Investment Demand and Structural Change

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SED, Warsaw, June 2015
Balanced Growth Paths?

- **Kuznets-Maddison facts + Kaldor facts →**
  - models of structural change under Balanced Growth Path
    - Kongsamut, Rebelo, Xie (2001); Ngai, Pissarides (2007); Boppart (2014)
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- Between 50’s and 10’s: **large low-frequency movements of investment**
  Song, Storesletten, Zilibotti (2011); Buera, Shin (2013); Hornstein, Chang (2013)
Balanced Growth Paths?

(a) Anglosaxon countries

- AUS
- CAN
- GBR
- USA
Balanced Growth Paths?

(a) Anglosaxon countries

(b) Some early transitions

(c) Some Asian countries

(d) Some other Asian countries
Investment and industrial production

May these change in investment be related to changes in the sectoral composition of the economy?
Investment and industrial production

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  - In the data (cross-country, 50's to 10's), we observe
    - a correlation between investment and manufacturing of 0.45 (0.57 w/ FE)
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    - a hump of investment with development as in manufacturing
Investment and manufacturing

(a) Agriculture share

(b) Services share

(c) Industry share

(d) Investment rate
Investment and industrial production

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- *May these change in investment be related to changes in the sectoral composition of the economy?*

  ▶ In the data (cross-country, 50’s to 10’s), we observe
    
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  → Because investment goods are more intensive in manufactures, an increase in the investment rate increases the share of manufactures
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  - *How much of structural change in developing economies can be accounted for changes in investment? Shall we move away from BGP assumption?*
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- Questions:
  - *How much of structural change in developing economies can be accounted for changes in investment? Shall we move away from BGP assumption?*
  - *Is the change in investment particularly important in some episodes?*
Sectoral intensity by type of good

*Input-Output evidence*

- WIOD: 35 (mostly developed) countries, 1995-2011
Sectoral intensity by type of good

*Input-Output evidence*

- **WIOD**: 35 (mostly developed) countries, 1995-2011

1) Substantial differences in sectoral composition of goods

- Investment goods more intensive in manufactures (40%) 
- Consumption goods more intensive in services (38%)

<table>
<thead>
<tr>
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<th>investment ((x))</th>
<th>consumption ((c))</th>
<th>difference ((x - c))</th>
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<td>0.05 0.15 0.80</td>
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\[
\begin{array}{l|ccc|ccc|ccc}
\text{investment} (x) & \text{investment} (c) & \text{difference} (x - c) \\
\text{a} & m & s & \text{a} & m & s & \text{a} & m & s \\
\hline
\text{mean} & 0.03 & 0.55 & 0.42 & 0.05 & 0.15 & 0.80 & -0.02 & 0.40 & -0.38 \\
\end{array}
\]

2) These differences widen with development
   - The share of services increases faster in consumption than in investment
   - The share of manufactures declines faster in consumption than in investment
Sectoral intensity by type of good

Between country variation

(a) Agriculture share

(b) Services share

(c) Manufacturing share
Sectoral intensity by type of good

Within country variation

(a) Agriculture share

(b) Services share

(c) Manufacturing share
What we do

- Write a standard neo-classical growth model
  - Three sectors: agriculture, industry, services
  - Two final goods: consumption and investment
  - Closed economy (more on that later)
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    - non-homothetic demands (Kongsamut, Rebelo, Xie, 2001)
    - non-unitary elasticity of substitution (Baumol, 1967; Ngai, Pissarides, 2007)
    - changes in investment rate
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- Use unbalanced panel (1960-2010) of cross-country data to estimate the sectoral intensity of investment and consumption goods

- Unplug the change in investment rate and quantify its importance
Consumer Side

- Households
  - buy consumption goods $c$ that give utility
  - buy investment goods $x$ to form physical capital
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  - buy consumption goods $c$ that give utility
  - buy investment goods $x$ to form physical capital

- But we abstract from the consumer side:
  
  *take investment rate as given from the data*

  - Plain neo-classical model cannot reproduce the hump in investment
  
  - Keep it simple, not needed for the main question of the paper
**Final Goods**

- Two final goods that aggregate output from three sectors: $y_a$, $y_m$, $y_s$
Final Goods

