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

<table>
<thead>
<tr>
<th></th>
<th>Mainland China</th>
<th>Hong Kong</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of firms</td>
<td>4,154</td>
<td>1,323</td>
<td>265</td>
</tr>
<tr>
<td>Market capitalization (local currency)</td>
<td>80 trillion (CNY)</td>
<td>35.4 trillion (HKD)</td>
<td>1.9 trillion (USD)</td>
</tr>
<tr>
<td>Market capitalization (USD)</td>
<td>12.2 trillion (USD)</td>
<td>4.5 trillion (USD)</td>
<td>1.9 trillion (USD)</td>
</tr>
</tbody>
</table>

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 with missing data or perfectly predict in selection model: e.g. Luckin coffee (LKNCY)
- Dual-listed in AH markets or cross-listed in HK-US markets: e.g. HTSC (6886)
- Not meeting listing financial requirement of A share market: e.g. Pinduoduo (PDD)
- Subject to restrictions on foreign investment: e.g. Alibaba (BABA)
Firms in the Baseline Sample

- 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

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
Valuation by Tobin's Q

<table>
<thead>
<tr>
<th>Tobin’s Q</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
<th>4th Years</th>
<th>5th Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mainland</td>
<td>Overseas</td>
<td>Mainland</td>
<td>Overseas</td>
<td>Mainland</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>4.05</td>
<td>1.91</td>
<td>3.23</td>
<td>1.75</td>
<td>3.25</td>
</tr>
<tr>
<td><strong>p25</strong></td>
<td>2.32</td>
<td>0.98</td>
<td>1.87</td>
<td>0.88</td>
<td>1.84</td>
</tr>
<tr>
<td><strong>p50</strong></td>
<td>3.29</td>
<td>1.41</td>
<td>2.62</td>
<td>1.16</td>
<td>2.58</td>
</tr>
<tr>
<td><strong>p75</strong></td>
<td>5.05</td>
<td>2.22</td>
<td>4.00</td>
<td>1.85</td>
<td>3.83</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>2,153</td>
<td>576</td>
<td>1,963</td>
<td>492</td>
<td>1,864</td>
</tr>
</tbody>
</table>

- 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
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.
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.

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.

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.
Capital Outflow Control – The Powerful

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

- 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**

<table>
<thead>
<tr>
<th></th>
<th>China</th>
<th>HK &amp; US</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IPO system</strong></td>
<td>Administrative Approval</td>
<td>Registration</td>
</tr>
<tr>
<td><strong>Regime</strong></td>
<td>Merit-based</td>
<td>Disclosure-based</td>
</tr>
<tr>
<td><strong>Philosophy</strong></td>
<td>Regulators make a value judgement to protect investors and to foster national policy</td>
<td>Regulators believe that an informed investor is a protected investor</td>
</tr>
<tr>
<td><strong>Practice</strong></td>
<td>New listings to be cleared by regulators on a case-by-case basis</td>
<td>New listings to be registered with regulators as long as meeting disclosure requirements</td>
</tr>
<tr>
<td><strong>Feature</strong></td>
<td>Opaque, prolonged and with ad-hoc interventions</td>
<td>transparent, streamlined and well-expected</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>1-5 years</td>
<td>6-12 months</td>
</tr>
</tbody>
</table>
**Regulations in IPO System – IPO Issue Price**

- **Distortions in IPO Issue Price**

<table>
<thead>
<tr>
<th>Period</th>
<th>Rules or Reforms</th>
<th>IPO PE Restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before July 1997</td>
<td>Window guidance</td>
<td>12 ≤ PE ≤ 15</td>
</tr>
<tr>
<td>July 1997 – Nov 2001</td>
<td>CSRC followed “Security Law”</td>
<td>No PE restrictions</td>
</tr>
<tr>
<td>Dec 2004 – June 2009</td>
<td>Book building reform</td>
<td>PE ≤ 30</td>
</tr>
<tr>
<td>June 2009 – April 2012</td>
<td>CSRC issued “Guiding Opinions”</td>
<td>No PE restrictions</td>
</tr>
<tr>
<td>April 2012 – Oct 2012</td>
<td>CSRC issued “Further Notice”</td>
<td>PE &lt; 125% industry average</td>
</tr>
<tr>
<td>Oct 2012 – April 2014</td>
<td>IPO suspension</td>
<td>No IPO</td>
</tr>
<tr>
<td><strong>April 2014 – next reform</strong></td>
<td>Window guidance</td>
<td>PE ≤ 23</td>
</tr>
<tr>
<td>June 2019 – present</td>
<td>Establishment of STAR</td>
<td>No PE restrictions</td>
</tr>
<tr>
<td>June 2020 – present</td>
<td>IPO reform for ChiNext</td>
<td>No PE restrictions</td>
</tr>
<tr>
<td>Feb 2023 – present</td>
<td>IPO reform for main board</td>
<td>No PE restrictions</td>
</tr>
</tbody>
</table>
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
  • ς: 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

\[
\text{PV of 1 RMB} = \frac{Q_0}{(1 + r)^{T_0}}
\]

\[
Q_0 = \text{PV of } (CF_{T_0} \ldots \ldots CF_T)
\]

\[
\text{PV of 1 USD} = \frac{Q_1}{(1 + r)^{T_0}}
\]

\[
Q_1 = \text{PV of } (CF_{T_1} \ldots \ldots CF_T)
\]
Valuation in Home and Overseas Market

