



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

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Abstract This study explores the graduation of initial public offering (IPO) firms and regulatory reforms in junior stock markets. Using firms listed on the two junior stock markets of the Tokyo Stock Exchange (TSE), the Market of the high-growth and emerging stocks (MOTHERS) and JASDAQ Securities Exchange (JASDAQ), we examine the factors that affect 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 (MOTHERS and JASDAQ). The results also reveal that listing regulations on graduation to the TSE main market, which were introduced only to the MOTHERS, but not to the JASDAQ, accelerate the graduation of IPO firms. Furthermore, we provide evidence that IPO firms that ultimately graduate to the TSE main markets exhibit better performance.

Plain English Summary Do junior stock markets create better-performing graduations? We investigate this issue using the case of two junior stock markets of the TSE. While young IPO firms and those with high R&D intensity are less likely to graduate from junior stock markets, listing requirements on graduation to main stock markets accelerate the graduation of IPO firms in junior stock markets. Firms listed on a junior stock market with more stringent listing environments are more likely to graduate to main stock markets and exhibit better performance. Our findings suggest that the promotion system introduced through regulatory reforms provides a strong incentive for IPO firms to aim higher and helps create better-performing graduations.

Keywords Graduation · Initial public offering · Junior stock market · Listing regulation · Promotion system · Young and innovative firm

JEL Classification G32 · G38 · L26 · M13

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1 Introduction

A promotion system is often introduced to motivate 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 obtain the opportunity to graduate to the main

(i.e., upper) stage. Whether such a promotion system is effective will be manifested by the performance of graduated players.

In stock exchanges, junior stock markets (synonymously, second-tier stock exchanges) allow the shares of young firms to be publicly floated (Abbate and Sapio 2019). Junior stock markets are also introduced to promote the formation of new technology firms (Eberhart and Eesley 2018). For firms with an incentive to grow rapidly, an IPO in junior stock markets must be a preparatory stage in firm growth, and successful IPO firms seek main stock markets (synonymously, senior stock exchanges). Junior stock markets are dedicated to nurturing young firms until they get large enough to move to main stock markets (Carpentier and Suret 2019; Revest and Shapiro 2013; Vismara et al. 2012). If young and innovative firms, which essentially have a higher demand for investment in R&D, develop their businesses in junior stock markets, junior stock markets may play a critical role in fostering firms with growth potential. However, even if these firms acquire access to public equity markets by going public in junior stock markets, it is unclear whether they exhibit better performance. Presumably, the ultimate goal of junior stock markets is to transfer the best performers to main stock markets (Carpentier et al. 2010). Whereas stock exchanges expect to produce fast-growing firms via junior stock markets, there is little evidence on whether such a promotion system is effective for the creation of fast-growing firms.

While a substantial number of studies have examined IPOs in junior stock markets (Bernstein et al. 2020; Ritter et al. 2013; Vismara et al. 2012), several scholars have shed light on their graduation (Carpentier et al. 2010; Pandes and Robinson 2013). Some studies estimated the long-run performance of firms having graduated from junior stock markets (Carpentier and Suret 2019; Meoli et al. 2018), and others examined the determinants of graduation to main stock markets (Carpentier and Suret 2011; Carpentier et al. 2010). These studies suggest the importance of graduation from junior stock markets in the creation of fast-growing firms. Meanwhile, it is thought that listing regulations affect the firms' decisions to go public and then graduate from junior stock markets. Indeed, numerous scholars have examined listing regulations on stock exchanges (Akyol et al. 2014; Cattaneo et al. 2015; Gerakos et al. 2013), and some have

argued that listing regulations help create viable junior stock markets (Pandes and Robinson 2014, 2018). In this respect, it is plausible that regulations regarding the promotion system are crucial for the role of junior stock markets. However, it is unclear whether the promotion system for graduation helps foster fast-growing firms, and studies on regulatory reforms regarding the promotion system are globally scarce. The desirability and efficacy of listing regulations in junior stock markets are still important open questions (Carpentier and Suret 2011). Research focusing on IPO firms in junior stock markets that wish to graduate to main stock markets may explain how to create fast-growing firms in an economy.

This study explores the graduation of IPO firms and regulatory reforms in junior stock markets. The major research question of this study is to examine whether promotion systems in junior stock markets create better-performing firms. We examine the impact of regulatory reforms on the time to graduation, using firms listed on the two junior stock markets of the TSE in Japan: MOTHERS and JASDAQ. The TSE is a unique case for two reasons: (1) it has two junior stock markets with different backgrounds derived from the historical reorganization of stock exchanges and (2) listing regulations on graduation to the TSE main markets were introduced only to the MOTHERS, but not to the JASDAQ. This enables us to examine the impact of regulatory reforms—specifically, IPO firms' choice of either graduation to the TSE main markets or retention in the junior market within 10 years (“10-year rule” hereafter)—on the likelihood of graduation thorough comparison between the two TSE junior markets (MOTHERS and JASDAQ). Moreover, we examine whether young and innovative firms in the TSE junior markets are more likely to graduate to the TSE main markets. Although we did not examine IPO firms' sellout strategy, our findings suggest how they graduate from junior stock markets.

Using a sample of non-financial firms listed on these markets by December 2020, we find that approximately 40% of IPO firms graduated to the TSE main markets (first and second sections of the TSE) by January 2021, while approximately 13% of IPO firms were delisted from the TSE junior markets. Using a survival analysis approach, we examine the factors that affect the time to graduation to the TSE main markets. 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 the higher market capitalization (market value of equity) are more likely to graduate to the TSE main markets. Moreover, listing regulations on graduation called the 10-year rule, which was introduced only to the MOTHERS, accelerate the graduation of IPO firms, especially when the sample is restricted to IPOs before the enactment (announcement) of the 10-year rule. Furthermore, we provide evidence that IPO firms that ultimately graduate to the TSE main markets exhibit better performance.

The contributions of this study are threefold. First, we clarify whether young and innovative firms, which appear to be promising targets in junior stock markets, achieve rapid growth by graduating from junior stock markets. Whereas public equity financing in junior stock markets helps in nurturing young and innovative firms, there is scant evidence on the behavior and performance of these firms. Our findings suggest that young and innovative firms do not aim higher and are not highly evaluated even if they graduate from junior stock markets. Rather, such firms tend to stay in junior stock markets. Second, we provide novel insights into the behavior and performance of IPO firms in terms of graduation from junior stock markets. Whereas the existing literature has examined the survival of IPO firms, especially in senior stock exchanges (Jain and Kini 1999, 2000), a few studies have focused on the graduation of IPO firms on the Toronto Stock Exchange's Venture Exchange (TSXV) (Carpentier and Suret 2011; Carpentier et al. 2010; Meoli et al. 2018).¹ However, studies of listing regulations on graduation are globally scarce. Although our findings are limited to graduation within domestic stock markets, we provide new evidence on the graduation of IPO firms, including the impact of regulatory reforms, in junior stock markets. Third, using valuable analytical approaches based on two junior stock

markets comparable in the same stock exchange, we provide evidence on the impact of listing regulations on the graduation of IPO firms. Akyol et al. (2014) emphasized the importance of analytical approaches using a control sample of IPOs when examining corporate governance reforms. While the 10-year rule was introduced only to the MOTHERS, it was not applied to those listed on the JASDAQ. The comparison of two groups before and after the enactment of the 10-year rule is effective for the evaluation of regulatory reforms. Indeed, our results reveal that listing regulations on graduation accelerate the graduation of IPO firms in the regulated market. To the best of our knowledge, this is the first examination of regulatory reforms that differ between two junior stock markets in the same stock exchange.

The remainder of this paper is organized as follows. The following section introduces the research background. The third section discusses the methods used in this study. The fourth section explains the data. The fifth section presents the estimation results. Finally, we present concluding remarks.

2 Research background

2.1 Junior stock markets for young and innovative firms

Several countries, such as Canada, Japan, Korea, and some European nations, have introduced junior stock markets (also called second-tier stock exchanges) since the mid-1990s, following the National Association of Securities Dealers Automated Quotation (NASDAQ) in the US. Junior stock markets provide young and innovative firms with an opportunity to access public equity markets. Examples of junior stock markets include the Alternative Investment Market (AIM) (UK), Neuer Markt (Germany), Korean Securities Dealers Automated Quotations (Korea), Nouveau Marché (France), Nuovo Mercato (Italy), and TSXV (Canada).

Owing to these markets' less stringent listing requirements, compared to senior stock exchanges, IPOs in junior stock markets account for a large proportion in countries, such as Canada, Japan, Korea, and the UK (Granier et al. 2019; Pandes and Robinson 2013, 2014, 2018; Park et al. 2016). As young and small firms find the listing requirements of senior

¹ Several studies have examined transferring from the National Association of Securities Dealers Automated Quotation (NASDAQ), which cannot be regarded any longer as a junior stock market, to the American or New York Stock Exchanges (Cheng 2005; Dharan and Ikenberry 1995). Others have highlighted transferring between the Alternative Investment Market (AIM), which has special listing regulations, and the London Stock Exchange (Gerakos et al. 2013; Jenkinson and Ramadorai 2013; Vismara et al. 2012). In another country's case, Park et al. (2016) examined switching from a junior stock market to the Korean Stock Exchange.

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 after the Internet bubble crash (Revest and Sapio 2012; Vismara et al. 2012). In practice, the Neuer Markt, Nouveau Marché, and Nuovo Mercato were reorganized or closed in the 2000s. Even though the number of IPOs decreased after the global financial crisis in these countries (Akyol et al. 2014; Ritter et al. 2013), an IPO is still the most common sell-out (exit) strategy in some countries, such as Japan (Granier et al. 2019; Honjo 2021a).

From the economic growth perspective, fast-growing firms are expected to stimulate product and financial markets (Bos and Stam 2014; Colombelli et al. 2014). To compensate for their lack of internal financing, young and innovative firms seek external financing (Mina et al. 2013). Despite their growth potential, these firms often face difficulties in acquiring external financing (Cowling et al. 2021; Czarnitzki and Hottenrott 2011; Lee et al. 2015). Owing to a high level of uncertainty for businesses derived from the scant operating histories and track records, external suppliers of capital, such as banks, are hesitant to provide funds to young and innovative firms. Indeed, external suppliers of capital face difficulties in assessing the quality of the firms' projects (Colombo and Grilli 2007; Müller and Zimmermann 2009). This is because the information asymmetries between entrepreneurs and external suppliers of capital are severe in young and innovative firms (Aslan and Kumar 2011; Cowling et al. 2021). In addition, collateral requirements often prevent young and innovative firms from raising funds through debt financing because such firms tend to have less collateral value (Colombo and Grilli 2007, 2010).

