Estimating the Cost of Capital Market Distortions: Evidence from Chinese Overseas IPOs*

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Abstract

Both capital controls and domestic capital market regulations impose a cost on firms. By comparing to firms listed at home, we estimate the entrepreneurs of overseas listed Chinese firms are willing to pay a 60% haircut in firm value in order to bypass these costs. With a structurally estimated model, we quantify the welfare loss due to capital market distortions to be 18% for a representative Chinese entrepreneur.

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"The fortunate man is seldom satisfied with the fact of being fortunate. Beyond this, he needs to know that he has a right to his good fortune. He wants to be convinced that he 'deserves' it, and above all, that he deserves it in comparison with others. Good fortune thus wants to be legitimate fortune." — Max Weber

1 Introduction

Capital controls are common, especially among emerging market economies and developing countries. A number of countries also have behind-the-border regulations on domestic capital market. Such controls or regulations are often justified by the authorities on either financial stability or investor protection ground, but can be costly. We propose a willingness-to-pay approach to estimate the overall cost of such distortions in China from the viewpoint of entrepreneurs, by comparing the Chinese firms listed on stock exchanges either at home or abroad. Importantly, we take into account the endogenous nature of the IPO locational choices so that the valuation differences due to a possible negative or positive selection of the overseas listings are corrected. With an estimated structural model, we convert them into a calculation of a loss in entrepreneurs' welfare. We also evaluate the extent of entrepreneurial gains from reforming the IPO regulations and removing capital controls.

Overseas listing by domestic firms provides an important linkage of an individual country to international capital markets. In recent decades, few countries can beat China in terms of the number of entrepreneurs who take their firms for listings outside their home countries. By the end of 2020, about 1,700 Chinese firms, or about 30% of all Chinese publicly listed firms, are listed outside mainland China. Hong Kong and the US are the top two most popular destinations of Chinese issuers. The total market capitalization of Chinese firms in the Hong Kong and US stock markets reached USD 5.4 trillion in 2020, or about 44% of the mainland China's total market capitalization.[1]

Overseas listings by themselves are neither new nor uncommon. As early as in the 1980s, many non-US firms were listed in the United States. The explanations offered in the literature include[2]: making shares accessible to global investors (Errunza

[1] In Feng et. al. (2024), "A Narrative on Overseas Listing by Chinese Firms", we present a detailed description of the number of listed Chinese firms and their market capitalization in mainland China, Hong Kong, US, Singapore, and UK stock markets. We also document the evolution of Chinese firms' initial public offerings outside mainland China; discuss the important reforms of the listing requirements in both mainland China and Hong Kong; and examine the recent delisting pressure on Chinese stocks from the US exchanges from both the Chinese and US authorities.

[2] Karolyi (2006), Roosenboom and Van Dijk (2009) and Liu (2014) provide a nice review of the extensive literature on the subject.

and Losq, 1985; Miller, 1999), increasing stock liquidity in a more developed equity market (Merton, 1987; Foerster and Karolyi, 1999), signalling firm quality by accepting stronger disclosure requirements (Baker et al., 2002; Lang et al., 2003), improving corporate governance by "bonding" themselves to stronger investor protection (Coffee, 1999, 2002; Lel and Mill, 2008), insulating firms from potential hostile takeovers (Tsang et al, 2022), as well as building a stronger brand in the product or labor market (Pagano et al., 2001; Tolmunen and Torstila, 2005). Most studies find that listing in the US generates a reduction in the cost of capital and a premium in firm valuation. For example, Doidge et al. (2004) summarize that "foreign companies with shares cross-listed in the US had Tobin's Q ratios that were 16.5% higher than the Q ratios of non-cross-listed firms from the same country." It is also worth noting that very few Chinese firms are included in the samples of these studies because overseas listing by Chinese firms only become common in more recent years.

The overseas listed Chinese firms, however, do exhibit some differences. First, while foreign firms in the US stock market typically have a listing in their home country, most overseas listed Chinese firms do not. Out of the 1586 Chinese firms listed the Hong Kong or US stock markets in 2020, 1431 do not have a corresponding listing inside mainland China.[3] Second and more importantly, instead of achieving a higher valuation than domestic peers after an overseas listing, the overseas listed Chinese firms appear to receive a lower valuation. The most well-known example is the puzzling A-H premium or H-A discount. [4] To see whether a valuation discount of overseas listing is a general phenomenon beyond A-H dual-listed firms, we look at the valuation of all Chinese firms that went an IPO during 2009 to 2019 and that could potentially choose to list either in a domestic or an overseas market. As we illustrate later in detail when describing the data, a striking fact arises: across all statistics and using various valuation measures, the overseas listed Chinese firms on average receive a much lower valuation than their domestic peers. For example, the average Tobin's Q one year after IPO for domestic listed Chinese firms is 4.05 but is only 1.91 for those listed overseas. This suggests a 53% valuation discount facing overseas listed Chinese firms.

[3] Among the rest, 130 are dual-listed in Hong Kong and mainland China; 21 are cross-listed in Hong Kong and US via ADRs; 4 are cross-listed in Hong Kong, US, Singapore and Canada via ordinary shares.

[4] A-shares, listed on Shanghai or Shenzhen Stock Exchange, are issued by firms registered in China. About 130 of them also list H-shares in the Hong Kong stock market. These dual-listed A-H shares offer identical shareholder rights, cash flow rights, and fundamental value. However, except during mainland China stock market crises, the prices of A-shares have been persistently higher than the corresponding H-shares, often by a margin more than 20%.

This paper aims to understand why so many Chinese firms choose to go overseas IPOs despite of the substantial valuation discount. Our key hypothesis is that the valuation discount can be thought of as a willingness-to-pay by the entrepreneurs to bypass the inconveniences associated with China's capital market regulations. China has both binding restrictions on cross-border capital account transactions and regulation of domestic capital market.[5] First, neither firms nor individuals can easily convert their assets or savings into foreign currencies, or otherwise send them abroad. Such restrictions might be justified by a rationale to safeguard domestic financial stability, but it could be a legacy of the previous central plan mode. Second, an application for IPO on a Chinese stock exchange involves a long review process by China Securities Regulatory Commission (CSRC) with an uncertain outcome. Even after a successful IPO, major shareholders have to face a one-to-three years' lock-up period. One interpretation to these regulations is that the government wants to select "good" firms to be on the stock market in order to protect the interests of households as investors. This is part of China's paternalistic approach to domestic capital market regulation. It also suggests at least in principle that overseas listed Chinese firms are negatively selected - they might have poorer fundamentals on average than domestically listed.

An important motivation for an entrepreneur to choose to list her firm on an overseas stock exchange is to bypass these regulations. For example, when a firm is listed in Hong Kong or US stock markets, the dividends payment and the proceeds from IPO and future selling down shares would be in a foreign currency and can be kept and used outside the border. By choosing to list her firm on an overseas stock exchange, the entrepreneur also bypasses the long IPO application process, long lock-up period and potential restrictions on initial offering prices in mainland China. An overseas listing provides a legitimate avenue to circumvent both distortions. Presumably, the entrepreneur is willing to pay something in order to use this venue. The valuation haircut in the overseas stock valuation can thus be used to indirectly infer the cost of China's capital controls and domestic capital market regulations facing the entrepreneurs.

We use three set of "tools" to elaborate and test this hypothesis — a theoretical model, an empirical model and a structural estimation. First of all, we propose an optimal IPO locational choice model, similar to international migration decision as in Borjas (1987; 1988). The model has three important predictions. First, an overseas

[5] Amstad, Sun, and Xiong (2020) provide an overview of China's financial system and various significant reforms. Li and Wei (2020) and Allen et al (2023) provide a more specialized review on reforms and challenges in China's international and domestic capital markets, respectively.

IPO decision boils down to the comparison between the cross market valuation gap and the cost of domestic capital market distortions. Second, taking the overseas listed firms as the treatment group and the domestic listed firms as the control group, the average treatment effect of an overseas listing speaks the distortion cost facing the marginal entrepreneur. Third, the observed group mean difference in firm valuation is a combination of the average treatment effect on the treated and the selection bias in the domestic market. This suggests the 53% valuation discount facing the overseas listed Chinese firms, could be because they face significant capital market distortions, or because they might be inferior to domestic listed firms in the domestic market.

We then take the theory to the data via an endogenous treatment effect model. The model can simultaneously and consistently estimate the probability of an overseas listing and the firm valuation from different markets. We address the endogeneity rising from the correlation between factors that influence the IPO locational choice and factors that affect the firm valuation with two innovative instrumental variables. For both IVs, our key identification assumption is that, pre-IPO industry-average and market-wide conditions offer informative variation in the determinants of entrepreneur's listing locational choice. However, such information is redundant to the post-IPO market valuation, once the market prices each firm according to its characteristics and post-IPO industry and market conditions.

Our main results are as follows. First, we can reject the negative selection hypothesis. If anything, overseas listings exhibit a positive selection on average. The selection can be regarded as arising from both observable and unobservable factors. After controlling for a long list of observable firm characteristics suggested by the literature and by our hypothesis, we estimate that the unobservable factors leading to a decision to do an overseas listing tend to be positively correlated with factors leading to a higher market valuation of the firm in the domestic market. Second, the valuation discount for overseas listings is sizable. While unconditional Tobin's Q for overseas listed Chinese firms is 53% lower than otherwise, a simple model that acknowledges the endogenous nature of the treatment produces 59% haircut for overseas listed Chinese firms. With a generalized model that also allows similar firm or market characteristics to produce different valuations in domestic versus overseas markets, the haircut rises to 66%. Third, in both specifications, the valuation discount is persistent - the valuation gap in terms of the Tobin's Q in the two markets does not disappear even five years after the IPOs. Finally, additional evidences from a set of validity checks and

extensions systematically suggest that the entrepreneurs have given up a substantial portion of firm valuation in an overseas listing.

While our estimated valuation discount may not fully tease out other differences across the domestic and overseas markets in addition to capital market distortions, we validate our interpretation by examining how the estimated treatment effect responds to shocks that alter the strength of some distortions. For example, during the time periods when China tightens capital controls (2018-2019) or when it suspends the domestic IPO approval (2013-2014) or when it imposes PE restrictions at IPO (2014-2019), we find that the entrepreneurs appear to be willing to accept an even larger valuation haircut for overseas listings. Firms with certain characteristics, such as a higher foreign ownership and a higher operating risk, that are more sensitive to capital control and IPO regulation, also face a larger valuation discount in an overseas listing, and an even further discount when the distortions get worse. These findings support the interpretation that the valuation discount reflects an entrepreneur's willingness-to-pay to bypass capital controls and IPO regulations.

Finally, we estimate the structural parameters in our the theoretical model by matching the simulated moments to the empirical moments drawing from the econometric estimates. The parameter that captures the average distortion cost is found to be significantly positive. The estimate suggests that due to capital market distortions, a representative Chinese entrepreneur has paid 32 cents for every 1 dollar of capital offered at an IPO. Together with parameters that characterize the correlation between valuation and cost and therefore the optimal IPO locational choice, we assess that the total utility loss of the entrepreneurs to be 18.1%, with two-thirds due to capital controls and one-third due to IPO regulations. Those Chinese entrepreneurs who list their firms in the domestic market are also willing to give up 28% of firm valuation in order to enjoy a distortion-free environment.

Note that our calculation should be a component of a broader welfare analysis that also takes into account potential benefits of capital controls and investor protection. Nonetheless, the loss of the entrepreneurs due to IPO regulations is new in the literature, and the loss of the entrepreneurs due to capital controls has typically been missing in the discussion of the welfare effect of capital controls. Our research suggests the loss could be sizable quantitatively.

Our paper contributes to several strands of literature. First, the existing theories on cross-listings emphasize overcoming transaction costs due to market segmentation

or mitigating asymmetric information between foreign investors and domestic firms. In addition to these frictions, we propose a willingness-to-pay approach to estimate the cost of all capital market imperfections from the viewpoint of an entrepreneur. More broadly, while the international migration literature often focuses on the migration cost to the destination country, our paper points out the importance of the regulations in the source country that might motivate a migration, for labor or for capital.

Second, our paper contributes to the literature on measuring resource misallocation which lowers aggregate total factor productivity (Restuccia and Rogerson, 2013). While China is known to have capital misallocation (Dollar and Wei, 2007; Hsieh and Klenow, 2009; Song and Wu, 2015), the existing research focuses primarily on distortions in the credit market (Song et al., 2011; Wu, 2018; Ek and Wu, 2018). We instead propose a way to estimate the size of the distortions in the capital market, especially restrictions on capital flows and IPO process.

Third, our paper contributes to the broad literature on the effect of financial globalization for developing economies. As surveyed in Kose et al. (2009), there has been a long-lasting and intense debate on the benefits and costs of integrating into the international capital market. Our paper provides one estimate of the cost of capital market regulations. Our methodology can be applied to other countries with capital account restrictions and overseas listings.

Finally, our paper is also related to the recent literature on global capital allocation. According to Clayton et. al (2023), in the past two decades, China's presence went from raising a negligible amount of capital in offshore equity markets to accounting for more than half. Our paper provides one microfoundation to understand the rise of Chinese firms in global stock market.

The rest of the paper is organized as follows. Section 2 introduces the institutional background for the capital market distortions of our focus. Section 3 describes the data, sample and pattern of market valuation gap. Section 4 presents a theoretical model of IPO locational choice. Section 5 explains how to consistently estimate the model using an endogenous treatment effect framework. Section 6 reports main empirical results. Section 7 presents causal evidence for the effect of policy distortions on valuation discounts. Section 8 provides a structural estimation of the model and conducts counterfactual simulations. Section 9 concludes. A set of extensions, validity checks, and robustness checks, together with additional discussions is provided as appendices.

2 Capital Market Distortions

2.1 Capital Controls

Capital controls are often used by emerging countries to prevent capital flights or currency crises but can generate their own inefficiencies. While China has pursued current account convertibility in 1996, it retains restrictions on capital account transactions on both inflows and outflows.

For Chinese citizens, each individual only has a USD 50,000 annual foreign exchange quota. There is also explicit forbiddance on offshore property purchase or portfolio investment. For Chinese firms, activities that may lead to capital outflows, such as outbound direct investment and offshore portfolio investment, must seek approval from the related departments to obtain foreign exchange. The approval or review process may take a long time especially when the government tightens capital outflow controls. Finding a way around the regulations is something of a national enthusiasm. For middle-class families, this means making money and diversifying portfolio.[6] For rich[7] and powerful[8], this means protecting fortunes and setting a backup plan.

An overseas listing provides a way for entrepreneurs to move wealth outside the country without triggering the capital controls. When a firm is listed in New York, all the dividends payout will be in US dollars outside China, which the entrepreneur and other shareholders can keep and use freely outside China. In addition, when the entrepreneur downsizes her ownership holdings, the proceeds will also be in US dollars. She would not need to deal with Chinese capital control regimes for moving assets around the world. It is useful to note that, for the purpose of bypassing capital controls, listing a firm in Hong Kong is similar to doing so in New York since Hong Kong has no capital controls and the entrepreneur and shareholders can easily convert proceeds from selling shares or dividends from Hong Kong dollars to other currencies.

Using an overseas IPO to bypass capital control is by no means easy and cheap, compared with some loopholes or alternative measures in the financial system, such as

[6] See, for example, the report from Financial Times on "Why wealthy Chinese buy their insurance in Hong Kong?" at https://www.ft.com/content/e990ec76-b98f-3649-aaa5-bbe7cbdb3db4

[7] See, for example, Bloomberg's report on how "Soho China's founders shifted much of their fortune out of the country before controls tightened and the market imploded via its IPO in Hong Kong" at https://www.bloomberg.com/news/articles/2022-11-30/soho-china-s-founders-safeguard-their-fortune-with-new-york-real-estate

[8] See, for example, the report from Reuters on "Ant Group is connected to former Hangzhou party secretary's corruption case" at https://www.reuters.com/markets/funds/ant-group-is-connected-former-hangzhou-party-secretarys-corruption-case-ft-2022-01-21

underground wire or outbound guarantee. However, first, although Chinese regulators sometimes turn a blind eye, they do crackdown loopholes and tighten alternatives when foreign reserve declines quickly. Potential sanctions for violating capital controls range from a monetary fine to jail terms. More importantly, the amount of wealth involved in an overseas IPO is often too large to go through other channels. Finally, the capital gains and dividends payout in the subsequent years after an overseas IPO provides a sustainable gateway of moving money across the border and keeping wealth offshore.

2.2 Approval-Based IPO System

China's stock market is well-known for its highly regulated IPO system.[9] First of all, until the recent registration-based IPO reform,[10] the CSRC reviews all applications for an IPO on a domestic stock exchange and only grants a formal approval on a case-by-case basis. Importantly, the CSRC's review not only checks the authenticity of information disclosures but also makes a value judgment on the "quality" of the stocks. This means not all applications will result in an approval, and even conditional on eventual approval, the time it takes from initial application to eventual listing could be a lengthy process. In contrast, the Hong Kong and US markets use a checklist-based registration system. The presumption is that as long as an aspirant firm satisfies a set of known financial and legal conditions, and fully and truthfully discloses the required information, the firm will be listed, usually within 6 to 12 months of initial application. In our baseline sample, the mean (and median) waiting time is 464 (and 459) days for a domestic listing, compared to 185 (and 155) days for an overseas listing. This means a cost arising from the risk and delay for entrepreneurs who take the firm public on domestic market.

Occasionally, the IPO waiting time could be unpredictable when the CSRC suspends reviews of any IPO application. For example, this happened in 2014 when the regulator thought an IPO suspension could help to support stock price or prevent further decline in the broad market index. For the entrepreneurs, an IPO suspension is a negative shock to an already long and uncertain waiting period for a domestic IPO.

Furthermore, even after a successful IPO, the entrepreneurs may not have their

[9] Among many others, see Qian et al. (2022) for a comprehensive and informative review on China's IPO policies. Tsang (2010) discusses the IPO application process and listing requirements in Hong Kong and New York.

[10] Specifically, China first piloted the registration-based IPO system on the science and technology innovation board (STAR) in 2019, and expanded it to the ChiNext board in 2020 and to shares on the Beijing Stock Exchange in 2021, and finally fully rolled out the system to the main board in 2023.

hands on cash immediately due to the regulations on lock-up period. An IPO lock-up period is a period of time after a company has gone public when insiders are prohibited from selling their shares. It is a common practice widely adopted in many stock markets. For example, in Hong Kong and the US, the lock-up period is typically 6 to 12 months.[11] In mainland China, the Company Law has specified a 12-month lock-up period. However, concerned on the possibility that insiders might inundate the market with large numbers of shares after IPO, the CSRC has further implemented a set of regulations so that the applicable lock-up period in domestic market actually varies from 18 months to 36 months.[12] This implies an additional cost of delay for entrepreneurs who seek for a domestic listing.

Finally, from time to time, especially following major reforms of the stock market, the CSRC also sets explicit or implicit restrictions on initial offered price. During our sample period, after a long period of IPO suspension, from April 2014 and until the recent reform of the registration IPO system, the CSRC implicitly mandated that the initial offered price cannot be more than 23 times of the estimated earnings. The ceiling on the initial PE ratio is meant to improve the chance that the stock price will rise after the IPO. In contrast, in Hong Kong and the US, where regulators believe that an informed investor is a protected investor, there is no ceiling on initial stock price. Presumably, those entrepreneurs who believe the fair value of their stocks is more than 23 times the earnings see a serious cost of listing their stocks at home.

3 Data

3.1 Initial Sample

We start with all Chinese firms that were debuted between 2009 and 2019 on either one of the two domestic stock exchanges in Shanghai and Shenzhen, or one of the exchanges in Hong Kong and New York (NYSE and NASDAQ). Following FTSE Russell's Guide to Chinese Share Classes, a firm is defined as "Chinese" if it meets any of the following criteria: (1) incorporated in mainland China; (2) with the headquarters, establishment, or origin of the firm in mainland China; (3) with the controlling shareholder (holding more than 30% of the total outstanding shares) located in mainland China; or (4) with more than 55% of the sales revenue from mainland China.

[11] The specific rule on lock-up period is HKEX's Rule 10.07 (main board) and Rule 13.16A (GEM) and SEC's Rule 144.

[12] See, for example, a summary for various applicable lock-up period in China's stock market at https://www.dehenglaw.com/CN/tansuocontent/0008/023941/7.aspx?MID=0902

We choose 2009 as the starting year of our sample for two reasons. First, ChiNext was launched that year as a new segment of the SZSE to provide an opportunity for small and medium-sized firms to become public traded firms. While Chinese stock exchanges generally have more demanding listing conditions, especially minimum financial performance requirements than either Hong Kong or New York, ChiNext has the least demanding requirements among all segments of Chinese stock exchanges. Second, due to an agreement between Hong Kong and mainland China on accounting reporting requirements in 2007, 2009 is also the first year for which two previous years of accounting data can be obtained on a consistent basis.

We choose 2019 as the end year of our IPO sample in order to filter out the impacts of major regulatory changes in both China and the US since 2020. As documented in Feng et al. (2024), the Market Regulation and Anti-Monopoly Guidelines for the Platform Economy issued by the Chinese authorities, and the delisting risk facing US-listed Chinese firms due to the Holding Foreign Companies Accountable Act (HFCAA), both imply a structural change in the general environment facing Chinese overseas listed firms after 2020.[13]

According to our definition on Chinese firms, listing locations and sample period, using sources from the Wind Financial Database, the Chinese Stock Market and Accounting Research (CSMAR) and the S&P Capital IQ, our initial sample is made of 2207 firms listed in mainland China, 777 in Hong Kong, and 255 in the US markets.

3.2 Comparable Groups

Since our theoretical framework and empirical exercises apply to a set of Chinese firms that are potentially free to choose where to go IPO, we exclude a set of firms from our initial sample to increase the comparability between our treatment group – the overseas listed Chinese firms, and control group – the domestic listed Chinese firms.

As detailed in Appendix 1.1, due to the Negative List for foreign investment and the stringent financial listing requirements in mainland China, some Chinese firms are not eligible to list in the domestic market in the first place. Therefore, we first exclude those overseas listed firms that are either on the Negative List (334 firms) or do not satisfy the lowest financial indicator requirements in mainland China at the times of

[13] Overseas IPO, however, is still an ongoing venture for many Chinese firms. After the CSRC and the Ministry of Finance of China formally signed an Audit Regulation Cooperation Agreement with PCAOB on 26 August 2022, the delisting risk for Chinese concept stocks was temporarily resolved. According to the disclosure of the CSRC, in 2023, 81 Chinese firms have received approval for an overseas IPO, of which 26 went to New York.

their IPOs (199 firms), or both (100 firms). The fact that 40% of firms in the initial overseas listing sample are excluded needs some discussion. On the one hand, this assures the comparability between the treatment and control group in our empirical exercises, since these firms do not have the liberty to choose between domestic and foreign markets for IPO. On the other hand, the Negative List and the stringent financial listing requirements can also be regarded as capital market distortions in a broad sense. Therefore, we also apply our analyses by including all overseas listed Chinese firms in the treatment group as an extension. Results for the extended sample are reported in Appendix 2.2.

In addition, because A-H dual listed firms are different from other overseas listed firms, we also exclude 59 such firms from our baseline sample, though we will report some information from them later for a validity check. Finally, another 57 overseas listed firms are also dropped out of the sample, either due to missing value or due to a perfect prediction in our selection model. In the end, as summarized in Figure 1, we are left with a baseline sample of 2,153 Chinese firms listed in mainland China, 512 in Hong Kong, and 64 in the US markets. These firms in principle can choose where to list and about 21% of them had chosen an overseas IPO. Figure 1A further describes how the final overseas listing sample is obtained as the result of each of the filters discussed earlier.

3.3 Variables and Patterns

We download the official prospectus of IPO from the website of corresponding listing exchanges for mainland China and Hong Kong listed firms, and from the SEC website for US listed firms. We then hand-collect from each firm's prospectus the information on pre-IPO ownership structure and corporate governance, such as the ownership share of each of the top five shareholders, the presence of strategic investors, number of independent directors, and whether CEO and chairman are the same person. From Wind Financial Database, we obtain basic firm characteristics and financial indicators such as year of establishment, industry, headquarters address, and standard financial variables from balance sheet, income statement and cash flow tables, together with stock prices at various points in time. Table A1 provides a list of the variables and their definitions. Tables A2, A3 and A4 present their summary statistics for firms listed in the mainland China, Hong Kong and the US markets, respectively.