• The wealth generated from 1 RMB or 1/e USD after IPO in two markets are $Q_0$ and $Q_1/e$

• The PV of wealth after discounting the delay in waiting and lock-up period are
  \[
  \frac{Q_0}{(1+r)^T_0} \quad \text{and} \quad \frac{1}{e} \frac{Q_1}{(1+r)^T_1}
  \]

• The PV of wealth in market 0 that is denominated in USD at a subjective exchange rate $(1+\delta)e$ 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 ($\tau$) 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

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

• 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 (\( \tau \)) and IPO regulation (\( d \)), on top of individual subjective exchange rate (\( \delta \))
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 \( \mu_c \) are potential mean of population valuation and cost

• And \( \varepsilon_0 \), \( \varepsilon_1 \) and \( \varepsilon_c \) follow a tri-variate normal distribution

\[
\begin{pmatrix}
\varepsilon_0 \\
\varepsilon_1 \\
\varepsilon_c
\end{pmatrix}
\sim N
\begin{pmatrix}
0 \\
0 \\
0
\end{pmatrix}
,
\begin{pmatrix}
\sigma_0^2 & \rho_{01}\sigma_0\sigma_1 & \rho_{0c}\sigma_0\sigma_c \\
\rho_{01}\sigma_0\sigma_1 & \sigma_1^2 & \rho_{1c}\sigma_1\sigma_c \\
\rho_{0c}\sigma_0\sigma_c & \rho_{1c}\sigma_1\sigma_c & \sigma_c^2
\end{pmatrix}
\]
Probability of Overseas IPO

• Recall the distribution of Tobin’s Q and cost
  \[ q_0 = \mu_0 + \varepsilon_0, \quad q_1 = \mu_1 + \varepsilon_1, \text{ and } c = \mu_c + \varepsilon_c \]

• The decision rule for overseas IPO
  \[ q_1 - q_0 \geq -c \]

• The probability of overseas IPO is
  \[ P = Pr[\varepsilon_1 - \varepsilon_0 + \varepsilon_c > -(\mu_1 - \mu_0 + \mu_c)] \]
  \[ = Pr\left[\frac{\nu}{\sigma_\nu} > -(\mu_1 - \mu_0 + \mu_c)/\sigma_\nu\right] \]
  \[ = 1 - \Phi(w) \]
  \[ = \Phi(-w) \]

• where \( -w = (\mu_1 - \mu_0 + \mu_c)/\sigma_\nu \) and \( \nu = \varepsilon_1 - \varepsilon_0 + \varepsilon_c, \nu \sim N(0, \sigma_\nu^2) \)

• 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

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

• 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

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

SB speaks the sign of selection in domestic market \(S_0\)

• GMD: the group mean difference observed by econometrician

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

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

\begin{align*}
(1) \quad t_i &= 1\{X_i \alpha_1 + Z_i \alpha_2 + v_i > 0\} \\
(2) \quad y_i &= t_i y_i1 + (1 - t_i)y_i0 \\
(3) \quad y_i1 &= X_i \beta_{11} + \varepsilon_{i1} \\
(4) \quad y_i0 &= X_i \beta_{10} + \varepsilon_{i0}
\end{align*}

\begin{equation}
\begin{pmatrix}
\varepsilon_{i0} \\
\varepsilon_{i1} \\
v_i
\end{pmatrix} \sim D \left\{ \begin{pmatrix}
0 \\
0 \\
0
\end{pmatrix}, \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_0 & \rho_{1v} \sigma_1 & 1
\end{pmatrix} \right\}
\end{equation}

• $t_i$: 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
• $\varepsilon_i$: unobserved factors which may affect market valuation
Link with the Theory

• Empirical model

\[(1) \quad t_i = 1\{X_i\alpha_1 + Z_i\alpha_2 + \nu_i > 0\}\]
\[(2) \quad y_i = t_i y_{i1} + (1 - t_i)y_{i0}\]
\[(3) \quad y_{i1} = X_i\beta_{11} + \varepsilon_{i1}\]
\[(4) \quad y_{i0} = X_i\beta_{10} + \varepsilon_{i0}\]