- Two final goods that aggregate output from three sectors: \( y_a, y_m, y_s \)
  - Consumption good

\[
c = F^c(y_a^c, y_m^c, y_s^c) = \left[ \sum_{j \in \{a, m, s\}} \left( \theta_j^c \right)^{1-\rho} (y_j^c + \bar{c}_j)^\rho \right]^{\frac{1}{\rho}}
\]
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  - Investment good
    \[ x = F^x(y_a, y_m, y_s) = \left[ \sum_{j \in \{a, m, s\}} (\theta_j^x)^{1-\rho} (y_j^x + \bar{x}_j)^{\rho} \right]^{1/\rho} \]
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\]

- Key difference: they have different sectoral composition
  - different intensities \( \theta_j^c, \theta_j^x \)
  - different non-homotheticities \( \bar{c}_j, \bar{x}_j \)
**Intermediate goods**

- The production of intermediate goods $y_j$:
  
  (a) Neoclassical production function for each good $j = \{a, m, s\}$
  
  $$y_j = F^j(k^j, n^j)$$

  (b) Factor markets clear

  $$k = k^a + k^m + k^s, \quad n = n^a + n^m + n^s$$

  (c) Intermediate goods markets clear

  $$y_a = y_a^c + y_a^x, \quad y_m = y_m^c + y_m^x, \quad y_s = y_s^c + y_s^x$$
Intermediate goods

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- But (a) and (b) not needed if
  - we take as given the investment rate
  - we only use the share equations for estimation
Investment demand and structural change

The share of manufacturing in total GDP can be decomposed into:

- the share of manufacturing in investment \( \times \) the investment rate
- the share of manufacturing in consumption \( \times \) the consumption rate

\[
\frac{p_{m}y_{m}}{y} = \frac{p_{m}(y_{m}^{x} + y_{c}^{m})}{y} = \frac{p_{m}y_{m}^{x}}{p_{x}x} \frac{p_{x}x}{y} + \frac{p_{m}y_{m}^{c}}{p_{c}c} \left(1 - \frac{p_{x}x}{y}\right)
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Investment demand and structural change

- The share of manufacturing in total GDP can be decomposed into:
  
  the share of manufacturing in investment $\times$ the investment rate
  
  + the share of manufacturing in consumption $\times$ the consumption rate

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\frac{p_m y_m}{y} = \frac{p_m (y_m^x + y_m^c)}{y} = \frac{p_m y_m^x}{p_x x} \frac{p_x x}{y} + \frac{p_m y_m^c}{p_c c} \left(1 - \frac{p_x x}{y}\right)
\]

- Changes in the investment rate $\Rightarrow$ changes the share of manufactures if

\[
\frac{p_m y_m^x}{p_x x} \neq \frac{p_m y_m^c}{p_c c}
\]
The sectoral composition in consumption and investment

- Our aggregators for the final goods imply:

\[
\frac{p_m y_m^c}{p_c c} = \left[ \sum_{i=a,m,s} \frac{\theta_i^c}{\theta_m^c} \left( 1 + \frac{\bar{c}_m}{y_m^c} \right) \left( \frac{p_m}{p_i} \right)^{\frac{\rho}{1-\rho}} \right]^{-1}
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There is scope for structural change within each type of good due to:
- non-homotheticities
- non-unitary elasticity of substitution between goods
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- There is scope for structural change *within* each type of good due to:
  - non-homotheticities
  - non-unitary elasticity of substitution between goods
Two estimation strategies

1) With IO tables:
   - build time series for $\frac{p_m y_m^x}{p_x^x}$ and $\frac{p_m y_m^c}{p_c^c}$
   - estimate parameters of each aggregator separately
   → Difficult to get consistent IO tables over long periods of time
     (WIOD: data from 1995-2011 only, 35 mostly developed countries)
Two estimation strategies

1) With IO tables:
   - build time series for \( \frac{p_m y_x m}{p_x x} \) and \( \frac{p_m y_c m}{p_c c} \)
   - estimate parameters of each aggregator separately
   \[ \rightarrow \] Difficult to get consistent IO tables over long periods of time
      (WIOD: data from 1995-2011 only, 35 mostly developed countries)