For R&D investment, equity financing has several advantages over debt financing (Carpenter and Petersen 2002; Colombo and Grilli 2007; Hall 2002; Müller and Zimmermann 2009). Generally, no collateral is required, the probability of financial distress is stable, and investors' upside returns are not bound for equity financing (Brown et al. 2012; Carpenter and Petersen 2002). Owing to their lack of collateralizable assets, young and innovative firms favor equity financing. Indeed, young and innovative firms have more incentive to access public equity markets by going public (Honjo 2021a). Moreover, it is difficult

for these firms to generate positive cash flow shortly after their foundation, suggesting that the interest payments on debt financing become a burden (Honjo 2021b; Honjo and Kato 2019). Consequently, young and innovative firms prefer equity financing to debt financing.

An IPO is a critical stage in a firm's life cycle (Filatotchev and Piesse 2009; He 2008; Honjo 2021a; Mumi et al. 2019). By going public, firms can access public equity markets, and access to public equity markets through an IPO helps these firms increase their financing cash flow. Gaining access to a source of financing alternative to banks is also a benefit of an IPO (Pagano et al. 1998). An IPO reinforces the advantages for firms facing difficulties in financing. Therefore, firms with a higher demand for external financing pursue an IPO to secure equity financing from public equity markets. Especially for young and innovative firms devoted to R&D, an IPO is crucial for securing financing for R&D investment (Honjo 2021a; Honjo and Nagaoka 2018). As accessing public equity markets is important for young and innovative firms, these firms may seek public equity as a source of finance (Brown et al. 2009). Hence, an IPO in junior stock markets is a significant avenue for young and innovative firms to raise capital.

2.2 Post-IPO behavior and performance

The previous literature has explored post-IPO performance (Jain and Kini 1994; Krishnan et al. 2011; Ritter 1991). Numerous scholars have investigated IPO stock returns (Loughran and Ritter 1995). In particular, several scholars have highlighted the high initial returns of IPOs—often called “underpricing” (Ekkayokkaya and Pengniti 2012; Engelen and Van Essen 2010; Ljungqvist 2007). Notably, previous studies have repeatedly found that operating performance declines after going public (Jain and Kini 1994; Mikkelsen et al. 1997; Wang 2005). These findings suggest that many firms simply secure equity financing and rebalance their capital structures by going public (Pagano et al. 1998).

Studies on post-IPO performance include three types of analytical approaches. First, pre- and post-IPO operating performance, including profitability and cash flow, is estimated. Some studies have demonstrated a significant decline in operating performance after going public (Jain and Kini 1994;

Mikkelsen et al. 1997). Among the studies of junior stock markets in Japan, Kutsuna et al. (2002) found sharply decreasing operating performance of firms listed on the over-the-counter (OTC) market (currently JASDAQ). Furthermore, Eberhart and Easley (2018) found increased investment in new technology firms but decreased growth after the introduction of the MOTHERS and other markets in 2000. Second, the time to delisting—conversely, IPO survival—is estimated through a survival analysis approach (Jain and Kini 1999, 2000, 2008). While many scholars have examined IPO survival in stock exchanges, some have focused on IPO survival in junior stock markets (Gerakos et al. 2013; Pour and Lasfer 2013).² Although junior stock markets are expected to create opportunities for providing risk capital to young and innovative firms, several scholars found that younger firms are less likely to survive in junior stock markets (Carpentier and Suret 2011; Espenlaub et al. 2012). Third, buy-and-hold abnormal returns (BHARs) and cumulative abnormal returns are estimated based on stock prices after going public (Carpentier and Suret 2018; Gao and Jain 2011; Gerakos et al. 2013; Gregory et al. 2010). Many scholars have examined post-IPO performance in junior stock markets, compared to senior stock exchanges with more stringent listing requirements (Gerakos et al. 2013; Nielsson 2013; Takahashi and Yamada 2015; Vismara et al. 2012). This approach identifies post-IPO performance based on the market evaluation.

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

While numerous scholars investigated the survival probability, including the time to failure, some shed light on graduation from junior stock markets

(Carpentier and Suret 2011; Pandes and Robinson 2018). Graduation ostensibly represents true success (Carpentier et al. 2010). In this context, a few studies have examined the likelihood of graduation from the TSXV (Carpentier and Suret 2011; Carpentier et al. 2010; Meoli et al. 2018). Their findings on the graduation of IPO firms on the TSXV could provide valuable evidence on graduation to main stock markets. In addition, others provided empirical evidence on the long-run performance of IPOs on the TSXV, including graduations to the Toronto Stock Exchange (TSX), using BHARs (Meoli et al. 2018; Pandes and Robinson 2018). However, there is a paucity of empirical evidence on graduation from junior stock markets other than the TSXV. Further studies on graduation would be useful to understand the role of junior stock markets better in fostering IPO firms with growth potential.

2.3 Regulatory reforms in junior stock markets

To date, numerous scholars have examined the impact of regulatory reforms in stock exchanges—in other words, changes of listing environments—on the IPO decision (Dambra et al. 2015; Engelen et al. 2019; Gao et al. 2013; Link et al. 2021). For instance, as the Sarbanes–Oxley Act of 2002 imposed additional compliance costs on IPO firms in the US, the Jumpstart Our Business Startups (JOBS) Act was introduced to stimulate economic growth by improving access to public capital markets and eliminating listing requirements for growing firms. Such policy reforms, such as the JOBS Act, increased IPO value and the proportion of small firm issuers (Dambra et al. 2015). Others found that the Small Business Innovation Research program increases the likelihood of an IPO (Link et al. 2021). It is conceivable that regulatory reforms are associated with IPO firms' behavior and performance in addition to their IPO decisions.

Among junior stock markets, numerous scholars have examined IPOs on the AIM in the UK (Abbate and Sapio 2019; Espenlaub et al. 2012; Gregory et al. 2010; Nielsson 2013; Revest and Sapio 2019). The AIM is designed to use private sector regulations to private oversight, which can reduce the cost of raising capital by providing customized regulations by private sectors (Gerakos et al. 2013). The AIM, which can be regarded as the demand-side segmentation

² A substantial number of studies have examined IPO survival using data on IPOs in the US (Chou et al. 2013; Feng et al. 2020; Gounopoulos and Pham 2018). Espenlaub et al. (2016b) also examined the impact of legal institutions on IPO survival using data on IPOs in 32 economies.

model, is successful in helping firms access capital and transfer to senior stock exchange (Vismara et al. 2012). The AIM has been relatively successful at attracting new IPOs among junior stock markets (Granier et al. 2019; Revest and Sapio 2012).

The impact of the JOBS Act and the success of the AIM suggest that lower listing regulations attract firms with growth potential. Less regulated markets, such as the AIM, may rather attract higher-quality firms (Nielsson 2013). Tighter listing regulations make young and innovative firms more reluctant to go public (Engelen et al. 2019). Indeed, some empirical evidence indicates relaxing listing requirements enable firms with growth potential to go public (Takahashi and Yamada 2015). Moreover, there is evidence that special programs introduced to junior stock markets—for example, the Capital Pool Company program, a highly regulated blind-pool program in the TSXV in Canada—help increase the number and quality of IPOs (Pandes and Robinson 2013, 2014, 2018). However, there is empirical evidence that tightening regulatory changes improve post-IPO performance (Cattaneo et al. 2015). These findings suggest that regulatory reforms in junior stock markets affect the IPO decision and post-IPO performance.

As for graduation from junior stock markets, it is unclear how regulatory reforms related to the promotion system in junior stock markets help create successful IPOs that graduate to main stock markets. Further research on graduation from junior stock markets would be useful for improving listing environments in junior stock markets.

2.4 Determinants of graduation and post-graduation performance

Generally, young firms exhibit higher failure rates (Caves 1998; Geroski 1995). This is due to the lack of necessary resources, such as human and financial ones (Carpentier and Suret 2011). These arguments suggest that firm age, in addition to firm size, is associated with post-IPO performance, including graduation to main stock markets. Meanwhile, young and innovative firms may have lower failure rates than young and non-innovative ones (Cefis and Marsili 2011). Indeed, Carpentier and Suret (2011) found that firms producing high-tech products are more likely to graduate from the TSXV in Canada, while the likelihood of graduation is not linked to financial conditions at the IPO.

Even though young and innovative firms have a higher risk of failure, they may possibly achieve successful outcomes through innovation and graduate from junior stock markets. In these respects, it is possible that the likelihood of graduation is associated with firm age and innovative activity. In addition, firms may seek to graduate from junior stock markets during favorable market conditions, as the IPO pricing is found to depend on market conditions, often called hot and cold markets (Derrien 2005; Ljungqvist et al. 2006).

More importantly, as discussed, regulatory reforms may significantly affect post-IPO performance (Cattaneo et al. 2015; Engelen et al. 2019; Takahashi and Yamada 2015). The promotion system strengthened by regulatory reforms may increase the likelihood of graduation from junior stock markets. Essentially, listing regulations on graduation create a strong incentive to improve performance after going public. IPO firms in junior stock markets regulated by policy reforms—especially unexpected regulatory reforms after going public—may have a strong incentive to graduate to main stock markets. Such a promotion system encourages these firms to aim higher. However, it is unclear whether the intended effects of regulatory reforms are amplified for firms listed on junior stock markets. As IPOs that violate listing standards in junior stock markets are forced to delist, an impulsive trial for graduation may increase the risk of delisting. Rather, equity financing in junior stock markets unrestricted by listing regulations on graduation may allow IPO firms to improve performance toward graduation.

Furthermore, IPO firms that seek the next stage after going public in junior stock markets presumably have a growth orientation. Such firms are expected to be highly evaluated in main stock markets. In practice, Meoli et al. (2018) found that graduations from the TSXV to the TSX exhibit positive long-run performance in the TSX. Moreover, listing requirements must be fulfilled to graduate to main stock markets. Such requirements, including the number of shareholders and trading volume, reflect firms' growth potential in main stock markets. Among the listing requirements, market capitalization seems to be more binding for IPO firms in junior stock markets. Graduations to main stock markets may also be highly evaluated because higher listing requirements provide a signaling effect (Johan 2010). Meanwhile, Carpentier et al. (2010) found that the performance of firms that have graduated to the TSX is negative but insignificant. While Meoli et al. (2018) found

better post-graduation performance, Carpentier et al. (2010) did not find it. In this study, we thus identify post-graduation performance; specifically, we examine whether firms that graduate from the TSE junior markets to the TSE main markets exhibit better performance.