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

• Relation to the theory model

• \(\mu_1 = X_i\beta_{11}, \mu_0 = X_i\beta_{10}\)
• \(-\nu = (\mu_1 - \mu_0 + \mu_c)/\sigma_v = (-X_i\alpha_1 - Z_i\alpha_2)/\sigma_v\)
• \(\nu_i = \varepsilon_{i1} - \varepsilon_{i0} + \varepsilon_{ic}\)

• Subsample vs Population

• Notice \(\sigma'_0\) and \(\sigma'_1\) 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 \(\sigma'_v\) 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 ($S_{0\epsilon}$ and $S_{1\epsilon}$)

• We have $S_{0y} = S_{0x} + S_{0\epsilon}$ and $S_{1y} = S_{1x} + S_{1\epsilon}$ where

\[
S_{0x} = \beta_{10} E[(X_i | t_i = 1) - (X_i | t_i = 0)](1 - P_i)
\]
\[
S_{1x} = \beta_{11} E[(X_i | t_i = 1) - (X_i | t_i = 1)](1 - P_i)
\]
\[
S_{0\epsilon} = \frac{\sigma_0 \sigma_1}{\sigma_v} \left[ \left( \rho_{10} - \frac{\sigma_0}{\sigma_1} \right) + \rho_{0c} \frac{\sigma_c}{\sigma_1} \right] h
\]
\[
S_{1\epsilon} = \frac{\sigma_0 \sigma_1}{\sigma_v} \left[ \left( \frac{\sigma_1}{\sigma_0} - \rho_{10} \right) + \rho_{1c} \frac{\sigma_c}{\sigma_0} \right] h
\]

• 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

\begin{align*}
(1') \quad & t_i = 1\{X_i \alpha_1 + Z_i \alpha_2 + v_i > 0\} \\
(2') \quad & y_i = X_i \beta_1 + \theta t_i + \epsilon_i \Rightarrow \\
& \begin{cases} 
  y_{i0} = X_{i0} \beta_1 + \epsilon_{i0} \\
  y_{i1} = X_{i1} \beta_1 + \theta + \epsilon_{i1} 
\end{cases} \\
(3') \quad & \begin{pmatrix} \epsilon_i \\ v_i \end{pmatrix} \sim D \left\{ \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma^2 & \rho \sigma \\ \rho \sigma & 1 \end{pmatrix} \right\}
\end{align*}

• Under (2'), $\beta_{10} = \beta_{11}$ for $X_i$; $\theta$ 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. \( y_{i0} = X_i \beta_{10} + \varepsilon_{i0} \)

  \[
  \begin{pmatrix}
  \varepsilon_{i0} \\
  \varepsilon_{i1} \\
  y_i
  \end{pmatrix}
  \sim N
  \begin{pmatrix}
  0 \\
  0 \\
  0
  \end{pmatrix},
  \begin{pmatrix}
  \sigma_0^2 & \rho_{01} \sigma_0 \sigma_1 & \rho_{0v} \sigma_0' \\
  \rho_{01} \sigma_0 \sigma_1 & \sigma_1^2 & \rho_{1v} \sigma_1' \\
  \rho_{0v} \sigma_0' & \rho_{1v} \sigma_1' & 1
  \end{pmatrix}
  \]

• 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 \\
  y_i
  \end{pmatrix}
  \sim N
  \begin{pmatrix}
  0 \\
  0
  \end{pmatrix},
  \begin{pmatrix}
  \sigma^2 & \rho \sigma \\
  \rho \sigma & 1
  \end{pmatrix}
  \]

Unobserved variables

\( \varepsilon_i \) \quad \text{Outcome(firm’ valuation)} \quad \text{Treatment(overseas listing)} \quad \varepsilon_i \quad \nu_i \
Identification: Estimation Methods

• Both models could be consistently estimated by MLE or Heckman’s two-step procedure, under distributional assumption on $v_i$ and $\varepsilon_i$

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

• Main idea: projecting $\varepsilon_i$ 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 $\varepsilon_i$ 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 $\varepsilon_i$ 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, \( v_i \) is obtained as \( t_i - E(t_i | X_i, Z_i) \)

