The Cost of Capital Market Distortions: Evidence from Chinese Overseas IPOs

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Overview

- **Capital controls** and **restrictions on firm's access to domestic stock market** are common, often justified by the authorities on either financial stability or investor protection ground, but can be costly
- This paper: **Estimating the overall cost in China with a willingness-to-pay approach from the viewpoint of a Chinese entrepreneur**
- For overseas listed Chinese firms, we ask how much valuation they may have given up by not listing on the domestic stock exchanges
- For a representative Chinese entrepreneur, we ask how much welfare loss he has faced due to the presence of capital market distortions
- Taking into the endogenous nature of IPO locational choice and the potential correlation between valuation and cost

Roadmap

- Facts, Puzzles and Questions
- Capital Market Distortions in China
- A Theoretical Framework
- An Endogenous Treatment Effect Model
- Empirical Evidences
- Structural Estimation
- Counterfactual Analyses
- Conclusion

Facts on China's Overseas IPO

- China leads the world in the number and value of overseas listings
- Number: over **1600** Chinese firms
- Market capitalization: about **$5.4** trillion
- HK and US are the top two most popular destinations

Table: Chinese firms listed in mainland China and major overseas markets by 2020

	Mainland China	Hong Kong	US
Number of firms	4,154	1,323	265
Market capitalization (local currency)	80 trillion (CNY)	35.4 trillion (HKD)	1.9 trillion (USD)
Market capitalization (USD)	12.2 trillion (USD)	4.5 trillion (USD)	1.9 trillion (USD)

Note: including dual-listing and ADRs

Why List Overseas? The Literature vs China

- Literature on motives for cross listings in developed markets
  - Market segmentation theory (Errunza and Losq, 1985)
  - Bonding theory (Coffee, 1999, 2002; Didge et al., 2004)
  - Globalization strategy theory (Pagano et al., 2001)

- Findings: Non-US firms cross-listed in the US market have **lower costs of capital** and **valuation premiums** compared with their domestic counterparts

- Recent overseas listing of Chinese firms seems puzzling
  - First, most overseas listed Chinese firms solely list in offshore markets
  - Second, overseas listed Chinese firms face a **valuation discount**
    - Example: The well-known A-H premium or H-A discount puzzle

Research Questions

- **Why** do Chinese firms choose to go IPO overseas?

- **How much** is the valuation gap in general?

- Key challenge: comparability

1. Some overseas listed firms may be ineligible for domestic listing
   - Listing financial requirements are higher in domestic exchanges
   - Restriction on foreign investment by the Negative List

2. Overseas listing is by self-selection so the quality of domestic and overseas listed firms might be different

Constructing the Treatment and Control Groups

- A firm is Chinese if (1) incorporated in, (2) headquartered in, (3) with a controlling shareholder in, *or* (4) with more than 55% revenue comes from mainland China

- Treatment group (baseline): Chinese firms that went for an IPO in Hong Kong or New York during 2009-2019, traded only outside China, and satisfy the listing financial and restrictive criteria of the domestic stock exchanges

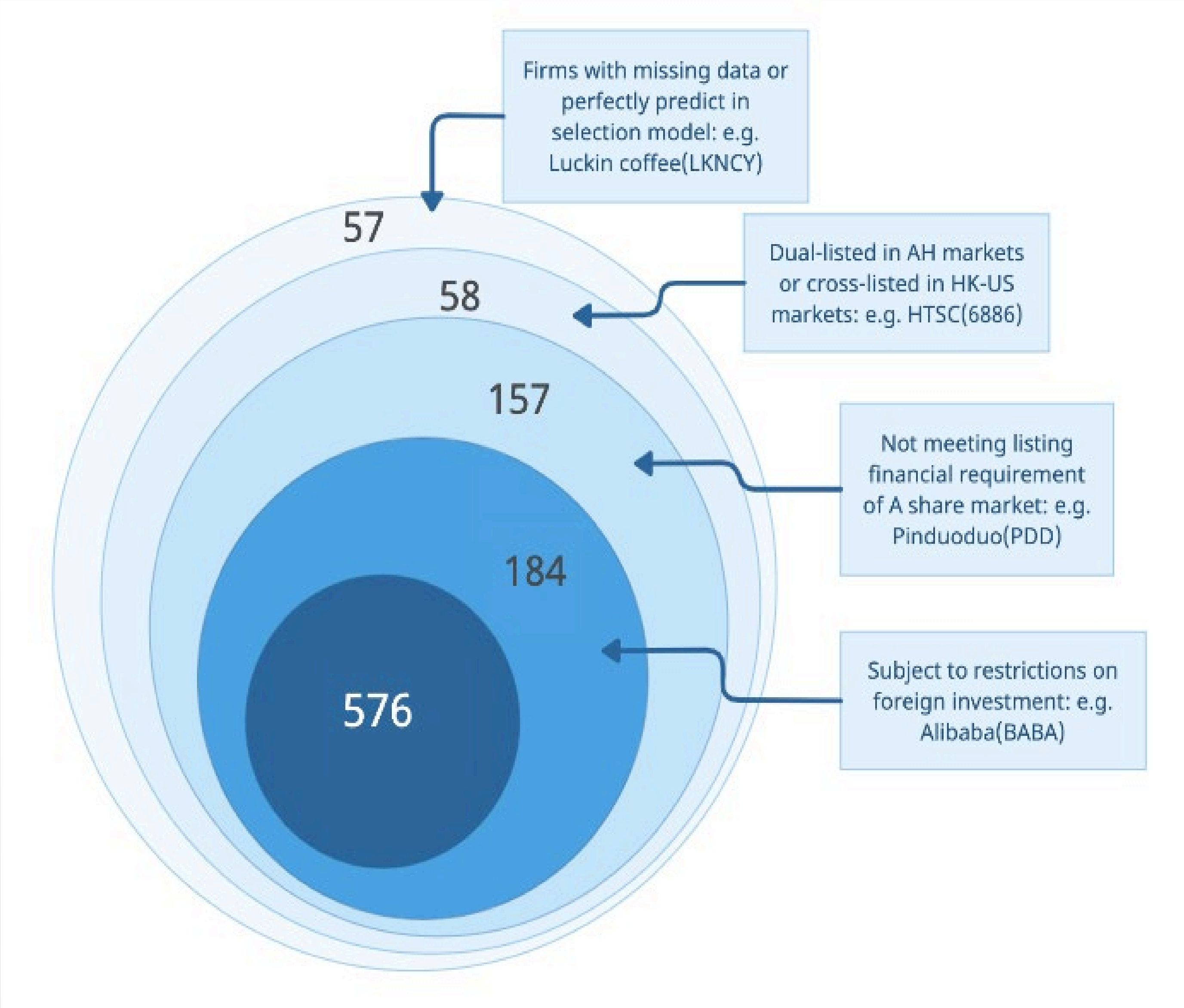
- Treatment group (extension): Chinese firms that went for an IPO in Hong Kong or New York during 2009-2019, traded only outside China

- Control group: Chinese firms that went for an IPO in either Shanghai or Shenzhen stock exchange during 2009-2019, traded only inside Mainland China