2.5 Junior stock markets and VC investments in Japan

By the early 2000s, Japan established junior stock markets for new ventures in its stock exchanges: MOTHERS (TSE), Ambitious (Sapporo Stock Exchange), Centrex (Nagoya Stock Exchange), Hercules (formerly NASDAQ Japan) (Osaka Stock Exchange; OSE), and Q-Board (Fukuoka Stock Exchange). Figure 3 in the Appendix illustrates the number of IPOs in the Japanese stock markets over time. IPOs on the MOTHERS and JASDAQ account for more than 80% of all IPOs in 2020.

Among the junior stock markets, MOTHERS is the leading junior stock market for new ventures in Japan. The 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. The first IPO on the MOTHERS emerged in December 1999. Meanwhile, the JASDAQ was founded in December 2004 when the OTC market was renamed JASDAQ after the NASDAQ in the US and reorganized as a general stock exchange. The new entrepreneurs' opportunity market (NEO), a special market of the JASDAQ intended for new ventures, was also founded in August 2007. Thereafter, the OSE acquired more than half of the shares of the JASDAQ in December 2008, and the JASDAQ was absorbed into the OSE in April 2010. The JASDAQ and NEO, in addition to the Hercules, were reorganized as the new JASDAQ in October 2010. Moreover, the Japan Exchange Group (JPX) emerged, and the cash equity market of the OSE was integrated into the TSE in July 2013. Eventually, both the MOTHERS and JASDAQ became subsidiaries of the TSE held by the JPX, and they are regarded as Japan's representative junior stock markets.³ The TSE has two junior stock markets (MOTHERS and JASDAQ) and two main stock markets (first and second sections). Furthermore, the TSE's market

restructuring, including reorganization of the main and junior stock markets, is scheduled for April 2022.

One main difference between the MOTHERS and the JASDAQ is related to listing regulations on graduation. The TSE enacted the revision of delisting criteria for firms listed for more than 10 years on the MOTHERS, which was announced in March 2011. Listing regulations on graduation (i.e., 10-year rule) were applied to firms listed for more than 10 years on the MOTHERS in March 2014. The 10-year rule includes two stages: "delisting criteria" and "choice of market." The delisting criteria address the number of shareholders, number of tradable shares, the market capitalization of tradable shares, and market capitalization, which correspond to the standards of the second section of the TSE. Firms listed on the MOTHERS, unlike the JASDAQ, must overcome the delisting criteria within 10 years of going public.⁴ Then firms that have overcome the delisting criteria are required to choose to either remain listed on the MOTHERS or alter their listing to the second section (main market) of the TSE. Whereas the TSE promotes IPO firms on the MOTHERS to graduate to the Second Section, the firms have an option to stay in the MOTHERS without graduation. If a firm chooses to remain listed on the MOTHERS, it chooses again 5 years later. By contrast, the 10-year rule has not been introduced to the JASDAQ.

Meanwhile, it is conceivable that IPOs in junior stock markets are significantly associated with private equity capital, including venture capital (VC). In Japan, VC investments are approximately 2.5 billion USD in 2019, which is lower than those in some countries, such as the US, the UK, and Canada.⁵ Angel investment is less prevalent in Japan compared to other countries

³ 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].

⁴ There are differences in listing criteria between the MOTHERS and the JASDAQ, especially for net profits (or ordinary profits), market capitalization, and the number of shareholders (see also Takahashi and Yamada (2015)). Unprofitable firms may seek an IPO in the MOTHERS. For more details on the listing criteria, in addition to the 10-year rule, of the TSE junior markets, see the following JPX website.

<https://www.jpx.co.jp/english/equities/listing/criteria/listing/index.html> [accessed on August 18, 2020].

<https://www.jpx.co.jp/english/equities/listing/criteria/mothers/index.html> [accessed on August 18, 2020].

⁵ For more details on VC investments in Japan and other countries, see the following OECD website.

https://stats.oecd.org/Index.aspx?DataSetCode=VC_INVEST [accessed on October 30, 2021].

(Honjo and Nakamura 2020). In addition, mergers and acquisitions (M&A) are less common as a strategic sell-out (exit) in Japan (Honjo and Nagaoka 2018; Kubo and Saito 2012). Hence, an IPO appears to be virtually established as the most successful sellout strategy for early-stage shareholders (Honjo 2021a). Moreover, VC firms tend to invest in the early stages of firms, and bridge financing is not easily available in Japan, where private equity markets are underdeveloped (Honjo and Nagaoka 2018). Access to public equity markets helps some firms acquire bridge financing, partly because VC firms seek to recover their investment in the firms' early stages. In this respect, firms that rely on equity financing—specifically, young firms devoted to R&D—need access to public equity markets instead of VC and angel investors. Indeed, start-up firms that rely on equity financing at founding are more likely to go public earlier than others (Honjo 2021a). Therefore, market conditions regarding private equity capital in Japan may enhance the importance of junior stock markets. This is partly because private equity capital, including VC, is underdeveloped in Japan (Honjo and Nagaoka 2018).

In Japan, listing regulations on graduation (i.e., 10-year rule) were introduced only to the MOTHERS but not to the JASDAQ in the TSE. In this respect, the Japanese junior stock markets are a unique case for examining the impact of regulatory reforms through comparison tests because listing regulations on graduation differ between the MOTHERS and the JASDAQ. If listing regulations on graduation lead to an incentive for graduation, it is considered that firms listed on a junior stock market with listing regulations on graduation (i.e., MOTHERS) are more likely to graduate to main stock markets than those listed on a junior stock market without them (i.e., JASDAQ). Using the case of the TSE junior markets, we clarify the impact of listing regulations on the likelihood of graduation from junior stock markets.

3 Method

3.1 Time to graduation: regression estimation

To describe the determinants of graduation, we estimate a regression equation for IPO firms' graduation to the main stock market. A binary logit or probit model can be used for this purpose. 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 of firm i at t , $h_i(t;x)$, is written as follows:

$$h_i(t;x) = h_0(t)\exp(x'_{it}\gamma), \quad (1)$$

where x_{it} 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.

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 represents graduation from junior stock markets. Indeed, as shown later, more than 10% of the 1014 IPOs in the TSE junior markets were delisted from the markets by January 2021. 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 (Ahmad and Jelic 2014; Espenlaub, Goyal et al. 2016; Espenlaub, Khurshed et al. 2016).

As for the determinants of graduation, we include the covariates of firm age (young) and R&D intensity. We also include the dummies for the MOTHERS and 10-year rule. Generally, comparison tests are effective to show the treatment effect of regulatory reforms on firm behavior and performance. However, it is not easy to find adequate treatment and control groups to investigate the impact of regulatory reforms on the behavior of IPO firms in junior stock markets. To identify the impact of listing regulations on graduation to the TSE main markets, we include the interaction term of the MOTHERS and 10-year rule dummies, which may be similar to the analytical framework of the difference-in-difference approach. While the MOTHERS dummy indicates the differences between the MOTHERS and the JASDAQ, the interaction term of the MOTHERS and 10-year rule indicates the impact of the 10-year rule on the likelihood of graduation, compared to firms listed on the JASDAQ.

Moreover, we add the covariates of fixed assets, leverage (debt ratio), market capitalization, and the

industry dummies to the model to control for other firm-specific characteristics. Firms tend to have different asset and capital structures. In addition, growth opportunities are often captured by market capitalization in the literature (Kogan and Papanikolaou 2014). Firms with growth opportunities have more incentive to graduate from junior stock markets (Carpentier et al. 2010). Furthermore, according to the undervaluation hypothesis, firms go private when their share prices are undervalued in relation to their true potential (He et al. 2010; Renneboog et al. 2007). This conversely indicates that firms with higher market capitalization have a strong incentive to graduate to main stock markets.⁶ In addition, market capitalization is set as a variable over time to reflect market conditions. Table 7 in the Appendix presents the definitions of the covariates used in this study.

3.2 Post-IPO performance: BHARs

Following studies that employ BHARs to assess post-IPO performance (Gao and Jain 2011; Gao et al. 2013), we measure the BHARs of firms that graduated to main stock markets.⁷ To evaluate the effects of graduation from junior stock markets, we calculate the BHARs of the firm i in year-month T after graduation ($BHAR_{iT}$) as follows:

$$BHAR_{iT} = \prod_{\tau=1}^T (1 + R_{i\tau}) - \prod_{\tau=1}^T (1 + E(R_{i\tau})) \quad (2)$$

where $R_{i\tau}$ is the return of firm, i 's market value in year-month τ , and $E(R_{i\tau})$ is the expected benchmark return, which is often measured by market indices.⁸

Previous studies calculated the BHARs of graduations using market indices (Meoli et al. 2018; Pandes

and Robinson 2018). We also use the standard market index, the Tokyo Stock Price Index (TOPIX). However, while market indices, such as the TOPIX, are generally used as the benchmark return, they include older IPO firms with a long history in senior stock exchanges. Thus, we propose a new index to capture the benchmark return, in addition to the TOPIX. Our new index—"stage-skipping-IPO (SS-IPO) index" hereafter—consists of firms directly conducting an IPO in the TSE main markets, despite the emergence of the TSE junior markets. Specifically, we select firms that have directly conducted an IPO in the TSE main markets (first and second Sections of the TSE) since 1999 (the first IPO was launched on the MOTHERS this year). This index is based on the market capitalization of firms directly listed on the TSE main markets. The comparison of graduations relative to direct IPOs is meaningful for evaluating the promotion system in stock exchanges. The SS-IPO index in year-month T ($SSIPO_T$) is defined as follows:

$$SSIPO_T = \prod_{\tau=1}^T \frac{\sum_{j \in R_{\tau-1} \cap R_{\tau}} MV_{j\tau}}{\sum_{j \in R_{\tau-1} \cap R_{\tau}} MV_{j\tau-1}} \quad (3)$$

where $MV_{j\tau}$ is firm j 's market capitalization in year-month τ and R_{τ} is a set of firms directly conducting an IPO in the TSE main markets in year-month τ .

Furthermore, to demonstrate what types of firms perform better, we present the post-IPO performance of the following groups: (1) young firms (young), defined as those less than 6 years after their foundation; (2) R&D intensive firms (R&D intensity), defined as those with 1% or more R&D intensity; and (3) early graduated firms (early graduation), defined as those that graduate to the TSE main markets in less than 2 years of going public in the TSE junior markets. Table 7 presents the definition of these firms.

4 Data

4.1 Data sources

We construct a list of IPOs on the MOTHERS and JASDAQ (including the NEO) using Kabushiki Kokai Hakusho (White Paper on IPOs) edited by Pronexus, Inc. Hence, the sample does not include IPOs in senior stock exchanges (i.e., the TSE, Sapporo Stock Exchange, Nagoya Stock Exchange, OSE, and

⁶ Among listing requirements, market capitalization seems to be more binding for IPO firms in junior stock markets. In this respect, it is considered that market capitalization is positively associated with graduation from junior stock markets. Other listing requirements, such as tradable shares, trading volume, and net profits, are set for graduation to main stock markets. However, these requirements may be related to market capitalization. To avoid multicollinearity, we include only market capitalization in the regression equation.