While firms listed in different markets do seem to exhibit some interesting differ-

ences, especially on ROA, sales growth rate, and foreign ownership, the single most remarkable difference lies in their market valuation. The top panel of Table 1 tabulates the mean, 25^{th} percentile, median and 75^{th} percentile of Tobin's Qs for the two group of firms at the moment of IPO, at the end of first trading day, and one to five-year post-IPO. A striking fact is that, across all the statistics and over all the horizons, the Tobin's Qs for overseas listed Chinese firms are always lower than those in mainland China. For example, the average value one year after IPO is 4.05 for the control group but only 1.91 for the treatment group. This suggests a 53% valuation discount for overseas-listed Chinese firms relative to their domestic peers.

When we look at the Price-to-Book Value ratio and Price-to-Earnings ratio as alternative ways to gauge market valuation, as shown in the middle and lower panel of Table 1, we reach a similar conclusion. The valuation is always higher inside China than outside, and the magnitude of the valuation discount for overseas listed firms is substantial. To visualize the valuation gap between these two groups of firms, we plot the 25^{th} percentile, the median and the 75^{th} percentile of Tobin's Q, the PB ratio and the PE ratio (normalized by 10 to be on the similar scale), 1, 3 and 5 years post-IPO in Figure A2. The horizontal and vertical axes correspond to the values for overseas-listed and domestic-listed firms, respectively. All the 27 dots appear far above the 45-degree line. Once again, this highlights the large and robust valuation discount facing overseas-listed Chinese firms relative to domestic-listed counterparts.

As a generalization of MM proposition, in a perfect capital market, firm values should be independent of their listing location, conditional on the same fundamentals. Of course, even for firms in our comparable groups, they may still have different fundamentals. Considering the intention to select "good" firms to list in China's stock market by the CSRC, if Chinese investors have the same assessment on "good" firms as the regulator, the valuation discount of the overseas listed Chinese firms may reflect the differences in the fundamentals across the two groups. On the other hand, had these two group of firms have the same fundamentals, the valuation gap would reveal the hidden cost facing the overseas listed Chinese firms if they had chosen to list at home. Furthermore, if the overseas listed Chinese firms in fact have better fundamentals than domestic listed firms, they would have faced a cost of capital market distortion that is even larger than the valuation gap. Since firms choose their listing location optimally, based on both the potential market valuation determined by the their fundamentals and the cost from capital market distortions, a correct inference of the cost needs to

take into account this self-selection effect.

4 A Model on IPO Locational Choice

4.1 Basic Setup

To guide our econometric estimation and welfare analysis, we propose a theoretical model of IPO locational choice that features the self-selection effect. The model is inspired by Borjas's (1987; 1991) classic model of international migration, which in turn was built on the insight from Roy (1951).

Suppose entrepreneur i is contemplating to list her firm i on either a home stock exchange, denoted by 0, or a stock exchange abroad, denoted by 1. Assume the domestic market prices her 1 CNY initial public offering at Q_{i0} CNY and the overseas market prices her 1 USD initial public offering at Q_{i1} USD. Under the assumption of market efficiency, Q_{i0} and Q_{i1} are the present value of all the future cash flows that will be generated by the 1 CNY and 1 USD capital, when the firm is listed in the domestic and overseas market, respectively. This implies that Q_{i0} and Q_{i1} have priced in the potential effects on firm valuation associated with a particular listing location. Such effects may include corporate governance, product and labor market synergy with the capital market, the differences in investor base, transaction schemes, and tax rates, as well as the opportunity of seasonal equity offering, bond issues and M&A. Crucially, from an individual entrepreneur's point of view, Q_{i0} and Q_{i1} are determined by the market and are therefore taken as given.

If she applies for an IPO in the domestic market, there is a waiting period of T_{0a} for the CSRC to scrutinize the application before the IPO takes place. In our sample period, T_{0a} is about 16 months. In addition, there is a minimum lock-up period of T_{0b} before the entrepreneur can sell down her shares after the IPO. In our sample, T_{0b} is about 24 months. We use $T_0 = T_{0a}+T_{0b}$ to denote total minimum amount of time needed by entrepreneur i from the time of an application for an IPO to the time that she can obtain her welfare from selling down her shares. T_0 is about 40 months or 3.33 years in the Chinese domestic stock market. Similarly, T_1 denotes the total minimum time needed by entrepreneur i to realize her equity wealth if she chooses to list her firm on an overseas stock exchange. In our sample, T_1 is on average about 15 months or 1.25 years, including 6 months for IPO review and 9 months of lock-up period. Assume that entrepreneur i offers K_i CNY assets to public as stock. Let r

denotes the discount rate. If the entrepreneur chooses to debut her firm on a domestic stock exchange with an initial offering of K_i CNY, the present value of her wealth after discounting the delay in waiting and lock-up period is $\frac{Q_{i0} \cdot K_i}{(1+r)^{T_0}}$. If she chooses to go IPO abroad, at the official exchange rate of 1 USD = e CNY, the present value of her wealth is $\frac{1}{e} \cdot \frac{Q_{i1} \cdot K_i}{(1+r)^{T_1}}$.

While an overseas listing directly raises USD, a domestic listing brings in IPO proceeds and future capital gains or dividends in CNY. With binding capital controls, she needs to spend time and face risk to obtain foreign exchanges. This might involve using black market or other underground channels to bypass capital controls. Using τ to denote the proportional cost of converting CNY to USD, K_i CNY can only be converted to $(1-\tau)\frac{K_i}{e}$ USD. Even with dollars at hand, the entrepreneur might not be indifferent between holding her wealth onshore versus offshore due to differences in wealth tax or risk of expropriation. Let us assume that, in entrepreneur i's subjective assessment, 1 unit of offshore wealth = $(1+\delta_i)$ units of onshore wealth. If $\delta_i > 0$, the entrepreneur prefers keeping her wealth offshore on the margin. On the hand, if $\delta_i < 0$, she prefers keeping her wealth onshore. In the end, the present value of her wealth from listing in home market that is denominated in USD and can safely and freely move across border is $\frac{(1-\tau)}{(1+\delta_i)e} \cdot \frac{Q_{i0} \cdot K_i}{(1+r)^{T_0}}$.

For given initial public offering assets denominated in USD $\frac{K_i}{e}$, to decide where to list her firm, the entrepreneur compares her utility from one dollar offered in each location, which are, respectively,

$$U_{i0} = \ln\left[\frac{(1-\tau)}{(1+\delta_i)} \cdot \frac{Q_{i0}}{(1+r)^{T_0}}\right], \tag{1}$$

and

$$U_{i1} = \ln\left[\frac{Q_{i1}}{(1+r)^{T_1}}\right]. \tag{2}$$

She would choose an overseas IPO if and only if her utility from doing so is her, $U_{i1} \geq U_{i0}$. Equivalently, an overseas IPO is chosen if and only if

$$\ln Q_{i1} - \ln Q_{i0} \geq \ln(1-\tau) - \ln(1+\delta_i) - (T_0 - T_1) \cdot \ln(1+r).$$

Denote $q_{i1} = \ln Q_{i1}$, $q_{i0} = \ln Q_{i0}$, $d = r(T_0 - T_1)$ and use approximation $\ln(1-\tau) \simeq -\tau$, $\ln(1+\delta_i) \simeq \delta_i$ and $\ln(1+r) \simeq r$, the overseas IPO decision nails down to:

$$t_i = \mathbf{1}\{q_{i1} - q_{i0} \geq -c_i\} \tag{3}$$

where $\mathbf{1}$ is an indicator function with value 1 if the condition holds, and

$$c_i \equiv \tau + d + \delta_i. \tag{4}$$

Here c_i summarizes the combined cost associated with a domestic IPO relative to an overseas IPO due to differences in the capital market regulations. This cost arises from the cost of bypassing capital controls, represented by τ, the frictions due to the differences in the IPO review process and lock-up period, represented by d, and the idiosyncratic subjective preference on holding her wealth offshore, represented by δ_i.

4.2 Probability of Overseas Listings

Following Roy (1951) and Borjas (1987; 1991), we decompose individual Tobin's Q and cost into an observable economic component and a part due to unobservable characteristics. Specifically, if firm i is listed at home, its Tobin's Q takes on the value:

$$q_{i0} = \mu_0 + \varepsilon_{i0}, \tag{5}$$

On the other hand, if it is listed abroad, its Tobin's Q would be:

$$q_{i1} = \mu_1 + \varepsilon_{i1}, \tag{6}$$

The cost of capital market distortions can be written as

$$c_i = \mu_c + \varepsilon_{ic}. \tag{7}$$

Here, μ_0, μ_1 and μ_c are the potential mean of population valuation and cost arising from capital market distortions. In general, they are functions of observable firm characteristics such as firm size, industry, and growth prospect. We will discuss these characteristics more fully when we go to econometric estimation. In contrast, ε_{i0}, ε_{i1} and ε_{ic} are firm-specific characteristics unobservable to researchers. We assume they follow a tri-variate normal distribution with zero mean and with the following variance-covariance matrix:

$$\begin{bmatrix} \sigma_0^2 & \rho_{01}\sigma_0\sigma_1 & \rho_{0c}\sigma_0\sigma_c \\ \rho_{01}\sigma_0\sigma_1 & \sigma_1^2 & \rho_{1c}\sigma_1\sigma_c \\ \rho_{0c}\sigma_0\sigma_c & \rho_{1c}\sigma_1\sigma_c & \sigma_c^2 \end{bmatrix} \tag{8}$$

Here, σ_0, σ_1 and σ_c describe the dispersion of ε_{i0}, ε_{i1} and ε_{ic} in the population. And ρ_{01}, ρ_{0c} and ρ_{1c} are the pair-wise correlation coefficients between ε_{i0}, ε_{i1} and ε_{ic}.

According to the decision rule (3), together with equation (5), (6), and (7), and

under the normality assumption, the probability of an overseas IPO is given by

$$\begin{aligned} P &= \Pr[\varepsilon_{i1} - \varepsilon_{i0} + \varepsilon_{ic} > -(\mu_1 - \mu_0 + \mu_c)] \\ &= \Pr[v_i/\sigma_v > -(\mu_1 - \mu_0 + \mu_c)/\sigma_v] \\ &= 1 - \Phi(w) \\ &= \Phi(-w) \end{aligned} \tag{9}$$

where

$$v_i = \varepsilon_{i1} - \varepsilon_{i0} + \varepsilon_{ic}, \tag{10}$$

and

$$-w = (\mu_1 - \mu_0 + \mu_c)/\sigma_v, \tag{11}$$

$v_i \sim N(0, \sigma_v^2)$ and Φ is the standard normal distribution function.

As summarized by equation (9), the probability of an overseas IPO is, first, a positive function of the expected Tobin's Q in the overseas market μ_1, or $\partial P/\partial \mu_1 > 0$; second, a negative function of the expected Tobin's Q in domestic market μ_0, or $\partial P/\partial \mu_0 < 0$; and third, a positive function of the expected cost associated with listing at home versus abroad, μ_c, or $\partial P/\partial \mu_c > 0$.

When μ_0, μ_1, and μ_c are modelled as a function of firm characteristics x, the effect x on the probability of overseas listing could be derived as

$$\frac{\partial P}{\partial x} = \frac{d\Phi(-w)}{d(-w)} \frac{\partial(-w)}{\partial x} \tag{12}$$

Since $\frac{d\Phi(-w)}{d(-w)} > 0$, the sign of $\frac{\partial P}{\partial x}$ thus depends on the sign of $\frac{\partial(-w)}{\partial x}$, that is

$$\frac{\partial(-w)}{\partial x} = \frac{\partial[\mu_1(x) - \mu_0(x) + \mu_c(x)]}{\partial x} \frac{1}{\sigma_v}$$

4.3 Self-Selection

Notice that $v_i = \varepsilon_{i1} - \varepsilon_{i0} + \varepsilon_{ic}$, which affects the overseas listing decision, while at the same time ε_{i0} and ε_{i1} affects q_{i0} and q_{i1}, the market valuations from different listing location, overseas IPO is therefore an endogenous decision. To address this endogeneity, we first introduce some notations. We use $E[q_{i0}]$ and $E[q_{i1}]$ to denote the population mean if all Chinese firms were listed at home and if all Chinese firms were listed abroad. By definition, $E[q_{i0}] = \mu_0$, and $E[q_{i1}] = \mu_1$. We use $E[q_{i0}|t_i = 1]$ to denote the counterfactual average Tobin's Q in the domestic market of those overseas listed Chinese firms if they were to be listed at home, while $E[q_{i1}|t_i = 1]$ denotes the

factual average Tobin's Q of those overseas listed Chinese firms when they are listed overseas. Under the normality assumption, the two subpopulation conditional means are given by

$$E[q_{i0}|t_i = 1] = E[q_{i0}] + \frac{\sigma_0\sigma_1}{\sigma_v}[(\rho_{01} - \frac{\sigma_0}{\sigma_1}) + \rho_{0c}\frac{\sigma_c}{\sigma_1}]h, \tag{13}$$

and

$$E[q_{i1}|t_i = 1] = E[q_{i1}] + \frac{\sigma_0\sigma_1}{\sigma_v}[(\frac{\sigma_1}{\sigma_0} - \rho_{01}) + \rho_{1c}\frac{\sigma_c}{\sigma_0}]h, \tag{14}$$

where $h = \phi(-w)/\Phi(-w) = \phi(w)/P$ with ϕ being the density of the standard normal. h is known as the hazard rate, or the inverse Mills ratio in Heckman (1979).

Denote

$$S_0 \equiv \frac{\sigma_0\sigma_1}{\sigma_v}[(\rho_{01} - \frac{\sigma_0}{\sigma_1}) + \rho_{0c}\frac{\sigma_c}{\sigma_1}]h, \tag{15}$$

as the difference in the expected Tobin's Q between the overseas listed Chinese firms and all Chinese listed firms when they are both listed at home, and

$$S_1 \equiv \frac{\sigma_0\sigma_1}{\sigma_v}[(\frac{\sigma_1}{\sigma_0} - \rho_{01}) + \rho_{1c}\frac{\sigma_c}{\sigma_0}]h, \tag{16}$$

as the difference in the expected Tobin's Q between the same two groups when they are both listed abroad. Since S_0 and S_1 capture the valuation difference between the overseas listed Chinese firms relative to the population Chinese firms, the sign of S_0 and S_1 indicate on average from which part of the Tobin's Q distribution that those overseas listed firms are selected, in the domestic and overseas market, respectively. Appendix 1.2 discusses four cases of interest on the sign of selection and their economic implications.

4.4 The "Treatment" Effect of an Overseas Listing

Recall that 21% of the Chinese listed firms choose to list outside mainland China. Using our model, we interpret this as an equilibrium outcome when all entrepreneurs shopping around different listing locations. Consequently, there exists a marginal entrepreneur m, who is indifferent between listing at home versus abroad, given his firm characteristics and the general market and policy environment. By definition of (1) and (2), $E[U_{m1}] - E[U_{m0}] = 0$ suggests that

$$E[q_{m1}] - E[q_{m0}] = -c_m \tag{17}$$

If this market equilibrium condition did not hold, due to, for example, one additional entrepreneur moving from the overseas to domestic market, he would find his expected

waiting period at the domestic market increases and his expected waiting period at the overseas market decreases. This would reduce his $E[U_{m0}]$ and increase his $E[U_{m1}]$, attracting him back to the overseas market. Such adjustment continues until the marginal entrepreneur is indifferent between listing in any of the two markets.

We use ATE and $ATET$ to denote the average treatment effect and the average treatment effect on the treated. Assume that at the moment of contemplating where to list, the marginal entrepreneur's best estimate for $E[q_{m1}] = \mu_1$ and for $E[q_{m0}] = \mu_0$. Then, according to equation (5), (6) and (17),

$$ATE = E[q_{i1}] - E[q_{i0}] = \mu_1 - \mu_0 = -c_m, \tag{18}$$

and according to equation (13) and (14),

$$ATET = E[q_{i1} - q_{i0}|t_i = 1] = (\mu_1 - \mu_0) + (S_1 - S_0) = -c_m + (S_1 - S_0)\,. \tag{19}$$

Thus, there is an important prediction from our theoretical model: the ATE reveals the capital market distortions facing the marginal entrepreneur ($-c_m$); and the $ATET$ tells both capital market distortions ($-c_m$) and the relative position of those overseas listed Chinese firms in the overseas and domestic market value distribution ($S_1 - S_0$).

It is interesting to compare our findings with the migration literature or the existing literature on cross-listed stocks. Both only consider a migration cost to the foreign market without taking into account the potential cost associated with working or listing at home market. As the migration cost is typically positive, it is common for the literature to find a positive ATE. In contrast, we will report a negative estimate of ATE, suggesting a positive relative cost to the marginal entrepreneur associated with listing in the home market.

Since $c_m \equiv \tau + d + \delta_m$, equation (18) also provides a clear prediction for how a particular policy shock or firm characteristic may affect the magnitude of ATE:

$$\frac{\partial ATE}{\partial \tau} < 0,\ \frac{\partial ATE}{\partial d} < 0,\ \text{and}\ \frac{\partial ATE}{\partial \delta_m} < 0 \tag{20}$$

In other words, either a tighter capital control, a longer IPO review process or lock-up period at home relative to the overseas market, or a stronger subjective preference of holding wealth offshore should translate into a larger valuation discount. We will report results from various difference-in-differences exercises that are consistent with these predictions.

We label the gap in the expected domestic market valuation between those actually listed overseas ($t_i = 1$) and domestic ($t_i = 0$) as the selection bias or SB:

$$\begin{aligned} SB &= E[q_{i0}|t_i = 1] - E[q_{i0}|t_i = 0] \\ &= (\mu_0 + S_0) - \left(\mu_0 - \frac{P}{1-P}S_0\right) \\ &= \frac{S_0}{1-P} \end{aligned} \tag{21}$$

By definition, SB has the same sign as S_0. Therefore, SB can be used to determine the direction of selection in the domestic market. Note that researchers can only observe the group mean difference or GMD across the treated ($t_i = 1$) and the control ($t_i = 0$), which is by definition

$$\begin{aligned} GMD &= E[q_{i1}|t_i = 1] - E[q_{i0}|t_i = 0] \\ &= (\mu_1 + S_1) - \left(\mu_0 - \frac{P}{1-P}S_0\right) \\ &= -c_m + (S_1 - S_0) + \left(\frac{S_0}{1-P}\right) \\ &= ATET + SB \end{aligned} \tag{22}$$

Equation (22) states that GMD can be decomposed as the sum of $ATET$ and SB. Therefore, as conjectured earlier, the observed valuation discount ($GMD < 0$) across our comparable groups could come from the treatment effect of capital market distortions on the treated ($ATET < 0$), or simply be the results of a negative selection in the domestic market ($SB < 0$). If the selection bias is in fact positive, the actual treatment effect will be even larger than the observed valuation discount. We will empirically estimate the model, which allows us to decompose GMD into different components to quantify the actual effect of capital market distortions.

5 An Endogenous Treatment Effect Model

5.1 A General Model

Our theoretical model has shown that going IPO overseas is an optimal choice by self-selecting into the treatment. An empirical specification for the endogenous treatment effect model is made of the following equations:

$$
\begin{aligned}
t_i &= \mathbf{1}\{X_i'\alpha_1 + Z_i'\alpha_2 + v_i > 0\}, && (23)\\
y_i &= t_i y_{i1} + (1 - t_i) y_{i0}, && (24)\\
y_{i0} &= X_i'\beta_{10} + \varepsilon_{i0}, && (25)\\
y_{i1} &= X_i'\beta_{11} + \varepsilon_{i1}, && (26)\\
cov[\varepsilon_{ij}, v_i] &\neq 0 \text{ for } j \in \{0, 1\}. && (27)
\end{aligned}
$$

Equation (23) is an empirical correspondence of the decision rule (3) and the probability of an overseas IPO (9). t_i is the observed treatment indicator, which equals 1 if firm i is listed overseas and 0 otherwise. Equation (24) says y_i is the observed outcome, that is the firm valuation, while y_{i1} and y_{i0} are the potential outcome of receiving and not receiving the treatment.

According to equation (25) and (26), each one of the potential outcomes is determined by a set of regressors X_i and an unobserved random component ε_{ij}. We consider a set of firm characteristics together with market and policy variables that determine firm's market valuation in X_i, including both those from the existing cross-listing literature and those highlighting the role of capital market distortions. Similarly, the treatment is determined by a set of regressors X_i and Z_i, and an unobserved component v_i. Thus, Z_i represents those variables that affect listing location choice but not market valuation after the listing. As usual, we assume that $E[v_i|X_i, Z_i] = 0$ so that α_1 and α_2 can be consistently estimated from a probit model on equation (23).

Equation (27) highlights endogeneity of the framework. It states that the unobservables in the potential-outcome equations ε_{ij} are correlated to treatment status v_i, as specified in our theoretical model $v_i = \varepsilon_{i1} - \varepsilon_{i0} + \varepsilon_{ic}$ in equation (10). For example, all else being equal, entrepreneur i's network with the US financial market ($\varepsilon_{i1} > 0$) would make i both more likely to be listed in the US and more likely to achieve a higher market valuation after listing there.

5.2 Link to the Theory

Putting together, to apply the empirical model to our economic theory, we have employed the following specification:

$$\begin{aligned}
\mu_0 &= E[X_i'\beta_{10}] \\
\mu_1 &= E[X_i'\beta_{11}] \\
-w &= (\mu_1 - \mu_0 + \mu_c)/\sigma_v = E[(X_i'\alpha + Z_i'\gamma)/\sigma_v] \\
v_i &= \varepsilon_{i1} - \varepsilon_{i0} + \varepsilon_{ic}
\end{aligned}$$

We assume that the vector of error terms $(\varepsilon_{i0}, \varepsilon_{i1}, v_i)'$ comes from a tri-variate joint distribution with mean zero and with the following variance-covariance matrix

$$\begin{bmatrix} \sigma_0'^2 & \rho_{01}'\sigma_0'\sigma_1' & \rho_{0v}'\sigma_0' \\ \rho_{01}'\sigma_0'\sigma_1' & \sigma_1'^2 & \rho_{1v}'\sigma_1' \\ \rho_{0v}'\sigma_0' & \rho_{1v}'\sigma_1' & 1 \end{bmatrix} \tag{28}$$

Here we use σ_0' and σ_1' to describe the dispersion of ε_{i0} and ε_{i1} in the subpopulation of control ($t_i = 0$) and treated ($t_i = 1$). σ_v' is normalized to be 1, as it is neither identified nor relevant for any inference. ρ_{01}' is not identified, since we never observe a firm listed in the overseas and domestic market simultaneously. Comparison between the two matrices (8) and (28) highlights an interesting and useful fact: although researchers only observe the valuation for any firm in one market and do not directly observe the cost facing the firms, the endogenous treatment effect framework will allow us to indirectly infer the distribution of market valuation and cost in the entire population, from the potential outcome predicted by the empirical model.

5.3 Quantities of Interest

The empirical model allows us to estimate a set of quantities of interest defined in the theoretical model. Specifically,

$$\begin{aligned}
ATE &= E[y_{i1} - y_{i0}] = E[X_i'\beta_{11} + \varepsilon_{i1} - X_i'\beta_{10} - \varepsilon_{i0}] \\
&= E[X_i'(\beta_{11} - \beta_{10})],
\end{aligned} \tag{29}$$

where $E[\varepsilon_{i1}] = E[\varepsilon_{i0}] = 0$, regardless of endogeneity. In addition,

$$\begin{aligned}
ATET &= E[y_{i1} - y_{i0}|t_i = 1] = E[X_i'\beta_{11} + \varepsilon_1 - X_i'\beta_{10} - \varepsilon_0|t_i = 1] \\
&= E[X_i'(\beta_{11} - \beta_{10})|t_i = 1] + E[\varepsilon_{1i} - \varepsilon_{0i}|t_i = 1].
\end{aligned} \tag{30}$$

Since we now model μ_0 and μ_1 by observable firm characteristics, the selection effect S_0 and S_1 also have an observable component. We therefore denote them as S_{0y} and S_{1y} and decompose them into the selection on observables (S_{0x} and S_{1x}) and selection on unobservables ($S_{0\varepsilon}$ and $S_{1\varepsilon}$). To be specific, we have $S_{0y} = S_{0x} + S_{0\varepsilon}$ and $S_{1y} = S_{1x} + S_{1\varepsilon}$, where

$$
\begin{aligned}
S_{0x} &= [E(X_i'|t_i = 1) - E(X_i'|t_i = 0)]\beta_{10}(1 - P), && (31)\\
S_{1x} &= [E(X_i'|t_i = 1) - E(X_i'|t_i = 0)]\beta_{11}(1 - P), && (32)\\
S_{0\varepsilon} &= E[\varepsilon_{0i}|t_i = 1] = \frac{\sigma_0\sigma_1}{\sigma_v}[(\rho_{01} - \frac{\sigma_0}{\sigma_1}) + \rho_{0c}\frac{\sigma_c}{\sigma_1}]h, && (33)\\
S_{1\varepsilon} &= E[\varepsilon_{1i}|t_i = 1] = \frac{\sigma_0\sigma_1}{\sigma_v}[(\frac{\sigma_1}{\sigma_0} - \rho_{01}) + \rho_{1c}\frac{\sigma_c}{\sigma_0}]h. && (34)
\end{aligned}
$$

Similarly, the GMD, $ATET$, and SB can all be decomposed into an observable and an unobservable component. Quantifying the treatment effect of overseas listing and the importance of self-selection now boils down to consistently estimating the model.