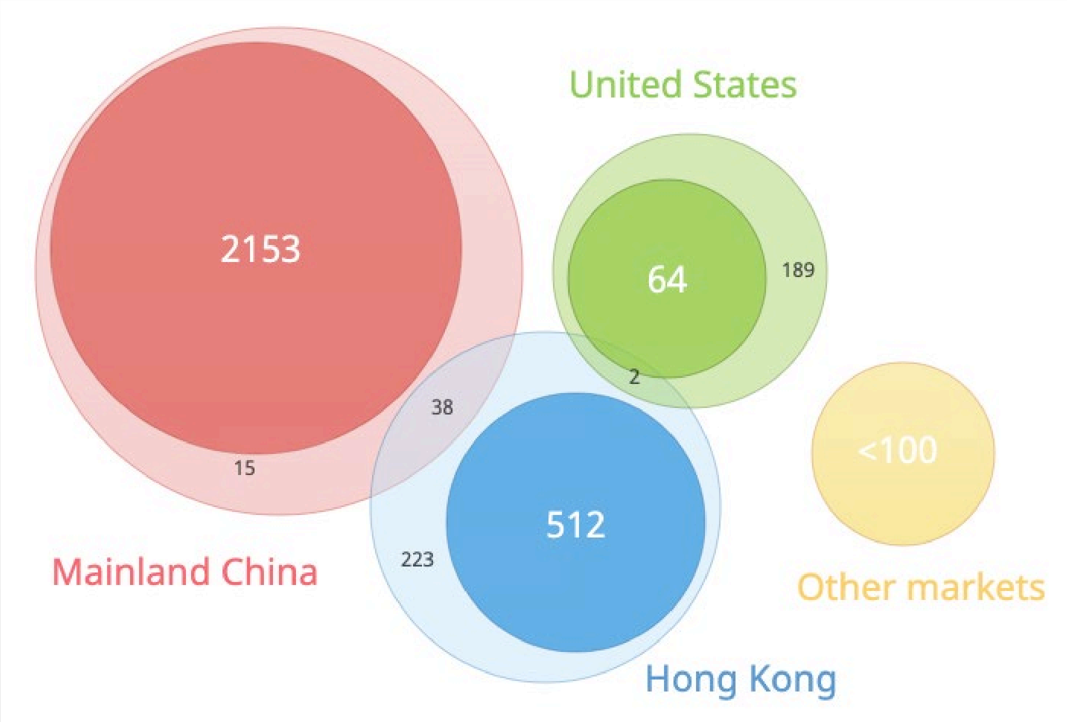
- Start in 2009 - ChiNext established in 2009
- End in 2019: Before the regulatory changes in both China and US

- Data source: Wind, CSMAR, and firm IPO prospectus

Comparable Overseas Listed Sample



Firms in the Baseline Sample



Exclude double-counting

- AH dual listed firms

38 dual listed firms

13 A shares of dual listed firms in Mainland

19 H shares of dual listed firms in Hong Kong

- HK shares of those stocks listed in the US simultaneously

2 cross listed firms in Hong Kong

Exclude unqualified firms

- By financial requirements & Negative List

2 firms in Mainland China

201 firms in Hong Kong

186 firms in United States

Exclude 8 firms with missing data and 2 firms with no counterparts in mainland China market

- **Firms in baseline sample could in principle list both at home and overseas**
- **In a perfect capital market, listing location would be irrelevant for firm value**

Valuation by Tobin's Q

Tobin's Q	1st Year		2nd Year		3rd Year		4th Years		5th Years	
	Mainland	Overseas	Mainland	Overseas	Mainland	Overseas	Mainland	Overseas	Mainland	Overseas
Mean	4.05	1.91	3.23	1.75	3.25	1.53	3.44	1.45	3.63	1.38
p25	2.32	0.98	1.87	0.88	1.84	0.84	1.88	0.82	2.10	0.79
p50	3.29	1.41	2.62	1.16	2.58	1.09	2.68	1.07	3.00	0.98
p75	5.05	2.22	4.00	1.85	3.83	1.70	4.13	1.59	4.43	1.47
N	2,153	576	1,963	492	1,864	414	1,431	356	1,202	315

- Note: Tobin's Q = market value of a company divided by its assets' replacement cost = (market value of equity + book value of debt)/book value of total assets
- Similar patterns for P/B ratio or P/E ratio

Puzzles and Hypotheses

- **Why in a "comparable" sample, market valuation is still systematically lower for overseas listed Chinese firms? Why they still choose to go IPO abroad?**
- Listing location is an optimal choice made by firm
- Each firm is a set of observable and unobservable characteristics
- Each firm also faces a set of different capital market distortions
- Is it because domestic and overseas listed firms have different distribution of characteristics and on average overseas listed firms are of lower quality?
  - **Negative selection hypothesis**
- Is it because overseas listed firms face a set of capital market distortions, and the valuation discount is the willingness to pay to bypass such distortions?
  - **Capital market distortions hypothesis**

Goals of the Paper

- **Model** overseas IPO as the outcome of optimal IPO locational choice of a representative Chinese entrepreneur

- **Feature two specific distortions** in China's capital market
  - Cross-the-border: Capital outflow controls
  - Behind-the-border: Regulations in IPO system

- **Consistently estimate** the motives and valuation discount of the overseas listing with an endogenous treatment effect model

- **Identify causal relationship** between capital market distortions and valuation discount, using exogenous policy shocks and a DIDs strategy

- **Estimate the model structurally and Conduct counterfactual analyses** for welfare loss of a representative Chinese entrepreneur due to capital market distortions

Main Findings

- The observed valuation discount is a combination of willingness to pay to overcome capital market distortions and firm quality differential
- Overseas listing is a **positive selection**: overseas listed Chinese firms are on average better than their domestic peers
- **Substantial** (>50%) **and persistent** valuation discount for overseas listings
- The discounts are greater
  - when there is a **tightening of capital outflow controls** or **RMB↓**
  - during mainland market **IPO suspension** or **PE restriction**
- A representative Chinese entrepreneur faces welfare loss
  - **6.2% due to regulations in IPO system**
  - **12.9% due to capital outflow controls**
  - **18.1% due to both distortions**

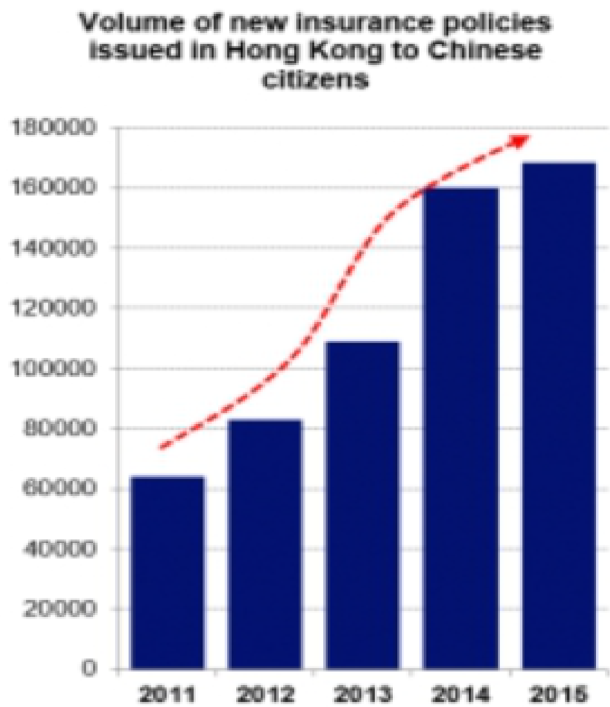
Institutional Background – Capital Outflow Control

- In 1996 China implemented current account convertibility
- **Continued restrictions on capital account transactions**
- Strong capital controls on both directions, but especially on outflows
    - Chinese citizens face a $50,000 annual foreign exchange quota
    - No offshore property purchase or portfolio investment
- Capital outflow restrictions also exist in other countries
    - Malaysia (1998); India (2013); Argentina (2011)
- Finding a way around the regulations is something of a national pastime
    - For middle-class families: making money and diversifying portfolio
    - For rich and powerful: protecting fortunes and setting a backup plan

Capital Outflow Control – Middle-Class Family

Mainland Chinese use Hong Kong life insurance policies as a new way of getting their money abroad

Written by Kapronasia || February 05 2016



With an estimated USD 1 trillion worth of capital outflows from Mainland China in 2015, it is clear that a subset of Chinese citizens would rather keep their money outside of China. Following the country's turbulent stock market and depreciating Yuan, an estimated 100,000+ Mainland Chinese citizens have been venturing out to Hong Kong in order transfer more than the stipulated USD 50,000 outside of China through the means of insurance policies.

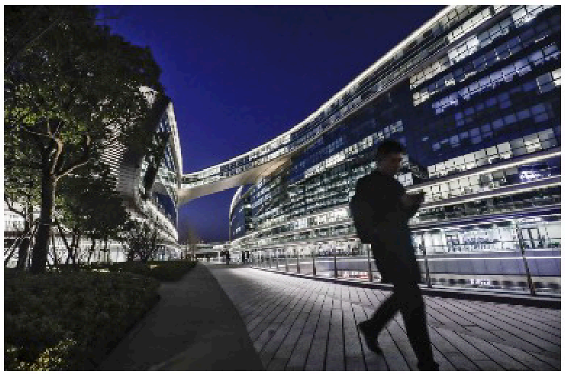
Capital Outflow Control – The Rich

Bloomberg

Wealth | Investing

NYC Becomes One Billionaire Family's Haven From China Property Crash

Soho China's founders shifted much of their fortune out of the country before controls tightened and the market imploded.



