865	52
Market capitalization									
Graduation	19,112	10,049	370	22,001	11,883	261	12,193	5,986	109
Retention	16,011	6,889	421	20,408	8,900	272	7,983	4,082	149
Delisting	24,484	7,649	124	23,361	9,192	72	26,037	6,450	52
Market-to-book ratio									
Graduation	6.981	4.568	369	8.506	5.879	260	3.344	2.312	109
Retention	6.866	4.096	421	9.102	5.831	272	2.783	1.583	149
Delisting	5.456	3.341	123	7.349	5.435	72	2.783	2.196	51

This table presents the mean and median of operating performance, market capitalization, and market-to-book ratio of firms listed on MOHERS and JASDAQ by graduation, retention, and delisting. *N* indicates the number of firms.

Table A3 Estimation results (hazard ratios) for graduation to the TSE main markets: subsample of IPOs after December 2004.

	PH	PH	CR	CR
Covariate	(i)	(ii)	(iii)	(iv)
Firm age	1.497***	1.505***	1.548***	1.552***
	(0.210)	(0.213)	(0.221)	(0.223)
R&D intensity	0.526***	0.527***	0.547***	0.548***
	(0.101)	(0.101)	(0.104)	(0.104)
Fixed assets	0.720	0.718	0.688	0.687
	(0.255)	(0.254)	(0.263)	(0.263)
Leverage	1.256	1.266	1.240	1.244
	(0.291)	(0.289)	(0.284)	(0.284)
Market capitalization	1.791***	1.793***	1.713***	1.713***
	(0.110)	(0.109)	(0.110)	(0.110)
Manufacturing	0.618*	0.618*	0.671	0.672
	(0.162)	(0.162)	(0.173)	(0.173)
ICT	1.332*	1.333*	1.332*	1.333*
	(0.221)	(0.221)	(0.220)	(0.219)
Infra & energy	2.384***	2.381***	2.335***	2.336***
	(0.535)	(0.533)	(0.539)	(0.537)
Whole & retail	1.140	1.137	1.146	1.145
	(0.218)	(0.218)	(0.218)	(0.218)
Real estate	1.334	1.326	1.111	1.108
	(0.361)	(0.362)	(0.336)	(0.336)
MOTHERS	1.163	1.325	1.266	1.341
	(0.216)	(0.461)	(0.246)	(0.480)
10-year rule	3.420***	3.673***	3.695***	3.815***
	(0.656)	(0.979)	(0.697)	(0.999)
MOTHERS×10-year rule		0.861		0.936
		(0.303)		(0.338)
# observations	49,482	49,482	49,482	49,482
# subjects	819	819	819	819
# events	306	306	306	306
# competing events			80	80
Wald χ^2	257***	257***	240***	239***