• So that \( v_i \) 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

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Overseas listing</th>
<th>Tobin's Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.034***</td>
<td>-0.006</td>
</tr>
<tr>
<td>Log(total asset)</td>
<td>-0.154***</td>
<td>-0.530***</td>
</tr>
<tr>
<td>ROA(%)</td>
<td>0.036***</td>
<td>0.062***</td>
</tr>
<tr>
<td>Sales growth rate (%)</td>
<td>0.007***</td>
<td>0.006***</td>
</tr>
<tr>
<td>Leverage (%)</td>
<td>0.023***</td>
<td>-0.007**</td>
</tr>
<tr>
<td>Intangible assets ratio (%)</td>
<td>0.014***</td>
<td>0.017***</td>
</tr>
<tr>
<td>State ownership percentage (%)</td>
<td>0.003</td>
<td>0.004***</td>
</tr>
<tr>
<td>Independent director ratio (%)</td>
<td>0.071***</td>
<td>-0.007</td>
</tr>
<tr>
<td>CEO=Chairman</td>
<td>0.315***</td>
<td>0.090</td>
</tr>
<tr>
<td>Top5 ownership percentage (%)</td>
<td>0.007**</td>
<td>-0.007</td>
</tr>
<tr>
<td>Controlling shareholder dummy</td>
<td>0.329***</td>
<td>0.146</td>
</tr>
<tr>
<td>Import and export ratio (%)</td>
<td>-0.001</td>
<td>-0.002</td>
</tr>
<tr>
<td>Strategic investor dummy</td>
<td>0.693***</td>
<td>0.084</td>
</tr>
<tr>
<td>Foreign reserve growth rate (%)</td>
<td>-0.011</td>
<td>0.003</td>
</tr>
<tr>
<td>Foreign ownership percentage (%)</td>
<td>0.011***</td>
<td>0.003</td>
</tr>
<tr>
<td>Operating cash flow ratio(%)</td>
<td>-0.026***</td>
<td>0.012*</td>
</tr>
<tr>
<td>PE regulation</td>
<td>0.022*</td>
<td>-0.027**</td>
</tr>
<tr>
<td>Expected relative waiting days</td>
<td>0.350***</td>
<td><strong>ATE = ATET = \theta</strong></td>
</tr>
<tr>
<td>Log(relative market index)</td>
<td>0.409***</td>
<td>YES</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Industry</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>YES</td>
</tr>
<tr>
<td>Province GDP per capita</td>
<td>YES</td>
</tr>
<tr>
<td>Observations</td>
<td>2,729</td>
</tr>
</tbody>
</table>

ATE = ATET = \theta
## Decomposition: Simple Model - 1-Year post IPO

<table>
<thead>
<tr>
<th></th>
<th>Estimates</th>
<th>Observable</th>
<th>Unobservables</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E[Y0</td>
<td>t=0]$: observed</td>
<td>4.05***</td>
<td></td>
</tr>
<tr>
<td>$E[Y1</td>
<td>t=1]$: observed</td>
<td>1.91***</td>
<td></td>
</tr>
<tr>
<td>$E[Y1</td>
<td>t=0]$: predicted</td>
<td>1.43***</td>
<td></td>
</tr>
<tr>
<td>$E[Y0</td>
<td>t=1]$: predicted</td>
<td>4.53***</td>
<td></td>
</tr>
<tr>
<td>$ATET = ATE = E[Y1</td>
<td>t=1] - E[Y0</td>
<td>t=1]$</td>
<td>-2.62***</td>
</tr>
<tr>
<td>Valuation discount = $ATET/E[Y0</td>
<td>t=1]$</td>
<td>-57.8%</td>
<td></td>
</tr>
<tr>
<td>$\mu_0 = (1-P)*E[Y0</td>
<td>t=0] + P*E[Y0</td>
<td>t=1]$</td>
<td>4.15***</td>
</tr>
<tr>
<td>$\mu_1 = (1-P)*E[Y1</td>
<td>t=0] + P*E[Y1</td>
<td>t=1]$</td>
<td>1.53***</td>
</tr>
<tr>
<td>$S_0 = E[Y0</td>
<td>t=1] - \mu_0$</td>
<td>0.38</td>
<td>0.27*</td>
</tr>
<tr>
<td>$S_1 = E[Y1</td>
<td>t=1] - \mu_1$</td>
<td>0.38</td>
<td>0.27*</td>
</tr>
<tr>
<td>$GMD = E[Y1</td>
<td>t=1] - E[Y0</td>
<td>t=1]$: observed</td>
<td>-2.14***</td>
</tr>
<tr>
<td>$ATET = E[Y1</td>
<td>t=1] - E[Y0</td>
<td>t=1]$: estimated</td>
<td>-2.62***</td>
</tr>
<tr>
<td>$SB = E[Y0</td>
<td>t=1] - E[Y0</td>
<td>t=0]$: estimated</td>
<td>0.48</td>
</tr>
</tbody>
</table>

- Significant treatment effect due to capital market distortions
- Mild positive selection and largely due to observables
## Decomposition: General Model - 1-Year post IPO