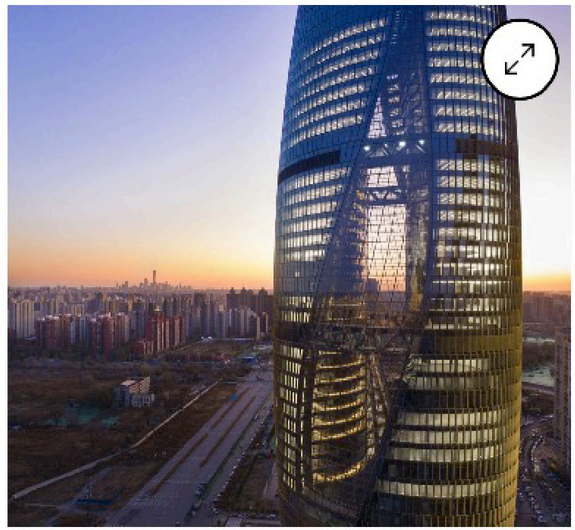
A pedestrian walks past the illuminated Sky Soho building in Shanghai. *Photographer: Qilai Shen/Bloomberg*

The General Motors Building in New York. *Photographer: Andrew Harrer/Bloomberg*

Zhang and Pan's story is a case study in how to be prepared. Their five-part strategy – build a successful business in China, list it on a global exchange, pay out billions of dollars in dividends, set up a family office abroad and buy up foreign real estate – means their fortune is relatively protected while other Chinese billionaires have seen their riches crumble after running foul of President Xi Jinping's clampdowns.

Right Moves

What's saved their personal fortune was the decision to list Soho on the Hong Kong stock exchange in 2007 rather than in China, said four people familiar with the matter, who asked not to be identified discussing private information. Goldman Sachs Group Inc., who Zhang worked for in London after earning a master's degree in development economics at the University of Cambridge, handled the listing.



Capital Outflow Control – The Powerful

Ant Group is connected to former Hangzhou party secretary's corruption case - FT

Reuters

- In October 2020, Ant Group was set to raise US$34.5 billion in the world's largest IPO at the time simultaneously in SSE and HKEX
- Suspended 2 days before scheduled IPO
- Reported: Zhou Jiangyong and family invested 500m RMB in Ant Group before its IPO and a 520m RMB was returned after the IPO suspension

Institutional Background – Regulations in IPO System

- Despite of constant reforms, China's stock market is known to be highly regulated, especially its IPO system (Allan, et al, 2020; 2023; Tian, 2020)

- Three major distortions in the administrative approval IPO system
  - Distortions in IPO waiting period
  - Distortions in IPO issue price
  - Distortions in IPO lock-up period

Regulations in IPO System – Waiting Period

- **Distortions in IPO Waiting Period**

	China	HK & US
IPO system	Administrative Approval	Registration
Regime	Merit-based	Disclosure-based
Philosophy	Regulators make a value judgement to protect investors and to foster national policy	Regulators believe that an informed investor is a protected investor
Practice	New listings to be cleared by regulators on a case-by-case basis	New listings to be registered with regulators as long as meeting disclosure requirements
Feature	Opaque, prolonged and with ad-hoc interventions	transparent, streamlined and well-expected
Duration	**1-5 years**	**6-12 months**

Regulations in IPO System – IPO Issue Price

- **Distortions in IPO Issue Price**

Period	Rules or Reforms	IPO PE Restrictions
Before July 1997	Window guidance	12 < = PE < = 15
July 1997 – Nov 2001	CSRC followed "Security Law"	No PE restrictions
Nov 2001 – Dec 2004	CSRC issued "Notice"	PE < = 20
Dec 2004 – June 2009	Book building reform	PE < = 30
June 2009 – April 2012	CSRC issued "Guiding Opinions"	No PE restrictions
April 2012 – Oct 2012	CSRC issued "Further Notice"	PE < 125% industry average
Oct 2012 – April 2014	IPO suspension	No IPO
April 2014 – next reform	**Window guidance**	**PE < = 23**
June 2019 – present	Establishment of STAR	No PE restrictions
June 2020 – present	IPO reform for ChiNext	No PE restrictions
Feb 2023 – present	IPO reform for main board	No PE restrictions

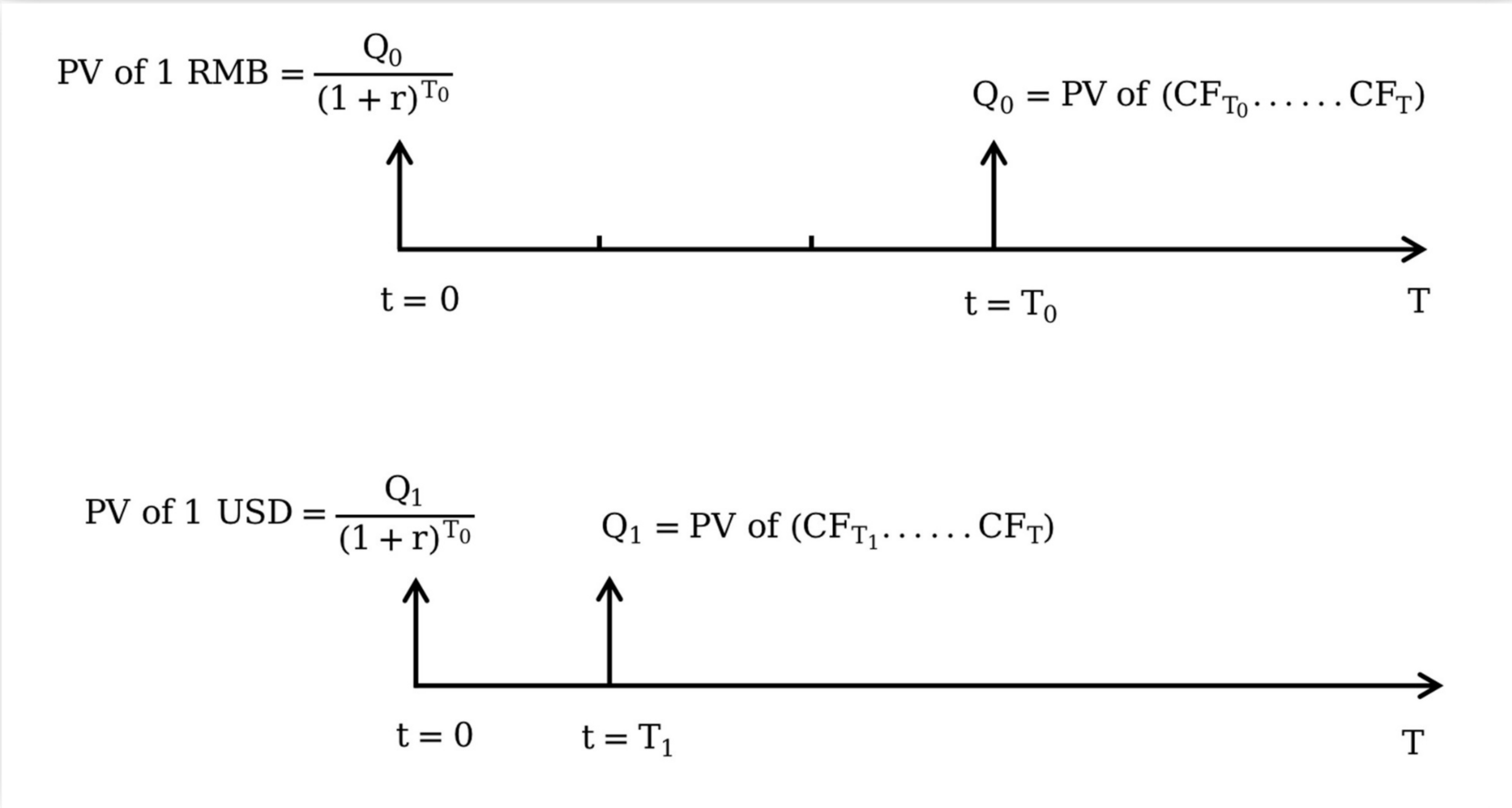
Regulations in IPO System – Lock-up Period

- **Distortions in IPO 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
- Lock-up periods typically apply to insiders such as a company's founders, owners, early investors, managers, and employees
- The purpose of an IPO lock-up period is to prevent insiders from inundating the market with large numbers of shares after IPO
- Typical lock-up period
  - **Mainland China: 1-3 years**
  - **Hong Kong and US: typically, 180 days**