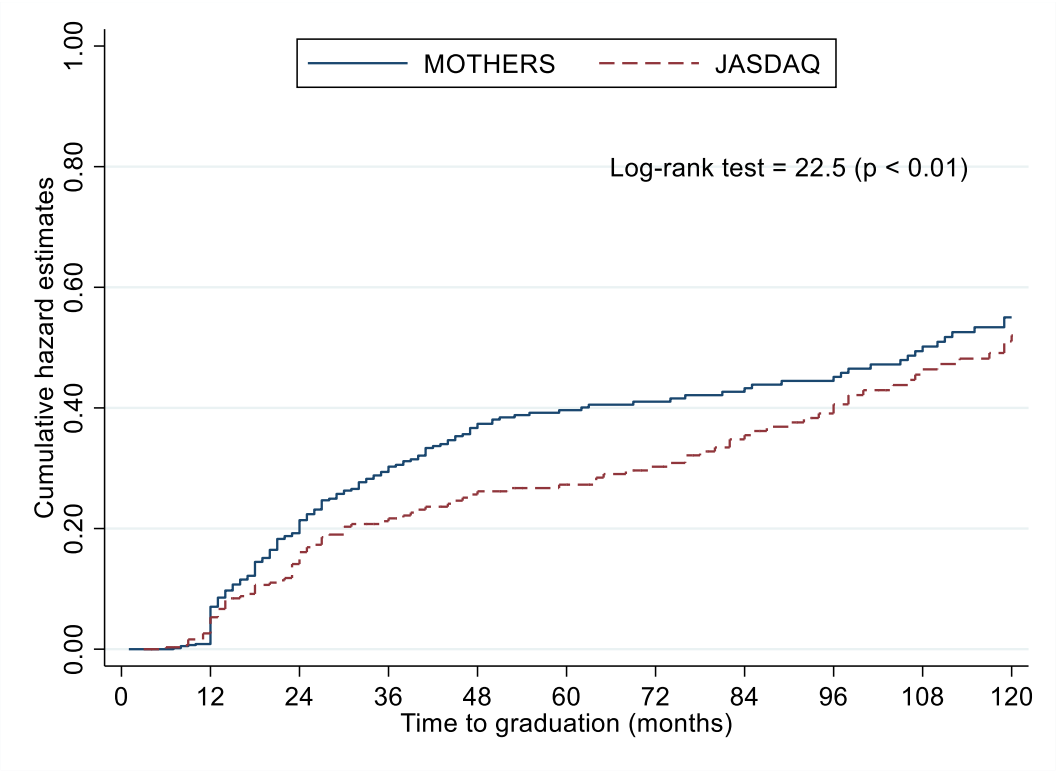
This table presents the hazard ratios for the graduation to the TSE main markets in columns (i) and (ii) and the sub-hazard ratios in columns (iii) and (iv). PH indicates the proportional hazards model. CR indicates the competing-risks regression model. Figures in parentheses are robust estimates of standard errors. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively. The covariates of firm age, market capitalization, and 10-year rule are time-variant (monthly). The covariates of R&D intensity, fixed assets, and leverage are also time-variant (yearly).

Table A4 Estimation results (coefficients) for retention in the TSE junior markets: AFT model.