<table>
<thead>
<tr>
<th></th>
<th>Estimates</th>
<th>Observable</th>
<th>Unobservables</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E[Y_0</td>
<td>t=0]$ : observed</td>
<td>4.05***</td>
<td></td>
</tr>
<tr>
<td>$E[Y_1</td>
<td>t=1]$ : observed</td>
<td>1.91***</td>
<td></td>
</tr>
<tr>
<td>$E[Y_1</td>
<td>t=0]$ : predicted</td>
<td>3.24***</td>
<td></td>
</tr>
<tr>
<td>$E[Y_0</td>
<td>t=1]$ : predicted</td>
<td>5.57***</td>
<td></td>
</tr>
<tr>
<td>$ATE = E[Y_1] - E[Y_0]$</td>
<td></td>
<td></td>
<td>-1.42***</td>
</tr>
<tr>
<td>Valuation discount for population: $ATE/E[Y_0]$</td>
<td></td>
<td>-32.4%</td>
<td></td>
</tr>
<tr>
<td>$ATET = E[Y_1</td>
<td>t=1] - E[Y_0</td>
<td>t=1]$</td>
<td></td>
</tr>
<tr>
<td>Valuation discount for treated: $ATET/E[Y_0</td>
<td>t=1]$</td>
<td></td>
<td>-65.7%</td>
</tr>
<tr>
<td>$\mu_0 = (1-P)*E[Y_0</td>
<td>t=0] + P*E[Y_0</td>
<td>t=1]$</td>
<td>4.38***</td>
</tr>
<tr>
<td>$\mu_1 = (1-P)*E[Y_1</td>
<td>t=0] + P*E[Y_1</td>
<td>t=1]$</td>
<td>2.96 ***</td>
</tr>
<tr>
<td>$S_0 = E[Y_0</td>
<td>t=1] - \mu_0$</td>
<td>1.19***</td>
<td>0.79***</td>
</tr>
<tr>
<td>$S_1 = E[Y_1</td>
<td>t=1] - \mu_1$</td>
<td>-1.05***</td>
<td>-0.62***</td>
</tr>
<tr>
<td>GMD = $E[Y_1</td>
<td>t=1] - E[Y_0</td>
<td>t=1]$ : observed</td>
<td>-2.14***</td>
</tr>
<tr>
<td>ATET = $E[Y_1</td>
<td>t=1] - E[Y_0</td>
<td>t=1]$ : estimated</td>
<td>-3.66***</td>
</tr>
<tr>
<td>SB = $E[Y_0</td>
<td>t=1] - E[Y_0</td>
<td>t=0]$ : estimated</td>
<td>1.52***</td>
</tr>
</tbody>
</table>

- 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

\begin{align*}
\text{Graph 1: } S_o > 0 & \quad t_i = 0 \\
\text{Graph 2: } S_i < 0 & \quad t_i = 1
\end{align*}
### Simple Model – Valuation Discount by Horizon

<table>
<thead>
<tr>
<th>Variables</th>
<th>At IPO</th>
<th>1-Day</th>
<th>1-Year</th>
<th>2-Year</th>
<th>3-Year</th>
<th>4-Year</th>
<th>5-Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATET = ATE</td>
<td>-2.24***</td>
<td>-4.01***</td>
<td>-2.62***</td>
<td>-1.49***</td>
<td>-0.92***</td>
<td>-1.33***</td>
<td>-1.99***</td>
</tr>
<tr>
<td></td>
<td>(0.32)</td>
<td>(0.54)</td>
<td>(0.37)</td>
<td>(0.29)</td>
<td>(0.26)</td>
<td>(0.27)</td>
<td>(0.23)</td>
</tr>
<tr>
<td>E[Y0</td>
<td>t=1]</td>
<td>5.08***</td>
<td>7.28***</td>
<td>4.53***</td>
<td>3.25***</td>
<td>2.45***</td>
<td>2.78***</td>
</tr>
<tr>
<td></td>
<td>(0.33)</td>
<td>(0.55)</td>
<td>(0.33)</td>
<td>(0.26)</td>
<td>(0.25)</td>
<td>(0.26)</td>
<td>(0.23)</td>
</tr>
<tr>
<td>ATET/E[Y0</td>
<td>t=1]</td>
<td>-44%</td>
<td>-55%</td>
<td>-58%</td>
<td>-46%</td>
<td>-38%</td>
<td>-48%</td>
</tr>
<tr>
<td>Observations</td>
<td>2,675</td>
<td>2,675</td>
<td>2,729</td>
<td>2,455</td>
<td>2,278</td>
<td>1,787</td>
<td>1,517</td>
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</tbody>
</table>
### General Model – Valuation Discount by Horizon

