FDI and Firm Productivity: The Role of Financial Constraints

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PBC School of Finance, Tsinghua University
Advantages of FDI firms

- Higher productivity
  - Direct effect: Introduce advanced technology/skills
  - Indirect effect: Technology/human capital spillovers
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- Less financially constrained
  - Improve the host countries’ financial conditions
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- The above two factors may not work in the same direction.
A case with inefficient local financial markets

- Local firms face serious financial constraints.
  - Underdevelopment of financial markets
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  - Show this in a simple theoretical model.
  - Find empirical evidence in the firm-level data of China.
A simple theoretical model

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- Entrepreneurs with higher productivity are financially less constrained.
  - High-productivity firms are financed by local banks for start-up costs.
- FDI finances firms with middle-range productivity.
Empirical findings in the firm-level data of China

- TFP of new firms decreases with their FDI shares.
Empirical findings in the firm-level data of China

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  - More pronounced in financially more constrained sectors
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- Consistent with China’s capital account liberalization
A well-known puzzle for FDI

- Theory: More productive FDI firms $\Rightarrow$ spillovers to local firms
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Our results suggest that

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Policy implications and related literature

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Policy implications and related literature

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- Our results suggest that
  - Previous mixed findings are not surprising.
  - FDI could reduce the host country’s welfare.
    - Negative effect on local firm’s credit constraint: Harrison and McMillan (2003)
Policy implications and related literature

- Reform domestic financial markets to improve the effect of FDI
  - Efficient local financial markets $\Rightarrow$ local firms less financial constrained

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- Economies with better financial institutions benefit more from FDI for economic growth.
  - Alfaro et al. (2004)
  - Better local financial institutions finance technology spillovers more efficiently.

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Policy implications and related literature

- The more FDI, the better?
  - FDI may be an indicator of inefficient local financial markets
  - Improving local financial markets can decrease FDI inflows.
  - No policy is needed to maintain FDI inflows in this case.
    - Subsidize low-productivity firms at the cost of high-productivity firms.
Data
Data: China Annual Surveys of Industrial Production

- Chinese manufacturing firms with sales ≥ $600,000 between 2000 and 2007
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- **Chinese manufacturing firms with sales $\geq$ $600,000** between 2000 and 2007
- **120,000 observations per year**
- **Basic firm information**: identification, registration type, start year, employment, etc.
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  - **FDI share**: share of capital from Hong Kong, Macau, Taiwan and foreign countries
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- Basic firm information: identification, registration type, start year, employment, etc.
- Balance sheet: total assets, liabilities, owner’s equity, etc.
  - FDI share: share of capital from Hong Kong, Macau, Taiwan and foreign countries
- Income statement: total sales, production, exports, income, costs, etc.
Follow Ackerberg, Caves and Frazer (2006)

- Assumption: Productivity affects firms’ decision on labor and capital

\[ y_{it} = \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \epsilon_{it} \]

Estimation result: \( \hat{\omega}_{it} \Rightarrow \tilde{\omega}_{it} \)

\[ \tilde{\omega}_{it} = \frac{\hat{\omega}_{it} - \mu_t}{\sigma_t} \]

- \( \mu_t \): Industry mean
- \( \sigma_t \): Industry standard deviation
Financial vulnerability

- Measure financial vulnerability
  - Measuring financial constraints at the firm level: endogeneity
Measure financial vulnerability

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- Variables to capture industry characteristics (e.g., Rajan and Zingales (1998))
Financial vulnerability

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  - Measuring financial constraints at the firm level: endogeneity
  - Variables to capture industry characteristics (e.g., Rajan and Zingales (1998))
  - Five variables calculated from publicly traded US firms (Manova, et al. (2013))
Financial vulnerability