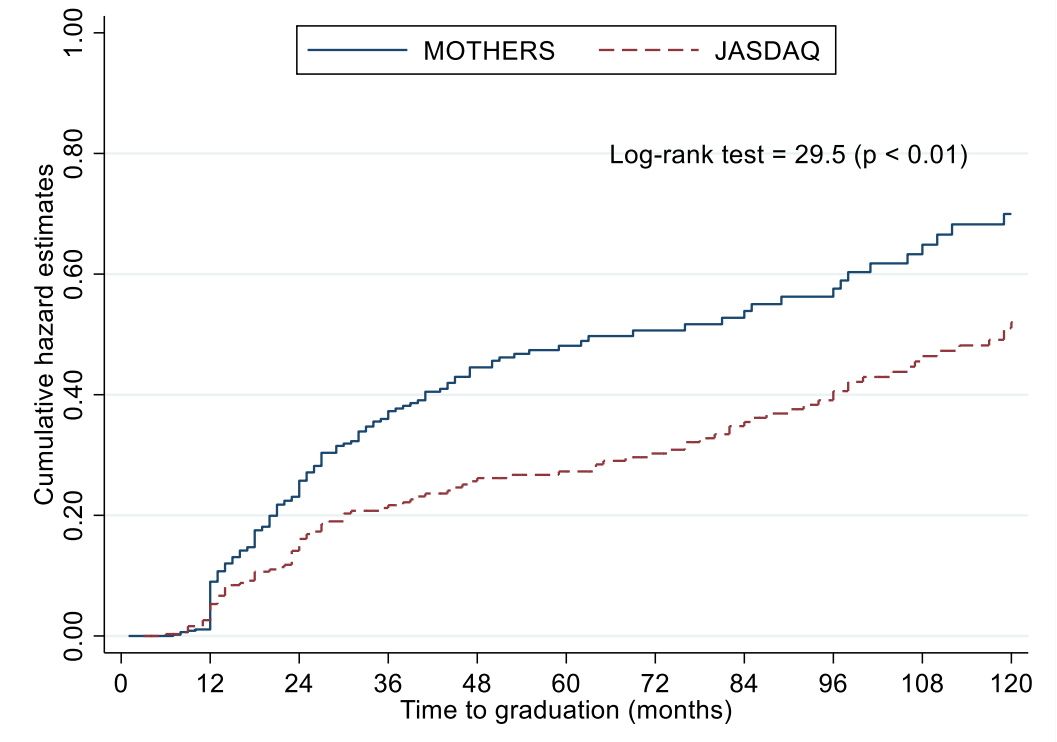
Covariate	Exponential (i)	Weibull (ii)	Log-normal (iii)	Log-logistic (iv)	Gamma (v)
Firm age	–0.356***	–0.266**	–0.206**	–0.265**	–0.148
	(0.128)	(0.127)	(0.102)	(0.115)	(0.100)
R&D intensity	0.761***	0.724***	0.718***	0.720***	0.675***
	(0.172)	(0.162)	(0.151)	(0.163)	(0.149)
Fixed assets	0.483	0.524*	0.408	0.382	0.421
	(0.309)	(0.291)	(0.270)	(0.284)	(0.258)
Leverage	–0.080	–0.100	–0.218	–0.117	–0.346
	(0.192)	(0.168)	(0.193)	(0.180)	(0.249)
Market capitalization	–0.548***	–0.506***	–0.645***	–0.680***	–0.658***
	(0.051)	(0.048)	(0.043)	(0.044)	(0.039)
Manufacturing	0.305	0.271	0.307	0.379*	0.238
	(0.228)	(0.213)	(0.199)	(0.226)	(0.196)
ICT	–0.297*	–0.289*	–0.173	–0.158	–0.166
	(0.156)	(0.149)	(0.126)	(0.137)	(0.117)
Infra & energy	–0.907***	–0.864***	–0.531***	–0.522**	–0.366*
	(0.223)	(0.223)	(0.196)	(0.217)	(0.215)
Whole & retail	–0.211	–0.213	0.046	0.032	0.130
	(0.179)	(0.168)	(0.153)	(0.159)	(0.156)
Real estate	–0.263	–0.245	–0.188	–0.252	–0.115
	(0.246)	(0.233)	(0.200)	(0.217)	(0.200)
MOTHERS	–0.106	–0.016	0.254	0.226	0.327*
	(0.302)	(0.285)	(0.208)	(0.232)	(0.189)
10-year rule	–0.909***	–0.746***	–0.762***	–0.691***	–0.826***
	(0.244)	(0.247)	(0.195)	(0.227)	(0.195)
MOTHERS×10-year rule	–0.320	–0.378	–0.349	–0.451*	–0.226
	(0.297)	(0.279)	(0.229)	(0.261)	(0.248)
Constant term	Yes	Yes	Yes	Yes	Yes
Parameter 1		0.080**	0.095***	–0.461***	0.117***
		(0.037)	(0.034)	(0.039)	(0.035)
Parameter 2 (kappa)					–0.448*
					(0.255)
# observations	63,180	63,180	63,180	63,180	63,180
# subjects	943	943	943	943	943
# events	370	370	370	370	370
Wald χ^2	319***	284***	397***	392***	433***

AIC	1,534	1,533	1,452	1,467	1,447
BIC	1,661	1,669	1,587	1,602	1,592

This table presents the estimated coefficients of the time to graduation to the TSE main markets using the AFT model. Gamma indicates the generalized gamma survival distribution. AIC and BIC indicate Akaike's and Schwarz's Bayesian information criteria, respectively. Figures in parentheses are robust estimates of standard errors. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively. The covariates of firm age and market capitalization are time-variant (monthly). The covariates of R&D intensity, fixed assets, and leverage are also time-variant (yearly).