<table>
<thead>
<tr>
<th>Variables</th>
<th>1-Year</th>
<th>2-Year</th>
<th>3-Year</th>
<th>4-Year</th>
<th>5-Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATET</td>
<td>5.57***</td>
<td>-1.74***</td>
<td>-1.18***</td>
<td>-1.56***</td>
<td>-2.51***</td>
</tr>
<tr>
<td></td>
<td>(0.40)</td>
<td>(0.35)</td>
<td>(0.40)</td>
<td>(0.48)</td>
<td>(0.40)</td>
</tr>
<tr>
<td>E[Y0</td>
<td>t=1]</td>
<td>-66%</td>
<td>-50%</td>
<td>-44%</td>
<td>-52%</td>
</tr>
<tr>
<td></td>
<td>(0.40)</td>
<td>(0.34)</td>
<td>(0.40)</td>
<td>(0.48)</td>
<td>(0.38)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>samples</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AH dual-listed</td>
<td>other overseas listed</td>
<td>AH dual-listed</td>
<td>other overseas listed</td>
<td>AH dual-listed</td>
<td>other overseas listed</td>
<td>AH dual-listed</td>
<td>Overseas listed</td>
<td>AH dual-listed</td>
<td>other overseas listed</td>
</tr>
<tr>
<td>1st Year</td>
<td>29</td>
<td>30</td>
<td>31</td>
<td>38</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd Year</td>
<td>31</td>
<td>38</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3rd Year</td>
<td>38</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th Year</td>
<td>35</td>
<td></td>
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<td>5th Year</td>
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<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Overseas Code</th>
<th>Year of delisting</th>
<th>Firms in A shares</th>
<th>A-share Code</th>
<th>Year of relisting in A</th>
<th>Tobin's Q 1 year after relisting</th>
<th>Tobin's Q 1 year before delisting</th>
<th>Valuation discount-Tobin's Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTFO.O</td>
<td>2012</td>
<td>千方科技</td>
<td>002373.SZ</td>
<td>2013</td>
<td>10.07</td>
<td>0.92</td>
<td>-90.91%</td>
</tr>
<tr>
<td>PWRD.O</td>
<td>2015</td>
<td>完美世界</td>
<td>002624.SZ</td>
<td>2015</td>
<td>12.87</td>
<td>1.23</td>
<td>-90.43%</td>
</tr>
<tr>
<td>0597.HK</td>
<td>2011</td>
<td>华润微</td>
<td>688396.SH</td>
<td>2020</td>
<td>5.73</td>
<td>0.96</td>
<td>-83.29%</td>
</tr>
<tr>
<td>MR!.N</td>
<td>2016</td>
<td>迈瑞医疗</td>
<td>300760.SZ</td>
<td>2018</td>
<td>8.98</td>
<td>1.63</td>
<td>-81.90%</td>
</tr>
<tr>
<td>YTEC.O</td>
<td>2012</td>
<td>宇信科技</td>
<td>300674.SZ</td>
<td>2018</td>
<td>4.11</td>
<td>0.76</td>
<td>-81.45%</td>
</tr>
<tr>
<td>JASO.O</td>
<td>2018</td>
<td>晶澳科技</td>
<td>002459.SZ</td>
<td>2018</td>
<td>4.04</td>
<td>0.77</td>
<td>-80.92%</td>
</tr>
<tr>
<td>FMCN.O</td>
<td>2013</td>
<td>分众传媒</td>
<td>002027.SZ</td>
<td>2016</td>
<td>10.44</td>
<td>2.00</td>
<td>-80.87%</td>
</tr>
<tr>
<td>0963.HK</td>
<td>2017</td>
<td>华熙生物</td>
<td>688363.SH</td>
<td>2019</td>
<td>11.52</td>
<td>2.43</td>
<td>-78.94%</td>
</tr>
<tr>
<td>GA.N</td>
<td>2014</td>
<td>巨人网络</td>
<td>002558.SZ</td>
<td>2016</td>
<td>11.52</td>
<td>2.99</td>
<td>-74.00%</td>
</tr>
<tr>
<td>TSL.N</td>
<td>2017</td>
<td>天合光能</td>
<td>688599.SH</td>
<td>2020</td>
<td>2.47</td>
<td>0.95</td>
<td>-61.69%</td>
</tr>
<tr>
<td>QIHU.N</td>
<td>2016</td>
<td>三六零</td>
<td>601360.SH</td>
<td>2018</td>
<td>5.33</td>
<td>2.98</td>
<td>-44.12%</td>
</tr>
<tr>
<td>MONT.O</td>
<td>2014</td>
<td>澜起科技</td>
<td>688008.SH</td>
<td>2019</td>
<td>12.76</td>
<td>7.96</td>
<td>-37.64%</td>
</tr>
<tr>
<td>MY.N</td>
<td>2016</td>
<td>明阳智能</td>
<td>601615.SH</td>
<td>2019</td>
<td>1.39</td>
<td>0.88</td>
<td>-36.66%</td>
</tr>
<tr>
<td>CEO.N</td>
<td>2021</td>
<td>中国海油</td>
<td>600938.SZ</td>
<td>2022</td>
<td>1.20</td>
<td>0.88</td>
<td>-27.00%</td>
</tr>
<tr>
<td>XUE.N</td>
<td>2016</td>
<td>学大教育</td>
<td>000526.SZ</td>
<td>2016</td>
<td>1.98</td>
<td>1.51</td>
<td>-23.79%</td>
</tr>
<tr>
<td>CHL.N</td>
<td>2021</td>
<td>中国移动</td>
<td>600941.SZ</td>
<td>2022</td>
<td>1.13</td>
<td>0.94</td>
<td>-17.21%</td>
</tr>
<tr>
<td>CHA.N</td>
<td>2021</td>
<td>中国电信</td>
<td>601728.SH</td>
<td>2021</td>
<td>0.91</td>
<td>0.75</td>
<td>-17.01%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>6.26</strong></td>
<td><strong>1.80</strong></td>
<td><strong>-71.32%</strong></td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>5.33</strong></td>
<td><strong>0.96</strong></td>
<td><strong>-82.04%</strong></td>
</tr>
</tbody>
</table>
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 ($\tau > 0 \Rightarrow ATE \downarrow$)
  • Exchange rate reform in 2015 ($\delta > 0 \Rightarrow ATE \downarrow$)