⁷ Other scholars used buy-and-hold returns without controlling for the average changes in the markets (Gerakos et al. 2013).

⁸ If a firm is delisted after graduation, we do not calculate the firm's BHAR because the firm's market value is not obtainable.

Fukuoka Stock Exchange) and junior stock markets other than the MOTHERS and JASDAQ (i.e., Ambitious, Centrex, Hercules, and Q-board).⁹ In addition, the sample does not include firms listed on the OTC market and NASDAQ Japan (subsequently Hercules). Among IPOs on the MOTHERS and JASDAQ, 29 financial firms were excluded from the sample. In addition, 14 firms were excluded as outliers.¹⁰ Consequently, the final sample consists of 1014 non-financial firms: 690 firms listed on the MOTHERS from December 1999 to the end of December 2020 and 324 firms listed on the JASDAQ from December 2004 to the end of December 2020. We observe the time to IPO firms' graduation and delisting from these markets when the observation window is set to the period from IPO to January 2021. In other words, the time to graduation and delisting is right-censored.

Moreover, we 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. We also obtain data on the TOPIX and collect monthly market capitalization of firms directly listed on the TSE main markets to calculate the SS-IPO index.

4.2 Sample

Table 1 provides the distribution of IPO firms for graduation and delisting (demotion) in the sample.

⁹ In this study, we ignore listing experience in the Tokyo Pro Market (formerly the Tokyo AIM), a special market that offers new investment opportunities to professional investors. We also ignore listing experience in the OTC market. In practice, only a few firms have listing experience in the Tokyo Pro Market and the OTC market before going public in the JASDAQ and MOTHERS. These firms are regarded as IPOs in the TSE junior markets.

¹⁰ Originally, we obtained a list of 1057 firms listed on the MOTHERS and JASDAQ from *Kabushiki Kokai Hakusho*. 29 financial firms were excluded from the sample. Five firms are excluded because these firms are regarded as the group of foreign firms by Nikkei, and four firms are excluded because these firms simultaneously went public in other stock exchanges. In addition, one firm is excluded because it has experience in listing and delisting from the TSE main market. One firm is excluded because it was reorganized as a holding company and went public in less than 1 year. One firm is excluded because it went public in the Fukuoka Stock Exchange on the day after the IPO on the JASDAQ. Moreover, two firms are excluded as outliers because the total debt was more than total assets prior to the IPO, that is, excess of debt.

Among the 1014 firms in the TSE junior markets (MOTHERS and JASDAQ), 40% graduated to the TSE main markets when the observation window is set to January 2021. Of the 690 firms listed on the MOTHERS, 42% graduated to the TSE main markets, compared with 35% of the 324 firms listed on JASDAQ. The results reveal that the proportion of graduations from the MOTHERS is higher than that from the JASDAQ. By contrast, 11% were delisted from the MOTHERS, and 17% were delisted from the JASDAQ. Hence, 47% and 48% retain their status on the MOTHERS and JASDAQ, respectively.

Considering the purpose of junior stock markets to provide funds to young and innovative firms, we examine whether these firms are more likely to graduate to the TSE main markets. Table 1 also provides the distributions of these firms that graduated or were delisted by January 2021. As shown in Table 1, 42% of firms that go public in less than 6 years graduate to the TSE main markets, and 28% of firms with 1% or more R&D intensity graduate to them. We found little 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 listed on the TSE junior markets. These firms are less likely to graduate from junior stock markets, and the proportion of graduations is lower for firms with high R&D intensity.

To precisely identify the impact of the 10-year rule, which was announced to be introduced to the MOTHERS in March 2011, we use the subsample of firms that went public before March 2011. IPO firms' decisions to choose the MOTHERS or JASDAQ may be influenced by the enactment of the 10-year rule. In other words, their decisions differ between pre- and post-enactment of the 10-year rule. To account for the selection bias made from the enactment of the 10-year rule, the sample is restricted to 444 IPOs before March 2011. Table 1 also provides the distributions of IPO firms for graduation and delisting. When using the subsample of 444 firms that went public in the TSE junior markets before March 2011, we found that the proportion of graduations from the MOTHERS (57%) is higher than that from the JASDAQ (34%). These results indicate that firms listed on the MOTHERS are more likely to graduate to the TSE main markets than those listed on the JASDAQ.

Table 2 presents the time to graduation and delisting from the TSE junior markets. The mean times to

Table 1 Distribution of IPO firms for graduation, retention, and delisting from the TSE junior markets

Type	IPO	(%)	Graduation	(%)	Retention	(%)	Delisting	(%)
Entire sample								
TSE junior markets	1014	(100)	406	(40)	480	(47)	128	(13)
MOTHERS	690	(100)	293	(42)	323	(47)	74	(11)
JASDAQ	324	(100)	113	(35)	157	(48)	54	(17)
Young	199	(100)	83	(42)	74	(37)	42	(21)
R&D intensity	230	(100)	65	(28)	131	(57)	34	(15)
IPOs before March 2011								
TSE junior markets	444	(100)	207	(47)	119	(27)	118	(27)
MOTHERS	243	(100)	138	(57)	36	(15)	69	(28)
JASDAQ	201	(100)	69	(34)	83	(41)	49	(24)
Young	114	(100)	55	(48)	19	(17)	40	(35)
R&D intensity	122	(100)	42	(34)	47	(39)	33	(27)

This table presents the distribution of IPOs on the MOTHERS and JASDAQ by December 2020. Graduation, retention, and delisting are measured up to January 2021. TSE junior markets indicate both the MOTHERS and JASDAQ. “Young” is defined as an IPO firm less than 6 years after founding (incorporating). “R&D intensity” is defined as an IPO firm with 1% or more of the ratio of R&D expenditures to sales in the pre-IPO accounting year. “IPOs before March 2011” targets those that went public after the announcement of the 10-year rule (March 2011). Figures in parentheses are the percentages of frequencies by row in each column

graduation of firms listed on the MOTHERS and JASDAQ are 59 and 54 months (approximately less than 5 years), respectively. In addition, the median times to graduation of firms listed on the MOTHERS and JASDAQ are 31 and 35 months (approximately less than 3 years), respectively. While the proportion of graduations from the MOTHERS is higher than that from the JASDAQ, on average, the time to graduation from the MOTHERS is not different from that from the JASDAQ. As the minimum times indicate, few firms graduate to the TSE main markets within a year. As shown in Table 2, the median times to graduation of young firms and those with high R&D intensity are 44 and 63 months, respectively, which are longer than others.

4.3 Cumulative hazard estimates

To provide the likelihood of graduation to the TSE main markets, we describe the time to graduation of IPOs using the cumulative hazard function proposed by Nelson (1972) and Aalen (1978). Figure 1 illustrates the cumulative hazard estimates of graduation of IPOs on the MOTHERS and JASDAQ. The cumulative hazard estimate of graduation from the MOTHERS is above that from the JASDAQ. The results reveal that firms listed on the MOTHERS are more likely to graduate to the TSE main markets than those on JASDAQ. Figure 2 also illustrates the cumulative hazard

estimates of graduation of IPOs before and after March 2011, according to the enactment of the 10-year rule. The cumulative hazard estimate of graduation of IPOs on the TSE junior markets (MOTHERS and JASDAQ) in and after March 2011 is higher than before. The results reveal that IPO firms listed on the MOTHERS and JASDAQ after the enactment of the 10-year rule are more likely to graduate to the TSE main markets. While the number of IPOs on the MOTHERS increased after the enactment of the 10-year rule, in addition to the global financial crisis in 2008 (see Fig. 3), the proportion of graduations from the TSE junior markets after the enactment of the 10-year rule is higher than before.

5 Results

5.1 Determinants of the time to graduation

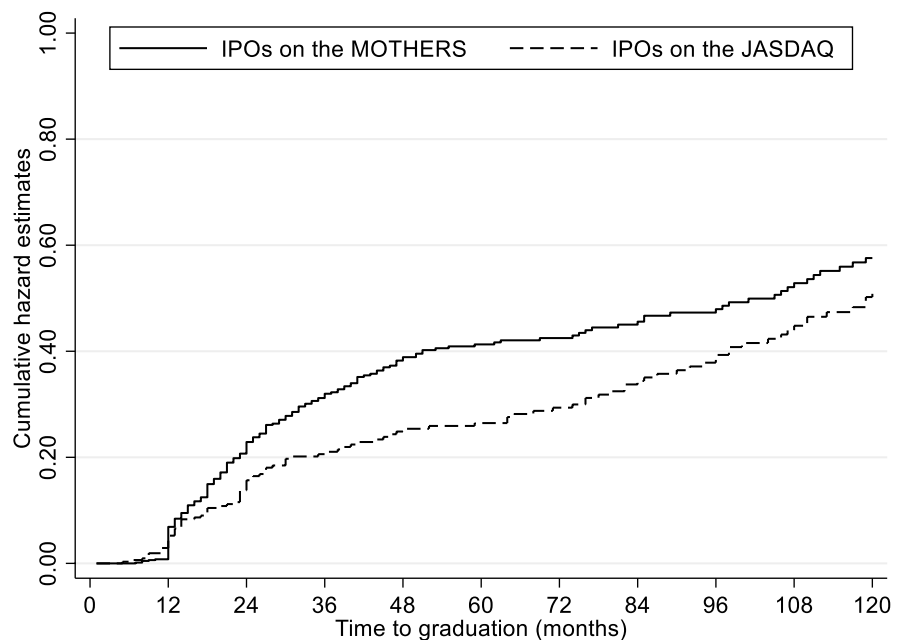
As explained in Section 3.2, we estimate the regression equations for graduation to the TSE main markets using the following covariates: firm age, R&D intensity, fixed assets, leverage, market capitalization, MOTHERS, 10-year rule, and industry dummies. Table 3 provides the descriptive statistics of the covariates at the IPO. These covariates, other than MOTHERS and industry dummies, are time-variant

Table 2 Time to graduation to the TSE main markets (entire sample)

Type	Mean	SD	Min	25%	Median	75%	Max	<i>N</i>
TSE junior markets	57.9	50.7	5	18	31	107	228	406
MOTHERS	59.4	53.5	7	17	31	122	228	293
JASDAQ	53.8	42.6	5	18	35	90	151	113
Young	73.6	60.3	5	18	44	133	228	83
R&D intensity	76.6	57.6	8	21	63	128	228	65