5.4 A Simple Model

Rather than the full-fledged general model as specified in equation (23) to (27), an alternative model simplifies equation (24), (25) and (26) into one single equation

$$y_i = X_i'\beta_1 + \gamma t_i + \varepsilon_i \tag{35}$$

and the reduces the variance-covariance matrix for the error terms $(\varepsilon_i, v_i)'$ into

$$\begin{bmatrix} \sigma'^2 & \rho'\sigma' \\ \rho'\sigma' & 1 \end{bmatrix} \tag{36}$$

Compared with the general model, (35) assumes that a given characteristic x is assigned the same valuation in the two markets. Thus, the only difference in the valuation comes from the listing location or treatment dummy t_i. Intuitively, this leads to $ATE = E[y_{i1} - y_{i0}] = \gamma$. Furthermore, (36) imposes the common distributional assumption on the unobserved random component ε_i. This implies $E[\varepsilon_{1i} - \varepsilon_{0i}|t_i = 1] = 0$ in equation (30) of the general model, or $S_0 = S_1 = \rho\sigma h$ in equation (15) and (16) of the theoretical model. As the result, in the simple model $ATET = ATE = \gamma$.

Two comments are in order. First, the simple model allows us to obtain the $ATET$ and ATE from a single parameter γ, which is computationally efficient. This is particularly useful when the treatment effect rather than the selection effect is of our key interest. Second, the $ATET$ and ATE are equal in this model, not because

there is no selection effect but because the selection effect in the domestic and overseas markets is now assumed to be the same. This means that it is still an endogenous treatment effect model, as highlighted by non-zero off-diagonal element in (36). A consistent estimate on γ therefore requires us to address the endogeneity of treatment.

5.5 Identification

If one is willing to assume tri-variate (or bivariate) normal distributional assumption on $(\varepsilon_{i0}, \varepsilon_{i1}, v_i)'$ (or $(\varepsilon_i, v_i)'$) in the general (or simple) model, β_{10} and β_{11} (or β_1 and γ) could be consistently estimated by MLE or the Heckit. When normality is not assumed, a less restrictive and more efficient alternative is the control function (CF) approach (Wooldridge, 2010). We use the simple model to illustrate the approach, while the principle naturally extends to the general model. The main idea of the CF approach is to model the correlation between endogenous treatment t_i and the error term ε_i in equation (35) by projecting ε_i on t_i, X_i and identifying variables Z_i. Given that $t_i = E[t_i|X_i, Z_i] + (t_i - E[t_i|X_i, Z_i])$, we derive

$$\begin{aligned} & E[\varepsilon_i|t_i, X_i, Z_i] \\ = \; & E[\varepsilon_i|E(t_i|X_i, Z_i) + (t_i - E(t_i|X_i, Z_i)), X_i, Z_i] \\ = \; & E[\varepsilon_i|t_i - E(t_i|X_i, Z_i)] = E[\varepsilon_i|v_i] = v_i\beta_2 \end{aligned}$$

where $v_i = t_i - E[t_i|X_i, Z_i]$. This implies

$$E[y_i|t_i, X_i, Z_i] = X_i'\beta_1 + \gamma t_i + v_i\beta_2. \tag{37}$$

The correlation between t_i and ε_i due to the self selection of firm's listing location is now controlled by including the additional term v_i. This suggests that (β_1, γ) can be consistently estimated by regressing y_i on X_i, t_i and v_i, where v_i is proxied by $\widehat{v}_i = t_i - \Phi(X_i'\widehat{\alpha}_1 + Z_i'\widehat{\alpha}_2)$, the residual from the probit regression (23). This also implies that the sign and significance of selection bias can be tested by looking at the coefficient β_2.

Similarly, in the general model with heterogeneous responses, the CF approach deals with the selection bias due to the correlation (27) by adding v_i as an additional regressor into (25) and (26),

$$y_{ij} = X_i'\beta_{1j} + v_i\beta_{2j} + e_{ij}, \; j \in \{0, 1\} \tag{38}$$

where the error term e_{ij} is no longer correlated with the treatment status. Furthermore, β_{20} and β_{21} speak the sign and significance of selection bias in the domestic and overseas

market, respectively. The estimated ATE and $ATET$ can then be calculated as

$$\begin{aligned}\widehat{ATE} &= \frac{1}{N}\sum_{i=1}^{N} X_i'\left(\hat{\beta}_{11}-\hat{\beta}_{10}\right)\\ \widehat{ATET} &= \frac{1}{\sum_{i=1}^{N} t_i}\sum_{i=1}^{N} X_i'\left(\hat{\beta}_{11}-\hat{\beta}_{10}\right)t_i+\frac{1}{\sum_{i=1}^{N} t_i}\sum_{i=1}^{N}\widehat{v}_i\left(\hat{\beta}_{21}-\hat{\beta}_{20}\right)t_i,\end{aligned}$$

where $\hat{\beta}_{11},\hat{\beta}_{10},\hat{\beta}_{21}$,and $\hat{\beta}_{20}$ can be simultaneously estimated with $\widehat{\alpha}_1$ and $\widehat{\alpha}_2$ using GMM in the one-step CF approach. Alternatively, in the two-step CF approach, $\hat{\beta}_{11},\hat{\beta}_{10},\hat{\beta}_{21}$,and $\hat{\beta}_{20}$ are the OLS estimates from equation (38) in the second step, after obtaining $\widehat{v}_i$ as the residual from the probit regression (23) in the first step. Further technical details are discussed in Appendix 1.3.

5.6 Instrumental Variables

Our identification strategy requires different variables from X_i to be included in $\upsilon_i = t_i - E[t_i|X_i, Z_i]$, for example, Z_i. This is because, without the additional identifying variables Z_i in υ_i, which is merely a non-linear function of X_i, parameters β_1 in equation (37) and β_{1j} in equation (38) might not be well-identified due to multi-collinearity. How to find an identifying or instrumental variable Z_i, which is a predictor of firm i's listing location choice (23) but is uncorrelated with its post-IPO valuation?

We consider two innovative variables. First, we make use of the prolonged and uncertain IPO review period in mainland China stock market to construct a relative waiting days at the industry level for firm i as its instrumental variable z_i. To be specific, we ask for each firm i, before its IPO application, what the average number of days firms in the same industry have waited in the domestic and overseas market, respectively? This is a public information that is observable to and will be considered by every entrepreneur contemplating where to list. Refer to our model, the idea here is to construct an expected $d = r(T_0 - T_1)$, a component of c_i, which will affect i's listing location. However, since d is not part of q_{i0} or q_{i1}, this pre-IPO industry-average condition is unlikely to affect i's post-IPO valuation, conditional on firm-specific characteristics and post-IPO industry fixed effects.

The second IV is inspired by the general IPO literature, such as Ljungqvist et al. (2006) and Pastor and Veronesi (2005), that firms tend to time their IPO. That is why stock exchanges often see hot IPO waves during market boom. We leverage this rationale to construct the relative market index between overseas and domestic stock markets 12-months prior to the IPO application date of firm i as its instrumental

variable Z_i. We also experiment 6-months or 24-months as alternative horizon in our robustness check of Appendix 4.2. Refer to our model, the idea here is to utilize the fact that, prior to IPO, entrepreneur's expected relative market valuation $(q_{i1} - q_{i0})$ depends on the overall sentiments in the two markets. All else being equal, she chooses to list i in a market under more favorable condition. However, under efficient market hypothesis, this pre-IPO market-wide condition is unlikely to affect i's post-IPO valuation, conditional on firm-specific characteristics and post-IPO market-wide conditions.

6 Empirical Results

6.1 Motivations of an Overseas IPO

Table 2 reports the regression results for the probit model (23), which includes the coefficients, the marginal effects and the marginal effects multiplied with one standard deviation of each explanatory variable. All the regressors are collected from firm's prospectus and financial statements one-year before IPO. We consider five category of regressors as the determinants of IPO locational choice. First, a firm's fundamentals, such as its age, total assets, ROA, sales growth rate, leverage, intangible assets ratio and state-ownership percentage; second, measurement on corporate governance, such as independent director ratio, duality between CEO and chairman, top 5 ownership percentage, and controlling shareholder dummy; third, controls for globalization motives, such as ratio of import and export to total sales, and strategic investor dummy; fourth, variables that capture the incentives to bypass capital controls, which include China's foreign reserve growth rate and growth rate of USD to CNY exchange rate that are common across all firms, and foreign ownership percentage that is collected from prospectus for each firm; and fifth, variables that capture the need for a timely and unrestricted IPO, which include operating cash flow ratio, and a measure on PE restriction at IPO. Finally, there are two IVs: the expected relative waiting days for an IPO application in different markets, and the relative market index prior to IPO.

According to Table 2, older, smaller firms with higher ROA, higher growth rate, more intangible assets and higher leverage ratio are more likely to go overseas IPO. Firms that choose to list overseas, on the one hand, have more independent directors on their board, and on the other hand, also have a higher ownership concentration. Although engaging more in international trade does not have a clear prediction, having a strategic investor significantly enhances the probability of overseas IPO.

More interestingly, we see that a higher pre-IPO foreign ownership share (the sum of the ownerships of foreign individuals or entities) or a longer relative waiting days for IPO would significantly raise the chance that the entrepreneur takes her firm to an overseas stock exchange. Restrictive initial PE ratio regulation, a lower cash flow from operations, or the depreciation of CNY would also do the same. These results are consistent with the interpretation that an overseas listing is a way to bypass China's capital market regulations — long waiting time, low PE ratio, and restrictions on access to foreign currency, allowing both the founder and foreign investors to sell down their shares and receive future dividends, in a timely fashion, at an unrestricted price, and denominated in hard currency that can move across border freely.

6.2 Valuation Equations

Table 3 reports the estimation results for the valuation equations. Both the dependent variable and the regressors characterizing firm fundamentals take values one-year after IPO. Other pre-IPO regressors are the same as in Table 2. Column (1) reports the estimation results for the valuation equation (35) of the simple model. Firm fundamentals display the expected sign in explaining firm value: smaller firms with a higher ROA, a higher sales growth rate, a lower leverage, a higher intangible assets ratio and more state ownership on average have a higher market valuation. Furthermore, the coefficient for overseas listing dummy γ is estimated to be significantly negative. The coefficient for controlling the self selection β_2 is found to be positive though not significant. The estimate of γ suggests that on average one year after IPO, the Tobin's Q of overseas listed Chinese firm is significantly lower than domestic listed Chinese firms by 2.6. As discussed earlier, in the simple model, this is the value of ATE and $ATET$. Thus, the simple model predicts a significantly negative treatment effect of overseas listing, after controlling for observable firm characteristics and taking into account the endogenous nature of listing location.

Column (2) and (3) of Table 3 report the estimation results for the valuation equation of the treatment group and control group of the general model, respectively. The estimates for β_{20} and β_{21} from the CF approach are reported at the bottom of the corresponding columns. A significantly positive β_{20} indicates that those unobservable factors that lead to an overseas IPO is favorably valued in the domestic market, while such factors are unfavorably valued in the overseas market, according to a significantly negative β_{21}. This result once again certifies the endogenous nature of listing location.

Comparison across column (1) to (3) highlights the heterogeneous responses for the same firm characteristic across different markets. For example, both state ownership and foreign ownership are better appreciated in the domestic market than the overseas market. Column (4) and (5) therefore decompose $(\beta_{11}x_i|t_i = 1) - (\beta_{10}x_i|t_i = 0)$ - the differences in Tobin's Q between these two groups due to each observable firm characteristic x_i into $(\beta_{11} - \beta_{10})(x_i|t_i = 1)$ - the differential explained by the differences in the coefficients across treatment and control group, evaluated at each observed characteristic x_i, and $\beta_{10}((x_i|t_i = 1) - (x_i|t_i = 0))$ - the impact of between-group differences in each observed characteristic x_i, evaluated using the coefficient for control group.

According to column (4), the domestic stock market tends to value smaller firms, with higher ROA, higher sales growth rate, higher state ownership, more independent directors and more foreign ownership, significantly higher than the overseas market; while the overseas market prices firms with higher operating cash flow ratio and under home market PE restriction significantly more than the domestic market. According to column (5), firms listed in the overseas market are on average slightly larger, and have significantly higher ROA, higher sales growth rate, more intangible assets, more independent directors, higher ownership concentration and more foreign ownership.

Finally, although we do not model the cost as a function of firm characteristics explicitly, a link between Table 3 and Table 2 indirectly reveals how the capital market distortions vary across certain firm characteristics. Table 2 predicts that smaller firms with higher ROA, higher sales growth rate, higher independent director ratio and higher foreign ownership are more likely to list overseas. However, column (4) of Table 3 finds that the domestic market in fact values such firms more than the overseas market. But then why do such firms choose to list overseas? This suggests that all else being equal, smaller firms with higher ROA, higher sales growth rate, higher independent director ratio and higher foreign ownership must face a higher cost of capital market distortions at home.[14]

6.3 Treatment Effects and Selection Effects

Table 4 presents the treatment effects and selection effects decomposed from our regression results. We discuss the results from the general model in detail. The effects from the simple model are listed for comparison. Recall that the simple model can

[14]Formally, for a firm characteristic x_i, the fact that $\partial\{E[(\beta_{11} - \beta_{10})(x_i|t_i = 1)] + E[\mu_c(x_i)|t_i = 1]\}/\partial x_i > 0$ and $\partial\{E[(\beta_{11} - \beta_{10})(x_i|t_i = 1)]\}/\partial x_i < 0$ suggests that $\partial\{E[\mu_c(x_i)|t_i = 1]\}/\partial x_i > 0$.

be taken as a special case of the general model. As expected, there are some differences across the two models in terms of magnitude. However, they deliver the same empirical implications to our theoretical model.

First of all, $E[y_{i0}|t_i = 0] = 4.05$ and $E[y_{i1}|t_i = 1] = 1.91$ are the observed average Tobin's Q one-year post-IPO for the control group and treatment group. $E[y_{i1}|t_i = 0] = 3.08$ and $E[y_{i0}|t_i = 1] = 5.69$ are the model predicted counterfactuals — the Tobin's Q for the control group if they were listed in overseas market and for the treatment group if they were listed in domestic market. Together with a probability of overseas listing $P = 21\%$, these four quantities allow us to obtain the potential outcome for the population if all Chinese firms were listed in the domestic market $E[y_{i0}] = 4.40$ and if they were all listed overseas $E[y_{i1}] = 2.83$.

Second, by definition, $ATE = E[y_{i1} - y_{i0}] = -1.56$, which means a $1.56/4.40 = 35\%$ valuation discount. According to our model prediction, this suggests that the marginal entrepreneur has had a 35% valuation discount due to an overseas listing. Since the marginal entrepreneur is indifferent between domestic and overseas listing, this implies that he is facing a cost of capital market distortions in the domestic market equivalent to a 35% of his firm value. For those actually listed overseas, $ATET$ is of key interest: $ATET = E[y_{i1} - y_{i0}|t_i = 1] = 1.91 - 5.69 = -3.78$. This means if all overseas listed Chinese firms in our sample were listed in mainland China, their Tobin's Q one-year after IPO would be 5.69. As their actual value is 1.91, this leads to an $ATET$ being -3.78, or a 66% valuation discount relative to their counterfactual.

Third, recall the gap between $ATET$ and ATE comes from $(S_1 - S_0)$. To see the role of selection, by definition (13) and (14), we obtain $S_0 = E[y_{i0}|t_i = 1] - E[y_{i0}] = 1.29$ and $S_1 = E[y_{i1}|t_i = 1] - E[y_{i1}] = -0.92$. The fact that $S_0 > 0$ and $S_1 < 0$ falls into the Case 4 of the selection effect discussed in Appendix 1.2. That is, the overseas listed Chinese firms tend to be better firms in the domestic market but worse firms in the overseas market relative to domestically listed Chinese firms. To understand why, we then further decompose S_0 and S_1 into an observable and an unobservable component, according to (31), (32), (33) and (34). The results indicate that both the observable and unobservable factors suggest a positive selection in the domestic market and a negative selection in the overseas market. For observable factors, for example, the source of $S_{0x} > 0$ and $S_{1x} < 0$ can be inferred from column (4) and (5) of Table 3: The domestic market values some firm characteristics more than the overseas market; and the overseas listed firms on average have a higher realization on those

firm characteristics, such as ROA, sales growth rate and foreign ownership.

The same intuition extends to unobservable factors. $S_{0\varepsilon} > 0$ and $S_{1\varepsilon} < 0$ implies that overseas listed Chinese firms have some unobservable characteristics favored by mainland China investors but scorned by overseas investors. For example, government officials may encourage firms with close connections to list overseas for their private interest. Overseas investors may be concerned that these close ties to government agencies could lead to weak corporate governance or high political risk. However, domestic investors may value this connection as more investment opportunities and fewer regulations.

Finally, according to (22), we decompose the observed group mean difference $GMD = E[y_{i1}|t_i = 1] - E[y_{i0}|t_i = 0] = -2.15$ into the the $ATET$ and SB, and further decompose the $ATET$ and SB into an observable and an unobservable component. The observable component for $ATET$ and SB comes from column (4) and (5) of Table 3, respectively, while the unobservable component for $ATET$ and SB depends on the estimates of β_{21} and β_{20} reported in Table 3. We find the significant negative GMD is the sum of a significant negative $ATET$ and a significant positive SB, no matter whether the treatment is caused by observables or unobservables, and whether the selection comes from observables or unobservables.

It suggests that those "good" firms approved to list in China's domestic stock market by the regulators are not necessarily the "good" firms from the perspective of Chinese investors. Therefore, instead of a negative selection, the competing hypothesis to capital market distortions in explaining the valuation discount, there is in fact a positive selection: the firms with otherwise higher market valuation in the domestic market in fact choose to list overseas. The valuation discount presented in Table 1 and depicted in Figure A2 is not due to the fact that firms going overseas IPO are inherently worse, but due to the treatment effect of an overseas listing — entrepreneurs are willing to forgo some firm valuation in order to bypass the capital market distortions. For those who already listed their firms overseas, on average they have given up 66% of the potential valuation.

6.4 Additional Results

Our baseline results in Table 2, 3 and 4 have shown a significant valuation discount of an overseas listing one year after IPO. It is also interesting to examine the treatment effects at different time horizons. Column (1) to (7) of Table A5 lists the ATE and

$ATET$ at the moment of IPO, at the end of first trading day, one-year to five-year after IPO, estimated from the simple model in the upper panel, and from the general model in the lower panel. Detailed results are discussed in Appendix 2.1. The general finding is that all these treatment effects are significantly negative, suggesting that the valuation discount persists many years after the IPO.

As discussed in Section 3.2, in constructing our baseline sample, we exclude those overseas listed firms that are in the Negative List, such as Alibaba (BABA), and firms that are unqualified for listing even in ChiNext due to listing financial requirements, such as Pinduoduo (PDD). Excluding these firms from the baseline makes our sample more comparable, but we also lose 40% of the overseas listed observations. Furthermore, these firms are often market's first impressions of overseas listed Chinese firms and could be the most interesting ones. Therefore, it is important to know whether our results also hold for those excluded firms. Table A6 reports the treatment effects from the simple model when firms that are in the restrictive industries, prohibited industries and unqualified for domestic listing are sequentially added back into the extended sample. Detailed results are discussed in Appendix 2.2. What we find is an even larger absolute value of $ATET$ in the extended samples. The percentage valuation discount, on the other hand, is rather stable. This is driven by the model prediction that firms on the Negative List and/or unqualified to list in the domestic market would be valued even higher than firms in our baseline treatment group by the domestic investors.

Our baseline econometric model does not distinguish between Hong Kong and New York as separate overseas stock markets. In addition, in the extended sample with firms on the Negative List, it is also interesting to know whether the valuation discount also depends on whether a firm utilizes a VIE structure or not. In Appendix 2.3 we extend our analyses by treating Hong Kong and New York as separate markets, and IPO with and without VIE as different listing modes, using a multinomial logit model in the first step of the two-step CF approach. As shown in Table A7, the absolute value of discount is slightly larger in the US than in Hong Kong, and slightly larger for firms with a VIE than without a VIE. However, as firms listed in the US or with a VIE also tend to have a larger counterfactual valuation, the percentage valuation haircut is therefore similar across two overseas markets and with two different listing modes.

Taken as a whole, both our baseline results and extended analyses demonstrates a negative, significant and persistent treatment effects of an overseas listing. On average the Chinese entrepreneurs have given up more than 60% of their firm valuation in

an overseas listing. As the magnitude is fairly large, it is natural to wonder if such a discount is plausible. Three validity checks are in order, which are discussed in detailed in Appendix 3. First, as shown in Table A8, the valuation discount of the AH dual-listed firms, is somewhere between 22% to 40%, smaller than those experienced by the stocks solely listed outside mainland China but far above zero. This is consistent with the notion that overseas listed Chinese firms generally face both capital controls and IPO regulations while IPO regulations are less binding for AH dual-listed firms. Second, we look at a group of overseas listed Chinese firms that recently delisted from the US or Hong Kong market and relisted in the domestic market. As shown in Table A9 and Figure A3, their Tobin's Qs one-year before delisting are all lower than those one-year after relisting, which suggests a valuation discount of overseas listing by 70% to 80% on average. Finally, capital outflow restrictions also exist in other countries, such as Argentina. Auguste et al. (2002) find that Argentine ADR discounts exceed 50%, suggesting that Argentine investors were willing to pay a significant amount to legally move their money abroad when capital outflow controls exist. To sum, the three internal and external checks all seem to suggest the 66% valuation discount estimated from our general model is not implausibly too large.

Finally, a set of robustness checks are in place. First, in all the regressions we have shown, the dependent variable, Tobin's Q, is in its level, for an easy interpretation on the valuation and valuation discount. Detailed regression results and decomposition effects using logarithm of Tobin's Q as the dependent variable are provided in Appendix 4.1. The treatment effects using PB ratio as an alternative market valuation measure are in Appendix 4.2; with additional or a subset of the baseline regressors in Appendix 4.3; for subsamples made of different industries, firm sizes and sample periods in Appendix 4.4; and using alternative estimating approaches in Appendix 4.5.

7 Validating Roles of Capital Market Distortions

In contrast to the typical finding of a valuation premium in the cross-listing literature, our empirical exercises have found a significantly negative treatment effect of overseas listing for Chinese firms. According to our model, the negative average treatment effect reflects the cost from capital market distortions facing the marginal entrepreneur $ATE = -c_m$. One way to interpret the estimated valuation discount is therefore a willingness to pay of the entrepreneur to bypass capital controls and regulations on IPO. However, some other systematic factors might also matter for the average market

valuation gap across the domestic and overseas markets, such as home bias of investors, short-selling restrictions in mainland China market, and different dividends and capital gain taxes across markets. In our model, these differences are assumed to be taken as given by the entrepreneur in her decision making. If our empirical exercises haven't fully controlled for these differences, the level of ATE obtained earlier may include other factors in addition to the capital market distortions of our interest. We now seek to validate our willing-to-pay interpretation by exploiting how the ATE varies with some exogenous policy shocks or firm heterogeneities that alter the intensity or impact of capital market distortions.

7.1 Tightening of Capital Controls

In response to a sharp decline in China's foreign exchange reserve in 2016, the country tightened controls on capital account restrictions after 2017, mostly through "window guidance" from the central bank to commercial banks, aiming at reducing the speed of a loss of foreign exchange reserves.[15] If our interpretation of the ATE is correct, we should expect to see an even higher valuation discount. This is because with fewer legal channels and tightened loop holes to take assets outside China, τ, the cost of moving money crossing the Chinese borders increases. According to equation (**??**), the probability of an overseas listing increases or the urge to bypass capital controls via an overseas listing becomes stronger. Furthermore, according to equation (20), the valuation discount that the entrepreneurs are willing to take enlarges. In this sense, this policy change can serve as an opportunity to check our interpretation.