An IPO Locational Choice Model

- Inspired by Borjas (1987, 1988)'s international immigration model
- Suppose there are two markets: domestic 0 and overseas 1
- Consider a Chinese entrepreneur who chooses where to go IPO
- Introduce some notation:
  - Q: Tobin's Q; r: discount rate
  - T: waiting period for IPO approval + lock-up period for major shareholders
  - τ: iceberg transaction cost for moving money across border
  - e: official exchange rate, 1 USD = e RMB
  - δ: subjective exchange rate premium: 1 USD = (1+δ) e RMB
    - Expectation of USD appreciation
    - Diversification in portfolio choice
    - Preference of holding assets offshore
    - Insecurity of holding assets onshore

Timeline and PV of Wealth from IPO



Valuation in Home and Overseas Market

- The wealth generated from 1 RMB or 1/e USD after IPO in two markets are

$$Q_0 \text{ and } Q_1/e$$

- The PV of wealth after discounting the delay in waiting and lock-up period are

$$\frac{Q_0}{(1+r)^{T_0}} \text{ and } \frac{1}{e}\frac{Q_1}{(1+r)^{T_1}}$$

- The PV of wealth in market 0 that is denominated in USD at a subjective exchange rate (1+δ)e is :

$$\frac{1}{(1+\delta)e}\frac{Q_0}{(1+r)^{T_0}}$$

- The PV of wealth in market 0 that is denominated in USD and can freely move across border after paying a transaction cost (τ) is:

$$\frac{(1-\tau)}{(1+\delta)e}\frac{Q_0}{(1+r)^{T_0}}$$

Decision Rules

- The utility of the entrepreneur from IPO in the two markets are

$$U_0 = ln\left[\frac{(1-\tau)}{(1+\delta)e}\frac{Q_0}{(1+r)^{T_0}}\right] \quad \text{and} \quad U_1 = ln\left[\frac{1}{e}\frac{Q_1}{(1+r)^{T_1}}\right]$$

- The entrepreneur chooses to go for an overseas IPO if and only if

$$t = I[U_1 \geq U_0]$$

- Apply approximation $ln(1-\tau) \approx -\tau$, $ln(1+\delta) \approx \delta$ and $ln(1+r) \approx -r$
- Denote $q_0 = lnQ_0, q_1 = lnQ_1, d = r(T_0 - T_1)$
- Decision rule nails down to

$$q_1 - q_0 \geq -c$$

- Where $$c = \tau + d + \delta$$
- C represents the cost of capital market distortions due to capital control (τ) and IPO regulation (d), on top of individual subjective exchange rate (δ)

Distributional Assumptions

- Chinese firms listed in Mainland China have Tobin's Q distributed as

$$q_0 = \mu_0 + \varepsilon_0$$

- The Tobin's Q facing this population if they were to list overseas are

$$q_1 = \mu_1 + \varepsilon_1$$

- The cost of capital market distortion can be written as

$$c = \mu_c + \varepsilon_c$$

- where $\mu_0,\ \mu_1$ and μ_c are potential mean of population valuation and cost
- And ε_0, $\varepsilon_1$and ε_c follow a tri-variate normal distribution

$$\begin{pmatrix} \varepsilon_0 \\ \varepsilon_1 \\ \varepsilon_c \end{pmatrix} \sim N \left\{ \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \quad \begin{pmatrix} \sigma_0^2 & \rho_{01}\sigma_0\sigma_1 & \rho_{0c}\sigma_0\sigma_c \\ \rho_{01}\sigma_0\sigma_1 & \sigma_1^2 & \rho_{1c}\sigma_1\sigma_c \\ \rho_{0c}\sigma_0\sigma_c & \rho_{1c}\sigma_1 & \sigma_c^2 \end{pmatrix} \right\}$$

Probability of Overseas IPO

- Recall the distribution of Tobin's Q and cost

$$q_0 = \mu_0 + \varepsilon_0, q_1 = \mu_1 + \varepsilon_1, \text{ and } c = \mu_c + \varepsilon_c$$

- The decision rule for overseas IPO

$$q_1 - q_0 \geq -c$$

- The probability of overseas IPO is

$$\begin{aligned} P &= Pr[\varepsilon_1 - \varepsilon_0 + \varepsilon_c > -(\mu_1 - \mu_0 + \mu_c)] \\ &= Pr[v/\sigma_v > -(\mu_1 - \mu_0 + \mu_c)/\sigma_v] \\ &= 1 - \Phi(w) \\ &= \Phi(-w) \end{aligned}$$

- where $-w = (\mu_1 - \mu_0 + \mu_c)/\sigma_v$ and $v = \varepsilon_1 - \varepsilon_0 + \varepsilon_c$, $v \sim N(0, \sigma_v^2)$

- Proposition 1: $\frac{\partial P}{\partial \mu_1} > 0$, $\frac{\partial P}{\partial \mu_0} < 0$ and $\frac{\partial P}{\partial \mu_c} > 0$

Quality Differentials

- Average Tobin's Q in domestic market for those overseas listed firms
$$E[q_0|t=1] = \mu_0 + S_0 = E[q_0] + S_0$$
- Average Tobin's Q in overseas market for those overseas listed firms
$$E[q_1|t=1] = \mu_1 + S_1 = E[q_1] + S_1$$
- S_0 is Tobin's Q differential between the average overseas listed firms and the population when they were listed domestic

$$S_0 = \frac{\sigma_0\sigma_1}{\sigma_v}\left[\left(\rho_{10} - \frac{\sigma_0}{\sigma_1}\right) + \rho_{0c}\frac{\sigma_c}{\sigma_1}\right]h$$

- S_1 is Tobin's Q differential between the average overseas listed firms and the population when they were listed overseas

$$S_1 = \frac{\sigma_0\sigma_1}{\sigma_v}\left[\left(\frac{\sigma_1}{\sigma_0} - \rho_{10}\right) + \rho_{1c}\frac{\sigma_c}{\sigma_0}\right]h$$

- Where $h = \phi(w)/(1 - \Phi(w))$, known as the inverse Mills ratio

IPO Market Equilibrium

- Entrepreneurs shop around IPO markets and make optimal decisions
- The marginal entrepreneur is indifferent between two choices
- His expected utility from both markets will be the same

$$E[U_1] = E[U_0]$$

- Which is equivalent to

$$E[q_1] - E[q_0] = -c$$

- If equilibrium does not hold, expected IPO application waiting period in two markets changes, expected utility from two markets changes, so that marginal entrepreneur will re-optimize to re-establish equilibrium

Quantities of Interest: ATE and ATET

- Market equilibrium implies that $E[q_1] - E[q_0] = -c$
- ATE: the average treatment effect on the population

$$\text{ATE} \equiv E[q_1] - E[q_0] = \mu_1 - \mu_0 = -c$$

- ATE speaks out the cost c facing the marginal entrepreneur
- Proposition 2: if $\delta > 0, \tau > 0,$ and $d > 0, ATE < 0$
- Proposition 3: $\frac{\partial ATE}{\partial \delta} < 0, \frac{\partial ATE}{\partial \tau} < 0,$ and $\frac{\partial ATE}{\partial d} < 0$
- ATET: the average treatment effect on the treated

$$\text{ATET} \equiv E[q_0 - q_1 | t = 1] = -c + (S_1 - S_0) = \text{ATE} + (S_1 - S_0)$$

- ATET speaks distortions (c) and the relative position of those overseas listed firms in overseas and domestic market distribution $(S_1 - S_0)$

Quantities of Interest: GMD and SE

- SB: the effect of self-selection

$$\begin{aligned} \text{SB} &\equiv E[q_0|t=1] - E[q_0|t=0] \\ &= (\mu_0 + S_0) - \left(\mu_0 - \frac{P}{1-P} S_0\right) \\ &= \frac{S_0}{1-P} \end{aligned}$$

- SB speaks the sign of selection in domestic market S_0

- GMD: the group mean difference observed by econometrician

$$\begin{aligned} \text{GMD} &\equiv E[q_1|t=1] - E[q_0|t=0] \\ &= (\mu_1 + S_1) - \left(\mu_0 - \frac{P}{1-P} S_0\right) \\ &= (-c) + (S_1 - S_0) + \frac{S_0}{1-P} \\ &= \text{ATET} + \text{SB} \end{aligned}$$