This table presents the descriptive statistics of the time to IPO firms' graduation to the TSE main markets. Figures are measured by the number of months. SD indicates standard deviation. *N* indicates the number of graduations. TSE junior markets indicate both the MOTHERS and JASDAQ. "Young" is defined as an IPO firm less than 6 years after founding (incorporating). "R&D intensity" is defined as an IPO firm with 1% or more of the ratio of R&D expenditures to sales in the pre-IPO accounting year. The sample consists of graduations to the TSE main markets by January 2021

Fig. 1 Cumulative hazard estimates of graduation to the TSE main markets: IPOs on the MOTHERS and JASDAQ. This figure illustrates the cumulative hazard estimates of graduation of IPO firms on the MOTHERS and JASDAQ. The number of observations is 1014. The numbers of events (gradu-ations) are 293 and 113 for MOTHERS and JASDAQ, respectively. A chi-square log-rank test statistic is 28.6 ($p < 0.01$)



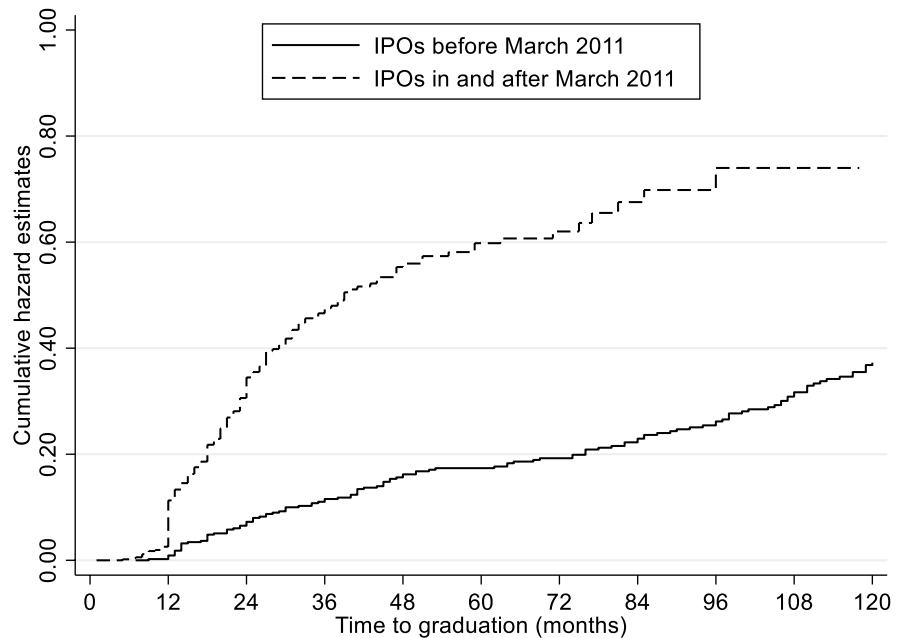
in the regression equations. While firm age and market capitalization vary by month, R&D intensity, fixed assets, and leverage vary by year because these covariates are measured by firms' financial statements (yearly data). As discussed, IPO firms' decisions to choose the MOTHERS or JASDAQ may be influenced by the enactment of the 10-year rule; thus, we estimate the regression equations when the sample is restricted to IPOs before March 2011, while taking into account the announcement effect of the 10-year rule.

Table 4 presents the estimation results for the time to graduation to the TSE main markets using the survival

analysis approach.¹¹ 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

¹¹ We estimated the regression equations using the entire sample (1014 IPOs), in order to show the impact of the covariates on the time to graduation with the larger sample size. Table 8 in the Appendix presents the estimation results for graduation from the TSE junior markets when using the entire sample. In addition, we estimated the regression equations using the subsample of firms that went public in or after December 2004 because the JASDAQ was founded in December 2004 behind the MOTHERS. The results using this subsample are similar to each other.

Fig. 2 Cumulative hazard estimates of graduation to the TSE main markets: IPOs before and after March 2011. This figure illustrates the cumulative hazard estimates of graduation of IPO firms before and after March 2011. The number of observations is 1014. The numbers of events (graduations) are 207 and 199 before and after March 2011, respectively. A chi-square log-rank test statistic is 90.3 ($p < 0.01$)



CR model where delisting is a competing event. The interaction term of the MOTHERS and 10-year rule dummies is included in columns (ii) and (iv).

As shown in Table 4, 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 (MOTHERS and JASDAQ) are less likely to graduate to the TSE main markets.¹² Rather, such firms tend to remain listed on the TSE junior markets. In addition, the hazard ratios of R&D intensity are below 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. Even though young and innovative firms acquire financing cash flow by going public, it is typically difficult for them to graduate from the TSE junior markets by achieving successful outcomes. Such firms may lose an incentive to aim higher, while IPOs satisfy the appetite of their shareholders.

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, the coefficients of fixed assets and leverage are not sufficiently significant. Moreover, the hazard ratios of market capitalization are above one, and its coefficients are significant at the 1% level. We found that firms with higher market capitalization are more likely to graduate to the TSE main markets.¹³ These results reveal that firms highly evaluated in the TSE junior markets are more likely to graduate to the TSE main markets.

As shown in Table 4, the hazard ratios of the dummy for the MOTHERS are above one, although its coefficients are insignificant in column (ii), where the interaction term is included, indicating that firms listed on the MOTHERS are more likely to graduate to the TSE main markets than those on the JASDAQ. This is consistent with the differences in the cumulative hazard ratios in Fig. 1. In addition, the hazard ratios of the dummy for the 10-year rule are above one, indicating that firms in the TSE junior markets are more likely to

¹² We also estimated the regression equations using the covariate of time-invariant firm age, measured at the IPO, instead of the time-variant covariate used in Table 4. The results with time-invariant firm age are almost similar to those shown in Table 4.

¹³ We also estimated the regression equations 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 the TSE main markets, depending on market conditions.

Table 3 Descriptive statistics of covariates at the IPO (IPOs before March 2011)

Covariate	Mean	SD	Min	25%	Median	75%	Max
TSE junior markets ($N=444$)							
ln Firm age	4.927	0.875	2.197	4.263	4.883	5.602	6.753
R&D intensity	0.286	—	—	—	—	—	—
Fixed assets	0.286	0.214	0.003	0.117	0.224	0.411	0.938
Leverage	0.542	0.227	0.005	0.373	0.564	0.731	0.961
ln Market capitalization	9.331	1.126	6.733	8.501	9.270	10.033	13.484
MOTHERS	0.547	—	—	—	—	—	—
Firm age	197	169	9	71	132	271	857
Market capitalization	24,009	53,833	840	4921	10,613	22,775	717,730
MOTHERS ($N=243$)							
ln Firm age	4.413	0.652	2.197	3.989	4.454	4.836	5.914
R&D intensity	0.292	—	—	—	—	—	—
Fixed assets	0.251	0.201	0.003	0.100	0.194	0.347	0.826
Leverage	0.481	0.226	0.005	0.310	0.458	0.670	0.942
ln Market capitalization	9.574	1.161	6.733	8.719	9.538	10.275	13.484
Firm age	101	68	9	54	86	126	370
Market capitalization	30,317	61,851	840	6115	13,873	29,006	717,730
JASDAQ ($N=201$)							
ln Firm age	5.549	0.688	3.526	5.170	5.628	6.100	6.753
R&D intensity	0.279	—	—	—	—	—	—
Fixed assets	0.328	0.223	0.012	0.148	0.282	0.471	0.938
Leverage	0.616	0.204	0.043	0.473	0.645	0.770	0.961
ln Market capitalization	9.037	1.010	7.055	8.308	8.926	9.613	13.187
Firm age	314	181	34	176	278	446	857
Market capitalization	16,383	41,029	1159	4056	7526	14,952	533,313

This table presents the descriptive statistics of IPO firms in the estimations in Table 4. SD indicates standard deviation. N indicates the number of IPO firms. TSE junior markets indicate both the MOTHERS and JASDAQ. The definitions of covariates are shown in Table 7. Firm age is measured by the number of months. Market capitalization is measured by million JPY. All the covariates are measured at the IPO (R&D intensity, fixed assets, and leverage are measured in the pre-IPO accounting year, and ln Market capitalization and Market capitalization are measured at the end of the IPO month. The sample consists of IPOs on the MOTHERS and JASDAQ before March 2011

graduate to the TSE main markets after the enactment of the 10-year rule. The coefficients of the interaction term of the MOTHERS and 10-year rule dummies are above one and approximately two in columns (ii) and (iv). We found evidence that the time to graduation of firms listed on the MOTHERS before the enactment of the 10-year rule is shorter after its enactment, compared to the time to graduation of firms listed on the JASDAQ. The results indicate that firms listed on the MOTHERS are more likely to graduate to the TSE main markets, in accordance with the 10-year rule, compared to those on the JASDAQ. The findings suggest that while IPO firms are more likely to graduate from the MOTHERS and JASDAQ after the enactment

of the 10-year rule, firms listed on the MOTHERS are more likely to graduate to the TSE main markets than those on the JASDAQ. It is thought that listing regulations on graduation (i.e., 10-year rule) introduced to the MOTHERS motivate IPO firms to graduate and that the promotion system is more effective, especially for firms listed on the MOTHERS before the regulatory reforms. It is concluded that the promotion system motivates IPO firms to aim higher.

Among the industry dummies, the hazard ratios of infrastructure and energy industries are above one, and their coefficients are significant. The results indicate that firms in the infrastructure and energy sectors are more likely to graduate to the TSE main markets.