Following Cappiello and Ferrucci (2008), we construct the capital control premium for mainland China using the covered interest rate parity. Details are discussed in Appendix 1.4. As shown in Figure A4, there is a clear episode of positive capital control premium or tightening of capital outflow controls during 2018 to 2019. Firms that submitted their IPO applications (to any stock market) during 2018 to 2019 are thus defined as affected by China's tightening of capital controls.

We use a straightforward DID specification to evaluate our hypothesis by including an interaction term between a dummy for this tightened capital control period and the overseas listing dummy in the valuation equation (35). As shown in column (1) of Table 5, the tightening of capital outflow controls amplifies the valuation discount:

[15] See, for example, an official Notice released in August 2017 on regulating China's overseas direct investment, at https://www.gov.cn/zhengce/content/2017-08/18/content_5218665.htm

the average Tobin's Q for overseas listed Chinese firms decline by a further 0.68.

7.2 IPO Suspension and PE Regulation

The administrative approval IPO system in mainland China is another potential "inconvenience" that Chinese entrepreneurs are willing to pay to bypass. China's suspension of initial public offerings in history between 2012 and 2014 represents a shock,[16] or an increase in d, to the already long wait for IPO approval in the country's domestic stock market. It therefore may provide another opportunity to check whether the valuation discount reflects a willingness to bypass the capital market distortions. According to equation (20), all else being equal, we expect the valuation discount during IPO suspension to enlarge.

Firms look harder for alternatives when the door to the domestic stock market is closed suddenly. For example, according to the documents from the Bank of Chongqing, the bank applied to the CSRC for an A-share listing on the Shanghai Stock Exchange in 2007, and spend the next few years responding to various inquiries from the CSRC, including extensive ones in both July 2009 and March 2013. Upon understanding that domestic IPOs have been suspended, the bank turned to the Hong Kong Stock Exchange and indeed succeeded in listing there in November 2013.

It is reasonable to assume that those firms that submitted an IPO application (to any stock exchange) between 2013 and 2014 are affected by the Chinese IPO suspension during 2012 to 2014. In column (2) of Table 5, we see that the Chinese IPO suspension indeed enlarges the valuation discount for overseas-listed Chinese firms. The coefficient on the interaction term indicates that the firms applying for an IPO during the IPO suspension period are willing to accept an additional haircut on Tobin's Q by -1.67.

The restriction on the PE ratio < 23 upon IPO is another policy distortion under the administrative IPO approval system. The PE restriction is in place from early 2014 - after the resume of IPO review, to June 2020 - until the recent IPO registration reform, and is probably motivated by a desire of the regulator to generate a stock price increase after the IPO. Presumably, an entrepreneur would estimate the likely PE ratio in the absence of the restriction, and if it is close to or above 23, she would be more inclined to take her firm for an overseas listing. Given the fact that she will only receive a price of her stock no larger than 23 times of the earnings per share,

[16] Exploiting the same exogenous shock, Cong and Howell (2021) studies how this IPO suspension reduces corporate innovation activity both during the delay and for years after listing.

she is more likely to accept a lower than otherwise price in the overseas market. In column (3) of Table 5, we see that the firms listed overseas during this period indeed experienced a larger valuation discount. Compared with those listed overseas during other time periods in the sample, firms overseas listed in this PE restriction period accept an additional or further reduction in Tobin's Q by -0.99.

In column (4) of Table 5, we include all three policy distortions in the same regression. We see that the valuation discount is significantly larger in periods when the capital controls are tightened, when the domestic IPOs are suspended, or when PE restrictions are binding.

7.3 Firm Heterogeneities

We can also infer the causal relationship between capital market distortions and valuation discount from the heterogenous impact of same distortion across different firms. One way to motivate this exercise is to look at equation (4). As one component in the cost of capital market distortions, while δ_i has been be interpreted as entrepreneur's idiosyncratic preference of holding wealth offshore, it can also represent a heterogenous impact of the same distortion across different firms that deviates from the population mean. We consider four firm-specific features in particular. The first and second feature reveals the heterogenous impact of τ, while the third and fourth can be viewed as the heterogenous impact of d.

First, state ownership should reduce the need to bypass domestic capital market restrictions. A large number of studies compare SOEs and non-SOEs and find that the political connection with the government helps SOEs obtain a low cost of capital, regulatory benefits, and strong market power (Sapienza, 2004; Khwaja and Mian, 2005; Li et al., 2008). Presumably, SOEs may also have more leeway to bypass capital outflow controls because of the political connection. Thus, one might expect firms with a higher state ownership are less likely to accept a large valuation discount. As shown in column (1) of Table 6, those firms with state ownership exhibit a smaller valuation discount than those without any state ownership by 24% (0.703/2.908).

Foreign investors in the pre-IPO stage generally prefer to get their returns in hard currency. We have found a higher share of foreign investment raises the chance of an overseas listing in Table 2. Now we examine whether it also leads to a larger valuation discount. We divide our sample into two groups of firms based on whether their foreign ownership share is above the sample median or not. From column (2), we indeed see

a larger valuation discount for those firms with a higher share of foreign ownership.

The CSRC, with a paternalistic view of investor protection, often prefers mature firms with stable cash flow and more tangible assets, increasing the difficulty of risky firms in the public offering. To reflect firms' needs for external equity finance and highlight the impact of the administrative approval IPO system, we investigate whether firms with high operating risks or high intangible assets ratio have a larger valuation discount. The operating risk is defined as the standard deviation of the ratio of earnings before interest and taxes (EBIT) to total assets (Billingsley et al.,1990). Following Peters and Taylor (2017), the intangible assets consist of two components, externally purchased intangible assets, which are usually measured by intangible assets on the balance sheet, and internally created intangible assets, which are measured by past accumulated intangible investments. The firms with a higher than the median level of operating risk are classified in the high operating risk group and firms with a higher than the median level of intangible assets ratio are classified in the high intangible assets group, where dummies equal 1. Presumably, such firms would have to wait for an even longer period in an IPO application in mainland China, provided their applications were finally approved or they even attempted to submit an application. This implies that all else being equal they might be willing to accept an even larger valuation discount in an overseas listing. In columns (3) and (4) of Table 6, the valuation discount is indeed even greater for these firms than other overseas listed Chinese firms - 32% (0.717/2.216) larger for the high operating risk group and 14.4% (0.381/2.63) larger for the high intangible assets group.

In column (5), we include measures of firm heterogeneity and indicators of policy distortions in the same regression. This specification has the most comprehensive list of variables and therefore is more general than other columns in either Table 5 or 6. We continue to see that a firm with a higher operating risk or a higher foreign ownership share tends to tolerate a larger valuation discount in an overseas market. Furthermore, the valuation discount tends to be bigger during the periods of tightening capital controls or suspension of domestic IPOs or binding PE restrictions.

7.4 Policy Distortions and Firm Heterogeneities

We previously examine the effects of capital market distortions on the valuation discount by exploring policy shocks based on the DID specification. Then, we also study the impact of policy distortions from firm heterogeneities. Next, we combine the capital

market regulations and the firm heterogeneities to further sharpen our identification. We focus on two capital market policy distortions: capital control and IPO suspension, and three corresponding firm-specific features: foreign ownership, operating risk, and intangible assets ratio. We use the triple DIDs specification to evaluate whether the firms with intense demand for circumvent capital controls or urgent need for access to equity finance are more sensitive during the period of policy reinforcement.

As we discussed before, foreign investors generally prefer pushing the firms going IPO abroad to get their return in foreign currency and bypass China's capital controls. This preference may be even stronger in period of tightened capital controls. As shown in column (1) of Table 7, the firms with higher shares of foreign ownership undertake a larger discount when capital control was tightened. During IPO suspension, if firms urgently need to raise equity capital to support their growth, they are likely to be willing to pay a greater discount to pursue an overseas listing. From columns (2) and (3), we indeed find a greater valuation discount for firms with high operating risk or high intangible asset ratio during the IPO suspension.

Taken together, the evidences presented in Table 5 to 7 are consistent with an interpretation that the significant valuation discount documented in our empirical exercises reflect the cost of China's capital market distortions. Chinese entrepreneurs who list their firms abroad are giving up more than 60% of their firm valuation in order to bypass such distortions. And when the distortions get more severe, they have to give up even more.

8 Welfare Analysis

8.1 Structural Estimation

We estimate the structural parameters in our model using the simulated method of moments (SMM). The SMM estimates a set of structural parameters by minimizing the quadratic distance between a set of simulated moments from the theoretical model and the same set of empirical moments from the data. Intuitively, the value of the simulated moments depends on the structural parameters imposed in each round of simulation. Therefore, if the model is well-specified, the distance between the moments is minimized at the optimal estimates of the parameters. A formal technical presentation can be found at Gourieroux and Monfort (1996). This methodology has been employed in the empirical investment and finance literature pioneered by Bloom

(2009) and Hennessy and Whited (2007).

In our case, the model has 9 structural parameters: μ_0, μ_1, and μ_c, the population means of the logarithm of Tobin's Q in the domestic and overseas market (q_{i0} and q_{i1}) and the population mean of the cost arising from capital market distortions (c_i); σ_0, σ_1, and σ_c, the standard deviation of the ε_{i0}, ε_{i1}, and ε_{ic}; together with ρ_{01}, ρ_{0c}, and ρ_{1c}, the pair-wise correlation coefficients between ε_{i0}, ε_{i1}, and ε_{ic}; where ε_{i0}, ε_{i1}, and ε_{ic} are the firm-specific random draws in valuation and cost. Our empirical exercises from the endogenous treatment effect model provides 9 moments that are informative for these 9 parameters. They are the population mean of the valuation in domestic and overseas market, predicted as the potential outcome $E[y_{i0}]$ and $E[y_{i1}]$, the probability of going overseas IPO in our final sample, $P(t_i = 1)$; the first and second moment of the residuals from the valuation equation for the control and treatment group in the general model $E[\varepsilon_{i0}|t_i = 0]$, $E[\varepsilon_{i1}|t_i = 1]$, $sd[\varepsilon_{i0}|t_i = 0]$, and $sd[\varepsilon_{i0}|t_i = 1]$, together with the correlation coefficients between the residuals from the probit model and the valuation equations $corr[v_i, \varepsilon_{i0}|t_i = 0]$ and $corr[v_i, \varepsilon_{i1}|t_i = 1]$.

Table 8 presents the SMM estimation results. The left panel lists the estimates for the structural parameters and their standard errors. The right panel reports the empirical moments and the simulated moments. Overall the model is able to fit the data closely. As this is an exactly identified model, we also compare two untargeted moments – the subsample mean of market valuation in the domestic market and overseas market. Different from the 9 targeted moments, which are estimated from the endogenous treatment effect model, these two untargeted moments are directly observed from data. As shown in Table 8, simulating our model at the structural estimates reported in the left panel generates the salient feature of the substantial valuation gap between the domestic and overseas listed Chinese firms. Appendix 4.1 and 4.6 discuss how we check the robustness of the structural estimation to model specification and small pertubation in data moments. Corresponding results are reported in Table A12 and Table A17.

The estimates for the structural parameters all have important economic implications. First, μ_0 is estimated to be significantly higher than μ_1. This suggests on average the mainland China stock market prices Chinese firms higher than the overseas market. The valuation gap in the population mean could be driven by many factors as discussed earlier. However, in our willingness-to-pay approach, entrepreneurs take μ_0 and μ_1 as given, and make optimal IPO locational choices according to equation (9).

Second, we find μ_c to be positive and statistically significant, indicating the significant distortions in the domestic market in the minds of entrepreneurs. On average, to make an initial public offering for every 1 dollar of capital, an entrepreneur has paid 32 cents due to capital market distortions. Third, the estimates for the three standard deviations σ_0, σ_1, and σ_c suggest three things. First, there is a substantial heterogeneity in valuation with either the domestic or overseas markets. Second, the dispersion is even greater for the valuation in the overseas market. Third, the dispersion in the distortion cost is even larger than either of the market valuations. According to (9), a large and significant σ_c highlights the role of cost in driving the overseas listing decision.

The relative magnitude of σ_0, σ_1, and σ_c also has direct implications on the self-selection, together with the estimates on ρ_{01}, ρ_{0c}, and ρ_{1c}. We cannot formally reject the null hypothesis that $\rho_{01} = 0$. In other words, the correlation between the unobservables in the valuation in the two markets is insignificant. In contrast, ρ_{0c} and ρ_{1c} are significantly positive and negative, respectively. According to (33) and (34), $S_{0\varepsilon}$ is negatively proportional to the third moment $S_{0\varepsilon} = -\frac{1-P}{P}E[\varepsilon_{i0}|t_i = 0]$, and $S_{1\varepsilon}$ is equal to the fourth moment $S_{1\varepsilon} = E[\varepsilon_{i1}|t_i = 1]$. Our structural estimation finds that $\sigma_c > \sigma_0$, $\sigma_c > \sigma_1$, together with $\rho_{0c} > 0$ and $\rho_{1c} < 0$, this explains mathematically why we have obtained $S_{0\varepsilon} > 0$ and $S_{1\varepsilon} < 0$ in our empirical exercises. Intuitively, all else being equal, those firms facing higher distortion costs in the domestic market are more likely to list overseas. However, since there is a positive correlation between the unobservables in valuation in domestic market and the unobservables in cost ($\rho_{0c} > 0$) and a negative correlation between the unobservables in valuation in overseas market and the unobservables in cost ($\rho_{1c} < 0$), those who finally choose to list overseas are on average selected from the right half in domestic market in terms of Tobin's Q distribution but end up in the left half of the overseas market. Figure A5 visualizes the potential population distribution in the domestic and overseas market and highlights the sign of selection of the treated in each market.

In summary, the structural estimation backs out the primitive parameters of our theoretical model. Going overseas IPO even under a valuation haircut is a seemingly puzzling stock market anomaly. However, this anomaly turns out to be an optimal choice of entrepreneurs, once taking into account the existence of hidden cost and the potential correlation between the cost and valuation.

8.2 Counterfactual Simulation

With the estimated structural parameters, we can use our model in Section 4 to assess the welfare effect of capital market distortions and to perform counterfactual thought experiments. In particular, the cost parameter c would be our central focus. While we hold other parameters constant, with a change in c, firms re-optimize to decide whether to go an overseas IPO and the utility of entrepreneurs from a domestic or overseas listing changes accordingly. The results are presented in Table 9.

Recall that we model $c_i = \tau + d + \delta_i$ and we estimate $c_i = \mu_c + \varepsilon_{ic}$, where $\mu_c = 0.32$ and $\sigma_c^2 \sim N(0, 1.17^2)$. One way to interpret c is to take $\mu_c = \tau + d$, as policy distortions that are common to all entrepreneurs; and $\varepsilon_{ic} = \delta_i$ as an idiosyncratic factor due to subjective preference for holding one's wealth offshore. Furthermore, recall that $d = r(T_0 - T_1)$. In the data, the average IPO waiting period for domestic listing in our sample is 16 months, together with a 2-year lockup period, we have a value for $T_0 = 3.33$ years. For overseas listing, the average IPO waiting period is 6 months, together with a 9-month lockup period, we assign a value $T_1 = 1.25$ years. If the discount rate is $r = 5\%$, the cost due to regulations in the IPO system will suggest $d = 0.10$. Since $\mu_c = 0.32$, this implies $\tau = 0.22$. In other words, the Chinese entrepreneurs on average face a 22% transaction cost to convert CNY to USD and move the money across the border. With these estimates, the simulated probability of overseas listing is 0.232,[17] and the expected utility from every one dollar of initial assets of a representative entrepreneur is 1.21.

Policy reforms can be performed by altering the value of some model parameters. If Chine streamline its IPO approval or review process, and harmonize the post-IPO lock-up period to the international form, the post-reform $T_0 = T_1 = 1.25$. This reform would reduce the probability of overseas listing to 0.188 and raise the expected utility of the representative entrepreneur to 1.29 or by 6.8% = (1.29-1.21)/1.21. While some of the entrepreneurs whose firms are currently listed overseas gain from the reform by switching to list their firms at home, all entrepreneurs with actual domestic IPOs benefit from this reform.

If China were to remove the binding capital controls so that capital $\tau = 0$, there would be a 14.6% gain in the entrepreneurs' welfare. If both reforms are implemented, the overseas listing probability will reduce to 0.115 and the gain in entrepreneurial wel-

[17] This is somewhere in between 0.211 - the probability of overseas listing in our baseline sample made of comparable groups, and 0.319 - the probability of overseas listing among all Chinese firms that went an IPO during 2009 to 2019.

fare reaches 22.1%. Alternatively, since the utility under no capital market distortions would be 1.48 and the actual utility is 1.21, the welfare loss facing a representative entrepreneur due to capital market distortions is (1.21-1.48)/1.48 =18.1%.

Counterfactuals associated with an increase in c is also informative. First, if either the Chinese authorities ban overseas listing, or overseas authorities ban Chinese firms on their stock exchanges, how much would this affect entrepreneurial welfare? Suppose we raise T_1 to 30, there would be no more overseas listing and the entrepreneur suffers a 7.8% welfare loss. As a second thought experiment, consider a complete capital control, $\tau = 1$. In this case, 65% of the entrepreneurs would choose overseas IPOs, even with a large haircut in firm valuations. Under this scenario, a representative entrepreneur faces a substantial welfare loss of 36.7%.

Finally, it is also interesting to separate welfare loss of those currently listed at home versus abroad. Table 10 reports such an anatomy. Under the ideal scenario when $\mu_c = 0$, only 11.5% of the entrepreneurs in our sample would still choose to go overseas listing. Those are entrepreneurs who happen to have such a large random draw on δ_i that home market reform does not change their choice and affect their welfare. However, there are 11.6% of the entrepreneurs in our sample who would list at home and have an average utility of 0.610 if $\mu_c = 0$, in fact switch to overseas IPO due to $\mu_c = 0.32$. Their factual average utility decreases to 0.436, which is equivalent to a 28.5% welfare loss. The most interesting group is those 76.8% of entrepreneurs, who would list at home if $\mu_c = 0$ and also currently list at home at $\mu_c = 0.32$. Although there seems no change in their listing locational choice, their average utility has decreased from 1.784 to 1.462, or a 18.0% welfare loss due to capital market distortions. Since the total welfare loss comes from those who switch and from those who currently list at home, with the proportion of each category of such entrepreneurs and the average welfare loss in each category, we find the switchers and the home listers contribute 19.3% and 80.7% respectively in the total welfare loss.

The fact that more than 80% of the welfare loss is in fact accrued to the group of entrepreneurs that have chosen a domestic listing is interesting. That is because they have to endure the longer IPO review process and lockup period, they have to pay a transaction cost when moving wealth from listing the firms at home across the border, and there are more of them than those with an overseas IPO. We investigate how much valuation discount these domestic listed entrepreneurs would be willing to give up for a capital market environment similar to that overseas. Specifically, we cal-

culate the percentage change in the counterfactual and factual firm valuation along an indifference curve: $U_{i0}\left(Q_{i0}, \tau = 0.22, T_0 = 3.33\right) = U_{i0}\left(Q_{i0}^{CF}, \tau = 0, T_0 = 1.25\right)$, from which we obtain $\frac{Q_{i0}^{CF} - Q_{i0}}{Q_{i0}} = -27.7\%$. This implies that domestic listed entrepreneurs on average are willing to give up 28% of firm valuation in exchange of a distortion-free capital market.

9 Conclusion

This paper uses a willingness-to-pay approach to estimate the cost of capital market regulations in China by comparing the valuations of Chinese overseas listed firms with their domestic counterparts. We find that overseas listings exhibit a positive selection - both observable firm characteristics and unobservable factors suggest overseas listed firms are on average better than domestic listed firms in the domestic market. Thus, the treatment effect of an overseas listing on those overseas listed firms is even larger than what directly observed from the valuation gap across the two group of firms. Empirical results from different models and various setups lead to a robust finding: There is a substantial, significant, and persistent valuation discount (about 60%) facing overseas listed Chinese firms.

With estimation of the structural model, we show that the combination of IPO regulations and capital controls reduces the entrepreneurial welfare by 18.1%. Interestingly, even though our estimation leverages the observation that a portion of the entrepreneurs in the data have chosen an overseas IPOs, about 80% the welfare loss comes from the group of entrepreneurs that have stayed in the domestic capital market. These entrepreneurs are willing to give up 28% of firm valuation in order to bypass the inconveniences associated with China's capital controls, IPO approval delays, and other capital market regulations.

With the estimates of the structural parameters, we show that reforming the IPO process and removing capital controls can both raise the welfare of the entrepreneurs (by 6.8% and 14.6%, respectively). On the other hands, making it harder to do overseas listing (such as through the actions of either overseas or domestic authorities), or tightening capital controls could substantially reduce the welfare of the entrepreneurs. These findings have important policy implications. Capital account liberalization and reforms of other capital market regulations would reduce the costs faced by entrepreneurs and reduce their incentive to take their firms for an overseas listing.