- GMD is the sum of ATET (distortion hypothesis – our story), and SB (negative selection hypothesis – our competing hypothesis)
- Apply the model to data to back out ATE, ATET, SB and GMD

Empirical Specification

- Econometric framework – The general model

(1) $t_i = 1\{X_i\alpha_1 + Z_i\alpha_2 + v_i > 0\}$

(2) $y_i = \mathrm{t}_i y_{\mathrm{i}1} + (1 - t_i)y_{\mathrm{i}0}$

(3) $y_{i1} = X_i\beta_{11} + \varepsilon_{i1}$

(4) $y_{i0} = X_i\beta_{10} + \varepsilon_{i0}$

(5) $$\begin{pmatrix} \varepsilon_{i0} \\ \varepsilon_{i1} \\ v_i \end{pmatrix} \sim D\left\{\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma'^2_0 & \rho'_{01}\sigma'_0\sigma'_1 & \rho'_{0v}\sigma'_0 \\ \rho'_{01}\sigma'_0\sigma'_1 & \sigma'^2_1 & \rho'_{1v}\sigma'_1 \\ \rho'_{0v}\sigma'_{\prime 0} & \rho'_{1v}\sigma'_1 & 1 \end{pmatrix}\right\}$$

- t_i: treatment indicator – **1 for overseas IPO and 0 for domestic listing**
- y_i: market valuation – Tobin's Q , PB ratio, PE ratio
- X_i: observable firm characteristics – from literature + our new hypothesis
- Z_i: instrumental variable for identification
- v_i: unobserved factors which may affect listing location choice
- ε_i: unobserved factors which may affect market valuation

Link with the Theory

- Empirical model

(1) $t_i = 1\{X_i\alpha_1 + Z_i\alpha_2 + v_i > 0\}$

(2) $y_i = \mathrm{t}_i y_{\mathrm{i}1} + (1 - t_i) y_{\mathrm{i}0}$

(3) $y_{i1} = X_i\beta_{11} + \varepsilon_{i1}$

(4) $y_{i0} = X_i\beta_{10} + \varepsilon_{i0}$

(5) $$(\varepsilon_{i0}, \varepsilon_{i1}, v_i) \sim D\left\{(0,0,0),\ \begin{pmatrix} \sigma_0'^2 & \rho'_{01}\sigma'_0\sigma'_1 & \rho'_{0v}\sigma'_0 \\ \rho'_{01}\sigma'_0\sigma'_1 & \sigma_1'^2 & \rho'_{1v}\sigma'_1 \\ \rho'_{0v}\sigma'_{\prime 0} & \rho'_{1v}\sigma'_1 & 1 \end{pmatrix}\right\}$$

- Relation to the theory model
  - $\mu_1 = X_i\beta_{11}, \mu_0 = X_i\beta_{10}$
  - $-w = (\mu_1 - \mu_0 + \mu_c)/\sigma_v = (-X_i\alpha_1 - Z_i\alpha_2)/\sigma_v$
  - $v_i = \varepsilon_{i1} - \varepsilon_{i0} + \varepsilon_{ic}$

- Subsample vs Population
  - Notice σ'_0 and σ'_1 here are for subsamples of $t_i = 0$ and $t_i = 1$ not for population
  - Notice $\rho'_{01}$is not identified as we never observe a firm at 0 and 1 simultaneously
  - Notice Stata normalizes σ'_v to 1 as it is not identified

Controlling for observables

- Since now $\mu_1 = X_i\beta_{11}$, $\mu_0 = X_i\beta_{10}$
- The empirical S_0 and S_1 has an observable component
- 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 $S_{1\varepsilon}$)
- We have $S_{0y} = S_{0x} + S_{0\varepsilon}$ and $S_{1y} = S_{1x} + S_{1\varepsilon}$ where

$$S_{0x} = \beta_{10}E[(X_i|t_i = 1) - (X_i|t_i = 0)](1 - P_i)$$

$$S_{1x} = \beta_{11}E[(X_i|t_i = 1) - (X_i|t_i = 1)]\,(1 - P_i)$$

$$S_{0\varepsilon} = \frac{\sigma_0\sigma_1}{\sigma_v}\left[\left(\rho_{10} - \frac{\sigma_0}{\sigma_1}\right) + \rho_{0c}\frac{\sigma_c}{\sigma_1}\right]h$$

$$S_{1\varepsilon} = \frac{\sigma_0\sigma_1}{\sigma_v}\left[\left(\frac{\sigma_1}{\sigma_0} - \rho_{10}\right) + \rho_{1c}\frac{\sigma_c}{\sigma_0}\right]h$$

- Similarly, the GMD, ATET, and SB can all be decomposed into an observable and an unobservable component

Alternative Empirical Specification

- Econometric framework – The simple model

(1’) $$t_i = 1\{X_i\alpha_1 + Z_i\alpha_2 + v_i > 0\}$$

(2’) $$y_i = X_i\beta_1 + \theta t_i + \varepsilon_i \Longrightarrow \begin{cases} y_{i0} = X_{i0}\beta_1 + \varepsilon_{i0} \\ y_{i1} = X_{i1}\beta_1 + \theta + \varepsilon_{i1} \end{cases}$$

(3’) $$\binom{\varepsilon_i}{v_i} \sim D\left\{\binom{0}{0}, \begin{pmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & 1 \end{pmatrix}\right\}$$

- Under (2’), $\beta_{10} = \beta_{11}$ for X_i; θ identifies the treatment effect
- Under (3), $\sigma'_0 = \sigma'_1 = \sigma$, $\rho'_{0v} = \rho'_{1v} = \rho$ so that $S_0 = S_1 = \rho\sigma h$
- Thus, in simple model $ATE = ATET = \theta$, $SB = \frac{\rho\sigma h}{1-P}$, $GMD = \theta + \frac{\rho\sigma h}{1-P}$

Identification: Endogeneity Issue

- The general model

(1) $t_i = 1\{X_i\alpha_1 + Z_i\alpha_2 + v_i > 0\}$

(2) $y_i = t_i y_{i1} + (1 - t_i) y_{i0}$

(3) $y_{i1} = X_i\beta_{11} + \varepsilon_{i1}$

(4) $y_{i0} = X_i\beta_{10} + \varepsilon_{i0}$

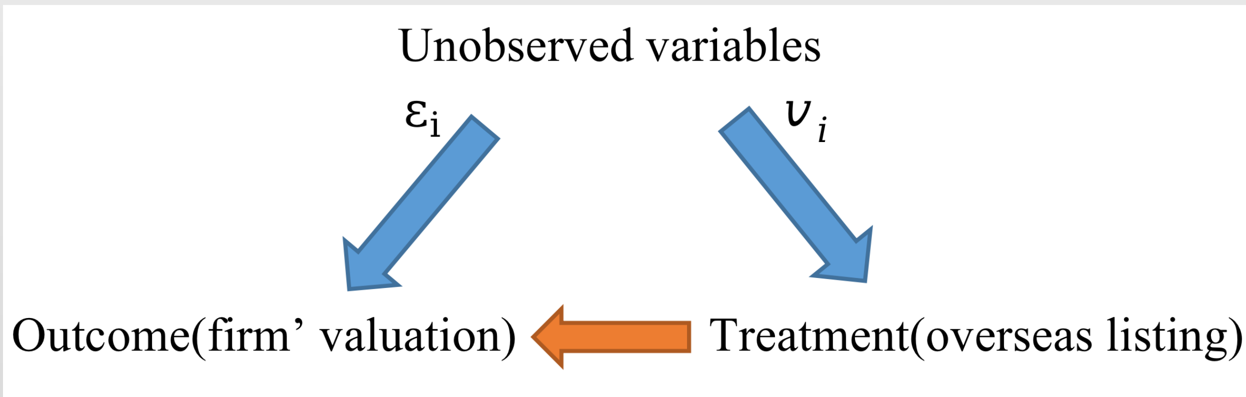
(5) $\begin{pmatrix} \varepsilon_{i0} \\ \varepsilon_{i1} \\ v_i \end{pmatrix} \sim N\left\{ \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma'^2_0 & \rho'_{01}\sigma'_0\sigma'_1 & \rho'_{0v}\sigma'_0 \\ \rho'_{01}\sigma'_0\sigma'_1 & \sigma'^2_1 & \rho'_{1v}\sigma'_1 \\ \rho'_{0v}\sigma'_{,0} & \rho'_{1v}\sigma'_1 & 1 \end{pmatrix} \right\}$