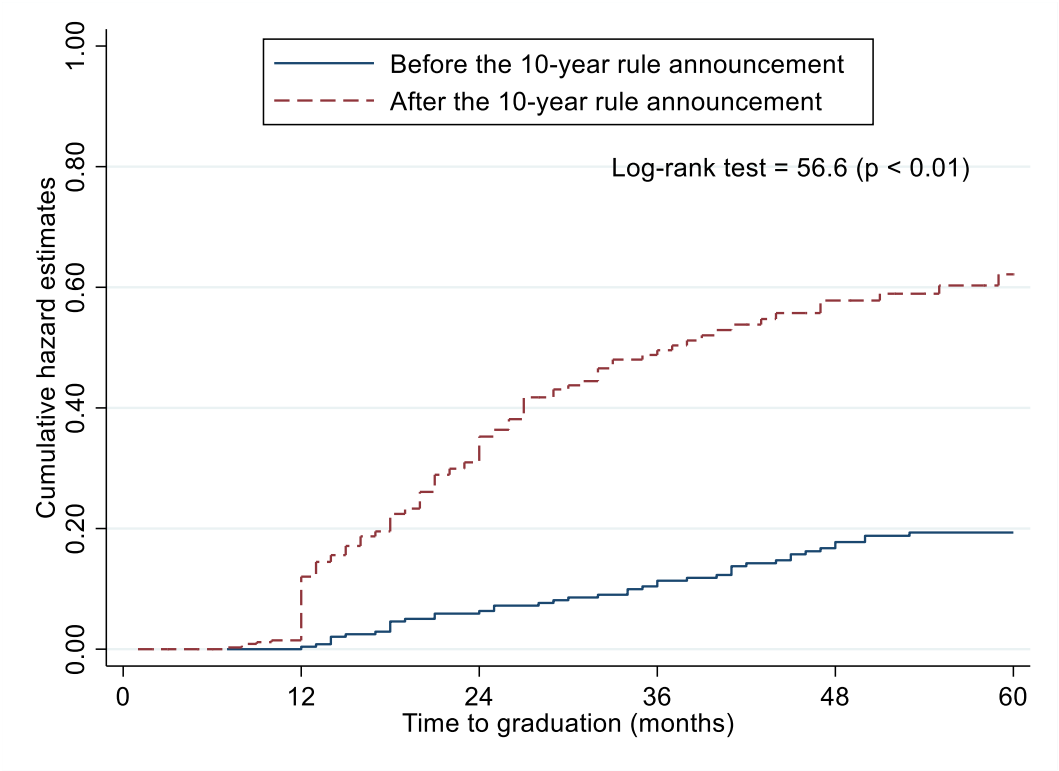
(a) IPOs on MOTHERS and JASDAQ in the entire sample



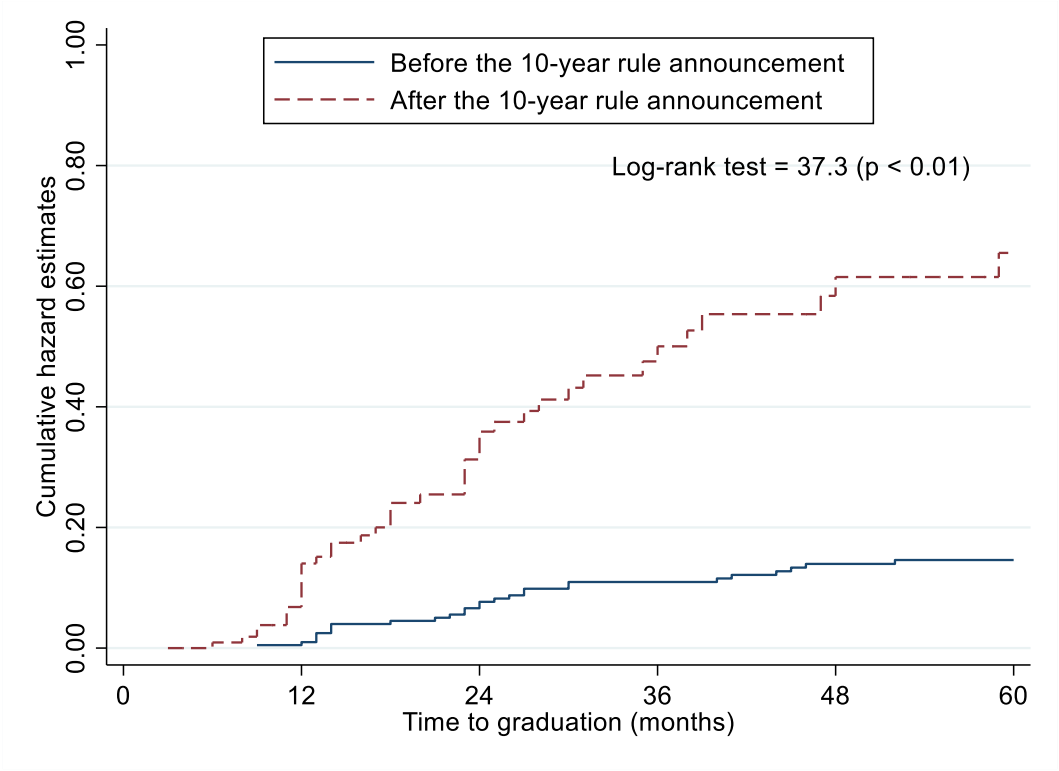
(b) IPOs on MOTHERS and JASDAQ in or after December 2004.