Table 4 Estimation results (hazard ratios) for graduation to the TSE main markets (IPOs before March 2011)

Covariate	PH	PH	CR	CR
	(i)	(ii)	(iii)	(iv)
In Firm age	2.056*** (0.366)	1.950*** (0.355)	2.421*** (0.424)	2.300*** (0.410)
R&D intensity	0.542*** (0.110)	0.542*** (0.111)	0.595** (0.120)	0.596** (0.122)
Fixed assets	0.534 (0.206)	0.522* (0.204)	0.522 (0.208)	0.519 (0.207)
Leverage	1.324* (0.209)	1.311* (0.214)	1.191 (0.151)	1.189 (0.151)
In Market capitalization	1.660*** (0.104)	1.660*** (0.107)	1.637*** (0.101)	1.648*** (0.104)
MOTHERS	2.759*** (0.586)	1.623 (0.520)	3.521*** (0.796)	1.968** (0.648)
10-year rule	3.891*** (1.091)	2.463** (0.891)	5.404*** (1.235)	3.297*** (1.058)
MOTHERS × 10-year rule		1.959** (0.635)		2.091** (0.695)
Manufacturing	0.800 (0.204)	0.804 (0.208)	0.816 (0.206)	0.814 (0.208)
ICT	1.346 (0.289)	1.349 (0.295)	1.277 (0.280)	1.280 (0.286)
Infra and energy	1.885* (0.623)	1.865* (0.633)	2.118** (0.630)	2.038** (0.646)
Wholesale and retail	1.385 (0.303)	1.396 (0.306)	1.366 (0.294)	1.365 (0.295)
Real estate	0.967 (0.311)	0.983 (0.315)	0.772 (0.290)	0.791 (0.291)
# observations	48,745	48,745	48,745	48,745
# subjects	444	444	444	444
# events	207	207	207	207
# competing events			118	118
Wald χ^2	152***	157***	194***	208***

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 In Firm age, In 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). The sample consists of IPOs on the MOTHERS and JASDAQ before March 2011

5.2 Performance of graduations

Table 5 presents the performance of firms that graduated to the TSE main markets by December 2020. Using the TOPIX and SS-IPO index, we calculate the

BHARs of graduations.¹⁴ For IPOs on the TSE junior markets, we calculate their BHARs up to January

¹⁴ Figure 4 in the Appendix displays the trend of the TOPIX and SS-IPO index.

Table 5 BHARs of graduations to the TSE main markets (entire sample)

TOPIX		BHAR[1, 3]	BHAR[1, 6]	BHAR[1, 12]	BHAR[1, 24]	BHAR[1, 36]
TSE junior markets (MOTHERS/JASDAQ)	Mean	0.021	0.052	0.113	0.304	0.501
	Median	-0.026	-0.030	-0.037	-0.007	0.029
	SD	0.321	0.460	0.666	1.322	1.572
	<i>N</i>	398	390	371	332	285
	<i>t</i>	1.30	2.23**	3.27***	4.19***	5.38***
MOTHERS	Mean	0.021	0.054	0.099	0.313	0.472
	Median	-0.027	-0.059	-0.072	-0.052	-0.043
	SD	0.361	0.512	0.713	1.504	1.709
	<i>N</i>	285	277	261	231	199
	<i>t</i>	0.972	1.75*	2.24**	3.17***	3.90***
JASDAQ	Mean	0.021	0.048	0.146	0.283	0.568
	Median	-0.015	0.002	0.032	0.084	0.268
	SD	0.188	0.301	0.542	0.763	1.204
	<i>N</i>	113	113	110	101	86
	<i>t</i>	1.19	1.68*	2.83***	3.73***	4.38***
SS-IPO index		BHAR[1, 3]	BHAR[1, 6]	BAHR[1, 12]	BHAR[1, 24]	BHAR[1, 36]
TSE junior markets (MOTHERS/JASDAQ)	Mean	0.021	0.053	0.116	0.309	0.506
	Median	-0.023	-0.034	-0.039	-0.011	0.035
	SD	0.320	0.461	0.666	1.322	1.570
	<i>N</i>	398	390	371	332	285
	<i>t</i>	1.31	2.25**	3.35***	4.26***	5.44***
MOTHERS	Mean	0.022	0.056	0.103	0.323	0.488
	Median	-0.027	-0.047	-0.070	-0.029	-0.043
	SD	0.359	0.513	0.713	1.504	1.703
	<i>N</i>	285	277	261	231	199
	<i>t</i>	1.02	1.81*	2.33**	3.27***	4.04***
JASDAQ	Mean	0.019	0.045	0.147	0.276	0.548
	Median	-0.012	-0.016	0.044	0.043	0.253
	SD	0.190	0.302	0.541	0.764	1.214
	<i>N</i>	113	113	110	101	86
	<i>t</i>	1.08	1.57	2.84***	3.63***	4.19***

This table presents the descriptive statistics of BHARs for firms that have graduated to the TSE main markets. To calculate BHARs, we use two benchmarks: the TOPIX and SS-IPO index (see the main text). For instance, BHAR[1, 3] indicates the BHAR on a monthly basis (measured at the end of the month) from 1 month through 3 months following graduation. SD indicates standard deviation. *N* indicates the number of firms. |*t*| indicates a test statistic for the null hypothesis that the BHAR equals zero. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively

2021. Table 5 presents the mean and median BHARs from 1 month through 3, 6, 12, 24, and 36 months following graduation (BHAR[1, 3], BHAR[1, 6], BHAR[1, 12], BHAR[1, 24], and BHAR[1, 36]) when we target firms that graduated to the TSE main markets from December 1999 to December 2020. We also provide the mean and median BHARs on the MOTHERS and JASDAQ, respectively.

As shown in Table 5, the mean BHARs of graduations from the MOTHERS and JASDAQ are positive for all the observation windows, while the median BHARs are partially negative. In particular, the mean BHARs of graduations from the TSE junior markets in the 12-, 24-, and 36-months observation windows are significant at the 1% level when we calculate them using the TOPIX, indicating that firms

that graduated to the TSE main markets are highly evaluated over a certain period. The results indicate that IPO firms that graduated to the TSE main markets outperform others. Conversely, we can infer that such firms are not highly evaluated in a shorter period (e.g., 3-months). As the median BHARs is negative but the mean BHARs is positively significant for IPOs on the MOTHERS, it is considered that a small portion of graduations from the MOTHERS considerably outperform others. We also found that the mean BHARs are positive and significant in the 12-, 24-, and 36-month observation windows when the sample is restricted to IPOs on the JASDAQ. Moreover, the mean BHARs of graduations from the TSE junior markets in the 12-, 24-, and 36-month observation windows are significant at the 1% level when we calculate them using the SS-IPO index. These results indicate that firms that graduated to the TSE main markets are highly evaluated over a certain period, compared to those directly having an IPO in the TSE main markets after the emergence of the TSE junior markets. Overall, the results reveal that IPO firms that graduate to the TSE main markets exhibit better performance. Furthermore, we calculate the BHARs of graduations when the sample is restricted to IPOs before March 2011. The mean and median BHARs are presented in Table 10 in the Appendix. The results are similar to those shown in Table 5 using the entire sample.

To confirm whether young and innovative firms that graduated from the TSE junior markets exhibit better performance, Table 6 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), defined as those that graduated to the TSE main markets in less than 2 years (24 months) of going public in the TSE junior markets. As shown in Table 6, the mean BHARs of young, R&D intensity and early graduation only in 36-year observation window are positive when we use the TOPIX and SS-IPO index. This indicates that junior stock markets provide young and innovative firms with risk capital, of which graduations outperform others, including those directly listed on the TSE main markets, in the long-run performance. However, we found no evidence that the mean BHARs of these firms are better in the short-run performance. Our findings suggest that young and innovative firms do not perform better within a

shorter period, even if they graduate to the TSE main markets. Whereas junior stock markets provide young and innovative firms with risk capital, these firms do not achieve better performance via junior stock markets. Furthermore, we calculate the BHARs of graduations when the sample is restricted to IPOs before March 2011. The mean and median BHARs are presented in Table 11 in the Appendix. While the mean BHARs of early graduations are negative and significant, indicating that early graduations exhibit worse performance, the other results are similar to those shown in Table 6 using the entire sample.

Our findings indicate that overall IPOs graduated from the TSE junior markets outperform others, although they do not necessarily exhibit better performance within a shorter period. Although Carpentier et al. (2010) found underperformance following graduation, our results are consistent with those of Meoli et al. (2018). The findings of this study suggest the importance of graduation in junior stock markets. 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 the new capital for growth. Their results suggest that firms do not improve performance without having a growth orientation, even if they overcome financial constraints through an IPO. We should recognize that an IPO in junior stock markets, which also provides an opportunity to restructure management and control, is simply a way to secure access to public equity markets. Rather, how firms aim higher and graduate from junior stock markets would lead to the creation of better-performing firms.

6 Conclusions

6.1 Summary

This study explored the graduation of IPO firms and regulatory reforms in the TSE junior markets: the MOTHERS and JASDAQ. In our sample, approximately 40% of IPO firms graduated to the TSE main markets by January 2021, while approximately 13% of IPO firms were delisted from the TSE junior markets. Using the survival analysis approach, we examined the factors that affect the

Table 6 BHARs of graduations to the TSE main markets: young, R&D intensity, and early graduation (entire sample)

TOPIX		BHAR[1, 3]	BHAR[1, 6]	BHAR[1, 12]	BHAR[1, 24]	BHAR[1, 36]
Young	Mean	-0.013	0.069	0.074	0.301	0.407
	Median	-0.023	-0.036	-0.147	-0.099	-0.173
	SD	0.195	0.576	0.868	1.902	1.829
	<i>N</i>	80	78	74	67	58
	<i>t</i>	0.577	1.06	0.733	1.30	1.70*
R&D intensity	Mean	0.001	0.053	0.058	0.264	0.462
	Median	-0.029	-0.028	-0.080	-0.056	0.141
	SD	0.208	0.575	0.854	1.853	1.733
	<i>N</i>	65	64	61	51	45
	<i>t</i>	0.0330	0.743	0.530	1.02	1.79*
Early graduation	Mean	-0.008	0.008	0.063	0.127	0.354
	Median	-0.035	-0.065	-0.102	-0.100	-0.162
	SD	0.226	0.386	0.596	0.884	1.436
	<i>N</i>	150	146	139	124	105
	<i>t</i>	0.449	0.260	1.24	1.60	2.53**
SS-IPO index		BHAR[1, 3]	BHAR[1, 6]	BHAR[1, 12]	BHAR[1, 24]	BHAR[1, 36]
Young	Mean	-0.008	0.072	0.081	0.318	0.426
	Median	-0.018	-0.040	-0.153	-0.080	-0.141
	SD	0.190	0.576	0.866	1.907	1.825
	<i>N</i>	80	78	74	67	58
	<i>t</i>	0.381	1.10	0.808	1.37	1.78*
R&D intensity	Mean	0.004	0.056	0.062	0.281	0.474
	Median	-0.027	-0.032	-0.067	-0.029	0.111
	SD	0.205	0.579	0.858	1.857	1.733
	<i>N</i>	65	64	61	51	45
	<i>t</i>	0.140	0.777	0.562	1.08	1.84*
Early graduation	Mean	-0.005	0.014	0.076	0.140	0.368
	Median	-0.037	-0.075	-0.094	-0.077	-0.131
	SD	0.225	0.384	0.591	0.879	1.441
	<i>N</i>	150	146	139	124	105
	<i>t</i>	0.289	0.445	1.51	1.77*	2.62**

This table presents the descriptive statistics of BHARs for firms that have graduated to the TSE main markets. To calculate BHARs, we use two benchmarks: the TOPIX and SS-IPO index (see the main text). For instance, BHAR[1, 3] indicates the BHAR on a monthly basis (measured at the end of the month) from 1 month through 3 months following graduation. SD indicates standard deviation. *N* indicates the number of firms. |*t*| indicates a test statistic for the null hypothesis that the BHAR equals zero. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively

time to graduation to the TSE main markets. 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 devoted to R&D achieve an IPO in junior stock markets shortly after their foundation, they do not necessarily improve operating performance by going public. In addition, firms with higher

market capitalization are more likely to graduate to the TSE main markets. Moreover, listing regulations on graduation called the 10-year rule, which was introduced only to the MOTHERS, accelerate the graduation of IPO firms, especially when the sample is restricted to firms listed before the enactment of the 10-year rule. Furthermore, we provided evidence that IPO firms

that ultimately graduate to the TSE main markets exhibit better performance.