- The simple model

(1') $t_i = 1\{X_i\alpha_1 + Z_i\alpha_2 + v_i > 0\}$

(2') $y_i = X_i\beta_1 + \theta t_i + \varepsilon_i$

(3') $\begin{pmatrix} \varepsilon_i \\ v_i \end{pmatrix} \sim N\left\{ \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & 1 \end{pmatrix} \right\}$



Identification: Estimation Methods

- Both models could be consistently estimated by MLE or Heckman's two-step procedure, under distributional assumption on v_i and ε_i

- A less restrictive and more efficient way is **control function approach** (CF) (Wooldridge, 2010)

- Main idea: projecting ε_i on t_i and additional variables Z_i and X_i
- $\varepsilon_i = E(\varepsilon_i|t_i, X_i, Z_i) + e_i = E(\varepsilon_i|t - E(t|X_i, Z_i)) + e_i = E(\varepsilon_i|v_i) + e_i = v_i\beta_2 + e_i$

- Replacing ε_i in equation (2') using eqn. above

(2'') $$y_i = X_i'\beta_1 + \theta t_i + v_i\beta_2 + e_i$$

- The endogeneity due to the correlation between t_i (v_i) and ε_i can then be controlled by the additional term $v_i\beta_2$
- In MLE or Heckman's two-step approach: this term is $\sigma\rho h$

Identification: Instrumental Variables

- In practice, $\boldsymbol{v_i}$ is obtained as $t_i - E(t_i|X_i, Z_i)$

- So that $\boldsymbol{v_i}$ is a function of X_i and Z_i

- Same as a flat inverse Mills ratio function in Heckman's sample selection model, without additional identifying instrumental variable Z_i, parameters in (2)' are not identified due to **multi-collinearity**

- Look for potential instrumental variable z_i
  - A predictor of a firm's listing location choice
  - A factor uncorrelated with a firm's post-IPO valuation

Instrumental Variables 1 and 2

- **IV1: Relative expected waiting days in different markets for firm *i***
  - A shorter waiting time relative to other markets is a primary determinant of the listing location choice
  - The expected waiting days is constructed by using the average waiting days of firms in the same industry 1-year before IPO application date

- **IV2: Relative market sentiment in different markets 12-months prior to the IPO application date of firm *i***
  - Favourable market condition relative to other markets is a primary determinant of the listing location choice
  - A pre-IPO market-wide condition is unlikely to affect the post-IPO valuation of individual firm, conditional on post-IPO market-wide condition and firm characteristics

Simple Model - 1-Year post IPO

Dependent	Overseas listing		Tobin's Q
Variables	Treatment		Outcome
Age	0.034***	Age	-0.006
Log(total asset)	-0.154***	Log(total asset)	-0.530***
ROA(%)	0.036***	ROA(%)	0.062***
Sales growth rate (%)	0.007***	Sales growth rate (%)	0.006***
Leverage (%)	0.023***	Leverage (%)	-0.007**
Intangible assets ratio (%)	0.014***	Intangible assets ratio (%)	0.017***
State ownership percentage (%)	0.003	State ownership percentage (%)	0.004***
Independent director ratio (%)	0.071***	Independent director ratio (%)	-0.007
CEO=Chairman	0.315***	CEO=Chairman	0.090
Top5 ownership percentage (%)	0.007**	Top5 ownership percentage (%)	-0.007
Controlling shareholder dummy	0.329***	Controlling shareholder dummy	0.146
Import and export ratio (%)	-0.001	Import and export ratio (%)	-0.002
Strategic investor dummy	0.693***	Strategic investor dummy	0.084
Foreign reserve growth rate (%)	-0.011	Foreign reserve growth rate (%)	0.003
Foreign ownership percentage (%)	0.011***	Foreign ownership percentage (%)	0.003
Operating cash flow ratio(%)	-0.026***	Operating cash flow ratio(%)	0.012*
PE regulation	0.022*	PE regulation	-0.027**
Expected relative waiting days	0.350***	**ATE = ATET = θ**	**-2.62*** **
Log(relative market index)	0.409***		
Industry	YES		YES
Year	YES		YES
Province GDP per capita	YES		YES
Observations	2,729		2,729

Decomposition: Simple Model - 1-Year post IPO

	Estimates	Observable	Unobservables
E[Y0|t=0]: observed	4.05***		
E[Y1|t=1]: observed	1.91***		
E[Y1|t=0]: predicted	1.43***		
E[Y0|t=1]: predicted	4.53***		
ATET = ATE = E[Y1|t=1] - E[Y0|t=1]	**-2.62*** **		
Valuation discount = ATET/E[Y0|t=1]	**-57.8%**		
μ_0 = (1-P)*E[Y0|t=0] + P*E[Y0|t=1]	4.15***		
μ_1 = (1-P)*E[Y1|t=0] + P*E[Y1|t=1]	1.53 ***		
$S_0 =$ E[Y0|t=1] - μ_0	0.38	0.27*	0.11
$S_1 =$ E[Y1|t=1] - μ_1	0. 38	0.27*	0.11
GMD = E[Y1|t=1] - E[Y0|t=1]: observed	**-2.14*** **		
ATET = E[Y1|t=1] - E[Y0|t=1] : estimated	**-2.62*** **	-2.62***	0
SB = E[Y0|t=1] - E[Y0|t=0]: estimated	**0.48**	0.34*	0.14

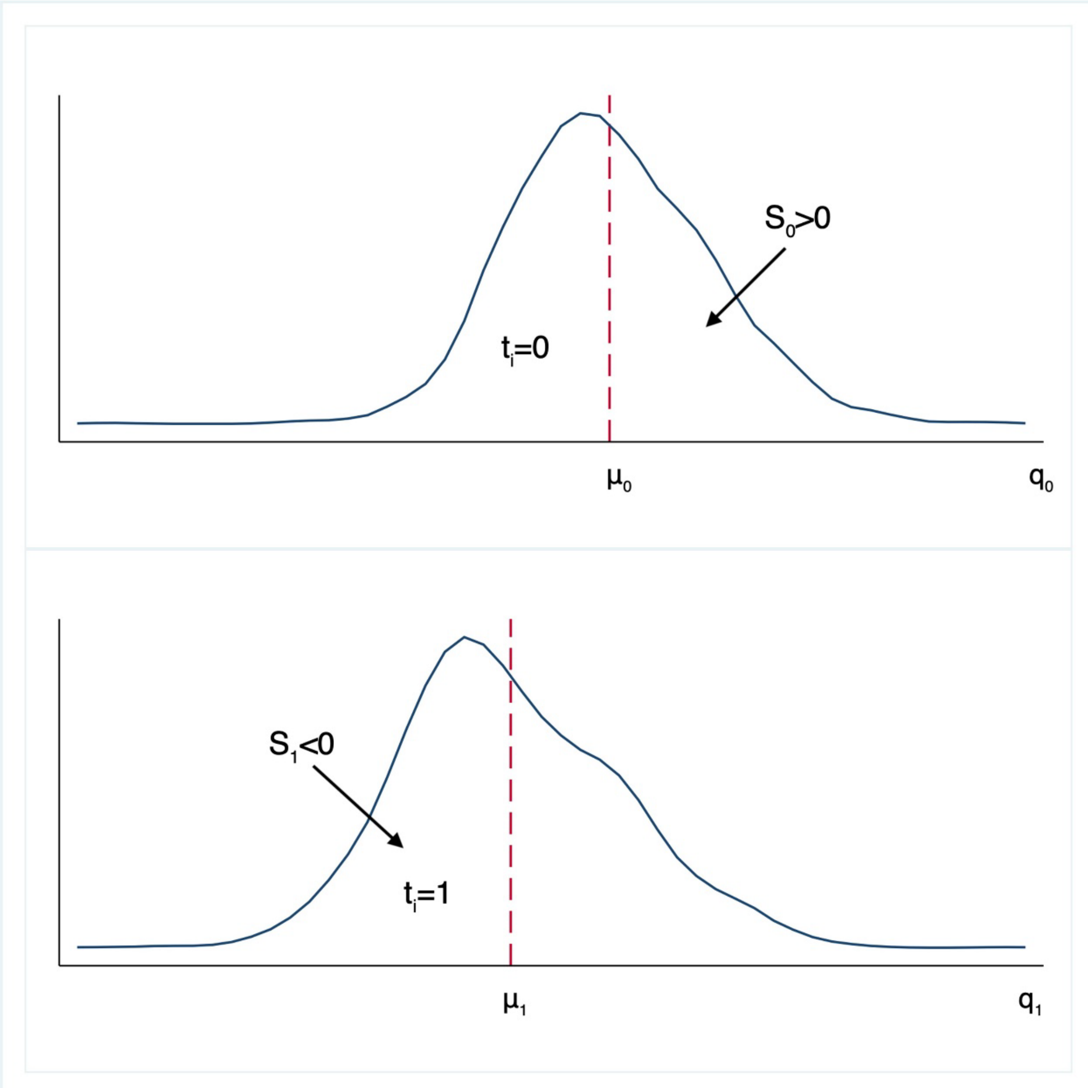
- Significant treatment effect due to capital market distortions
- Mild positive selection and largely due to observables