2) Without IO tables:
   - only data for \( \frac{p_m y_m}{y} \)
   - Need to rely on changes in the investment rate to identify the parameters
   \[ \rightarrow \] Time series from 1950 or 1960 for many countries
Two estimation strategies

1) With IO tables:
   - build time series for $\frac{p_{mx}}{px}$ and $\frac{p_{mym}}{pc}$
   - estimate parameters of each aggregator separately
   → Difficult to get consistent IO tables over long periods of time
     (WIOD: data from 1995-2011 only, 35 mostly developed countries)

2) Without IO tables:
   - only data for $\frac{p_{mym}}{y}$
   - Need to rely on changes in the investment rate to identify the parameters
   → Time series from 1950 or 1960 for many countries

Strategy 2 today. Working on integration of 1 and 2.
Strategy 2

Identifying the share parameters

- Simplest case ($\rho = 0$, $\bar{c}_j = 0$, and $\bar{x}_j = 0$):

$$\frac{p_m y_m}{y} = \theta_m^x \frac{p x x}{y} + \theta_m^c \left( 1 - \frac{p x x}{y} \right) = \theta_m^c + (\theta_m^x - \theta_m^c) \frac{p x x}{y}$$
Strategy 2

**Identifying the share parameters**

- Simplest case ($\rho = 0, \bar{c}_j = 0$, and $\bar{x}_j = 0$):

\[
\frac{p_{my}m}{y} = \theta_m^x \frac{p_{x}x}{y} + \theta_m^c \left(1 - \frac{p_{x}x}{y}\right) = \theta_m^c + \left(\theta_m^x - \theta_m^c\right) \frac{p_{x}x}{y}
\]

- Hence,
  - The covariance between $\frac{p_{x}x}{y}$ and $\frac{p_{my}m}{y}$ identifies $(\theta_m^x - \theta_m^c)$
  - The level of $\frac{p_{my}m}{y}$ identifies $\theta_m^c$
  - A simple OLS regression recovers $\theta_m^c$ and $\theta_m^x$
Strategy 2

*Identifying the non-homotheticities*

- Identifying the level $\bar{c}_m$ and $\bar{x}_m$:
  - the relationship between the size of sector $m$ and the level of GDP identifies one of the level terms $\bar{c}_m$ or $\bar{x}_m$

- Identifying the difference between $\bar{x}_m$ and $\bar{c}_m$:

  $$\frac{pmym}{y} = \frac{pmy_m}{pc} + \frac{pxx}{y} \left( \frac{pmy_m}{pxx} - \frac{pmy_m}{pc} \right)$$

  - If the covariance between $\frac{pxx}{y}$ and $\frac{pmym}{y}$ increases with GDP, the *differential intensity* must increase with GDP
  - This requires $\bar{c}_m > \bar{x}_m$
Strategy 2

Identifying the elasticity of substitution

If $\bar{x}_j = 0$, $\bar{c}_j = 0$:

$$\frac{p_m y_m^c}{p_s y_s^c} = \frac{\theta_m^c}{\theta_s^c} \left( \frac{p_s}{p_m} \right)^{\frac{\rho}{1-\rho}}$$

and

$$\frac{p_m y_m^x}{p_s y_s^x} = \frac{\theta_m^x}{\theta_s^x} \left( \frac{p_s}{p_m} \right)^{\frac{\rho}{1-\rho}}$$

Therefore, the covariance between

- the relative size of sectors $s$ and $m$: $\frac{p_s y_s}{p_m y_m}$
- their relative prices: $\frac{p_m}{p_s}$

identifies the elasticity of substitution $\frac{1}{1-\rho}$
Data

- Use 10 time series
  - Investment rate in current LCU (PWT)
  - Sectoral value added shares in current LCU (WDI)
  - Sectoral and GDP price deflators in LCU (WDI)
  - GDP per capita in constant LCU and PPP (PWT)
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- Selection of 41 countries (1960-2011)
  - Have all data since at least 1985
  - Not too small (Population in 2005 > 4M)
  - Not too poor (gdp pc in 2005 > 5% of US)
  - Not oil-based (oil rents < 10% of GDP)
  - Experienced development within sample (growth and investment variation)
Results