Fig. 1 Cumulative hazard estimates of graduation from MOTHERS and JASDAQ to the TSE main markets.

Fig. 1(a) presents the cumulative hazard estimates of graduation to the TSE main markets in the entire sample. Fig. 1(b) presents those of graduation when the sample is restricted to IPOs in or after December 2004.



(a) IPOs on MOTHERS.



(b) IPOs on JASDAQ

Fig. 2 Cumulative hazard estimates of graduation to the TSE main markets before and after the announcement of the 10-year rule.

Fig. 2(a) presents the cumulative hazard estimates of graduation of IPOs on MOTHERS. Fig. 2(b) presents those of graduation of IPOs on JASDAQ.

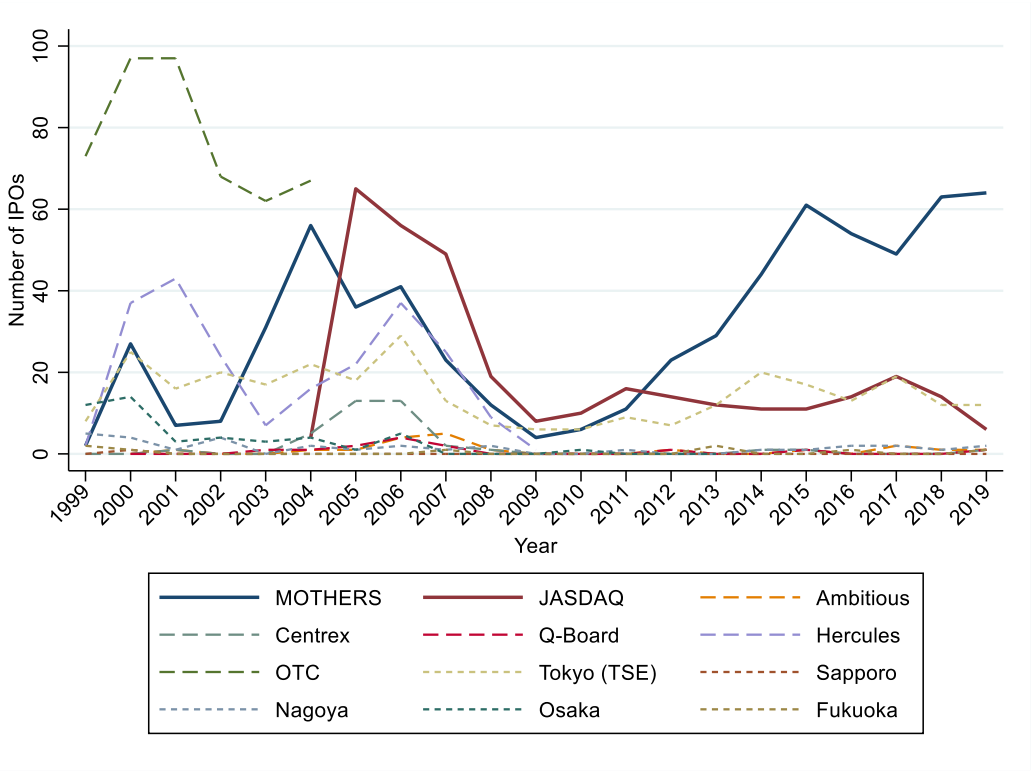