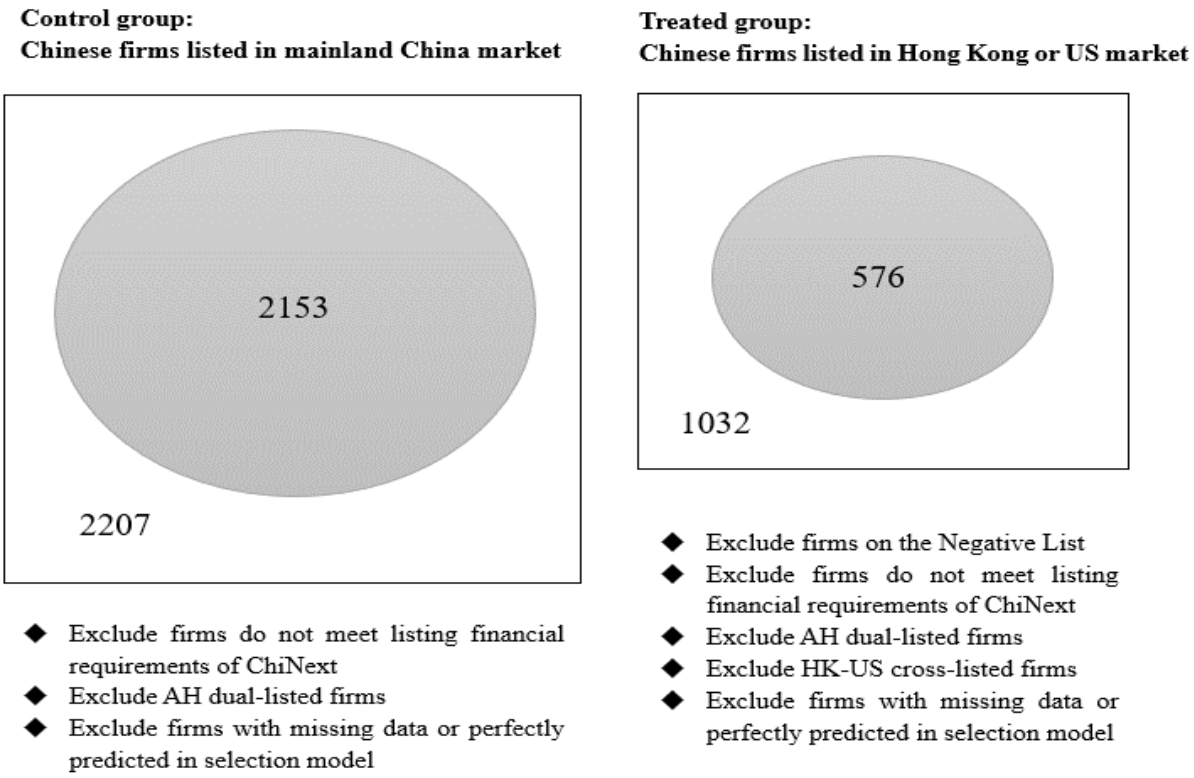

Figure 1: Sample construction for Chinese firms listed in mainland China and overseas

Table 1: Summary statistics for valuation

Valuation	Time	Market	Mean	p25	p50	p75	No. of firms
Tobin's Q	At IPO	Mainland	4.53	2.30	3.32	5.52	2,152
		Overseas	2.84	1.33	2.05	3.29	523
	1st Trading Day	Mainland	6.25	3.08	4.50	7.27	2,152
		Overseas	3.27	1.33	2.18	3.59	523
	1st Year	Mainland	4.05	2.32	3.29	5.05	2,153
		Overseas	1.91	0.98	1.41	2.21	576
	2nd Year	Mainland	3.23	1.87	2.62	4.00	1,963
		Overseas	1.75	0.88	1.16	1.85	492
	3rd Year	Mainland	3.25	1.84	2.58	3.83	1,864
		Overseas	1.53	0.84	1.09	1.70	414
	4th Year	Mainland	3.44	1.88	2.68	4.13	1,431
		Overseas	1.45	0.82	1.07	1.59	356
	5th Year	Mainland	3.63	2.10	3.00	4.43	1,202
		Overseas	1.38	0.79	0.98	1.47	315
PB ratio	At IPO	Mainland	4.10	1.87	2.96	5.10	2,152
		Overseas	2.27	0.73	1.50	2.78	523
	1st Trading Day	Mainland	5.82	2.62	4.08	6.89	2,152
		Overseas	2.70	0.75	1.61	3.13	523
	1st Year	Mainland	5.15	2.84	4.13	6.45	2,153
		Overseas	2.45	0.93	1.75	2.84	576
	2nd Year	Mainland	4.20	2.32	3.36	5.29	1,963
		Overseas	2.18	0.73	1.30	2.38	492
	3rd Year	Mainland	4.31	2.31	3.41	5.12	1,864
		Overseas	2.12	0.62	1.19	2.17	414
	4th Year	Mainland	4.65	2.46	3.66	5.68	1,431
		Overseas	1.91	0.59	1.13	2.13	356
	5th Year	Mainland	5.04	2.82	4.12	6.14	1,202
		Overseas	1.82	0.47	0.93	1.84	315
PE ratio	At IPO	Mainland	30.64	20.26	22.48	39.23	2,152
		Overseas	21.18	10.00	14.82	22.81	523
	1st Trading Day	Mainland	43.93	28.64	31.99	50.57	2,152
		Overseas	25.33	10.34	16.09	26.24	523
	1st Year	Mainland	57.54	32.16	46.88	68.96	2,153
		Overseas	19.33	7.06	12.45	22.79	576
	2nd Year	Mainland	57.88	28.55	41.65	63.30	1,963
		Overseas	18.33	5.78	10.72	19.19	492
	3rd Year	Mainland	72.82	27.83	44.50	77.30	1,864
		Overseas	20.48	4.31	9.54	18.24	414
	4th Year	Mainland	97.04	28.64	52.01	99.63	1,431
		Overseas	16.62	2.67	9.33	19.22	356
	5th Year	Mainland	98.05	29.23	56.07	111.84	1,202
		Overseas	12.27	-1.11	7.16	15.45	315

Table 2: Determinants of overseas listings

Dependent			
	(1)	(2)	(3)
		1st Year	
Variables	Coeff	dy/dx	dy/dx * S.D.
Age	0.034***	0.004***	4.25%
	(0.006)	(0.001)	
Log (total asset)	-0.157***	-0.020***	-3.30%
	(0.047)	(0.006)	
ROA (%)	0.036***	0.004***	5.42%
	(0.007)	(0.001)	
Sales growth rate (%)	0.007***	0.001***	4.63%
	(0.001)	(0.000)	
Leverage (%)	0.024***	0.003***	6.56%
	(0.003)	(0.000)	
Intangible assets ratio (%)	0.015***	0.002***	2.87%
	(0.004)	(0.001)	
State ownership percentage (%)	0.003	0.000	0.94%
	(0.002)	(0.000)	
Independent director ratio (%)	0.071***	0.009***	10.89%
	(0.008)	(0.001)	
CEO = Chairman	0.323***	0.040***	1.98%
	(0.084)	(0.011)	
Top5 ownership percentage (%)	0.008**	0.001**	1.43%
	(0.004)	(0.001)	
Controlling shareholders dummy	0.340***	0.042***	1.89%
	(0.096)	(0.012)	
Import and export ratio (%)	-0.001	-0.000	-0.38%
	(0.001)	(0.000)	
Strategic investor dummy	0.750***	0.093***	3.51%
	(0.125)	(0.015)	
Foreign reserve growth rate (%)	0.011	0.001	1.77%
	(0.009)	(0.001)	
Exchange rate growth (%)	0.199***	0.025***	4.35%
	(0.040)	(0.005)	
Foreign ownership percentage (%)	0.011***	0.001***	5.80%
	(0.001)	(0.000)	
Operating cash flow ratio (%)	-0.025***	-0.003***	-4.26%
	(0.005)	(0.001)	
PE regulation	0.018	0.002	2.22%
	(0.012)	(0.001)	
Expected relative waiting days	0.362***	0.045***	7.64%
	(0.040)	(0.005)	
Log (relative market index)	0.432***	0.054***	2.87%
	(0.105)	(0.013)	
Industry	YES	YES	
Year	YES	YES	
Province GDP per capita	YES	YES	
No. of Obs.	2,729	2,729	

Notes:

1. Column (1) reports the probit resluts.
2. Column (2) reports the partial effects.
3. Column (3) uses the standard deviation of X of overseas listed Chinese firms in baseline sample.
4. Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 3: Valuation equations in the endogeneous treatment effect model

Dependent	Tobin's Q				
	Simple model	General model			
	(1)	(2)	(3)	(4)	(5)
	All	Treated	Control	$(\beta_{11} - \beta_{10}) * (x_i \mid t_i = 1)$	$\beta_{10} * ((x_i \mid t_i = 1) - (x_i \mid t_i = 0))$
Variables	1st Year	1st Year	1st Year	1st Year	1st Year
Age	-0.006	-0.013*	-0.006	-0.120	-0.013
	(0.007)	(0.008)	(0.007)	(0.181)	(0.017)
Log (total asset)	-0.531***	-0.145	-0.809***	14.035***	-0.107*
	(0.068)	(0.105)	(0.065)	(2.644)	(0.058)
ROA (%)	0.062***	-0.002	0.146***	-2.074***	0.348***
	(0.014)	(0.013)	(0.014)	(0.275)	(0.081)
Sales growth rate (%)	0.006***	-0.000	0.011***	-0.316***	0.108***
	(0.002)	(0.001)	(0.002)	(0.076)	(0.033)
Leverage (%)	-0.006**	-0.003	-0.004	0.015	-0.054
	(0.003)	(0.006)	(0.004)	(0.279)	(0.054)
Intangible assets ratio (%)	0.017***	0.013**	0.015***	-0.021	0.027*
	(0.004)	(0.007)	(0.005)	(0.119)	(0.015)
State ownership percentage (%)	0.004***	-0.000	0.008***	-0.073**	0.001
	(0.002)	(0.003)	(0.002)	(0.033)	(0.010)
Independent director ratio (%)	-0.006	-0.031***	0.020**	-2.257***	0.142**
	(0.007)	(0.011)	(0.010)	(0.628)	(0.070)
CEO = Chairman	0.093	-0.113	0.064	-0.105	0.006
	(0.085)	(0.215)	(0.079)	(0.136)	(0.005)
Top5 ownership percentage (%)	-0.007	-0.020	-0.008**	-1.129	-0.064**
	(0.005)	(0.022)	(0.003)	(2.070)	(0.029)
Controlling shareholders dummy	0.152*	-0.110	0.181**	-0.211	0.048**
	(0.092)	(0.197)	(0.092)	(0.160)	(0.024)
Import and export ratio (%)	-0.002	0.002	-0.001	0.065	0.004
	(0.001)	(0.003)	(0.002)	(0.077)	(0.007)
Strategic investor dummy	0.102	-0.098	0.178	-0.047	0.021
	(0.140)	(0.163)	(0.163)	(0.040)	(0.020)
Foreign reserve growth rate (%)	0.005	-0.009	0.010	-0.155	0.002
	(0.009)	(0.018)	(0.011)	(0.176)	(0.010)
Exchange rate growth (%)	0.014	0.156	0.081*	-0.017	0.002
	(0.040)	(0.184)	(0.049)	(0.046)	(0.008)
Foreign ownership percentage (%)	0.003*	-0.002	0.007***	-0.330***	0.173***
	(0.002)	(0.002)	(0.002)	(0.107)	(0.052)
Operating cash flow ratio (%)	0.012*	0.028**	-0.006	0.361**	0.007
	(0.007)	(0.013)	(0.005)	(0.147)	(0.008)
PE regulation	-0.027**	0.001	-0.060***	0.547***	-0.006
	(0.013)	(0.009)	(0.019)	(0188)	(0.028)
Overseas listing	-2.717***				
	(0.350)				
Industry	YES	YES	YES	0.093	0.034
				(1.272)	(0.060)
Year	YES	YES	YES	1.592	0.353***
				(0.983)	(0.121)
Province GDP per capita	YES	YES	YES	-2.595	0.028
				(1.887)	(0.025)
Constant	YES	YES	YES	-10.172**	
				(4.663)	
β_{20}	0.446		1.399***		
	(0.330)		(0.413)		
β_{21}	0.446	-1.277***			
	(0.330)	(0.490)			
Observations	2729	576	2,153		

Notes:

1. Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 4: Decomposition for quantity of interest

Quantity of Interest	Simple model	General model
$E[y_{i0} \mid t_i = 0]$ - observed	4.05	4.05
$E[y_{i1} \mid t_i = 1]$ - observed	1.91	1.91
$E[y_{i1} \mid t_i = 0]$ - predicted	1.34	3.08
$E[y_{i0} \mid t_i = 1]$ - predicted	4.62	5.69
$E[y_{i0}]$ - potential outcome mean	4.17	4.40
$E[y_{i1}]$ - potential outcome mean	1.46	2.83
ATE	-2.72***	-1.56***
	(0.35)	(0.40)
$E[y_{i0}]$	4.17***	4.40***
	(0.09)	(0.10)
$ATE/E[y_{i0}]$	-65.23%	-35.45%
ATET	-2.72***	-3.78***
	(0.35)	(0.39)
$E[y_{i0} \mid t_i = 1]$	4.62***	5.69***
	(0.31)	(0.38)
$ATET/E[y_{i0} \mid t_i = 1]$	-58.87%	-66.43%
$S_0 = E[y_{i0} \mid t_i = 1] - E[y_{i0}]$	0.45*	1.29***
	(0.24)	(0.30)
obs: $\beta_{10} * (E[x_i \mid t_i = 1] - E[x_i \mid t_i = 0]) * (1-P)$	0.31*	0.84**
	(0.16)	(0.20)
unobs: $E[\varepsilon_{i0} \mid t_i = 1] = \beta_{20} * E[v_i \mid t_i = 1]$	0.14	0.45***
	(0.11)	(0.13)
$S_1 = E[y_{i1} \mid t_i = 1] - E[y_{i1}]$	0.45*	-0.92***
	(0.24)	(0.34)
obs: $\beta_{11} * (E[x_i \mid t_i = 1] - E[x_i \mid t_i = 0]) * (1-P)$	0.31*	-0.51**
	(0.16)	(0.21)
unobs: $E[\varepsilon_{i1} \mid t_i = 1] = \beta_{21} * E[v_i \mid t_i = 1]$	0.14	-0.41**
	(0.11)	(0.16)
$GMD = E[y_{i1} \mid t_i = 1] - E[y_{i0} \mid t_i = 0]$	-2.15***	-2.15***
	(0.10)	(0.10)
$ATET = E[y_{i1} \mid t_i = 1] - E[y_{i0} \mid t_i = 1]$	-2.72***	-3.78***
	(0.35)	(0.39)
obs: $(\beta_{11} - \beta_{10}) * E[x_i \mid t_i = 1]$	-2.72***	-2.92***
	(0.35)	(0.35)
unobs: $(\beta_{21} - \beta_{20}) * E[v_i \mid t_i = 1]$	0.00	-0.86***
	(0.00)	(0.21)
$SB = E[y_{i0} \mid t_i = 1] - E[y_{i0} \mid t_i = 0]$	0.57*	1.63***
	(0.31)	(0.38)
obs: $\beta_{10} * (E[x_i \mid t_i = 1] - E[x_i \mid t_i = 0])$	0.39**	1.06***
	(0.20)	(0.25)
unobs: $\beta_{20} * (E[v_i \mid t_i = 1] - E[v_i \mid t_i = 0])$	0.18	0.57***
	(0.13)	(0.17)

Table 5: Policy shocks and valuation discounts

Dependent	Tobin's Q			
	(1)	(2)	(3)	(4)
VARIABLES	Capital ontrol	IPO suspention	PE restriction	All distortions
Overseas listing	-2.845***	-2.490***	-2.219***	-2.083***
	(0.319)	(0.335)	(0.326)	(0.363)
Capital control	1.018***			0.960***
	(0.362)			(0.364)
Overseas listing*Capital controls	**-0.676***			**-0.728***
	(0.396)			**(0.435)**
IPO suspension		0.258		0.347
		(0.271)		(0.300)
Overseas listing*IPO suspension		**-1.669*****		**-1.550*****
		(0.325)		**(0.380)**
PE restriction			-0.804	-1.074**
			(0.503)	(0.531)
Overseas listing*PE restriction			**-0.986*****	**-0.695*****
			(0.202)	**(0.249)**
X	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Year	YES	YES	YES	YES
Province GDP per capita	YES	YES	YES	YES
Observations	2,729	2,729	2,729	2,729

Notes:

1. The results are estimated using simple endogeneous treatment effect model for firms in their first year of IPO.
2. Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively.
3. Capital control==1 if firms submit IPO application during 2018 and 2019.
4. IPO suspension==1 if firms submit IPO application during 2013 and 2014.
5. PE restriction==1 if firms go IPO during 31 March 2014 and 30 June 2020.

Table 6: Firm heterogeneities and valuation discounts

Dependent	Tobin's Q					
Variables	(1) SOE	(2) Foreign ownership	(3) Operating risk	(4) Intangible assets	(5) All firm heterogeneities	(6) Heterogeneities + policy distortions
Overseas listing	-2.908***	-2.308***	-2.216***	-2.630***	-1.632***	-0.686
	(0.324)	(0.370)	(0.411)	(0.319)	(0.508)	(0.529)
SOE dummy	0.007				0.090	0.067
	(0.149)				(0.151)	(0.149)
Overseas listing*SOE dummy	**0.703*** **				**0.075**	**0.093**
	(0.235)				**(0.256)**	**(0.231)**
High foreign ownership percentage		0.300**			0.305**	0.276*
		(0.139)			(0.143)	(0.143)
Overseas listing*High foreign ownership		**-0.909*** **			**-0.892*** **	**-0.862*** **
		(0.249)			**(0.290)**	**(0.277)**
High operating risk			0.396***		0.379***	0.406***
			(0.082)		(0.083)	(0.084)
Overseas listing*High operating risk			**-0.717*** **		**-0.614*** **	**-0.843*** **
			(0.191)		**(0.197)**	**(0.195)**
High intangible assets				0.246**	0.215**	0.189*
				(0.099)	(0.099)	(0.098)
Overseas listing*High intangible assets				**-0.381***	**-0.245**	**-0.132**
				(0.218)	**(0.219)**	**(0.213)**
Capital control						1.003***
						(0.358)
Overseas listing*Capital control						**-0.708***
						(0.428)
IPO suspension						0.280
						(0.305)
Overseas listing*IPO suspension						**-1.408*** **
						(0.383)
PE restriction						-0.745
						(0.523)
Overseas listing*PE restriction						**-0.921*** **
						(0.259)
X	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Province GDP per capita	YES	YES	YES	YES	YES	YES
Observations	2,729	2,729	2,698	2,729	2,698	2,698

Notes:

1. The results are estimated using simple endogeneous treatment effect model for firms in their first year of IPO.
2. Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 7: Triple DIDs

Dependent	Tobin's Q		
Variables	(1)	(2)	(3)
	Foreign ownership	Operating risk	Intangible assets
Overseas listing	-2.313***	-1.910***	-2.346***
	(0.405)	(0.472)	(0.347)
Capital control	0.236		
	(0.350)		
High foreign ownership percentage	0.142		
	(0.134)		
Overseas listing*High foreign ownership	-0.881***		
	(0.288)		
Overseas listing*Capital control	-0.185		
	(0.467)		
High foreign ownership percentage*Capital control	1.922***		
	(0.688)		
Overseas listing*High foreign ownership*Capital control	**-1.443***		
	(0.791)		
IPO suspension		-0.340	-0.161
		(0.275)	(0.290)
High operating risk		0.175**	
		(0.084)	
Overseas listing*IPO suspension		-0.866***	-1.255***
		(0.331)	(0.369)
Overseas listing*High operating risk		-0.508**	
		(0.208)	
High operating risk*IPO suspension		1.435***	
		(0.277)	
Overseas listing*High operating risk*IPO suspension		**-1.604***	
		(0.518)	
High intangible assets			0.116
			(0.099)
High intangible assets*IPO suspension			0.914***
			(0.288)
Overseas listing*High intangible assets			-0.265
			(0.244)
Overseas listing*High intangible assets*IPO suspension			**-1.025***
			(0.543)
X	YES	YES	YES
Industry	YES	YES	YES
Year	YES	YES	YES
Province GDP per capita	YES	YES	YES
Observations	2,729	2,698	2,729

Notes:

1. The results are estimated using simple endogeneous treatment effect model for firms in their first year of IPO.
2. Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 8: SMM estimation

paramater	estimate	s.e.	targeted moments	data	simulated
μ_0	1.500	0.028	$E[y_{i0}]$	**4.40**	4.74
μ_1	0.663	0.052	$E[y_{i1}]$	**2.83**	2.24
μ_c	0.322	0.085	$P[t_i = 1]$	**0.21**	0.23
σ_0	0.333	0.013	$E[\varepsilon_{i0} \mid t_i = 0]$	**-0.12**	-0.12
σ_1	0.540	0.037	$E[\varepsilon_{i1} \mid t_i = 1]$	**-0.41**	-0.48
σ_c	1.172	0.031	$sd[\varepsilon_{i0} \mid t_i = 0]$	**1.71**	1.57
ρ_{01}	0.229	0.614	$sd[\varepsilon_{i1} \mid t_i = 1]$	**1.81**	0.98
ρ_{0c}	0.584	0.089	$corr[v_i, \varepsilon_{i0} \mid t_i = 0]$	**0.15**	0.13
ρ_{1c}	-0.775	0.058	$corr[v_i, \varepsilon_{i1} \mid t_i = 1]$	**-0.23**	-0.15
			untargeted moments	**data**	**simulated**
			$E[Y_{i0} \mid t_i = 0]$	***4.05***	*4.62*
			$E[Y_{i1} \mid t_i = 1]$	***1.91***	*1.76*

Table 9: Counterfactual simulations

	τ	r	T_0	T_1	d	μ_c	P (t = 1)	expected U	Δ in U %
factual	**0.22**	**0.05**	**3.33**	**1.25**	**0.10**	**0.32**	**0.23**	**1.21**	**NA**
counterfactuals: reduce c									
IPO reform in China to US	0.22	0.05	1.25	1.25	0.00	0.22	0.19	1.29	6.8%
CA liberalization in China	0.00	0.05	3.33	1.25	0.10	0.10	0.15	1.39	14.6%
both reforms	0.00	0.05	1.25	1.25	0.00	0.00	0.12	1.48	22.1%
counterfactuals: increase c									
forbidden overseas listing	0.22	0.05	3.33	30.00	-1.33	-1.12	0.00	1.12	-7.8%
complete capital control	1.00	0.05	3.33	1.25	0.10	1.10	0.65	0.77	-36.7%

Table 10: Decomposition of welfare loss

$\mu_c = 0$	$U_0 = 1.784$	$U_s = 0.610$	$U_1 = 0.300$
identity	always $t_i = 0$	$t_i = 0$ if $\mu_c = 0$ switchers $t_i = 1$ if $\mu_c = 0.32$	always $t_i = 1$
$\mu_c = 0.32$	$U_0 = 1.462$	$U_s = 0.436$	$U_1 = 0.300$
proportion	76.8%	11.6%	11.5%

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Appendix

1 Further Discussion

1.1 Negative List and Financial Requirements

While some Chinese firms will eventually be able to go IPO in a domestic stock exchange after going through the opaque, prolonged and ad-hoc process, other firms are denied access to the domestic stock market in the first place, due to restriction on foreign investment, or stringent financial listing requirements.

Although foreign investment is generally welcomed and has played an important role in China's economic miracle, there are certain industry sectors that prohibit or restrict foreign investment. From the earliest Investment Catalogue in 1995, to the Free-Trade Zone Negative List in 2013, and to the first nationwide Negative List in 2018, the Chinese authorities have been adopting the traffic-light system to regulate foreign investment. For example, the 2020 Negative List sets 33 clauses across 12 industry sectors to restrict or prohibit foreign investment. In particular, foreign investment is prohibited in internet news provider, courier services, and gene diagnosis. Foreign ownership in automobile manufacturing should be 50% or less and in public air transportation should be 25% or less. Pre-school, general high school and higher education institutions are restricted to Sino-foreign cooperation.

Furthermore, China's domestic stock market, which is well-known for its emphases on investor protection, sets more stringent listing standards than its Hong Kong and US counterparts.[1] One of the most criticized financial requirements of the Chinese stock market is the requirement for profitability. Until the recent registration-based IPO reform, a positive net profit in two or three consecutive years before filing an IPO application was required for all issuers, regardless of which board they apply for. In contrast to mainland China stock exchanges imposing the *ex-ante* stringent financial requirements for IPOs, the US stock market focuses on full disclosure and strong enforcement. The Hong Kong authority utilizes a combination of financial requirements and legal arrangements somewhere in the middle of the two ends. As a result, there are several alternative standard categories for firms applying for IPOs on

[1] Feng et al. (2023) summarizes the operating history and threshold financial requirements that the issuer must satisfy for IPO in mainland China (main board, ChiNext and STAR) in Table 2. The requirements for listing in Hong Kong (main board and GEM), and NYSE and NASDAQ in the US are presented in Tables A2-A4 for comparison.

these exchanges. The standards typically include the earnings test, capitalization or revenue test, cash flow test, or some combinations of them. A firm that fits any one of these standards can be listed.

As early as late 1990s, foreign VC and PE seek for investment opportunities in China. Certain industries, such as internet and healthcare, also heavily rely on foreign VC and PE to finance capital expenditure and R&D. In normal circumstance, VC and PE achieve a profitable exit following a successful IPO. However, the Negative List imposes a legal restriction on domestic listing for firms with foreign investment in the specified industries. The positive profitability requirement also prevents firms with good growth potentials but no positive net profit from going public and raising capital in the homeland. Going IPO abroad via a Variable Interest Entity (VIE) has been the creative solution adopted by many Chinese firms. A VIE is an overseas holding company that is most often registered in a tax heaven. It separates the listed entity from the operational entity in terms of shareholding, as the listed entity controls the operating business in mainland China through a series of contracts. The VIE structure circumvents the Negative List by effectively disguising foreign ownership. That is why ever since the NASDAQ IPO of Sina.com in 2000, many private shares listed on Hong Kong and about two-thirds on New York have employed the VIE structure, including those most well-known internet giants "BAT" – Baidu, Alibaba and Tencent. About 30% of these firms do not make a positive net profit at the moment of IPO.

1.2 Sign of Selection

In the special case of $\sigma_c = 0$, we could follow Borjas (1987) and consider four cases of interest. Case 1: if $S_0 > 0$ and $S_1 > 0$, then overseas listings reflect a positive selection, where those firms choosing for an overseas IPO would on average be on the right side of the distribution for Tobin's Q across all Chinese firms in both home and overseas markets. Case 2: if $S_0 < 0$ and $S_1 < 0$, then overseas listings represent a negative selection. In Case 3, if $S_0 < 0$ and $S_1 > 0$, it would be called "refuge sorting" in the immigration context, where firms that are listed overseas are on average selected from "worse firms" in terms of Tobin's Q at the home market and would do better than other Chinese firms in the overseas market.

Finally, in Case 4, if $S_0 > 0$ and $S_1 < 0$, this would be considered nonsensical or irrational as those firms actually list abroad would have been the "better firms" in terms of Tobin's Q in the home market but "worse firms" compared to other Chinese

firms in the overseas market. Mathematically, this would require $\rho_{01} > 1$. However, in the more general case where $\sigma_c \neq 0$, the signs of S_0 and S_1 will also depend on ρ_{0c} and ρ_{1c}. Case 4 could happen if $\rho_{0c} > 0$ and $\rho_{1c} < 0$. In fact, if σ_c is sufficiently greater than σ_0 and σ_1, the sign of S_0 and S_1 largely depend on the sign of ρ_{0c} and ρ_{1c}.