Decomposition: General Model - 1-Year post IPO

	Estimates	Observable	Unobservables
E[Y0|t=0]: observed	4.05***		
E[Y1|t=1]: observed	1.91***		
E[Y1|t=0]: predicted	3.24***		
E[Y0|t=1]: predicted	5.57***		
ATE = E[Y1] - E[Y0]	**-1.42*** **		
Valuation discount for population: ATE/E[Y0]	**-32.4%**		
ATET= E[Y1|t=1] - E[Y0|t=1]	**-3.66*** **		
Valuation discount for treated: ATET/E[Y0|t=1]	**-65.7%**		
μ_0 = (1-P)*E[Y0|t=0] + P*E[Y0|t=1]	4.38***		
μ_1 = (1-P)*E[Y1|t=0] + P*E[Y1|t=1]	2.96 ***		
S_0 = E[Y0|t=1] - μ_0	1.19***	0.79***	0.42***
S_1 = E[Y1|t=1] - μ_1	-1.05***	-0.62***	-0.43**
GMD = E[Y1|t=1] - E[Y0|t=1]: observed	**-2.14*** **		
ATET = E[Y1|t=1] - E[Y0|t=1] : estimated	**-3.66*** **	-2.82***	-0.84***
SB = E[Y0|t=1] - E[Y0|t=0]: estimated	**1.52*** **	1.00***	0.52***

- Significant treatment effect due to capital market distortions
- Positive selection in domestic market and due to both observables & unobservables
- Negative selection in overseas market and due to both observables & unobservables

Predicted Population Distribution



Simple Model – Valuation Discount by Horizon

	Tobin's Q						
	At IPO	1-Day	1-Year	2- Year	3-Year	4-Year	5-Year
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATET = ATE	-2.24***	-4.01***	-2.62***	-1.49***	-0.92***	-1.33***	-1.99***
	(0.32)	(0.54)	(0.37)	(0.29)	(0.26)	(0.27)	(0.23)
E[Y0|t=1]	5.08***	7.28***	4.53***	3.25***	2.45***	2.78***	3.37***
	(0.33)	(0.55)	(0.33)	(0.26)	(0.25)	(0.26)	(0.23)
ATET/E[Y0|t=1]	**-44%**	**-55%**	**-58%**	**-46%**	**-38%**	**-48%**	**-59%**
Observations	2,675	2,675	2,729	2,455	2,278	1,787	1,517

General Model – Valuation Discount by Horizon

	Tobin's Q				
	1-Year	2- Year	3-Year	4- Year	5-Year
Variables	(3)	(4)	(5)	(6)	(7)
ATET	-3.66***	-1.74***	-1.18***	-1.56***	-2.51***
	(0.40)	(0.35)	(0.40)	(0.48)	(0.40)
E[Y0|t=1]	5.57***	3.49***	2.71***	3.01***	3.93***
	(0.40)	(0.34)	(0.40)	(0.48)	(0.38)
ATET/E[Y0|t=1]	-66%	-50%	-44%	-52%	-64%
Observations	2,729	2,455	2,278	1,787	1,517

Is such a substantial valuation discount sensible? Let's check…

Empirical results - Internal Validity Check

- AH dual-listed firms have passed regulations in the IPO system
- The dividends obtained in the A-share market, or the income from reducing shareholding, are still subject to restrictions on capital outflow
- H share price discount can be directly observed without fancy econometrics
- They are expected to have a smaller valuation discount than non-AH dual-listed

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
samples	AH dual-listed	other overseas listed	AH dual-listed	other overseas listed	AH dual-listed	other overseas listed	AH dual-listed	Other overseas listed	AH dual-listed	other 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%	-58%	-24%	-46%	-28%	-38%	-36%	-48%	-40%	-60%
Number of firms	29		30		31		38		35	

Empirical results - External Validity Check

The Case of "Home Coming" Stocks

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
CTFO.O	2012	千方科技	002373.SZ	2013	10.07	0.92	-90.91%
PWRD.O	2015	完美世界	002624.SZ	2015	12.87	1.23	-90.43%
0597.HK	2011	华润微	688396.SH	2020	5.73	0.96	-83.29%
MR!.N	2016	迈瑞医疗	300760.SZ	2018	8.98	1.63	-81.90%
YTEC.O	2012	宇信科技	300674.SZ	2018	4.11	0.76	-81.45%
JASO.O	2018	晶澳科技	002459.SZ	2018	4.04	0.77	-80.92%
FMCN.O	2013	分众传媒	002027.SZ	2016	10.44	2.00	-80.87%
0963.HK	2017	华熙生物	688363.SH	2019	11.52	2.43	-78.94%
GA.N	2014	巨人网络	002558.SZ	2016	11.52	2.99	-74.00%
TSL.N	2017	天合光能	688599.SH	2020	2.47	0.95	-61.69%
QIHU.N	2016	三六零	601360.SH	2018	5.33	2.98	-44.12%
MONT.O	2014	澜起科技	688008.SH	2019	12.76	7.96	-37.64%
MY.N	2016	明阳智能	601615.SH	2019	1.39	0.88	-36.66%
CEO.N	2021	中国海油	600938.SH	2022	1.20	0.88	-27.00%
XUE.N	2016	学大教育	000526.SZ	2016	1.98	1.51	-23.79%
CHL.N	2021	中国移动	600941.SH	2022	1.13	0.94	-17.21%
CHA.N	2021	中国电信	601728,SH	2021	0.91	0.75	-17.01%
Average					**6.26**	**1.80**	**-71.32%**
Median					**5.33**	**0.96**	**-82.04%**

Identifying the Causal Effect of Policy Distortions

- What causes such a substantial valuation discount?
- Recall for marginal entrepreneur $ATE = -c$
- Some systematic factors besides policy distortions might matter
    - Home bias of investors
    - Short-selling restrictions in mainland China market
    - Different dividends and capital gain taxes across markets…
- These are taken as given by the entrepreneur in his decision making
- Thus, the level of ATE itself does not imply a causal relationship
- Exploit exogenous policy shocks or variations to identify the causal relationship between specific policy distortions and valuation discount
- That is to estimate $\frac{\partial ATE}{\partial c} \frac{\partial c}{\partial shock} =?$

Policy Shocks

- Capital control regulations
  - **Tightening of capital outflow control after 2017 ($\tau > 0 \Longrightarrow ATE \downarrow$)**
  - **Exchange rate reform in 2015 ($\delta > 0 \Longrightarrow ATE \downarrow$)**

- Regulations in IPO system
  - **IPO suspension between 2012 and 2014 ($d > 0 \Longrightarrow ATE \downarrow$)**
  - **PE restriction between March 2014 and June 2020 ($q_0 \downarrow \Longrightarrow change\ in\ marginal\ entrepreneur \Longrightarrow ATE \downarrow$)**

DIDs Results for Policy Distortions

Dependent	Tobin's Q 1- year post IPO				
	(1)	(2)	(3)	(4)	(5)
Overseas listing	-2.737**	-2.439***	-2.340***	-2.088***	-1.808***
	(0.376)	(0.384)	(0.432)	(0.381)	(0.508)
Capital control	1.088***				1.106***
	(0.392)				(0.360)
Overseas listing*Capital controls	-0.897**				-1.671***
	(0.454)				(0.582)
Exchange rate reform		-0.275			0.176
		(0.195)			(0.277)
Overseas listing*Exchange rate reform		-1.293***			-2.153***
		(0.312)			(0.564)
IPO suspension			0.271		0.339
			(0.275)		(0.394)
Overseas listing*IPO suspension			-1.683***		-2.373***
			(0.327)		(0.533)
PE restriction				-0.806	-1.252**
				(0.504)	(0.563)
Overseas listing*PE restriction				-0.987***	0.327
				(0.202)	(0.447)
Observations	2,729	2,729	2,729	2,729	2,729