The findings of this study provide valuable insights into firms' behavior and performance after going public. We provide novel evidence on the impact of regulatory reforms on graduation from junior stock markets. Whether IPO firms can graduate from junior stock markets would reveal the business success of these firms beyond the preparatory stage in firm growth. Our findings suggest that IPO firms should aim higher—specifically, they should quickly seek to climb to main stock markets—to raise their performance.

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, can follow an IPO (Bruton et al. 2010; Kim et al. 2004). In particular, the top management team may affect post-IPO performance (Kroll et al. 2007; Le et al. 2013; Walters et al. 2010).¹⁵ However, we did not examine the impact of corporate ownership and management on post-IPO behavior and performance. Second, we did not take into account selections alternative to the TSE junior and senior markets, including foreign markets. In addition, we did not control for endogeneity issues associated with the selections. Third, we did not consider the selection of sellout (M&A) strategy—in other words, the selection of private equity capital—while young and innovative firms could grow by means of successful M&A. 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. Young and innovative firms with growth potential often attract policymakers because they are expected to stimulate the stagnant economy (Honjo 2021a). As discussed, young firms devoted to R&D are more likely to seek access to public equity markets in Japan, where private equity capital is underdeveloped (Honjo and Nagaoka 2018). In this respect, junior stock markets play a role

by providing equity financing for these firms. However, the results of this study indicate that young and innovative firms are less likely to graduate to the TSE main markets. Firms investing heavily in R&D may pursue hasty IPOs because of underdeveloped private equity capital; thus, they simply go public to maintain R&D activity by accessing public equity markets. In this respect, IPOs in junior stock markets may become complacent. Moreover, studies emphasize that the lack of improvement of the post-IPO performance of young and innovative firms is due to window-dressing in the IPO process (Jain and Kini 1994; Klein and Li 2009). 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 develop their businesses.

Furthermore, our novel findings on the impact of regulatory reforms—specifically listing regulations on graduation called the 10-year rule, which was introduced only to the MOTHERS—on the behavior and performance of IPO firms suggest that firms listed on junior stock markets with more stringent listing environments are more likely to graduate to main stock markets, thereby leading to the creation of better-performing firms. Such a promotion system may provide a strong incentive for IPO firms to aim higher, and graduation from junior stock markets results in better performance. These findings improve our understanding of the consequences of regulatory reforms in junior stock markets.

Appendix

Table 7 presents the definitions of the variables used in this study. Table 8 presents the estimation results of the time to graduation from the TSE junior markets when using the entire sample of IPOs from December 1999 to the end of December 2020. Table 9 also presents the estimation results when the sample is restricted to IPOs before March 2011, using the AFT model: the exponential, Weibull, log-normal, log-logistic, and generalized gamma distributions. It is important to note that Table 9 provides the estimated coefficients of the covariates, while

¹⁵ Gao and Jain (2012) investigated the impact of founder-CEOs on post-IPO performance.

Tables 10 and 11 provide the estimated hazards and sub-hazards. The findings in Tables 4, 8, and 9 are consistent with each other. Tables 10 and 11 present the BHARs of graduations when the sample is restricted to IPOs before March 2011.

Moreover, Fig. 3 illustrates the number of IPOs in the Japanese stock markets over time. The number of IPOs on the MOTHERS and JASDAQ was

almost 100 in 2005 and 2006. However, when the global financial crisis occurred in 2008, the number of IPOs on the MOTHERS and JASDAQ decreased considerably. After that, the number of IPOs on the MOTHERS has gradually increased with the economic recovery. Figure 4 displays the trend of the SS-IPO index proposed in this study, in addition to the TOPIX.

Table 7 Definitions of variables used in this study

Variables		Definitions
MOTHERS		If the firm goes public on the MOTHERS
JASDAQ		If the firm goes public on the JASDAQ
Graduation		If the firm graduates to the TSE main markets (first and second sections of the TSE) after going public in the TSE junior markets (MOTHERS and JASDAQ)
Early graduation		If the firm graduates to the TSE main markets in less than 2 years (24 months) of going public in the TSE junior markets
Time to graduation		The number of months from IPO to graduation to the TSE main markets
Retention		If the firm remains in the TSE junior markets
Delisting		If the firm is delisted from the TSE junior markets
Young		If the firm goes public in less than 6 years after founding (incorporating)
R&D intensity (pre-IPO)		If the ratio of R&D expenditures to sales in pre-IPO accounting year is 1% or more
Covariates in regressions	Time	Definitions
In Firm age	Monthly	The logarithm of the number of months from founding (incorporating) to the time
R&D intensity	Yearly	(= 1) if the ratio of R&D expenditures to sales is 1% or more, and (= 0) otherwise
Fixed assets	Yearly	The ratio of fixed assets to total assets
Leverage	Yearly	The ratio of total debt to total assets
In Market capitalization	Monthly	The logarithm of the market value of shareholders' equity (million JPY)
MOTHERS	(Invariant)	(= 1) if the firm goes public on the MOTHERS, and (= 0) if the firm goes public on the JASDAQ
10-year rule	Monthly	(= 1) if the 10-year rule is not enacted (before March 2011), and (= 0) otherwise (in and after March 2011)
Industry dummies	(Invariant)	Dummies for (i) manufacturing, (ii) ICT, (iii) infrastructure and energy, (iv) wholesale and retail, (v) real estate, and the others (reference)

These tables report the definitions of variables used in this study. The observation window for graduation (including early graduation), retention, and delisting is from the firm's IPO to January 2021. Covariates in regressions show those used in Tables 4, 8 and 9. Time indicates that the covariate is monthly, yearly, or time-invariant (invariant). While we prioritize consolidated financial statements to construct firms' financial data, we use unconsolidated financial statements if consolidated financial statements are not obtainable from the data source. We use financial data in the last accounting year if financial data are not available in the year

Table 8 Estimation results (hazard ratios) for graduation to the TSE main markets (entire sample)

Covariate	PH	PH	CR	CR
	(i)	(ii)	(iii)	(iv)
In Firm age	1.292 ^{***} (0.118)	1.481 ^{***} (0.185)	1.614 ^{***} (0.201)	1.598 ^{***} (0.199)
R&D intensity	0.538 ^{***} (0.084)	0.532 ^{***} (0.083)	0.575 ^{***} (0.088)	0.575 ^{***} (0.088)
Fixed assets	0.745 (0.218)	0.733 (0.216)	0.735 (0.232)	0.737 (0.233)
Leverage	1.119 (0.226)	1.110 (0.227)	1.067 (0.185)	1.059 (0.186)
In Market capitalization	1.676 ^{***} (0.081)	1.681 ^{***} (0.082)	1.646 ^{***} (0.082)	1.646 ^{***} (0.083)
MOTHERS	1.389 ^{**} (0.224)	1.190 (0.346)	1.614 ^{***} (0.275)	1.306 (0.390)
10-year rule	3.205 ^{***} (0.482)	2.774 ^{***} (0.709)	3.506 ^{***} (0.525)	2.964 ^{***} (0.757)
MOTHERS × 10-year rule		1.231 (0.367)		1.282 (0.390)
Manufacturing	0.694 [*] (0.143)	0.695 [*] (0.143)	0.723 (0.147)	0.722 (0.147)
ICT	1.119 (0.156)	1.133 (0.159)	1.113 (0.156)	1.113 (0.156)
Infra and energy	2.048 ^{***} (0.433)	2.001 ^{***} (0.434)	2.088 ^{***} (0.435)	2.082 ^{***} (0.438)
Wholesale and retail	1.044 (0.170)	1.047 (0.171)	1.047 (0.170)	1.049 (0.170)
Real estate	1.102 (0.250)	1.107 (0.253)	0.993 (0.245)	1.000 (0.247)
# observations	68,583	68,583	68,583	68,583
# subjects	1014	1014	1014	1014
# events	406	406	406	406
# competing events			128	128
Wald χ^2	294 ^{***}	301 ^{***}	309 ^{***}	316 ^{***}

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 In Firm age, In 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 9 Estimation results (coefficients) for retention in the TSE junior markets: AFT models (IPOs before March 2011)

Covariate	Exponential (i)	Weibull (ii)	Log-normal (iii)	Log-logistic (iv)	Gamma (v)
ln Firm age	-0.681*** (0.175)	-0.537*** (0.178)	-0.592*** (0.178)	-0.566*** (0.175)	-0.600*** (0.182)
R&D intensity	0.660*** (0.211)	0.587*** (0.189)	0.618*** (0.219)	0.586*** (0.206)	0.625*** (0.219)
Fixed assets	0.827** (0.396)	0.754** (0.350)	0.902** (0.408)	0.850** (0.386)	0.914** (0.410)
Leverage	-0.324* (0.179)	-0.294** (0.143)	-0.499* (0.282)	-0.406 (0.321)	-0.494* (0.278)
ln Market capitalization	-0.538*** (0.060)	-0.467*** (0.061)	-0.727*** (0.069)	-0.703*** (0.072)	-0.722*** (0.073)
MOTHERS	-0.420 (0.320)	-0.273 (0.296)	-0.023 (0.252)	-0.016 (0.257)	-0.039 (0.261)
10-year rule	-0.355 (0.261)	-0.088 (0.286)	0.054 (0.267)	0.226 (0.247)	0.045 (0.272)
MOTHERS × 10-year rule	-0.754** (0.326)	-0.705** (0.286)	-1.416*** (0.300)	-1.342*** (0.286)	-1.395*** (0.305)
Manufacturing	0.218 (0.267)	0.174 (0.235)	0.303 (0.249)	0.317 (0.232)	0.304 (0.249)
ICT	-0.279 (0.220)	-0.244 (0.195)	-0.226 (0.205)	-0.220 (0.205)	-0.223 (0.207)
Infra and energy	-0.715** (0.340)	-0.607* (0.314)	-0.444 (0.371)	-0.414 (0.453)	-0.457 (0.370)
Wholesale and retail	-0.419* (0.220)	-0.379* (0.194)	-0.125 (0.214)	-0.108 (0.211)	-0.137 (0.216)
Real estate	-0.013 (0.315)	-0.022 (0.278)	0.252 (0.295)	0.185 (0.292)	0.241 (0.295)
Constant term	Yes	Yes	Yes	Yes	Yes
Parameter 1		0.140* (0.078)	0.095 (0.071)	-0.553*** (0.076)	0.093 (0.072)
Parameter 2 (kappa)					0.045 (0.136)
# observations	48,745	48,745	48,745	48,745	48,745
# subjects	444	444	444	444	444
# events	207	207	207	207	207
Wald χ^2	197***	96***	183***	167***	165***
AIC	732	732	694	695	696
BIC	855	864	826	827	837