- At this stage,
  - We do a separate estimation for every country
  - We impose $c_m = 0, \bar{x}_a, \bar{x}_m, \bar{x}_s = 0$
  - Closed economy
  - WDI data for sectoral composition
Results

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→ **Very Preliminary!!**
Results

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→ **Very Preliminary!!**

- Plan:
  - Incorporate G10DB
    (longer time series but not for all countries and discrepancies)
  - Incorporate WIOD
  - Open economy
  - Joint estimation
    (some common parameters across countries)
Quality of model fit

All data points together

(a) Manufacturing: data vs model

\[ R^2 = 0.88 \]
\[ \text{slope} = 0.88 \]

(b) Services: data vs model

\[ R^2 = 0.97 \]
\[ \text{slope} = 0.98 \]
# Quality of model fit

*Country by country*

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<tr>
<th>Country</th>
<th>agr</th>
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<td>0.75</td>
</tr>
<tr>
<td>philippines</td>
<td>0.94</td>
<td>0.31</td>
<td>0.96</td>
<td>0.74</td>
</tr>
<tr>
<td>morocco</td>
<td>0.22</td>
<td>0.90</td>
<td>0.86</td>
<td>0.66</td>
</tr>
<tr>
<td>thailand</td>
<td>0.76</td>
<td>0.87</td>
<td>0.19</td>
<td>0.61</td>
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<tr>
<td>chile</td>
<td>0.80</td>
<td>0.52</td>
<td>0.50</td>
<td>0.61</td>
</tr>
<tr>
<td>malaysia</td>
<td>0.38</td>
<td>0.12</td>
<td>0.83</td>
<td>0.44</td>
</tr>
</tbody>
</table>
Results

Implied sectoral shares in \(x\) and \(c\) (average within country)

<table>
<thead>
<tr>
<th></th>
<th>investment ((x))</th>
<th>consumption ((c))</th>
<th>difference ((x - c))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(a)</td>
<td>(m)</td>
<td>(s)</td>
</tr>
<tr>
<td>mean</td>
<td>0.04</td>
<td>0.54</td>
<td>0.42</td>
</tr>
<tr>
<td>(p_{10}) (BEL)</td>
<td>0.01</td>
<td>0.25</td>
<td>0.74</td>
</tr>
<tr>
<td>(p_{50}) (MEX)</td>
<td>0.02</td>
<td>0.50</td>
<td>0.48</td>
</tr>
<tr>
<td>(p_{90}) (JAP)</td>
<td>0.06</td>
<td>0.93</td>
<td>0.00</td>
</tr>
</tbody>
</table>

- We recover lower (average) difference of sectoral intensity across goods than in the WIOD

- Large amount of heterogeneity in the asymmetry between consumption and investment goods

→ Changes in investment demand potentially important for some countries
  - Need large difference in sectoral composition of \(c\) and \(x\)
  - Need large changes of the investment rate
### Results

*Implied sectoral shares in $x$ and $c$ (average within country)*

<table>
<thead>
<tr>
<th>log gdp</th>
<th>x</th>
<th>c</th>
<th>dif</th>
<th>x</th>
<th>c</th>
<th>dif</th>
<th>x</th>
<th>c</th>
<th>dif</th>
<th>x</th>
<th>c</th>
<th>dif</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
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<td>583</td>
<td>583</td>
<td>1618</td>
<td>1618</td>
<td>1618</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>WIOD</td>
<td>-2.44</td>
<td>-6.62</td>
<td>4.16</td>
<td>-0.16</td>
<td>-3.64</td>
<td>3.48</td>
<td>6.74</td>
<td>14.0</td>
<td>-7.28</td>
<td>1.54</td>
<td>13.5</td>
<td>-12.0</td>
</tr>
<tr>
<td>WDI</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>WIOD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WDI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note:* The table entries represent the implied sectoral shares in manufacturing and services, with standard errors in parentheses.
## Results