- Higher values indicate financially more vulnerable.
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  - External finance dependence: \( \frac{\text{capital expenditure} - \text{operation cash flow}}{\text{capital expenditure}} \)
  - R&D intensity: \( \frac{\text{R&D expenditure}}{\text{total sales}} \)
  - Inventory intensity: \( \frac{\text{inventory}}{\text{total sales}} \)
  - Trade credit intensity: \( \frac{\text{account payable}}{\text{total assets}} \)
  - Asset tangibility: \( \frac{\text{tangible assets}}{\text{total assets}} \)
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Financial vulnerability: statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>25th percentile</th>
<th>75th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>External finance dependence</td>
<td>-0.27</td>
<td>0.06</td>
</tr>
<tr>
<td>Inventory ratio</td>
<td>0.13</td>
<td>0.18</td>
</tr>
<tr>
<td>R&amp;D ratio</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Tangibility</td>
<td>0.20</td>
<td>0.40</td>
</tr>
<tr>
<td>Trade credit</td>
<td>0.05</td>
<td>0.08</td>
</tr>
<tr>
<td>First principal component (FPC)</td>
<td>-0.79</td>
<td>0.79</td>
</tr>
</tbody>
</table>

- Obtained from Kroszner et al. (2007) and Fisman and Love (2003)
- First principal component (FPC)
  - Orthogonal transformation: 5 measures $\rightarrow$ 5 linearly uncorrelated principal components
  - FPC accounts for the largest portion of variance.
Empirical Results
Result 1: firm productivity and FDI shares
FDI firms more productivity?

For every year:

\[ \text{Productivity}_{ijp} = \alpha + \beta FDI_{ijp} + \gamma_1 \text{Firmcontrol}_i + \gamma_2 \text{Inddummy}_j + \gamma_3 \text{Locadummy}_p + \epsilon_{ijp} \]

- \( FDI_{ijp} \): FDI share
- \( \text{Firmcontrol}_i \): \( \log(\text{employment}), \log(\text{age}+1), \text{export/output} \)
- \( \text{Inddummy}_j \): 2-digit industry dummies
- \( \text{Locadummy}_p \): Province dummies, economic zone dummies
# Result for 2000

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficient</th>
<th>std. err.</th>
<th>t-value</th>
<th>95% Conf. Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDI share</td>
<td>0.168</td>
<td>0.0121</td>
<td>13.86</td>
<td>0.14</td>
</tr>
<tr>
<td>Employment</td>
<td>-0.054</td>
<td>0.0027</td>
<td>-20.34</td>
<td>-0.06</td>
</tr>
<tr>
<td>Age</td>
<td>-0.185</td>
<td>0.0038</td>
<td>-48.84</td>
<td>-0.19</td>
</tr>
<tr>
<td>Export ratio</td>
<td>0.001</td>
<td>0.0001</td>
<td>8.28</td>
<td>0.00</td>
</tr>
<tr>
<td>Economic zone</td>
<td>0.033</td>
<td>0.0094</td>
<td>3.52</td>
<td>0.01</td>
</tr>
</tbody>
</table>

**R-squared:** 0.12

**# of Observations:** 89,905

\[ \text{Productivity}_{ijpt} = \alpha + \beta FDI_{ijpt} + \gamma_1 \text{Firmcontrol}_{it} + \gamma_2 \text{Indcontrol}_{jt} + \gamma_3 \text{Locacontrol}_{pt} + \epsilon_{ijpt} \]

- \text{Indcontrol}_{jt}: HH index (competitiveness)
- \text{Locacontrol}_{pt}:
  - Market size: log(RGDP)
  - Market demand: log(RGDP per capita), log(retail sales)
  - Infrastructure: Railway, road
  - R&D: Number of scientists
  - Openness: import/GDP, export/GDP

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<tr>
<td>FDI share</td>
<td>0.0218</td>
<td>0.0071</td>
<td>3.06</td>
<td>0.0078 0.0358</td>
</tr>
<tr>
<td>Employment</td>
<td>-0.1030</td>
<td>0.0020</td>
<td>-52.79</td>
<td>-0.1068 -0.0992</td>
</tr>
<tr>
<td>Age</td>
<td>0.0990</td>
<td>0.0025</td>
<td>39.21</td>
<td>0.0941 0.1040</td>
</tr>
<tr>
<td>Export ratio</td>
<td>0.0000</td>
<td>0.0001</td>
<td>-0.20</td>
<td>-0.0001 0.0001</td>
</tr>
</tbody>
</table>

# of Observations 912,343  # of Groups 313,150
Diminishing elasticity of productivity w.r.t. FDI shares
Test: FDI’s productivity advantage diminished?

