Simultaneity Nature in Import and Productivity: Case Study of Indonesian Manufacturing

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24-25 February 2022  
Virtual Conference on Technology Transfer and Firm Competitiveness  
ADBI Tokyo
The Paper

• Address the role of technology in determining competitiveness of firms.
  ➢ Typical mechanism is through foreign direct investment (FDI), through its direct and spillover effect.
  ➢ The FDI mechanism is well covered in research; but not yet import mechanism.

• Address the import channel.
  ➢ Technology can also be brought in to domestic economy through the technology embedded in imported input.

• Explore the simultaneity and heterogeneity in the decision to import.
  ➢ While it is clear about the impact of import on productivity, it is not clear whether the other direction exists, ie. highly productive firm import high quality input.
  ➢ The impact of imports will also be determined by firm capability.
The Literature

• Existence of technology transfer from developed to developing economies (eg. Grossman and Helpman 1995).
  ➢ Trigger opening up in trade and investment regime in developing countries.

• Channels through which technology transfer are feasible: FDI, exporting, importing.
  ➢ Exporting (eg, Aw et al. 2000; Bernard and Jensen 1999; Blalock and Gertler 2004).

• Importing channel:
  ➢ Direct positive impact of high quality import on productivity (eg. Fernandez 2007; Kasahara and Rodrigue 2008).
  ➢ Spillover to domestic industries producing the same products as imported inputs (eg. Blalock and Veloso 2007; Amiti and Koenings 2007)
Data

• Utilize the plant level of annual medium and large manufacturers (ie. *Statistik Industri, SI*) published by the statistical agency (BPS).
  ➢ Used the plant level (main) dataset (industry defined at 5-digit extended ISIC).
  ➢ Used one of the components of SI data for the more detailed (ie. at product level) data on intermediate input used by each plant (product defined at 9-digit product).
  ➢ Intermediate inputs are decomposed by origin: import and domestic.
  ➢ Sample used to calculate the plant ‘age’ variable: 1990-2015.

• Used only the period 2007-2015 of the intermediate input product-level data for descriptive analysis, due to numerous missing values for the period 2000-2006.
Methodology

• Model specification

\[ PROD_{ft} = \beta_1 MI_{ft} + \beta_2 CV_{ft} + \varphi_f + \varphi_t + \varphi_s + \varepsilon_{ft} \]

\[ PROD = \{LP, TFP\} \]

\[ CV = \{\ln(age + 1), d(FDI), d(export), \ln(capin), \ln(size), \ln(size)^2\} \]

• Interaction model (capability)

\[ PROD_{ft} = \beta_1 MI_{ft} + \beta_2 MI_{ft} \times INT_{ft} + \beta_3 CV_{ft} + \varphi_f + \varphi_t + \varphi_s + \varepsilon_{ft} \]

\[ INT = \{\ln(age + 1), d(FDI), d(export), \ln(capin)\} \]

• Notes

- Method: OLS, IV, GMM (next plan)
- Instruments: Average values of endogenous variables at province-sector-year level (collective decision affect individual decision, but not the other way around).
- Dimension: \( f \) (plant), \( t \) (year), \( s \) (2-digit sector)
- Variables: \( LP \) (labor productivity), \( TFP \) (total factor productivity), \( MI \) (import intensity), \( capin \) (capital intensity), \( size \) (number of employees).
Results

Table 1. Descriptive statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>TFP</th>
<th>Labor productivity</th>
<th>Age</th>
<th>FDI (&gt;10%)</th>
<th>non-FDI</th>
<th>Export</th>
<th>Capital intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
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<td>High</td>
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<tr>
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<td>3.38</td>
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<td>3.83</td>
<td>3.34</td>
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<td>Imported input scope</td>
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<td>0.16</td>
<td>0.45</td>
<td>0.07</td>
<td>0.27</td>
<td>0.89</td>
<td>0.19</td>
</tr>
<tr>
<td>Import intensity</td>
<td>6.03%</td>
<td>5.47%</td>
<td>8.64%</td>
<td>3.69%</td>
<td>7.20%</td>
<td>5.11%</td>
<td>28.09%</td>
</tr>
<tr>
<td>Input only used by high &quot;productivity&quot; plants</td>
<td>0.46%</td>
<td>0.00%</td>
<td>0.38%</td>
<td>0.14%</td>
<td>0.24%</td>
<td>0.27%</td>
<td>0.66%</td>
</tr>
<tr>
<td>Import intensity</td>
<td>18.96%</td>
<td>0.00%</td>
<td>21.98%</td>
<td>7.50%</td>
<td>24.28%</td>
<td>14.34%</td>
<td>53.27%</td>
</tr>
<tr>
<td>Input only used by low &quot;productivity&quot; plants</td>
<td>0.00%</td>
<td>0.48%</td>
<td>0.20%</td>
<td>0.34%</td>
<td>0.26%</td>
<td>0.29%</td>
<td>0.46%</td>
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<td>Import intensity</td>
<td>0.00%</td>
<td>14.72%</td>
<td>13.30%</td>
<td>10.91%</td>
<td>13.76%</td>
<td>10.20%</td>
<td>37.31%</td>
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<tr>
<td>Input used by all levels of productivity</td>
<td>99.54%</td>
<td>99.52%</td>
<td>99.28%</td>
<td>99.42%</td>
<td>99.42%</td>
<td>99.29%</td>
<td>98.62%</td>
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<td>5.39%</td>
<td>8.47%</td>
<td>3.64%</td>
<td>7.06%</td>
<td>5.00%</td>
<td>27.78%</td>
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</table>