1.3 Control Function Approach

Some technical remarks on the control function (CF) approach are in order. First, compared with MLE or Heckit, an important advantage of the CF approach is that it does not require any distributional assumption on (ε_i, v_i), such as the bivariate normality. Second, similar to the Heckit, the CF approach deals with the selection bias by including an additional regressor v_i. Different variables from x_i should be included in v_i, for example, z_i. Without the additional identifying variables, parameters β_1 may not be identified due to multi-collinearity. Third, as pointed out by Wooldridge (2010), the CF approach includes the incremental variable estimation as a special case in linear regression models. Similarly, the endogenous treatment effect model can be considered as a two-equation simultaneous equations model. If overseas listing decision is considered as a linear probability model, it can then be treated as the first-stage regression, and the variables z_i in this equation can be considered as excluded exogenous variables and thus as instruments for endogenous variable t_i in the valuation equation. In this case, Hausman test for endogeneity is equivalent to the F test for $\beta_2 = 0$. Fourth, γ can be consistently estimated by the IV estimation directly from the valuation equation, thus it can also be interpreted as the local average treatment effect (LATE). Fifth, using GMM in the one-step CF approach provides efficient estimates while the two-step CF approach provides consistent estimates.

In Table 2, 3 and 4, we present the regression results and decompose the treatment and selection effects for a model where the valuation equation is for one-year after IPO Tobin's Q in great detail, followed by summarized results for other valuation horizons in Table A5. The one-year model is estimated using the two-step CF approach. The point estimates and standard errors for the model coefficients when using the one-step CF approach are very similar. However, with a two-step CF approach, the standard errors for the ATE, $ATET$, GMD, SB in addition to the model coefficients could be obtained via bootstrapping. Results using alternative estimating approaches are reported in Table A16 as robustness checks.

1.4 Capital Control Tightness

We can confirm the change in the tightness of capital controls from deviations from covered interest rate parity. Following Cappiello and Ferrucci(2008), a capital control premium is constructed as below:

$$P_t = (f_t - s_t) - (i_{dt} - i_{ft}),$$

where f_t is the logarithm of the one-period ahead forward rate and s_t is the logarithm of the spot rate. The difference between the forward rate and the spot rate is commonly referred to as the forward margin. i_{dt} and i_{ft} are domestic and foreign deposit rates, respectively. In open financial markets without any capital controls, the forward margin is equal to the interest rate differential between two currencies, implying capital control premium P_t is zero. A negative capital control premium suggests that the covered returns on foreign assets are lower than the returns on domestic assets, indicating the existence of arbitrage opportunity. This arbitrage opportunity has not been eliminated due to the strict capital account restrictions that prevent capital from flowing into the country. On the contrary, a positive capital control premium indicates that the covered returns on domestic assets are lower than the returns on foreign assets and capital controls prevent capital from fleeing the country.

We collect monthly data on the spot exchange rate, 3-month, 6-month, and 12-month RMB forward contract middle price in USD, and corresponding deposit interest rates in the US and mainland China to establish the capital control premium for mainland China. Figure A4 shows capital control tightness the mid prices of the RMB forward contracts (in USD) in the three maturities, respectively. We see a clear episode of tightening of capital controls during 2018 - 2019.

2 Extensions

2.1 Treatment Effects at Different Horizons

To examine how the treatment effects vary different time horizon, column (1) to (7) of Table A5 lists the ATE and ATET at the moment of IPO, at the end of first trading day, one-year to five-year after IPO, estimated from the simple model in the upper panel, and from the general model in the lower panel.

Comparison across column (1) to (3) shows that at IPO issue price, the valuation discount is in general smaller than that from their first year after IPO. This difference

could be due to the implicit PE restrictions at IPO in the mainland China stock market, as discussed in Section 2.2. If we look at the results using closing price after the first trading day of IPO, the estimated valuation discounts all bounce back. Indeed, both the simple model and the general model have predicted that the potential outcome $E[y_{i0}]$ and $E[y_{i0}|t_i = 1]$ are much higher at the end of first trading day than at IPO issue price. This finding is consistent with the well-known IPO underpricing in Chinese stock market.

Comparison across column (3) to (7) shows that the valuation discount varies somewhere between 30% to 66%, depending on whether one looks at ATE or ATET, and at the simple model or the general model. However, all these treatment effects are significantly negative, suggesting that the valuation discount persists many years after the IPO. Somewhat more interesting is a "V" shaped trend in valuation discounts across one to five years after IPO. The valuation discount in the third year after IPO is relatively small. This can be explained by the difference in lock-up period in mainland China and overseas markets. As discussed earlier in Section 2.2, based on the regulations of CSRC, the insiders have a lock-up period of 18 to 36 months, and the 36-months regulation applies to the actual controllers or controlling shareholders. While the lock-up period for controlling shareholders in Hong Kong and the US markets is 6 to 12 months. Some literature finds that IPO lock-up expiration is usually accompanied by a decline in stock price, an increase in trading volume, and negative abnormal returns (Bradley et al, 2001; Ofek, 2000; Brau et al, 2004; Field & Hanka, 2001). Consistent with the literature, our models also find that the potential outcome $E[y_{i0}]$ and $E[y_{i0}|t_i = 1]$ are indeed lowest at three-year after IPO compared with other horizons. This explains why there is a "V" shape trend in valuation discount one to five years after listing. Nevertheless, even at the bottom of the "V" shape, we still find a significantly negative treatment effect. More importantly, such effect soon bounces back and does not disappear even five years after listing.

2.2 Extended Samples

We include firms that cannot be listed domestically due to the Negative Lists and harsh financial listing requirements in Table A6. Column (1) lists the benchmark results from the simple model for one-year after IPO. Column (2) to (4) sequentially adds back firms that are in the restrictive industries, prohibited industries and unqualified for domestic listing. We report both $E[y_{i1}|t_i = 1]$ and $E[y_{i0}|t_i = 0]$, that is, the average Tobin's Q

of overseas listed firms when they are listed overseas and if they were listed at home. While there is little change in $E[y_{i1}|t_i = 1]$ from column (1) to (4), $E[y_{i0}|t_i = 0]$ has gradually increased from 4.6 to 5.4. It suggests that these "excluded" or "unqualified" firms would obtain an even higher valuation than firms in our "qualified" sample if they were listed in the domestic market, although the overseas market does not value them very differently. As a result, the absolute value of $ATET$ from column (2) to (4) is even larger than each from the previous column. As the percentage in valuation discount is defined as $ATET/E[y_{i0}|t_i = 0]$, it remains about 60% across all the columns.

Table A6 thus has two interesting implications. First, our finding on a significant negative value discount in the baseline sample is not driven by how we select the sample or by the fact some well-known overseas listed Chinese firms are not in our sample by construction. On the contrary, had these firms been included in our analyses, the absolute value of the estimated valuation discount would be even larger. Second, those Chinese firms that have been excluded or deemed unqualified to list in China's domestic market by the CSRC are in fact favored by Chinese investors. The additional valuation discount facing such firms relative to those in our baseline sample reflects the additional cost due to restrictions to capital market access.

2.3 Multiple Choices

We now consider a generalization that treats Hong Kong and New York as separate markets, and with and without VIE as different listing mode. Specifically, we consider a two-step estimation. We conduct a multinomial logit model in the first step to investigate the determinants of the different choices. In the spirit of a control function approach, we obtain the estimated residual from the multinomial logit model and plug it into the valuation equation of the simple model.

As shown in Table A7, in terms of listing locational choice, all else being equal, having a higher state ownership implies a lower probability of listing in the US or listing with a VIE; and having a controlling shareholder implies a higher probability of listing in the Hong Kong or listing without a VIE. In terms of valuation, both the Hong Kong-listed and US-listed Chinese firms face a valuation discount compared with their domestically-listed counterparts, with the absolute value of discount somewhat larger in the US (-3.11) than in Hong Kong (-2.67), and the absolute valuation discount is larger for firms with a VIE (-3.28) than without a VIE (-2.80). However, the differences in valuation discount percentage across listing location and listing mode is very small,

because listing in the US or listing with a VIE also implies a larger counterfactual valuation for those firms. The firms listed in the US or listed with a VIE structure are potentially even favored if they were listed in the mainland China stock market.

3 Validity Checks

3.1 A-H Dual-listed Shares

The AH dual-listed firms - the A shares in mainland China and H shares in Hong Kong issued by the same firms - are intentionally not in our sample, but the H shares also represent an interesting set of overseas listed Chinese stocks. The A-share and H-share are issued by the same firm, which have identical cash flow, voting rights, and fundamentals. Since for every H share in the dual listed pair, there is an A share already listed on a mainland Chinese stock exchange, there is no more additional IPO delay, and there is no question about whether such firm is on the Negative list or whether it meets listing financial requirement. Yet, such firms are still subject to capital controls. Dividends paid to the A shares are in CNY and cannot be converted into hard currency without going through the foreign exchange control. Proceeds from selling down the A shares are also in CNY. In other words, firms with A shares that also have H shares share a subset but not all of the "inconveniences" associated with those firms that are only listed in China. If the valuation discount in the previous estimates reflects the willingness to pay to bypass all the "inconveniences", one may expect the discount embedded in the H shares to be smaller than the previous estimates.

We can compute the haircut in the H share prices by directly comparing them to their corresponding A share prices. Table A8 reports the results for those AH shares whose H shares were listed during our sample period. We find the valuation discount, in this case, is somewhere between 22% to 40%, smaller than those experienced by the stocks solely listed outside mainland China but far above zero. This seems to be quite sensible. In particular, it indicates that capital controls are costly in the minds of Chinese entrepreneurs who are willing to give up a non-trivial part of their firm valuation to have a partial way to bypass the regulation. Presumably, they are willing to endure an even bigger haircut if they do not have a listing in the domestic market.

3.2 The Re-shoring Cases

To obtain additional validation on the plausibility of the estimated valuation discount, it is also useful to examine the set of stocks that used to be listed outside mainland China, but choose to delist from these overseas markets and relist on the domestic market. These stocks offer a window to see how the valuation might change for a given firm from an overseas listing to a domestic listing. About 40 Chinese firms went through the process of "delisting from overseas, and relisting at home" during 2009-2022. We have filtered out several firms as they have altered their business substantially in the relisting process. This leaves us with 17 firms - 15 delisted from the US and 2 from Hong Kong - with no known change of business and a reasonably short gap in time between delisting and relisting.

Table A9 reports their Tobin's Q one-year before delisting and one-year after relisting. Figure A3 visualizes the values in a diagram under the similar spirit as Figure A2. Once again, all the 17 dots lie above the 45 degree line. We calculate the percentage difference in Tobin's Q between the overseas listing and domestic listing. The average difference is 71%, and the median difference is 82%. Because this comparison does not account for possible endogenous nature of the delisting-relisting decision, the estimates need to be taken with a grain of salt. Nonetheless, these numbers suggest that the 66% valuation discount estimated from our general model is not implausibly too large.

3.3 The Argentine ADR Discounts

By the last quarter of 2001, Argentina's economy was teetering on the edge of a complete collapse. During the period between July and November 2001, more than $15 billion was withdrawn from banks by Argentines. In an effort to stem further massive capital outflows, Argentina implemented financial market controls on December 3, which included various restrictions, including a $1,000 monthly withdrawal limit. In January 2002, the Argentine peso was officially devalued. Under the financial market controls, depositors were restricted to withdrawing 250 pesos per week per account but they were still allowed to transfer funds within banking system. These measures have resulted in the inability of all investors, whether from within or outside the country, to transfer their funds abroad. However, the financial market control did not restrict investors from trading in Argentine securities, including securities cross-listed on other markets.

Auguste et al. (2002) studies cross-border trading under such financial market con-

trols in Argentina. Argentine residents purchase Argentine stock using bank deposits and transfer these stocks to ADRs in the US market if stocks happened to be cross listed in the US. Then, they sold the ADRs in US market and obtain the US dollars in their US account. By doing so, investors move money abroad legally under strict capital outflow controls. The study finds that Argentine ADR discounts exceed 50%, suggesting that Argentine investors were willing to pay a significant amount to legally move their money abroad when capital outflow controls exist. This is comparable to the valuation discounts we find in our empirical exercises.

4 Robustness Checks

4.1 Logarithm of Tobin's Q as Outcome Variable

We conduct a set of robustness checks and present results in the appendix. First, instead of using level of Tobin's Q as the outcome variable, we re-estimate both the simple model and general model using logarithm of Tobin's Q. The results are presented in Table A10. We then decompose the treatment effects and the selection effects from the estimation in Table A11. Comparison between Table A10 and Table 3, and Table A11 and Table 4 shows the robustness of our findings to the choice of dependent variable. Despite different magnitude in the estimated effects between the two sets of tables, we have obtained significant negative treatment effects and positive selection in the domestic market.

More interestingly, in our structural estimation using moments from logarithm of Tobin's Q, Table A12 shows that our estimated structural parameters are very close to those in Table 8. In particular, the estimated $\mu_c = 0.35$ and is significantly different from zero. Thus, both the reduced form results and the structural estimation suggest that our empirical findings are robust to the choice between level and logarithm of Tobin's Q, although the results using level of Tobin's Q are easier for interpretation.

4.2 PB Ratio and Pre-IPO Observation Period

In addition to Tobin's Q, we use Market-to-Book ratio (PB ratio), calculated by dividing the current market value by the most current book value on equity, as an alternative gauge for valuation discount. As shown in column (1) of Table A13, the motives for Chinese firms listed overseas remain similar to the baseline estimates and there is a substantial and persistent valuation discount for Chinese firms listed overseas.

In the previous estimation, we use the 12-month average relative market index prior to the IPO application date in the IPO locational decision equation. This is functionally equivalent to an instrumental variable. As a robustness check, we use the 6-month average relative market index and 24-month average relative market index prior to the IPO application date. From columns (2) and (3) of Table A13, we find the impact of the relative market index on the overseas listing to still be significantly positive. The estimated valuation discounts for the overseas listings are almost unchanged.

4.3 Missing or Redundant Explanatory Variables

Another set of robustness checks investigates whether our valuation equation misses any important variables or includes redundant ones. Results are reported in Table A14. Firstly, according to the Fama-French model, a stock's excess return can be explained by many risk, liquidity, and size factors. Thus, we include those factors in our outcome model to explain the firm's valuation. As a robustness check, the Beta coefficients, a measure of the sensitivity of securities to the movement of markets, turnover ratio, a measure of liquidity, and tradable shares, a measure of share size, are included. We find consistent results with our baseline model. The valuation discounts still exist for Chinese firms listed overseas. Secondly, in the baseline model, we include many pre-IPO features in both the treatment model and outcome models. Someone may argue that those pre-IPO features should not affect the firms' valuation after listing as these factors are pre-IPO features that may affect the post-IPO valuation only by affecting the listing location. Thus, we exclude those pre-IPO firm-specific features from our outcome models to examine whether the main findings remain unchanged. As we have the same observations, the treatment model is the same as the treatment model in our baseline results. Despite excluding the pre-IPO features in the outcome models, our main results still remain.

4.4 Industry, Firm Size and Sample Period

We also check the sensitivity of the results to sample construction. Results are reported in Table A15. In columns (1) to (3), we exclude the firms from various specific industries (e.g., real estate, finance, software), and find that the main results are robust. In other words, the valuation discount we find is not driven by a specific industry but a general feature of overseas listed Chinese firms. China's IPOs are tightly regulated, so many private companies choose to go public by reverse merger. Hence, the potential

for the smallest firms to serve as shells in reverse mergers is reflected largely in the market valuations of these firms. To investigate whether our results are driven by the shell value of very small firms, following Liu et al.(2019), we exclude the smallest 30% of Chinese firms based on their market capitalization. As Column (4) of Table A15, Chinese firms listed overseas still undertake 60% valuation discount.

Since November 2013, China's IPO system has entered a new phase. Some reforms and adjustments have been made to include some features of the registration system. We divide our sample into two groups: firms listed before 2014 and firms listed after 2014, to examine the time trend of valuation discount as a robustness check. In columns (5) and (6), the firms listed before 2014 face a smaller valuation discount compared with firms that go public after 2014. This could be due to the increased regulation of the IPO process and the tighter capital control in mainland China. The CSRC halted all reviews to cool down the secondary market in 2013 and employed window guidance on the PE ratio during the IPO in 2014. The foreign exchange reserve declined rapidly after June 2014. The Chinese government has begun to tighten controls on capital outflows. In this case, the Chinese firms are willing to pay a high cost to go IPO overseas.

4.5 Alternative Estimating Approaches

One may be curious whether the significant valuation discount of overseas-listed Chinese firms are due to our fancy model. Table A16 shows the results from instrumental variable (IV) regression, exogenous treatment effect model, and the matching approach. In column (2), the valuation discount still exists if we use IV regression. Columns (3) and (4) report the results of inverse-probability-weighted regression adjustment (IPWRA) estimator under the treatment effect model. The valuation discount is still exist if we ignore the endogeneity from unobserved factors. Column (5) presents the results using propensity score matching approach.

4.6 Small Pertubation in Data Moments

Since our structural parameters are obtained by matching the model simulated moments with the data moments from a reduced-form regression, it is important to check whether our structural estimation is robust to a small pertubation in the data moments. To do so, we increase each of the data moment by 5% and re-estimate the model under the same setup. Results are presented in Table A17. Compared with the

benchmark estimates listed in the first column, when there is a small change in each of the data moment listed in the first row, there are some corresponding changes in the optimal structural estimates.

This is a necessary condition of identification - the model simulated structural parameters do move with the data moments. Furthermore, the movements are in the direction consistent with the prediction of our economic theory. For example, when the potential outcome $E[y_{i0}]$ and $E[y_{i1}]$, and the probability of going overseas IPO $P(t_i = 1)$ increases one by one, the population mean of Tobin's Q listed at home μ_0 and abroad μ_1, and the cost of capital market distortions μ_c increases one by one accordingly.

Meanwhile, compared with the first column, estimates in the other columns are all in the neighborhood of the benchmark values. None of the changes are large enough to substantially change the model implications. This means our structural estimates are relatively robust to small pertubation in data moments. Thus, even if researchers obtain slightly different data moments with different samples, empirical models and estimating approaches, the ultimate structural estimates and hence the welfare implications could be very similar.

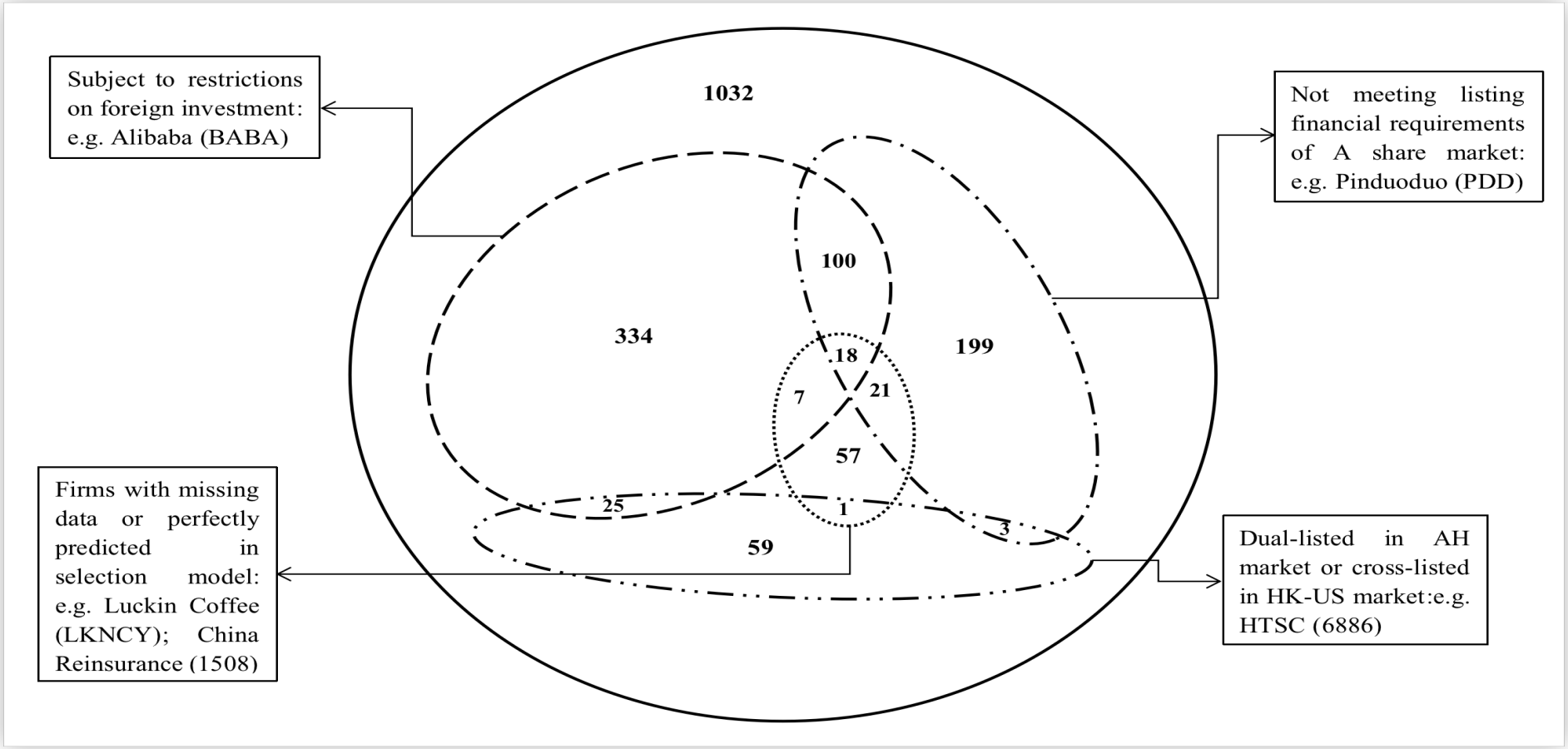

Figure A1: Sample construction for overseas listed Chinese firms

Note:

Number of overseas listed Chinese firms in our baseline sample = 1032 - (334+199+59+57-100-25-21-7-3-1-2×18) = 576.