- Seemingly Uncorrelated Regression
- Cross-model comparison
  - $H_0 : \beta^{t+1} = \beta^t$
  - $H_1 : \beta^{t+1} \neq \beta^t$
- A Wald Test
## Productivity Elasticity of FDI Share Over Time

<table>
<thead>
<tr>
<th>Year</th>
<th>Elasticity</th>
<th>t-value</th>
<th>Cross-year Comparison</th>
<th>$\chi^2$ Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>0.215</td>
<td>19.66</td>
<td>2002 vs. 2001</td>
<td>9.15***</td>
</tr>
<tr>
<td>2002</td>
<td>0.186</td>
<td>17.57</td>
<td>2003 vs. 2002</td>
<td>3.85**</td>
</tr>
<tr>
<td>2003</td>
<td>0.150</td>
<td>15.34</td>
<td>2004 vs. 2003</td>
<td>6.58***</td>
</tr>
<tr>
<td>2004</td>
<td>0.115</td>
<td>13.84</td>
<td>2005 vs. 2004</td>
<td>7.78***</td>
</tr>
<tr>
<td>2005</td>
<td>0.084</td>
<td>10.29</td>
<td>2006 vs. 2005</td>
<td>7.33***</td>
</tr>
<tr>
<td>2006</td>
<td>0.121</td>
<td>15.80</td>
<td>2007 vs. 2006</td>
<td>11.37***</td>
</tr>
<tr>
<td>2007</td>
<td>0.076</td>
<td>10.55</td>
<td>2001 vs. 2007</td>
<td>18.73***</td>
</tr>
</tbody>
</table>
TFP of new entrants decreases with the FDI share

<table>
<thead>
<tr>
<th>Year</th>
<th>Coefficient</th>
<th>std. err.</th>
<th>t-value</th>
<th>Coefficient</th>
<th>std. err.</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>-0.274</td>
<td>0.123</td>
<td>-2.220</td>
<td>0.159</td>
<td>0.012</td>
<td>13.040</td>
</tr>
<tr>
<td>2001</td>
<td>-0.101</td>
<td>0.072</td>
<td>-1.410</td>
<td>0.203</td>
<td>0.011</td>
<td>18.390</td>
</tr>
<tr>
<td>2002</td>
<td>-0.215</td>
<td>0.088</td>
<td>-2.440</td>
<td>0.184</td>
<td>0.011</td>
<td>17.330</td>
</tr>
<tr>
<td>2003</td>
<td>-0.129</td>
<td>0.062</td>
<td>-2.080</td>
<td>0.144</td>
<td>0.010</td>
<td>14.630</td>
</tr>
<tr>
<td>2004</td>
<td>-0.033</td>
<td>0.040</td>
<td>-0.820</td>
<td>0.111</td>
<td>0.008</td>
<td>13.150</td>
</tr>
<tr>
<td>2005</td>
<td>-0.070</td>
<td>0.047</td>
<td>-1.510</td>
<td>0.077</td>
<td>0.008</td>
<td>9.360</td>
</tr>
<tr>
<td>2006</td>
<td>-0.003</td>
<td>0.045</td>
<td>-0.070</td>
<td>0.114</td>
<td>0.008</td>
<td>14.740</td>
</tr>
<tr>
<td>2007</td>
<td>-0.041</td>
<td>0.044</td>
<td>-0.930</td>
<td>0.069</td>
<td>0.007</td>
<td>9.540</td>
</tr>
</tbody>
</table>

Wang, Wang, Wei

FDI, Firm Productivity and Financial Constraints
High-productivity FDI firms entered China before 2000.