Firm Heterogeneity

- Exploit firm heterogeneity to highlight impact of policy distortions

- Firms have more leeway to bypass capital controls ($ATE \uparrow$)
  - **High state ownership** vs low state ownership

- Firms are more impatient and risk averse ($ATE \downarrow$)
  - **High operating risk** vs low operating risk

- Firms have higher subjective exchange rates ($ATE \downarrow$)
  - **High foreign ownership** vs low foreign ownership

DIDs Results for Firm Heterogeneity

Dependent	Tobin's Q 1- year post IPO				
	(1)	(2)	(3)	(4)	(5)
Overseas listing	-2.787***	-2.173***	-2.091***	-1.632***	-0.558
	(0.385)	(0.463)	(0.428)	(0.502)	(0.452)
Overseas listing*SOE dummy	0.716***			0.099	0.065
	(0.236)			(0.259)	(0.236)
Overseas listing*High foreign ownership		-0.917***		-0.908***	-0.837***
		(0.253)		(0.286)	(0.260)
Overseas listing*High operating risk			-0.726***	-0.646**	-0.844***
			(0.189)	(0.198)	(0.198)
Overseas listing*Capital control					-1.477**
					(0.548)
Overseas listing*Exchange rate reform					-1.855***
					(0.545)
Overseas listing*IPO suspension					-2.049***
					(0.512)
Overseas listing*PE restriction					-0.099
					(0.458)
Observations	2,729	2,729	2,698	2,698	2,698

Back to the Theory Model

- The utility of the entrepreneur from IPO in the two markets are

$$U_0 = ln\left[\frac{(1-\tau)}{(1+\delta)e}\frac{Q_0}{(1+r)^{T_0}}\right] \quad \text{and} \quad U_1 = ln\left[\frac{1}{e}\frac{Q_1}{(1+r)^{T_1}}\right]$$

- Decision rule $q_1 - q_0 \geq -c$, where

$$q_0 = \mu_0 + \varepsilon_0$$

$$q_1 = \mu_1 + \varepsilon_1$$

$$c = \mu_c + \varepsilon_c$$

$$\begin{pmatrix}\varepsilon_0\\ \varepsilon_1\\ \varepsilon_c\end{pmatrix} \sim N\left\{\begin{pmatrix}0\\0\\0\end{pmatrix}, \begin{pmatrix}\sigma_0^2 & \rho_{01}\sigma_0\sigma_1 & \rho_{0c}\sigma_0\sigma_c\\ \rho_{01}\sigma_0\sigma_1 & \sigma_1^2 & \rho_{1c}\sigma_1\sigma_c\\ \rho_{0c}\sigma_0\sigma_c & \rho_{1c}\sigma_1 & \sigma_c^2\end{pmatrix}\right\}$$

- Welfare of entrepreneur depends on 9 primitive parameters

$$(\mu_0, \mu_1, \mu_c, \sigma_0, \sigma_1, \sigma_c, \rho_{01}, \rho_{0c}, \rho_{1c})$$

Simulated Method of Moments Estimation

paramater	estimate	s.e.
μ_0	1.500	0.028
μ_1	0.663	0.052
μ_c	0.322	0.085
σ_0	0.333	0.013
σ_1	0.540	0.037
σ_c	1.172	0.031
ρ_{01}	0.229	0.614
ρ_{0c}	0.584	0.089
ρ_{1c}	-0.775	0.058

targeted moments	data	simulated
$E[Y_{i0}]$	4.38	4.74
$E[Y_{i1}]$	2.96	2.24
$P[t_i = 1]$	0.21	0.23
$E[\varepsilon_{i0} \mid t_i = 0]$	-0.11	-0.12
$E[\varepsilon_{i1} \mid t_i = 1]$	-0.43	-0.48
$sd[\varepsilon_{i0} \mid t_i = 0]$	1.71	1.57
$sd[\varepsilon_{i0} \mid t_i = 0]$	1.82	0.98
$corr[v_i, \varepsilon_{i0} \mid t_i = 0]$	0.14	0.13
$corr[v_i, \varepsilon_{i1} \mid t_i = 1]$	-0.24	-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*

Interpretation of Cost

- We model $c = \tau + d + \delta$
- We estimate $c = \mu_c + \varepsilon_c$, where $\mu_c = 0.32$ and $\varepsilon_c \sim N(0, 1.17^2)$
- To offer every 1 dollar of capital to public, on average our entrepreneur pays a cost of 32 cents due to capital market distortions in China
- We take $\tau + d = \mu_c$, common factors due to institutional regulations
- We take $\delta = \varepsilon_c$, idiosyncratic factors due to subjective preference
- We observe in data $T_0 = 3.33$, $T_1 = 1.25$, so that $d = r(T_0 - T_1) = 10\%$
- At $\mu_c = 0.32$, this implies $\tau = 0.22$
- To move 1 dollar out of border, on average our entrepreneur pays a transaction cost of 22 cents due to capital outflow control

Counterfactual Analyses: Overall

	τ	r	T_0	T_1	d	μ_c	P (t = 1)	E[U]	Δ E[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%

- welfare loss due to regulation in IPO system: (1.21-1.29)/1.29 = -6.2%
- welfare loss due to capital outflow control: (1.21-1.39)/1.39 = -12.9%
- welfare loss due to capital market distortions: (1.21-1.48)/1.48 = -18.1%

Counterfactual Analyses: Decomposition

welfare loss	18.00%	28.50%	0%
$\mu_c = 0$	$U_0 = 1.784$	$U_0 = 0.610$	$U_1 = 0.300$
identity	currently $t_i = 0$	$t_i = 0$ if $\mu_c = 0$ switchers $t_i = 1$ if $\mu_c = 0.32$	always $t_i = 1$
$\mu_c = 0.32$	$U_0 = 1.462$	$U_1 = 0.436$	$U_1 = 0.300$
proportion	76.8%	11.6%	11.5%

Note: home listing (unshaded box); overseas listing (shaded box)

- welfare loss for always overseas listing: 0%
- welfare loss for switchers: (0.436-0.610)/0.610 = -28.5%
- welfare loss for currently domestic listing: (1.462-1.784)/1.784 = -18.0%

Conclusion

- Overseas listed Chinese firms are on average better than domestic listed Chinese firms in domestic market
- The valuation discount may be viewed as a “willingness to pay” of entrepreneurs to circumvent capital market distortions: **Capital controls** and **Regulations in IPO system**
- The seemingly puzzling stock market anomaly is an optimal decision of entrepreneurs, once taking into count the hidden cost they are facing
- How costly are such distortions?
  - On average overseas listed Chinese firms give up 50% valuation
  - A representative Chinese entrepreneur has lost 18% of welfare
- Capital market reforms in China to the efficiency level as HK or US could improve welfare of Chinese entrepreneurs by 22%

Robustness Checks

- Alternative samples vs benchmark sample of qualified firms
- Alternative valuation measure: Price/Book ratio
- Relative market sentiment measured in 6- or 24 months before IPO
- Excluding real estate, financial, or technology firms
- Including risk, liquidity and floating market cap measure in valuation
- Excluding pre-IPO factors in valuation
- Alternative approaches: IV, IPWRA, and matching

Estimates from Extended Sample

Table 16: Valuation Equation in the Simple Model across Different Sample

Dependent	Tobin's Q			
	(1)	(2)	(3)	(4)
	1st Year	1st Year	1st Year	1st Year
Variables	Benchmark sample	+Restricted	+Restricted & Prohibited	+Negative list & Unqualified firms
ATET=ATE	-2.62***	-2.73***	-2.88***	-3.13***
	(0.37)	(0.28)	(0.24)	(0.33)
POM_(E[Y0|t=1])	4.53	4.64	4.84	5.33
ATET/POM_(E[Y0|t=1])	-57.84%	-58.84%	-59.50%	-58.72%
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 1%, 5%, and 10% level.