- Small proportion of intermediates exclusively used by either more productive and less productive plants.
- ‘More capable plants’ source both high- and low-productivity intermediates more from imports than ‘less capable plants’.
  - High productivity intermediates are imported more intensively → Indicates import preference of capable plants.
- Common intermediates are imported less intensively than exclusive intermediates by both more and less capable plants.
Results

Table 3. Baseline Model

<table>
<thead>
<tr>
<th>Variables</th>
<th>OLS</th>
<th>IV</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>ln(TFP)</td>
<td>ln(LP)</td>
</tr>
<tr>
<td></td>
<td>[1]</td>
<td>[2]</td>
</tr>
<tr>
<td>ln(age+1)</td>
<td>0.0174**</td>
<td>0.0162***</td>
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<td></td>
<td>(0.00825)</td>
<td>(0.00560)</td>
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<tr>
<td>d(FDI)</td>
<td>-0.00262</td>
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<tr>
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<td>(0.0202)</td>
<td>(0.0161)</td>
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<td>d(export)</td>
<td>0.0186**</td>
<td>0.0393***</td>
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<tr>
<td></td>
<td>(0.00927)</td>
<td>(0.00758)</td>
</tr>
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<td>Import intensity</td>
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<td>(0.0200)</td>
<td>(0.0163)</td>
</tr>
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<td>ln(capital intensity)</td>
<td>0.104***</td>
<td>0.308***</td>
</tr>
<tr>
<td></td>
<td>(0.00243)</td>
<td>(0.00216)</td>
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<td>ln(labor)</td>
<td>0.125***</td>
<td>0.222***</td>
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<td>(0.0302)</td>
<td>(0.0243)</td>
</tr>
<tr>
<td>ln(labor)^2</td>
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<td>-0.0337***</td>
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<tr>
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<td>(0.00257)</td>
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<td>Kleibergen-Paap LM statistic</td>
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<td>436.3</td>
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<tr>
<td>Kleibergen-Paap Wald F statistic</td>
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<td>69.34</td>
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<td>Endogeneity test</td>
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<td>186</td>
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<td>[p-value]</td>
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</table>

- Parameters from IV model are different from OLS
  - Endogeneity test → explanatory variables are endogenous
  - Under- and weak identification test → instruments are valid and strong

- Import intensity is negative and significant in IV model with both TFP and LP as dependent → Might be related to ...
  - Trade processing: high import and export but low value added
  - Too dependent on import → less incentive to innovate production process
  - Possible heterogenous impacts of import, based on capability
Older and exporting plants gain more from imports than younger and non-exporting plants.

FDI plants have the productivity edge from the FDI itself, not from imports.

Capital intensity matters for LP but not for TFP.

Related to different measurement of TFP and LP.

Table 4. Interaction model

<table>
<thead>
<tr>
<th>Variables</th>
<th>ln(TFP)</th>
<th>ln(TFP)</th>
<th>ln(TFP)</th>
<th>ln(TFP)</th>
<th>ln(LP)</th>
<th>ln(LP)</th>
<th>ln(LP)</th>
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<tr>
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<td>[3]</td>
<td>[4]</td>
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<tr>
<td>ln(age+1)</td>
<td>-0.0345</td>
<td>-0.0132</td>
<td>-0.00945</td>
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<tr>
<td></td>
<td>(0.0132)</td>
<td>(0.0121)</td>
<td>(0.0123)</td>
<td>(0.0123)</td>
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<tr>
<td>d(FDI)</td>
<td>0.532***</td>
<td>0.649***</td>
<td>0.537***</td>
<td>0.600***</td>
<td></td>
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<td></td>
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<td>(0.240)</td>
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<td>d(export)</td>
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<td>ln(capital intensity)</td>
<td>0.211***</td>
<td>0.219***</td>
<td>0.214***</td>
<td>0.207***</td>
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<td>ln(labor)</td>
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<td>ln(labor)^2</td>
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<td>-0.113***</td>
<td>-0.122***</td>
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<td>Import intensity</td>
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<td>(0.161)</td>
<td>(0.405)</td>
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<td>Import intensity * d(FDI)</td>
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<td>Import intensity * d(export)</td>
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<td>(0.176)</td>
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<td>Import intensity * ln(capital</td>
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<td>intensity)</td>
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<td>Yes</td>
<td>Yes</td>
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</tr>
</tbody>
</table>
(Temporary) Conclusion

• Number of intermediates exclusively used by more productive and less productive plants are small in proportion (as compared to common intermediates).

• More capable plants import more than less capable plants, even more intensively for high productivity intermediates.

• Endogeneity and heterogeneity exist in the relation of import and productivity

• Surprisingly, on average, there is productivity loss from more intensive imports

• Older and exporting plants gain more from imports

• More capital intensive plants gain more from imports, in terms of labor productivity but not for TFP

• FDI plants have productivity edge from the FDI itself, but not from imports
Next plan

• Explore more literature on:
  ➢ Firm capability in relation to gaining from imports
  ➢ Other channels of productivity gain from imports (e.g., diversification)

• Include skill share of labor as capability variable

• Experiment with GMM method