• Regulations in IPO system
  • IPO suspension between 2012 and 2014 ($d > 0 \Rightarrow ATE \downarrow$)
  • PE restriction between March 2014 and June 2020 ($q_0 \downarrow \Rightarrow change in marginal entrepreneur \Rightarrow ATE \downarrow$)
## DID Results for Policy Distortions

**Dependent** | **Tobin’s Q 1-year post IPO**
--- | ---
| (1) | (2) | (3) | (4) | (5)
--- | --- | --- | --- | ---
(0.376) | (0.384) | (0.432) | (0.381) | (0.508)
Capital control | 1.088*** | 1.106*** | 1.106*** | 1.106*** | 1.106***
(0.392) | (0.360)
Overseas listing*Capital controls | -0.897** | -1.671*** | -1.671*** | -1.671*** | -1.671***
(0.454) | (0.582)
Exchange rate reform | -0.275 | 0.176 | 0.176 | 0.176 | 0.176
(0.195) | (0.277)
(0.312) | (0.564)
IPO suspension | 0.271 | 0.271 | 0.271 | 0.271 | 0.271
(0.275) | (0.394)
Overseas listing*IPO suspension | -1.683*** | -2.373*** | -2.373*** | -2.373*** | -2.373***
(0.327) | (0.533)
PE restriction | -0.806 | -1.252** | -1.252** | -1.252** | -1.252**
(0.504) | (0.563)
Overseas listing*PE restriction | -0.987*** | 0.327 | 0.327 | 0.327 | 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
## DID Results for Firm Heterogeneity

<table>
<thead>
<tr>
<th>Dependent</th>
<th>Tobin’s Q 1-year post IPO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Overseas listing</td>
<td>-2.787***</td>
</tr>
<tr>
<td></td>
<td>(0.385)</td>
</tr>
<tr>
<td>Overseas listing*SOE dummy</td>
<td>0.716***</td>
</tr>
<tr>
<td></td>
<td>(0.236)</td>
</tr>
<tr>
<td>Overseas listing*High foreign ownership</td>
<td>-0.917***</td>
</tr>
<tr>
<td></td>
<td>(0.253)</td>
</tr>
<tr>
<td>Overseas listing*High operating risk</td>
<td>-0.726***</td>
</tr>
<tr>
<td></td>
<td>(0.189)</td>
</tr>
<tr>
<td>Overseas listing*Capital control</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Overseas listing*Exchange rate reform</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Overseas listing*IPO suspension</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Overseas listing*PE restriction</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>2,729</td>
</tr>
</tbody>
</table>
Back to the Theory Model

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

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

• Decision rule \( q_1 - q_0 \geq -c \), where

\[ q_0 = \mu_0 + \varepsilon_0 \]
\[ q_1 = \mu_1 + \varepsilon_1 \]
\[ c = \mu_c + \varepsilon_c \]

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

• 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

<table>
<thead>
<tr>
<th>parameter</th>
<th>estimate</th>
<th>s.e.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu_0$</td>
<td>1.500</td>
<td>0.028</td>
</tr>
<tr>
<td>$\mu_1$</td>
<td>0.663</td>
<td>0.052</td>
</tr>
<tr>
<td>$\mu_c$</td>
<td>0.322</td>
<td>0.085</td>
</tr>
<tr>
<td>$\sigma_0$</td>
<td>0.333</td>
<td>0.013</td>
</tr>
<tr>
<td>$\sigma_1$</td>
<td>0.540</td>
<td>0.037</td>
</tr>
<tr>
<td>$\sigma_c$</td>
<td>1.172</td>
<td>0.031</td>
</tr>
<tr>
<td>$\rho_{01}$</td>
<td>0.229</td>
<td>0.614</td>
</tr>
<tr>
<td>$\rho_{0c}$</td>
<td>0.584</td>
<td>0.089</td>
</tr>
<tr>
<td>$\rho_{1c}$</td>
<td>-0.775</td>
<td>0.058</td>
</tr>
</tbody>
</table>