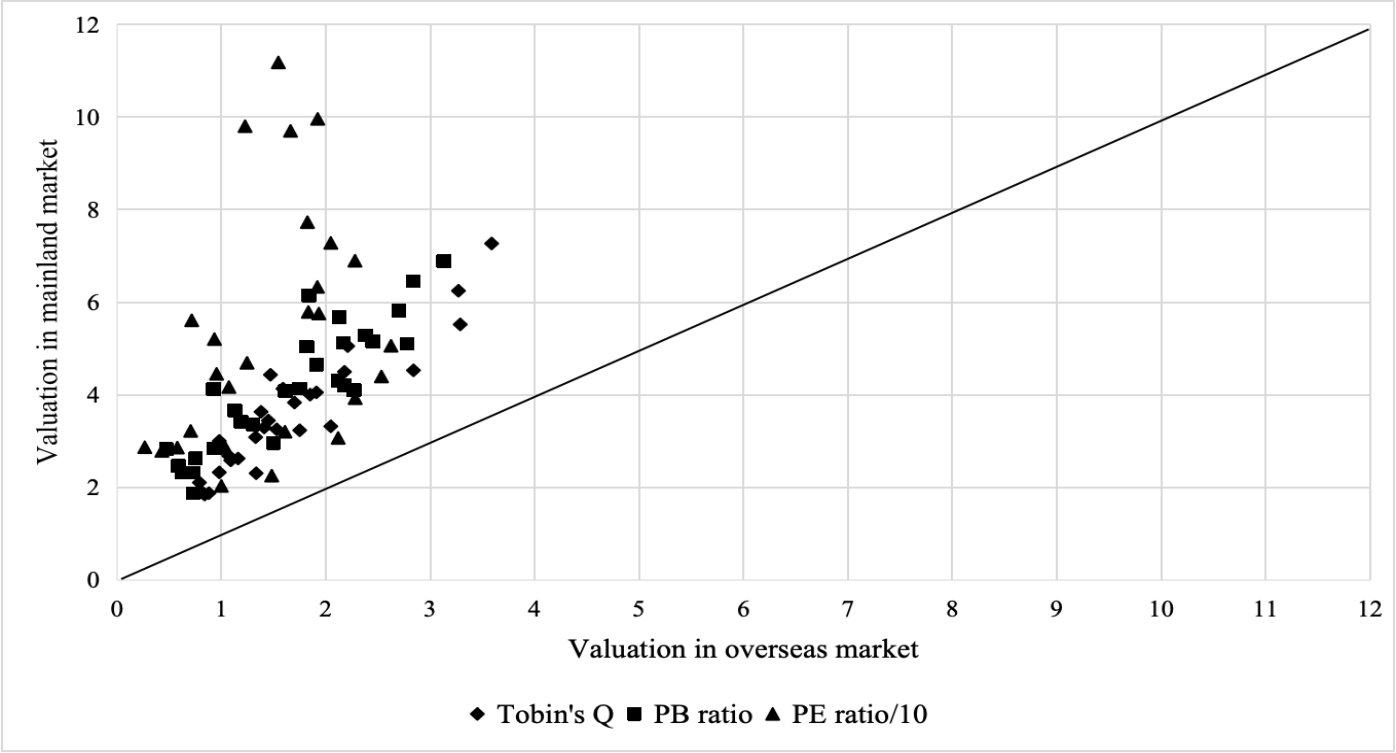

Figure A2: Market valuation of domestic and overseas listed Chinese firms

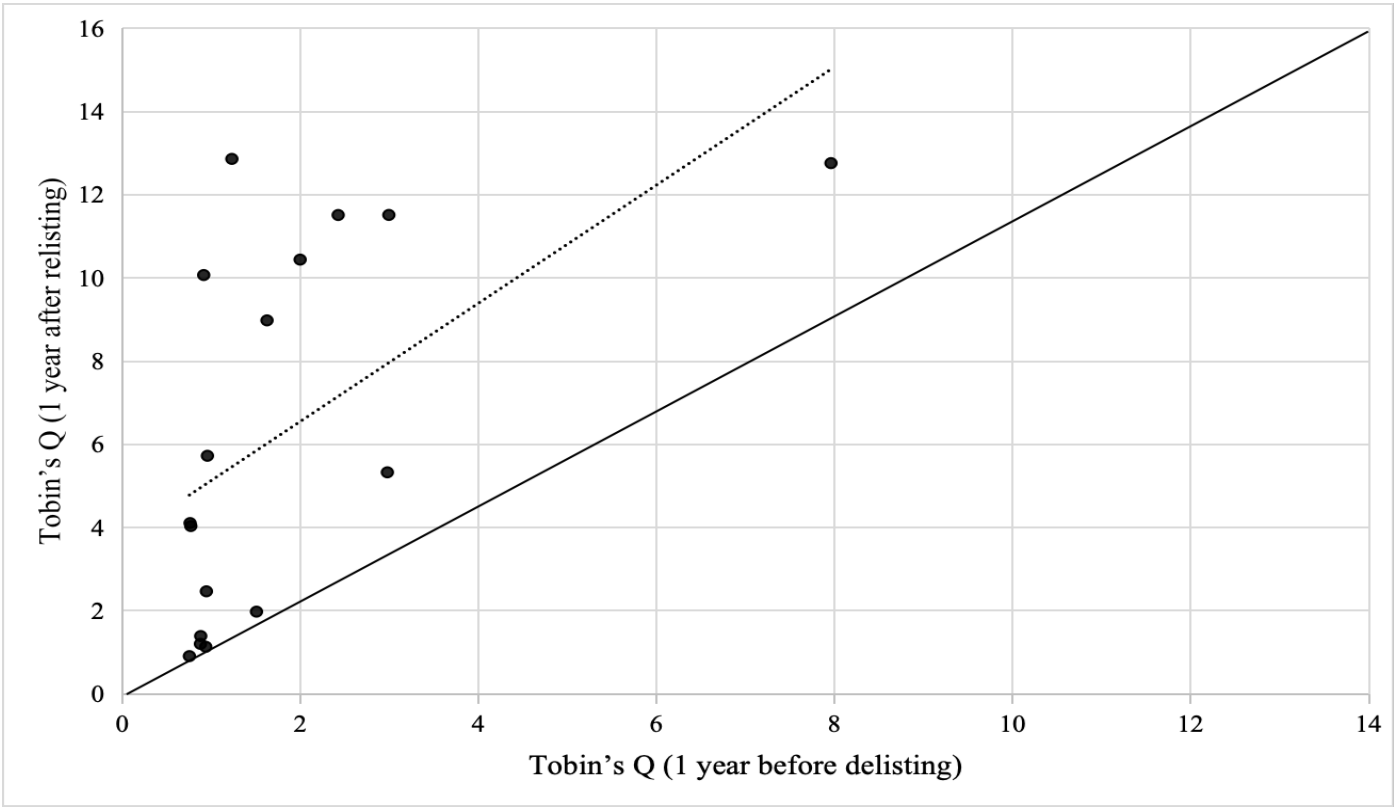

Figure A3: Market valuation of delisted and relisted Chinese firms

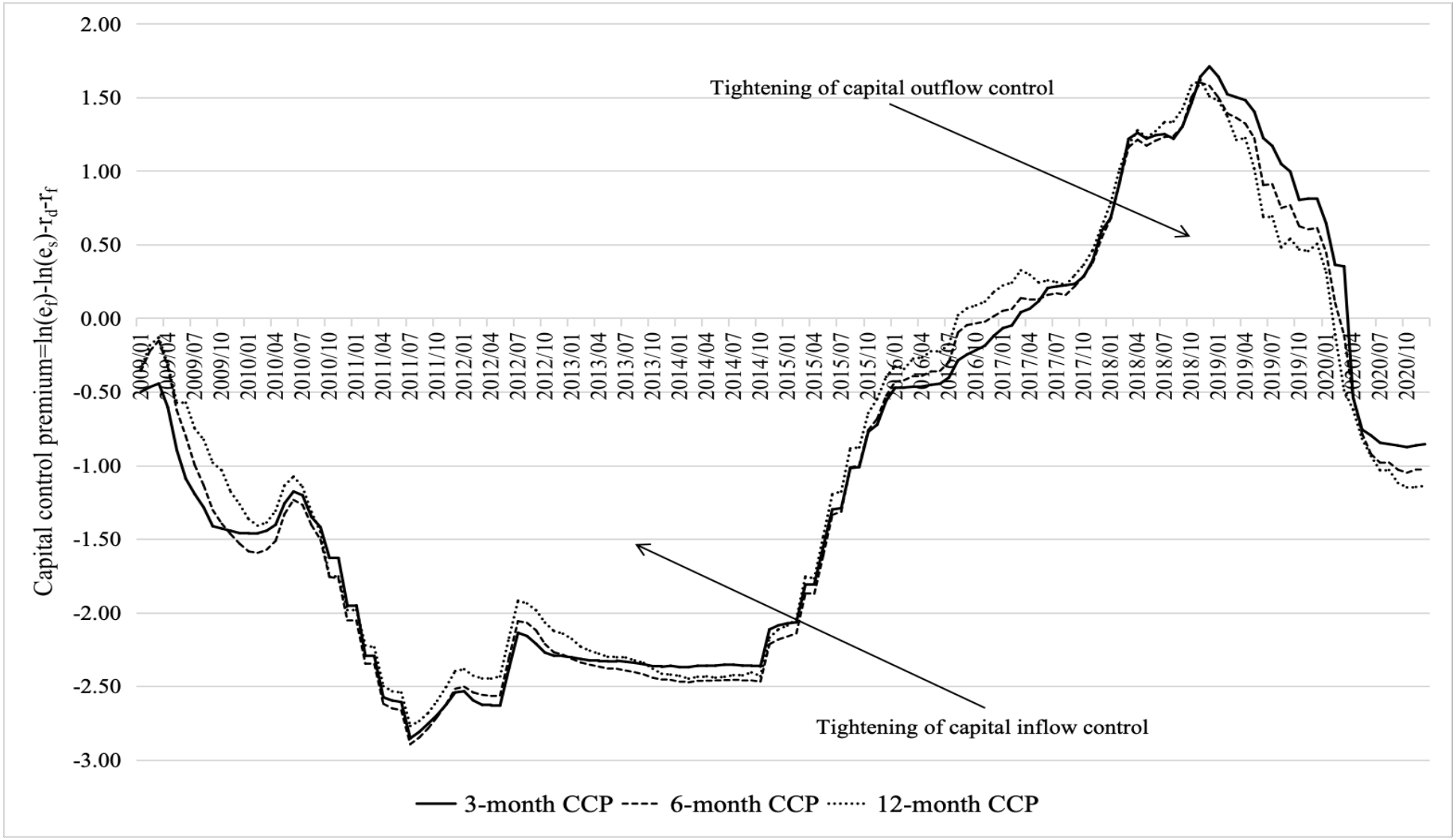

Figure A4: Capital control premium (CCP)

Note:

e_f is the forward exchange rate (USD/CNY); e_s is the spot exchange rate (USD/CNY); r_d is interest rate in China; r_f is interest rate in the US.

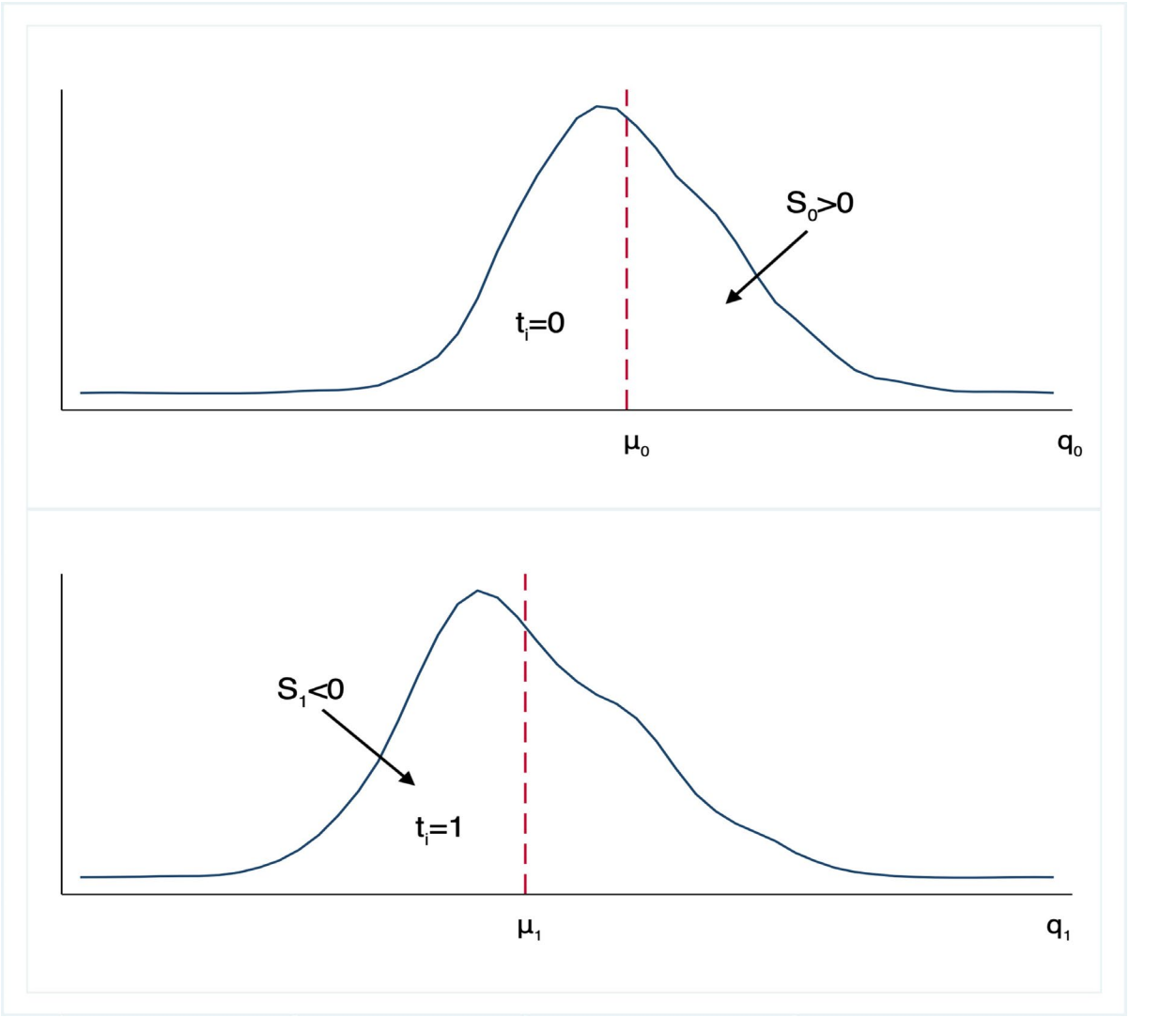

Figure A5: The population valuation distribution and the selection of the treated

Table A1: Variable list and data sources

Variable	Definition	Sources
Tobin's Q	(market value of equity + book value of total assets - book value of equity) / the book value of assets	Wind
OverList	Dummy = 1 if the firm is listed in Hong Kong or New York (NYSE or Nasdaq), and 0 otherwise.	Wind; CSMAR; S&P capital IQ
Age	number of years since establishment	Prospectus
Log (total asset)	Log (the book value of total assets)	Wind
ROA (%)	Earnings before interest and tax × 2/(total assets at the beginning of the period + total assets at the end of the period) × 100 (%)	Wind
Sales growth rate (%)	Growth rate of total sales × 100 (%)	Wind
Leverage (%)	Book value of total liabilities / book value of total assets × 100 (%)	Wind
Intangible asset ratio (%)	Intangible capital (constructed by following Peters and Taylor (2017)) / book value of total assets	Wind
State ownership percentage (%)	Percentage of shares owned by state entities prior to IPO (only the top5 shareholders considered)	Prospectus
Independent director ratio (%)	Number of independent directors/ number of directors on board	Wind
CEO = Chairman	Dummy= 1 if CEO and Chairperson of the board are the same person at IPO; 0 otherwise.	Prospectus
Top5 ownership percentage (%)	Total shares (%) owned by the top 5 shareholders just prior to IPO	Prospectus
Controlling shareholder dummy	Dummy: 1 if the top shareholder holds 50% or more of the shares and 30% or more of the voting rights prior to IPO; 0 otherwise	Wind; Prospectus
Import and export rate (%)	(imports/revenue + foreign sales/ revenue) × 100 (%). The import ratio is calculated from the input and output table at industry level, while the foreign sales revenue ratio is at the firm level. For those firms without observations on foreign sales revenue ratio, we replace them with industrial average export ratio from the input and output table.	Wind; National Bureau of Statistics of China
Stratigic investor dummy	Dummy: 1 if there is at least one of the strategic investors at IPO; 0 otherwise	Prospectus
Foreign reserve growth rate (%)	12-month growth rate of China's foreign exchange reserve before the firm's IPO application	SAFE
Exchange rate growth (%)	The growth rate of USD to RMB exchange rate 1 year before IPO	SAFE
Foreign ownership percentage (%)	Shares owned by foreign entities (among the top 5 owners) prior to IPO	Prospectus
Operating cash flow ratio (%)	Operating cash flow/total assets × 100 (%)	Wind
PE regulation	PE regulation=Max(median PE ratio in HK among those firms in the same industry, median PE ratio US among those firms in the same industry)* Dummy for IPO dates between 31 March 2014 and 30 June 2020	Wind
Expected relative waiting days	Average waiting days of those firms in the same industry when listed in Mainland China 1-year before IPO application date /Average waiting days of those firms in the same industry when listed overseas 1-year before IPO application date	Wind
Log (relative market index)	Log (Overseas market index 12-month before IPO application date / Mainland market index 12-month before IPO application date)	Wind
Industry dummy	4-digits code of Wind industry classification	Wind
Year dummy	Year dummy from 2009 to 2020	
Province GDP per capita	Log (provincial GDP per capita in 2009)	National Bureau of Statistics of China

Table A2: Summary statistics: Chinese firms listed in mainland China

Variables	N	Mean	S.D.	Min	P25	P50	P75	Max
Tobin's Q	2,153	4.05	2.58	1.01	2.32	3.29	5.05	15.95
Age	2,153	14.01	6.03	2	10	13	17	64
Log (total asset)	2,153	20.99	1.00	19.35	20.38	20.79	21.36	27.98
ROA (%)	2,153	11.63	5.16	-0.34	8.19	10.88	14.27	44.10
Sales growth rate (%)	2,153	18.81	24.72	-49.85	4.40	15.74	29.73	188.92
Leverage (%)	2,153	26.08	17.17	4.87	12.71	22.33	35.26	93.46
Intangible asset ratio (%)	2,153	11.61	9.29	0.48	5.84	9.39	14.01	83.28
State ownership percentage (%)	2,153	8.39	22.39	0	0	0	0	100
Independent director ratio (%)	2,153	37.18	5.03	33.33	33.33	33.33	42.86	80
CEO = Chairman	2,153	0.50	0.50	0.00	0.00	1.00	1.00	1.00
Top5 ownership percentage (%)	2,153	84.73	14.59	14.13	76.72	88.51	96.34	100
Controlling shareholder dummy	2,153	0.46	0.50	0	0	0	1	1
Import and export rate (%)	2,153	26.58	28.17	0.80	6.32	13.61	38.26	132.46
Stratigic investor dummy	2,153	0.05	0.22	0	0	0	0	1
Foreign reserve growth rate (%)	2,153	7.94	14.18	-13.35	-5.56	8.56	18.68	42.32
Exchange rate growth (%)	2,153	-0.25	1.75	-4.28	-1.08	-0.07	0.18	3.48
Foreign ownership percentage (%)	2,153	10.72	23.47	0	0	0	2.75	100
Operating cash flow ratio (%)	2,153	11.85	9.10	-17.28	5.96	11.13	17.05	36.69
PE regulation	2,153	8.98	8.11	0	0	11.84	16.49	25.02
Expected relative waiting days	2,153	2.47	1.24	0.78	1.56	2.11	3.04	8.21
Log (relative market index)	2,153	0.12	0.28	-0.41	-0.12	0.11	0.32	0.65

Note:

This sample is used as our baseline result for one year after IPO.

Table A3: Summary statistics: Chinese firms listed in Hong Kong

Variables	N	Mean	S.D.	Min	P25	P50	P75	Max
Tobin's Q	512	1.91	1.53	0.47	1.00	1.43	2.22	11.24
Age	512	16.76	10.14	2	11	15	20	68
Log (total asset)	512	21.22	1.69	17.63	20.11	20.99	22.12	27.29
ROA (%)	512	13.59	10.11	-72.73	7.76	12.07	18.44	51.22
Sales growth rate (%)	512	28.20	51.74	-73.86	3.97	20.54	38.84	496.18
Leverage (%)	512	41.10	22.04	5.75	23.56	38.40	56.90	102.70
Intangible asset ratio (%)	512	13.28	15.36	0.48	3.25	8.40	16.44	83.28
State ownership percentage (%)	512	9.53	27.18	0	0	0	0	100.01
Independent director ratio (%)	512	42.87	10.85	23.08	33.33	42.86	50	100
CEO = Chairman	512	0.57	0.50	0	0	1	1	1
Top5 ownership percentage (%)	512	95.45	10.52	25.53	96.64	100	100	100
Controlling shareholder dummy	512	0.76	0.43	0.00	1.00	1.00	1.00	1.00
Import and export rate (%)	512	22.18	31.05	0.80	2.42	7.33	27.31	132.46
Stratigic investor dummy	512	0.19	0.39	0	0	0	0	1
Foreign reserve growth rate (%)	512	6.55	11.14	-13.35	-2.00	4.63	15.63	32.92
Exchange rate growth (%)	512	-0.15	1.72	-4.15	-1.05	-0.25	1.17	3.48
Foreign ownership percentage (%)	512	35.65	41.87	0	0	10.73	89.50	100
Operating cash flow ratio (%)	512	10.32	13.59	-39.21	2.39	9.62	17.31	44.45
PE regulation	512	9.72	10.19	0	0	11.57	17.17	78.80
Expected relative waiting days	512	3.54	1.58	1.03	2.54	3.27	3.75	8.27
Log (relative market index)	512	0.19	0.38	-2.15	0.15	0.24	0.35	0.58

Note:

This sample is used as our baseline result for one year after IPO.

Table A4: Summary statistics: Chinese firms listed in the US

Variables	N	Mean	S.D.	Min	P25	P50	P75	Max
Tobin's Q	64	1.89	4.07	0.18	0.56	0.96	1.85	32.49
Age	64	12.25	7.42	2	6.5	11.5	16	40
Log (total asset)	64	20.37	0.99	17.63	19.83	20.45	20.77	23.40
ROA (%)	64	17.38	19.72	-84.75	12.89	18.30	28.34	44.73
Sales growth rate (%)	64	34.32	41.58	-57.18	11.52	28.29	53.77	196.89
Leverage (%)	64	31.47	19.94	4.69	13.62	30.15	43.75	84.26
Intangible asset ratio (%)	64	14.38	16.95	1.31	3.77	8.70	18.51	83.28
State ownership percentage (%)	64	0.11	0.92	0	0	0	0	7.32
Independent director ratio (%)	64	55.97	16.03	0	50	60	60	100
CEO = Chairman	64	0.77	0.43	0	1	1	1	1
Top5 ownership percentage (%)	64	73.37	21.65	13.70	56.95	75.95	93.23	100
Controlling shareholder dummy	64	0.44	0.50	0	0	0	1	1
Import and export rate (%)	64	26.62	31.14	0.96	4.43	13.55	32.89	132.46
Stratigic investor dummy	64	0.03	0.18	0	0	0	0	1
Foreign reserve growth rate (%)	64	20.96	16.73	-11.42	8.71	23.92	33.48	51.71
Exchange rate growth (%)	64	-0.83	1.93	-4.28	-2.10	-0.15	-0.04	3.35
Foreign ownership percentage (%)	64	29.30	34.46	0	0	14.33	46.59	100
Operating cash flow ratio (%)	64	13.11	15.96	-40.53	0.73	13.53	24.90	55.25
PE regulation	64	3.96	6.95	0	0	0	6.91	22.93
Expected relative waiting days	64	2.06	2.03	0.64	0.65	1.35	2.46	8.27
Log (relative market index)	64	0.35	0.46	-0.15	-0.02	0.13	0.79	1.24

Note:

This sample is used as our baseline result for one year after IPO.

Table A5: Treatment effect over different horizons

Dependent	Tobin's Q						
	(1) At IPO	(2) 1st Day	(3) 1st Year	(4) 2nd Year	(5) 3rd Year	(6) 4th Year	(7) 5th Year
Estimates from the Simple Model							
ATE	-2.117***	-3.731***	-2.717***	-1.608***	-0.989**	-1.285***	-1.998***
	(0.194)	(0.309)	(0.350)	(0.476)	(0.436)	(0.479)	(0.268)
$E[y_{i0}]$	4.610	6.394	4.174	3.260	3.117	3.301	3.581
$ATE/E[y_{i0}]$	−45.92%	58.35%	−65.09%	-49.33%	-31.73%	-38.93%	-55.79%
ATET	-2.117***	-3.731***	-2.717***	-1.608***	-0.989**	-1.285***	-1.998***
	(0.194)	(0.309)	(0.350)	(0.476)	(0.436)	(0.479)	(0.268)
$E[y_{i0} \mid t_i = 1]$	4.957	7.002	4.623	3.360	2.517	2.732	3.377
$ATET/E[y_{i0} \mid t_i = 1]$	−42.71%	−53.28%	−58.77%	-47.86%	-39.29%	-47.04%	-59.16%
Estimates from the General Model							
ATE	-1.583***	-3.248***	-1.564***	-1.012**	-1.371***	-1.883***	-2.420***
	(0.353)	(0.627)	(0.403)	(0.401)	(0.253)	(0.229)	(0.191)
$E[y_{i0}]$	4.416	6.118	4.399	3.324	3.204	3.364	3.655
$ATE/E[y_{i0}]$	-35.85%	-53.09%	-35.55%	-30.45%	-41.62%	-55.98%	-66.21%
ATET	-1.123***	-2.320***	-3.782***	-1.930***	-1.465***	-1.596***	-2.295***
	(0.406)	（0.717）	(0.387)	(0.331)	(0.334)	(0.414)	(0.384)
$E[y_{i0} \mid t_i = 1]$	3.962	5.590	5.687	3.683	2.997	3.049	3.735
$ATET/E[y_{i0} \mid t_i = 1]$	-28.34%	-41.50%	-66.50%	-52.40%	-48.88%	-52.35%	-61.45%
X	YES	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES	YES
Province GDP per capita	YES	YES	YES	YES	YES	YES	YES
Observations	2,675	2,675	2,729	2,455	2,278	1,787	1,517

Notes:

1. Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table A6: Valuation equation in the simple model across extended samples

Dependent	Tobin's Q			
Variables	(1) Benchmark sample	(2) +Restricted	(3) +Restricted & Prohibited	(4) +Negative list & Unqualified firms
ATE	-2.717***	-2.801***	-2.936***	-3.176***
	(0.350)	(0.270)	(0.234)	(0.331)
$E[y_{i0}]$	4.174	4.217	4.274	4.449
$ATE/E[y_{i0}]$	-65.09%	-66.42%	-68.69%	-71.39%
ATET	-2.717***	-2.801***	-2.936***	-3.176***
	(0.350)	(0.270)	(0.234)	(0.331)
$E[y_{i1} \mid t_i = 1]$	1.906	1.913	1.958	2.198
$E[y_{i0} \mid t_i = 1]$	4.623	4.714	4.894	5.374
$ATET/E[y_{i0} \mid t_i = 1]$	-58.77%	-59.42%	-59.99%	-59.10%
X	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Year	YES	YES	YES	YES
Province GDP per capita	YES	YES	YES	YES
Observations	2,729	2,857	2,913	3,072

Notes:

1. The outcome models are estimated with the treatment models simultaneously.
2. Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level.