Fig. A1 Number of IPOs by stock market

This figure presents the number of IPOs in the Japanese stock markets. OTC indicates the over-the-counter market. Tokyo (TSE), Sapporo, Nagoya, Osaka, and Fukuoka indicate the Tokyo, Sapporo, Nagoya, Osaka, and Fukuoka Stock Exchanges, respectively. Hercules includes the number of IPOs on the NASDAQ Japan and the Osaka New Market. JASDAQ includes NEO. Duplication counts are available if a firm goes public in multiple stock markets at the same time.

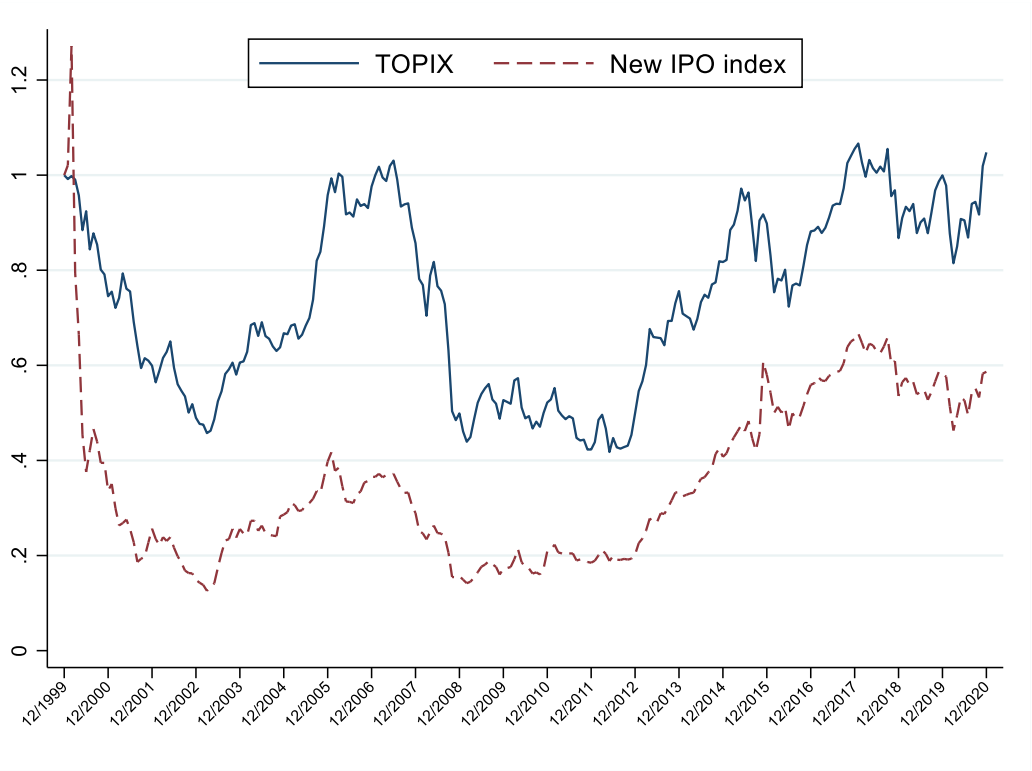


Fig. A2 Trend of the TOPIX and new IPO index

The ordinate indicates the TOPIX and new IPO index when the values in December 1999 are equal to 1.