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 ln Firm age, ln 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 10 BHARs of graduations to the TSE main markets (IPOs before March 2011)

TOPIX			BHAR[1, 3]	BHAR[1, 6]	BHAR[1, 12]	BHAR[1, 24]	BHAR[1, 36]
TSE junior markets (MOTHERS/JASDAQ)	Mean		0.036	0.063	0.123	0.290	0.546
	Median		-0.013	-0.023	-0.043	-0.007	0.130
	SD		0.383	0.509	0.741	1.454	1.651
	<i>N</i>		206	206	198	188	177
	<i>t</i>		1.35	1.78*	2.34**	2.73***	4.40***
MOTHERS	Mean		0.041	0.078	0.110	0.307	0.550
	Median		-0.027	-0.049	-0.080	-0.055	0.064
	SD		0.454	0.595	0.835	1.696	1.824
	<i>N</i>		137	137	132	127	117
	<i>t</i>		1.05	1.53	1.52	2.04**	3.26***
JASDAQ	Mean		0.027	0.034	0.149	0.253	0.537
	Median		-0.005	0.002	0.070	0.042	0.254
	SD		0.177	0.270	0.507	0.737	1.261
	<i>N</i>		69	69	66	61	60
	<i>t</i>		1.26	1.05	2.39**	2.69***	3.30***
SS-IPO index			BHAR[1, 3]	BHAR[1, 6]	BHAR[1, 12]	BHAR[1, 24]	BHAR[1, 36]
TSE junior markets (MOTHERS/JASDAQ)	Mean		0.035	0.060	0.120	0.287	0.543
	Median		-0.017	-0.030	-0.047	-0.020	0.111
	SD		0.382	0.511	0.740	1.448	1.644
	<i>N</i>		206	206	198	188	177
	<i>t</i>		1.30	1.67*	2.29**	2.72***	4.39***
MOTHERS	Mean		0.040	0.075	0.107	0.314	0.562
	Median		-0.023	-0.033	-0.090	-0.013	0.067
	SD		0.452	0.597	0.835	1.689	1.811
	<i>N</i>		137	137	132	127	117
	<i>t</i>		1.03	1.47	1.47	2.09**	3.36***
JASDAQ	Mean		0.024	0.028	0.147	0.231	0.507
	Median		-0.004	-0.021	0.062	-0.022	0.229
	SD		0.177	0.269	0.502	0.735	1.270
	<i>N</i>		69	69	66	61	60
	<i>t</i>		1.14	0.877	2.38**	2.45**	3.09***

This table presents the descriptive statistics of BHARs for firms that have graduated to the TSE main markets. To calculate BHARs, we use two benchmarks: the TOPIX and SS-IPO index (see the main text). For instance, BHAR[1, 3] indicates the BHAR on a monthly basis (measured at the end of the month) from 1 month through 3 months following graduation. SD indicates standard deviation. *N* indicates the number of firms. |*t*| indicates a test statistic for the null hypothesis that the BHAR equals zero. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively. The sample consists of graduations to the TSE main markets among IPOs before March 2011

Table 11 BHARs of graduations to the TSE main markets: young, R&D intensity, and early graduation (IPOs before March 2011)

TOPIX		BHAR[1, 3]	BHAR[1, 6]	BHAR[1, 12]	BHAR[1, 24]	BHAR[1, 36]
Young	Mean	0.016	0.116	0.103	0.330	0.612
	Median	0.006	-0.012	-0.128	-0.035	0.050
	SD	0.187	0.630	0.959	1.997	1.992
	<i>N</i>	54	54	51	47	44
	<i>t</i>	0.636	1.36	0.766	1.13	2.04**
R&D intensity	Mean	-0.041	0.036	0.044	0.315	0.456
	Median	-0.042	-0.040	-0.142	-0.057	0.130
	SD	0.185	0.670	0.991	2.124	1.897
	<i>N</i>	42	42	41	38	35
	<i>t</i>	1.43	0.348	0.282	0.915	1.42
Early graduation	Mean	-0.011	-0.121	-0.175	-0.233	-0.166
	Median	-0.033	-0.094	-0.206	-0.193	-0.202
	SD	0.158	0.204	0.371	0.498	0.644
	<i>N</i>	28	28	28	26	25
	<i>t</i>	0.362	3.13***	2.49**	2.38**	1.29
SS-IPO index		BHAR[1, 3]	BHAR[1, 6]	BHAR[1, 12]	BHAR[1, 24]	BHAR[1, 36]
Young	Mean	0.021	0.122	0.108	0.354	0.641
	Median	0.010	-0.019	-0.127	-0.013	0.008
	SD	0.183	0.633	0.957	1.993	1.979
	<i>N</i>	54	54	51	47	44
	<i>t</i>	0.850	1.41	0.808	1.22	2.15**
R&D intensity	Mean	-0.037	0.036	0.040	0.328	0.467
	Median	-0.027	-0.035	-0.172	-0.074	0.109
	SD	0.178	0.675	0.993	2.128	1.900
	<i>N</i>	42	42	41	38	35
	<i>t</i>	1.36	0.346	0.258	0.951	1.46
Early graduation	Mean	-0.007	-0.113	-0.142	-0.199	-0.144
	Median	-0.037	-0.083	-0.200	-0.167	-0.223
	SD	0.155	0.193	0.345	0.461	0.625
	<i>N</i>	28	28	28	26	25
	<i>t</i>	0.224	3.10***	2.17**	2.20**	1.15

This table presents the descriptive statistics of BHARs for firms that have graduated to the TSE main markets. To calculate BHARs, we use two benchmarks: the TOPIX and SS-IPO index (see the main text). For instance, BHAR[1, 3] indicates the BHAR on a monthly basis (measured at the end of the month) from 1 month through 3 months following graduation. SD indicates standard deviation. *N* indicates the number of firms. |*t*| indicates a test statistic for the null hypothesis that the BHAR equals zero. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively. The sample consists of graduations to the TSE main markets among IPOs before March 2011

Fig. 3 Number of IPOs by the 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

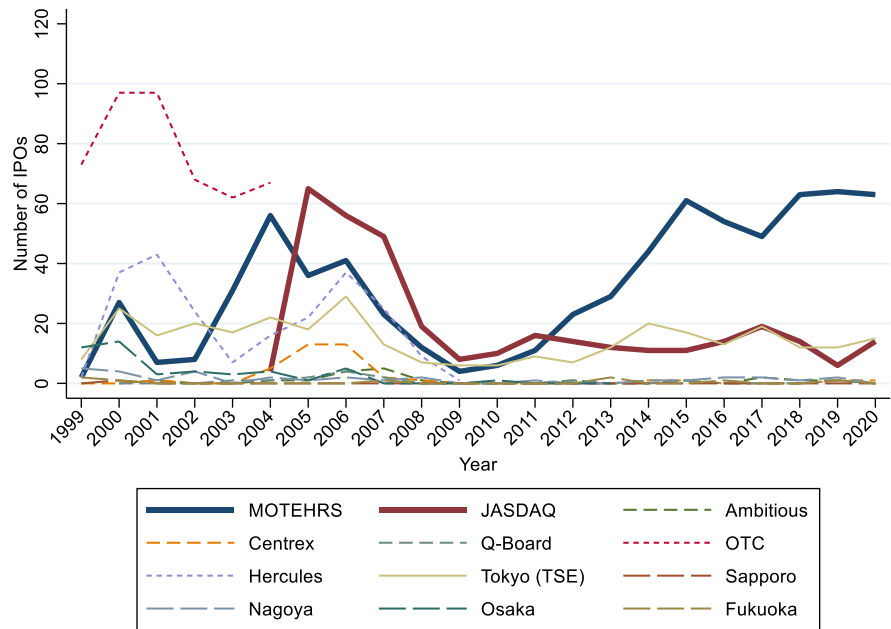
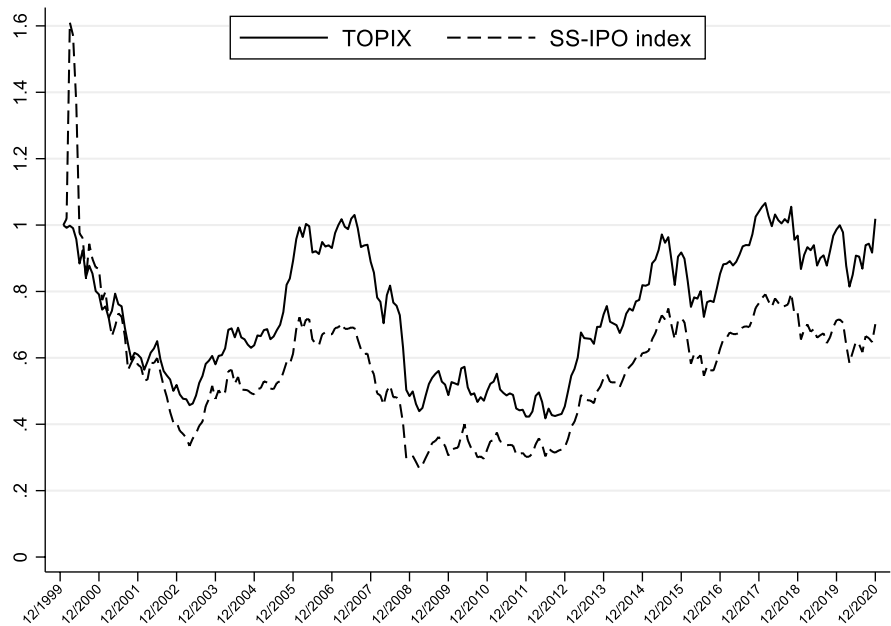


Fig. 4 Trend of the TOPIX and SS-IPO index. The ordinate indicates the TOPIX and SS-IPO index when the values in December 1999 are equal to one



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Declarations

Conflict of interest The authors declare no competing interests.

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