Table A7: Multiple listing location and listing mode

Dependent	HK listing	US listing	Tobin's Q	Without VIE	With VIE	Tobin's Q
	(1)	(2)	(3)	(4)	(5)	(6)
Age	0.050***	-0.069*	-0.005	0.056***	-0.088***	-0.005
	(0.012)	(0.037)	(0.006)	(0.011)	(0.028)	(0.005)
Log (total asset)	-0.165*	-0.359**	-0.455***	-0.198**	-0.189	-0.445***
	(0.088)	(0.176)	(0.063)	(0.087)	(0.155)	(0.062)
ROA (%)	0.055***	0.040**	0.044***	0.064***	0.021	0.044***
	(0.012)	(0.017)	(0.012)	(0.012)	(0.017)	(0.011)
Sales growth rate (%)	0.014***	0.021***	0.007***	0.013***	0.021***	0.007***
	(0.003)	(0.004)	(0.002)	(0.002)	(0.003)	(0.002)
Leverage (%)	0.044***	0.026***	-0.009***	0.044***	0.024***	-0.009***
	(0.005)	(0.010)	(0.003)	(0.006)	(0.009)	(0.003)
Intangible assets ratio (%)	0.033***	0.052***	0.015***	0.028***	0.043***	0.016***
	(0.008)	(0.009)	(0.004)	(0.008)	(0.009)	(0.004)
State ownership percentage (%)	0.000	-0.371***	0.003*	0.004	-0.046**	0.003*
	(0.004)	(0.114)	(0.001)	(0.004)	(0.021)	(0.001)
Independent director ratio (%)	0.107***	0.151***	-0.003	0.133***	0.118***	-0.003
	(0.013)	(0.021)	(0.005)	(0.014)	(0.016)	(0.006)
CEO = Chairman	0.615***	0.696**	0.053	0.641***	0.617**	0.060
	(0.155)	(0.306)	(0.081)	(0.152)	(0.286)	(0.075)
Top5 ownership percentage (%)	0.055***	-0.057***	-0.008*	0.016**	0.000	-0.006
	(0.011)	(0.011)	(0.005)	(0.008)	(0.011)	(0.005)
Controlling shareholders dummy	0.421**	0.272	0.169*	0.567***	0.024	0.169*
	(0.175)	(0.354)	(0.089)	(0.173)	(0.303)	(0.092)
Import and export ratio (%)	-0.002	-0.001	-0.002	-0.002	-0.006	-0.002
	(0.003)	(0.008)	(0.001)	(0.003)	(0.010)	(0.001)
Strategic investor dummy	1.423***	1.636***	0.100	1.354***	1.868***	0.139
	(0.223)	(0.498)	(0.123)	(0.219)	(0.398)	(0.124)
Foreign reserve growth rate (%)	-0.025	0.111***	0.006	0.010	0.012	0.004
	(0.016)	(0.032)	(0.008)	(0.016)	(0.029)	(0.008)
Exchange rate growth (%)	0.230***	0.591***	0.020	0.324***	0.337***	0.015
	(0.077)	(0.132)	(0.036)	(0.076)	(0.123)	(0.038)
Foreign ownership percentage (%)	0.016***	0.025***	0.003**	0.020***	0.008*	0.003**
	(0.002)	(0.005)	(0.001)	(0.002)	(0.005)	(0.001)
Operating cash flow ratio (%)	-0.041***	-0.007	0.014**	-0.042***	-0.012	0.013**
	(0.009)	(0.013)	(0.005)	(0.008)	(0.012)	(0.005)
PE regulation	0.031	0.034	-0.021**	0.036	0.075**	-0.022**
	(0.022)	(0.033)	(0.010)	(0.022)	(0.032)	(0.009)
US listing			-3.107***			
			(0.410)			
HK listing			-2.674***			
			(0.254)			
Listing with VIE						-3.277***
						(0.372)
Listing without VIE						-2.803***
						(0.245)
Expected relative waiting days	0.642***	0.028		0.616***	0.244**	
	(0.070)	(0.186)		(0.068)	(0.117)	
Log(relative market index)	0.732***	4.296***		0.852***	2.217***	
	(0.202)	(0.881)		(0.201)	(0.476)	
$E[y_{i0} \mid t_{i\,(\text{US listing})} = 1]$			5.322			
$E[y_{i0} \mid t_{i\,(\text{HK listing})} = 1]$			4.580			
$E[y_{i0} \mid t_{i\,(\text{with VIE})} = 1]$						5.729
$E[y_{i0} \mid t_{i\,(\text{without VIE})} = 1]$						4.665
$ATET/E[y_{i0} \mid t_{i\,(\text{US listing})} = 1]$			58.38%			
$ATET/E[y_{i0} \mid t_{i\,(\text{HK listing})} = 1]$			58.38%			
$ATET/E[y_{i0} \mid t_{i\,(\text{with VIE})} = 1]$						-57.20%
$ATET/E[y_{i0} \mid t_{i\,(\text{without VIE})} = 1]$						-60.09%
Industry	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Province GDP per capita	YES	YES	YES	YES	YES	YES
β_2			0.488*			0.651**
			(0.261)			(0.273)
No. of obs	2,913	2,913	2,913	2,913	2,913	2,913

Notes:

1. The results are estimated using firms in their first year of IPO.
2. The valuation equation added by residuals from the multinomial logit model are estimated by OLS.
3. Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table A8: H-Share discounts for A-H dual listed stocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
samples	AH dual-listed	only overseas listed	AH dual-listed	only overseas listed	AH dual-listed	only overseas listed	AH dual-listed	only overseas listed	AH dual-listed	only overseas listed
	1st Year	1st Year	2nd Year	2nd Year	3rd Year	3rd Year	4th Year	4th Year	5th Year	5th Year
Valuation discount	-22%	-59%	-24%	-48%	-28%	-39%	-36%	-47%	-40%	-59%
Number of firms	29	576	30	492	31	414	38	356	35	315

Table A9: Valuation changes for stocks moving from overseas to domestic markets

Overseas Code	Year of delisting	Firms in A shares	A-share Code	Year of relisting in A	Tobin's Q 1 year after relisting	Tobin's Q 1 year before delisting	Valuation discount-Tobin's Q
CHA.N	2021	China Telecom	601728,SH	2021	0.91	0.75	-17.01%
CHL.N	2021	China Mobile	600941.SH	2022	1.13	0.94	-17.21%
XUE.N	2016	Xueda Education	000526.SZ	2016	1.98	1.51	-23.79%
CEO.N	2021	CNOOC	600938.SH	2022	1.20	0.88	-27.00%
MY.N	2016	Ming Yang Smart Energy	601615.SH	2019	1.39	0.88	-36.66%
MONT.O	2014	Montage Technology	688008.SH	2019	12.76	7.96	-37.64%
QIHU.N	2016	360 Total Security	601360.SH	2018	5.33	2.98	-44.12%
TSL.N	2017	Trina Solar	688599.SH	2020	2.47	0.95	-61.69%
GA.N	2014	Giant Network	002558.SZ	2016	11.52	2.99	-74.00%
0963.HK	2017	Bloomage Biotech	688363.SH	2019	11.52	2.43	-78.94%
FMCN.O	2013	Focus Media	002027.SZ	2016	10.44	2.00	-80.87%
JASO.O	2018	JA Solar Technology	002459.SZ	2018	4.04	0.77	-80.92%
YTEC.O	2012	Yusys Technologies	300674.SZ	2018	4.11	0.76	-81.45%
MR!.N	2016	Mindray	300760.SZ	2018	8.98	1.63	-81.90%
0597.HK	2011	CR Micro	688396.SH	2020	5.73	0.96	-83.29%
PWRD.O	2015	Perfect World	002624.SZ	2015	12.87	1.23	-90.43%
CTFO.O	2012	China TransInfo Technology	002373.SZ	2013	10.07	0.92	-90.91%
Average					**6.26**	**1.80**	**-71.32%**
Median					**5.33**	**0.96**	**-82.04%**

Table A10: Valuation equations in the endogeneous treatment effect model - ln of Tobin's Q

Dependent	ln of Tobin's Q		
	Simple model	General model	
	(1)	(2)	(3)
	All	Treated	Control
Variables	1st Year	1st Year	1st Year
Age	-0.002	-0.004	-0.000
	(0.001)	(0.003)	(0.001)
Log(total asset)	-0.144***	-0.040	-0.221***
	(0.013)	(0.025)	(0.012)
ROA(%)	0.014***	0.002	0.030***
	(0.003)	(0.003)	(0.002)
Sales growth rate(%)	0.002***	0.000	0.002***
	(0.000)	(0.001)	(0.000)
Leverage(%)	-0.002***	-0.002	-0.001*
	(0.001)	(0.002)	(0.001)
Intangible assets ratio(%)	0.005***	0.006***	0.003***
	(0.001)	(0.002)	(0.001)
State ownership percentage(%)	0.000	-0.002	0.002***
	(0.000)	(0.001)	(0.000)
Independent director ratio(%)	-0.007***	-0.014***	0.003**
	(0.002)	(0.003)	(0.002)
CEO=Chairman	0.002	-0.038	-0.001
	(0.016)	(0.052)	(0.014)
Top5 ownership percentage(%)	0.000	0.002	-0.001**
	(0.001)	(0.004)	(0.001)
Controlling shareholders dummy	0.020	-0.076	0.041***
	(0.019)	(0.067)	(0.016)
Import and export ratio(%)	-0.000	0.001	-0.000
	(0.000)	(0.001)	(0.000)
Strategic investor dummy	0.057*	0.017	0.032
	(0.033)	(0.054)	(0.029)
Foreign reserve growth rate(%)	-0.002	-0.014**	0.003*
	(0.002)	(0.007)	(0.002)
Exchange rate growth (%)	-0.003	-0.008	0.022***
	(0.009)	(0.031)	(0.009)
Foreign ownership percentage(%)	0.000	-0.001	0.001***
	(0.000)	(0.001)	(0.000)
Operating cash flow ratio(%)	0.004***	0.009***	-0.000
	(0.001)	(0.002)	(0.001)
PE regulation	-0.002	0.001	-0.009***
	(0.002)	(0.004)	(0.003)
Overseas listing	-0.844***		
	(0.079)		
Industry	YES	YES	YES
Year	YES	YES	YES
Province GDP per capita	YES	YES	YES
Constant	YES	YES	YES
β_{20}	-0.024		0.237***
	(0.081)		(0.072)
β_{21}	-0.024	-0.456***	
	(0.081)	(0.138)	
Observations	2729	576	2, 153

Note:
Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level.

Table A11: Decomposition for quantity of interest - ln of Tobin's Q

Quantity of Interest	Simple model	General model
$E[y_{i0} \mid t_i = 0]$ - observed	1.240	1.240
$E[y_{i1} \mid t_i = 1]$ - observed	0.411	0.411
$E[y_{i1} \mid t_i = 0]$ - predicted	0.396	0.842
$E[y_{i0} \mid t_i = 1]$ - predicted	1.255	1.512
$E[y_{i0}]$ - potential outcome mean	1.243	1.297
$E[y_{i1}]$ - potential outcome mean	0.399	0.751
ATE	-0.844***	-0.546***
	(0.080)	(0.114)
$E[y_{i0}]$	1.243***	1.297***
	(0.018)	(0.018)
$ATE/E[y_{i0}]$	-71.12%	-42.10%
ATET	-0.844***	-1.101***
	(0.080)	(0.072)
$E[y_{i0} \mid t_i = 1]$	1.255***	1.512***
	(0.074)	(0.070)
$ATET/E[y_{i0} \mid t_i = 1]$	-67.25%	72.82%
$S_0 = E[y_{i0} \mid t_i = 1] - E[y_{i0}]$	0.012	0.215***
	(0.059)	(0.056)
obs: β_{10}*(E[$x_i \mid t_i = 1$] - E[$x_i \mid t_i = 0$])*(1-P)	0.020	0.139***
	(0.038)	(0.039)
unobs: $E[\varepsilon_{i0} \mid t_i = 1] = \beta_{20} * E[v_i \mid t_i = 1]$	-0.008	0.076***
	(0.025)	(0.023)
$S_1 = E[y_{i1} \mid t_i = 1] - E[y_{i1}]$	0.012	-0.340***
	(0.059)	(0.106)
obs: β_{11}*(E[$x_i \mid t_i = 1$] - E[$x_i \mid t_i = 0$])*(1-P)	0.020	-0.193***
	(0.038)	(0.067)
unobs: $E[\varepsilon_{i1} \mid t_i = 1] = \beta_{21} * E[v_i \mid t_i = 1]$	-0.008	-0.147***
	(0.025)	(0.045)
$GMD = E[y_{i1} \mid t_i = 1] - E[y_{i0} \mid t_i = 0]$	-0.829***	-0.829***
	(0.030)	(0.030)
$ATET = E[y_{i1} \mid t_i = 1] - E[y_{i0} \mid t_i = 1]$	-0.844***	-1.101***
	(0.080)	(0.072)
obs: $(\beta_{11} - \beta_{10}) * E[x_i \mid t_i = 1]$	-0.844***	-0.878***
	(0.080)	(0.074)
unobs: $(\beta_{21} - \beta_{20}) * E[v_i \mid t_i = 1]$	0.000	-0.223***
	(0.000)	(0.053)
$SB = E[y_{i0} \mid t_i = 1] - E[y_{i0} \mid t_i = 0]$	0.015	0.272***
	(0.075)	(0.071)
obs: β_{10}*(E[$x_i \mid t_i = 1$] - E[$x_i \mid t_i = 0$])	0.025	0.176***
	(0.048)	(0.050)
unobs: β_{20}*(E[$v_i \mid t_i = 1$] - E[$v_i \mid t_i = 0$])	-0.01	0.096***
	(0.032)	(0.029)

Table A12: SMM estimation - ln of Tobin's Q

paramater	estimate	s.e.	targeted moments	data	simulated
μ_0	1.414	0.035	$E[y_{i0}]$	**1.30**	1.41
μ_1	0.623	0.020	$E[y_{i1}]$	**0.75**	0.62
μ_c	0.353	0.047	$P[t_i = 1]$	**0.21**	0.26
σ_0	0.272	0.008	$E[\varepsilon_{i0} \mid t_i = 0]$	**-0.02**	-0.02
σ_1	0.426	0.013	$E[\varepsilon_{i1} \mid t_i = 1]$	**-0.15**	-0.18
σ_c	1.022	0.035	$sd[\varepsilon_{i0} \mid t_i = 0]$	**0.30**	0.27
ρ_{01}	0.276	0.431	$sd[\varepsilon_{i1} \mid t_i = 1]$	**0.55**	0.41
ρ_{0c}	0.560	0.066	$corr[v_i, \varepsilon_{i0} \mid t_i = 0]$	**0.14**	0.13
ρ_{1c}	-0.745	0.040	$corr[v_i, \varepsilon_{i1} \mid t_i = 1]$	**-0.28**	-0.17
			untargeted moments	**data**	**simulated**
			$E[Y_{i0} \mid t_i = 0]$	***1.24***	*1.39*
			$E[Y_{i1} \mid t_i = 1]$	***0.41***	*0.45*

Table A13 Robustness check for PB ratio and pre-IPO observation period

Dependent	PB ratio	Tobin's Q	Tobin's Q
	(1)	(2)	(3)
Variables	1st Year	6-month index	24-month index
ATE	-4.105***	-2.790***	-2.853***
	(0.674)	(0.309)	(0.300)
$E[y_{i0}]$	5.448	4.190	4.202
$ATE/E[y_{i0}]$	-75.35%	-66.59%	-67.90%
ATET	-4.105***	-2.790***	-2.853***
	(0.674)	(0.309)	(0.300)
$E[y_{i0} \mid t_i = 1]$	6.555	4.69	4.753
$ATET/E[y_{i0} \mid t_i = 1]$	-62.62%	-59.49%	-60.03%
X	YES	YES	YES
Industry	YES	YES	YES
Year	YES	YES	YES
Province GDP per capita	YES	YES	YES
Observations	2,729	2,729	2,727

Notes:

1. The outcome models are estimated with the treatment models simultaneously.

2. Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level.

Table A14 Robustness check for missing or redundant explanatory variables

Dependent	Tobin's Q	
	(1)	(2)
	including Factors in FF model	excluding pre-IPO firm charactistics
	Outcome	Outcome
Variables	1st Year	1st Year
ATE	-3.005***	-2.672***
	(0.315)	(0.224)
$E[y_{i0}]$	4.235	4.165
$ATE/E[y_{i0}]$	-70.96%	-64.15%
ATET	-3.005***	-2.672***
	(0.315)	(0.224)
$E[y_{i0} \mid t_i = 1]$	4.905	4.572
$ATET/E[y_{i0} \mid t_i = 1]$	-61.26%	-58.44%
x	YES	YES
Industry	YES	YES
Year	YES	YES
Province GDP per capita	YES	YES
Observations	2,728	2,729

Notes:

1. The outcome models are estimated with the treatment models simultaneously.

2. Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table A15 Robustness check for industry, firm size and sample period

Dependent						
	(1)	(2)	(3)	(4)	(5)	(6)
	Excluding real estate	Excluding financial industry	Excluding technology industry	Excluding small firms	IPO before 2014	IPO after 2014
Variables	1st Year	1st Year	1st Year	1st Year	1st Year	1st Year
ATE	-2.930***	-2.804***	-2.554***	-3.293***	-1.314***	-3.788***
	(0.297)	(0.262)	(0.344)	(0.456)	(0.188)	(0.440)
$E[y_{i0}]$	4.213	4.220	4.035	4.848	2.988	4.987
$ATE/E[y_{i0}]$	-69.55%	-66.45%	-63.30%	-67.92%	-43.98%	-75.96%
ATET	-2.930***	-2.804***	-2.554***	-3.293***	-1.314***	-3.788***
	(0.297)	(0.262)	(0.344)	(0.456)	(0.188)	(0.440)
$E[y_{i0} \mid t_i = 1]$	4.854	4.683	4.444	5.492	3.173	5.722
$ATET/E[y_{i0} \mid t_i = 1]$	-60.36%	-59.88%	-57.47%	-59.96%	-41.41%	-65.63%
X	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Province GDP per capita	YES	YES	YES	YES	YES	YES
Observations	2,659	2,655	2,525	1,817	1,119	1,610

Notes:

1. The outcome models are estimated with the treatment models simultaneously.

2. Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level.

Table A16: Robustness check for alternative estimating approaches

Dependent	Overseas Listing	Tobin's Q			Overseas Listing
	IV	IV	IPWRA	IPWRA	Matching
Variables	1st Year	1st Year	1st Year-treated	1st Year-control	1st Year
Age	0.005***	0.004	-0.005	-0.016**	0.034***
	(0.001)	(0.007)	(0.005)	(0.007)	(0.006)
Log(total asset)	-.0767***	-0.674***	-0.108	-0.773***	-0.157***
	(0.009)	(0.074)	(0.084)	(0.068)	(0.047)
ROA (%)	0.011***	0.084***	0.010**	0.143***	0.036***
	(0.002)	(0.018)	(0.005)	(0.013)	(0.007)
Sales growth rate (%)	0.000	0.006***	0.001	0.009***	0.007***
	(0.000)	(0.002)	(0.001)	(0.002)	(0.001)
Leverage (%)	0.007***	0.008	0.005	-0.002	0.024***
	(0.001)	(0.005)	(0.005)	(0.004)	(0.003)
Intangible assets ratio (%)	0.002***	0.020***	0.020***	0.007	0.015***
	(0.001)	(0.005)	(0.005)	(0.004)	(0.004)
State ownership percentage (%)	0.000	0.005***	-0.001	0.008***	0.003
	(0.000)	(0.002)	(0.002)	(0.002)	(0.002)
Independent director ratio (%)	0.012***	0.014*	-0.008**	-0.007	0.071***
	(0.001)	(0.008)	(0.004)	(0.006)	(0.008)
CEO=Chairman	0.035***	0.155*	-0.066	0.044	0.323***
	(0.011)	(0.087)	(0.134)	(0.076)	(0.084)
Top5 ownership percentage (%)	0.001**	-0.005	-0.004	-0.009***	0.008**
	(0.000)	(0.005)	(0.008)	(0.003)	(0.004)
Controlling shareholders dummy	0.043***	0.232**	-0.146	0.109	0.340***
	(0.013)	(0.095)	(0.152)	(0.087)	(0.096)
Import and export ratio (%)	-0.000	-0.002	0.003	-0.000	-0.001
	(0.000)	(0.002)	(0.003)	(0.001)	(0.001)
Strategic investor dummy	0.164***	0.401**	0.213*	0.014	0.750***
	(0.027)	(0.177)	(0.125)	(0.144)	(0.125)
Foreign reserve growth rate (%)	0.000	0.001	-0.008	0.017	0.011
	(0.001)	(0.009)	(0.010)	(0.010)	(0.009)
Exchange rate growth (%)	0.035***	0.060	0.086	0.052	0.199***
	(0.006)	(0.042)	(0.079)	(0.045)	(0.040)
Foreign ownership percentage (%)	0.002***	0.007***	0.002	0.004***	0.011***
	(0.000)	(0.002)	(0.002)	(0.002)	(0.001)
Operating cash flow ratio(%)	-0.002***	0.009	0.021***	0.001	-0.025***
	(0.001)	(0.007)	(0.005)	(0.005)	(0.005)
PE regulation	0.004***	-0.019	0.002	-0.071***	0.018
	(0.002)	(0.012)	(0.007)	(0.016)	(0.012)
Overseas listing		-4.418***			
		(0.595)			
Expected relative waiting days	0.068***				0.362***
	(0.007)				(0.040)
Log(relative market index)	0.057***				0.432***
	(0.013)				(0.105)
ATET		-4.418***	-2.575***	-2.575***	-1.610**
		(0.532)	(0.203)	(0.203)	(0.669)
$E[y_{i0} \mid t_i = 1]$			4.480***	4.480***	
			(0.195)	(0.195)	
$ATET/E[y_{i0} \mid t_i = 1]$			-57.48%	-57.48%	
Industry	YES	YES	YES	YES	YES
Province	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES
Cragg-Donald Wald F statistic	89.23				
Kleibergen-Paap rk LM statistic	88.23				
No. of Obs.	2,729	2,729	2,729	2,729	2,729
R^2		0.427			

Note:
Standard errors are reported in parenthesis. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level.

Table A17: Robustness check for structual estimation

	bencmark	$E[y_{i0}]$	$E[y_{i1}]$	$P[t_i = 1]$	$E[\varepsilon_{i0} \mid t_i = 0]$	$E[\varepsilon_{i1} \mid t_i = 1]$	$sd[\varepsilon_{i0} \mid t_i = 0]$	$sd[\varepsilon_{i1} \mid t_i = 1]$	$corr[v_i, \varepsilon_{i0} \mid t_i = 0]$	$corr[v_i, \varepsilon_{i1} \mid t_i = 1]$
μ_0	1.50	1.60	1.50	1.49	1.50	1.50	1.50	1.50	1.50	1.50
μ_1	0.66	0.70	0.76	0.67	0.66	0.62	0.65	0.64	0.62	0.59
μ_c	0.32	0.37	0.32	0.34	0.32	0.36	0.33	0.37	0.36	0.36
σ_0	0.33	0.31	0.31	0.36	0.32	0.32	0.35	0.33	0.31	0.35
σ_1	0.54	0.51	0.47	0.53	0.54	0.51	0.53	0.50	0.51	0.55
σ_c	1.17	1.16	1.02	1.20	1.21	1.22	1.22	1.17	1.21	1.27
ρ_{01}	0.23	0.26	0.17	0.25	0.32	0.32	0.24	0.20	0.30	0.24
ρ_{0c}	0.58	0.57	0.60	0.59	0.58	0.56	0.58	0.57	0.56	0.57
ρ_{1c}	-0.77	-0.75	-0.78	-0.78	-0.77	-0.76	-0.77	-0.75	-0.76	-0.75

Note:

The values in the table are the optimal structural etimates if there is a 5% increase in each of the moment listing in the corresponding column.