Targeted moments data simulated

<table>
<thead>
<tr>
<th>moment</th>
<th>data</th>
<th>simulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E[Y_{i0}]$</td>
<td>4.38</td>
<td>4.74</td>
</tr>
<tr>
<td>$E[Y_{i1}]$</td>
<td>2.96</td>
<td>2.24</td>
</tr>
<tr>
<td>$P[t_i = 1]$</td>
<td>0.21</td>
<td>0.23</td>
</tr>
<tr>
<td>$E[\epsilon_{i0}</td>
<td>t_i = 0]$</td>
<td>-0.11</td>
</tr>
<tr>
<td>$E[\epsilon_{i1}</td>
<td>t_i = 1]$</td>
<td>-0.43</td>
</tr>
<tr>
<td>$sd[\epsilon_{i0}</td>
<td>t_i = 0]$</td>
<td>1.71</td>
</tr>
<tr>
<td>$sd[\epsilon_{i0}</td>
<td>t_i = 0]$</td>
<td>1.82</td>
</tr>
<tr>
<td>$corr[v_{it}, \epsilon_{i0}</td>
<td>t_i = 0]$</td>
<td>0.14</td>
</tr>
<tr>
<td>$corr[v_{it}, \epsilon_{i1}</td>
<td>t_i = 1]$</td>
<td>-0.24</td>
</tr>
</tbody>
</table>

Untargeted moments data simulated

<table>
<thead>
<tr>
<th>moment</th>
<th>data</th>
<th>simulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E[Y_{i0}</td>
<td>t_i = 0]$</td>
<td>4.05</td>
</tr>
<tr>
<td>$E[Y_{i1}</td>
<td>t_i = 1]$</td>
<td>1.91</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>τ</th>
<th>r</th>
<th>$T_0$</th>
<th>$T_1$</th>
<th>d</th>
<th>$\mu_c$</th>
<th>$P(t=1)$</th>
<th>$E[U]$</th>
<th>$\Delta E[U]$ %</th>
</tr>
</thead>
<tbody>
<tr>
<td>factual</td>
<td>0.22</td>
<td>0.05</td>
<td>3.33</td>
<td>1.25</td>
<td>0.10</td>
<td>0.32</td>
<td>0.23</td>
<td>1.21</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>welfare loss</th>
<th>18.00%</th>
<th>28.50%</th>
<th>0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu_c = 0$</td>
<td>$U_0 = 1.784$</td>
<td>$U_0 = 0.610$</td>
<td>$U_1 = 0.300$</td>
</tr>
<tr>
<td>identity</td>
<td>currently $t_i = 0$</td>
<td>$t_i = 0$ if $\mu_c = 0$</td>
<td>$t_i = 1$ if $\mu_c = 0.32$</td>
</tr>
<tr>
<td>$\mu_c = 0.32$</td>
<td>$U_0 = 1.462$</td>
<td>$U_1 = 0.436$</td>
<td>$U_1 = 0.300$</td>
</tr>
<tr>
<td>proportion</td>
<td>76.8%</td>
<td>11.6%</td>
<td>11.5%</td>
</tr>
</tbody>
</table>

Note: □ home listing □ overseas listing

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

<table>
<thead>
<tr>
<th>Variables</th>
<th>Tobin's Q</th>
<th>1st Year</th>
<th>1st Year</th>
<th>1st Year</th>
<th>1st Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Benchmark sample</td>
<td>+Restricted</td>
<td>+Restricted &amp; Prohibited</td>
<td>+Negative list &amp; Unqualified firms</td>
<td></td>
</tr>
<tr>
<td>ATET=ATE</td>
<td>-2.62***</td>
<td>-2.73***</td>
<td>-2.88***</td>
<td>-3.13***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.37)</td>
<td>(0.28)</td>
<td>(0.24)</td>
<td>(0.33)</td>
<td></td>
</tr>
<tr>
<td>POM_(E[Y0</td>
<td>t=1])</td>
<td>4.53</td>
<td>4.64</td>
<td>4.84</td>
<td>5.33</td>
</tr>
<tr>
<td>ATET/POM_(E[Y0</td>
<td>t=1])</td>
<td>-57.84%</td>
<td>-58.84%</td>
<td>-59.50%</td>
<td>-58.72%</td>
</tr>
<tr>
<td>Observations</td>
<td>2,729</td>
<td>2,857</td>
<td>2,913</td>
<td>3,072</td>
<td></td>
</tr>
</tbody>
</table>

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.