- Before 2000: Performance requirements for FDI firms
- The requirements are removed after China joined the WTO.
A possible explanation

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  - The requirements are removed after China joined the WTO.
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A possible explanation

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  - Before 2000: Performance requirements for FDI firms
  - The requirements are removed after China joined the WTO.
  - More sectors are opened to FDI.
  - More FDI driven by financial advantages
- The shrinking difference in TFP is also caused by the fast catch-up by local firms.
New entrants and financial vulnerability

- Negative correlation between TFP and FDI share for new entrants
  - FDI due to financial advantages
  - Stronger evidence in financially more vulnerable industries?
New entrants and financial vulnerability

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- New entrants in two groups of industries
  - More financially vulnerable industries: top 25%
  - Less financially vulnerable industries: bottom 25%
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- New entrants in two groups of industries
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New entrants and financial vulnerability

For each group, regress

\[ Productivity_{ijp} = \alpha + \beta FDI_{ijp} + \gamma_1 Firmcontrol_i + \gamma_2 Inddummy_j + \gamma_3 Locadummy_p + \epsilon_{ijp} \]

Test if \( \beta \) is the same for these two groups

- \( H0 : \beta^{25th} = \beta^{75th} \)
- \( H1 : \beta^{25th} \neq \beta^{75th} \)
### Results

<table>
<thead>
<tr>
<th>Less vulnerable</th>
<th>More vulnerable</th>
<th>$\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ex. Fin.</strong></td>
<td>-0.039 (0.045)</td>
<td>4391</td>
</tr>
<tr>
<td></td>
<td>-0.184*** (0.044)</td>
<td>4460</td>
</tr>
<tr>
<td><strong>Inv.</strong></td>
<td>0.008 (0.037)</td>
<td>6922</td>
</tr>
<tr>
<td></td>
<td>-0.125*** (0.031)</td>
<td>7459</td>
</tr>
<tr>
<td><strong>R&amp;D</strong></td>
<td>-0.026 (0.026)</td>
<td>14185</td>
</tr>
<tr>
<td></td>
<td>-0.159** (0.045)</td>
<td>4641</td>
</tr>
<tr>
<td><strong>Tang.</strong></td>
<td>-0.091*** (0.040)</td>
<td>4575</td>
</tr>
<tr>
<td><strong>T. Credit</strong></td>
<td>-0.088 (0.070)</td>
<td>1725</td>
</tr>
<tr>
<td></td>
<td>-0.128*** (0.042)</td>
<td>5412</td>
</tr>
<tr>
<td><strong>FPC</strong></td>
<td>-0.024 (0.038)</td>
<td>6860</td>
</tr>
<tr>
<td></td>
<td>-0.184*** (0.040)</td>
<td>4820</td>
</tr>
</tbody>
</table>

Wang, Wang, Wei: FDI, Firm Productivity and Financial Constraints
Result 2: FDI share and financial vulnerability
FDI shares and financial vulnerability

- FDI firms finance through: Parent firms/international markets
- If no financial friction: FDI share is equalized across sectors
- Financial friction: FDI share should be higher in financially more vulnerable industries

\[ FDI\text{ share}_{ijp} = \alpha + \beta \text{Finvul}_i + \gamma_1 \text{Firmcontrol}_i + \gamma_2 \text{Inddummy}_j + \gamma_3 \text{Locadummy}_p + \epsilon_{ijp} \]
## Higher FDI Shares in Financially More Vulnerable Sectors

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2007</th>
<th>$\chi^2$</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex. Fin.</td>
<td>0.007***</td>
<td>0.016***</td>
<td>10.08***</td>
<td></td>
</tr>
<tr>
<td>Inv. ratio</td>
<td>0.017</td>
<td>0.323***</td>
<td>68.84***</td>
<td></td>
</tr>
<tr>
<td>R&amp;D ratio</td>
<td>0.009</td>
<td>0.016</td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>Tang.</td>
<td>-0.089***</td>
<td>-0.216***</td>
<td>115.45***</td>
<td></td>
</tr>
<tr>
<td>T. Credit</td>
<td>-0.299***</td>
<td>-0.160***</td>
<td>6.67***</td>
<td></td>
</tr>
<tr>
<td>FPC</td>
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<td>0.013***</td>
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Wang, Wang, Wei

FDI, Firm Productivity and Financial Constraints
Higher FDI Shares in Financially More Vulnerable Sectors

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<th>2000</th>
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*Ex. Fin.*: Externally Financed

### Higher FDI Shares in Financially More Vulnerable Sectors

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Wang, Wang, Wei: FDI, Firm Productivity and Financial Constraints
FDI Share Grows in Financially Vulnerable Industries

Wang, Wang, Wei

FDI, Firm Productivity and Financial Constraints
Summary and future work

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