### Changes in investment and manufacturing share

<table>
<thead>
<tr>
<th></th>
<th>Change in the Share of Manufactures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>period</strong></td>
<td><strong>model</strong></td>
</tr>
<tr>
<td>china 1962-2011</td>
<td>12.46</td>
</tr>
<tr>
<td>vietnam 1988-2007</td>
<td>16.68</td>
</tr>
<tr>
<td>japan 1970-2010</td>
<td>-16.84</td>
</tr>
<tr>
<td>indonesia 1966-2010</td>
<td>29.33</td>
</tr>
<tr>
<td>india 1968-2007</td>
<td>9.79</td>
</tr>
<tr>
<td>southkorea 1972-1991</td>
<td>9.47</td>
</tr>
<tr>
<td>srilanka 1973-1980</td>
<td>10.11</td>
</tr>
<tr>
<td>honduras 1961-1999</td>
<td>10.27</td>
</tr>
<tr>
<td>paraguay 1963-1981</td>
<td>5.49</td>
</tr>
<tr>
<td>bulgaria 1996-2007</td>
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</tr>
<tr>
<td>philippines 1976-2011</td>
<td>-7.28</td>
</tr>
<tr>
<td>tunisia 1970-1984</td>
<td>9.37</td>
</tr>
<tr>
<td>finland 1965-2009</td>
<td>-13.52</td>
</tr>
<tr>
<td>netherlands 1970-2010</td>
<td>-13.08</td>
</tr>
</tbody>
</table>
Results

China

(a) Manufacturing share: model fit

(b) Manufacturing share: counterfactual

(c) Investment rate

(d) Manufacturing share by type of good

García-Santana, Pijoan-Mas, Villacorta

Investment Demand and Structural Change
Results

Vietnam

(a) Manufacturing share: model fit

(b) Manufacturing share: counterfactual

(c) Investment rate

(d) Manufacturing share by type of good
Results

Japan

(a) Manufacturing share: model fit

(b) Manufacturing share: counterfactual

(c) Investment rate

(d) Manufacturing share by type of good

Manufacturing share by type of good

Within investment

Within consumption

Overall

García-Santana, Pijoan-Mas, Villacorta  
Investment Demand and Structural Change
Results

Indonesia

(a) Manufacturing share: model fit

(b) Manufacturing share: counterfactual

(c) Investment rate

(d) Manufacturing share by type of good
Results

India

(a) Manufacturing share: model fit

(b) Manufacturing share: counterfactual

(c) Investment rate

(d) Manufacturing share by type of good
Results

South Korea

(a) Manufacturing share: model fit

(b) Manufacturing share: counterfactual

(c) Investment rate

(d) Manufacturing share by type of good
Results

Sri Lanka

(a) Manufacturing share: model fit

(b) Manufacturing share: counterfactual

(c) Investment rate

(d) Manufacturing share by type of good
Results

Argentina

(a) Manufacturing share: model fit

(b) Manufacturing share: counterfactual

(c) Investment rate

(d) Manufacturing share by type of good
Results

Honduras

(a) Manufacturing share: model fit

(b) Manufacturing share: counterfactual

(c) Investment rate

(d) Manufacturing share by type of good
Results

Paraguay

(a) Manufacturing share: model fit

(b) Manufacturing share: counterfactual

(c) Investment rate

(d) Manufacturing share by type of good
Results

Colombia

(a) Manufacturing share: model fit

(b) Manufacturing share: counterfactual

(c) Investment rate

(d) Manufacturing share by type of good
Countries with problematic fit

- The model does not fit too well data for a few countries:
  - South East Asia: problems may be related to the 1997 crisis, the sudden stop, and the large share of imports of manufactures for investment. Thailand, South Korea, Malaysia, Philippines
  - In general, if increase of investment rate is associated to increase in imports of some manufacture goods our estimates are biased towards large manufacturing intensity in investment
Countries with problematic fit

1997 crisis: sharp drops in investment

(a) Investment Rate

Manufacturing share: Thailand

Investment Rate

(b) Investment Rate

Manufacturing share: South Korea

Investment Rate

(c) Investment Rate

Manufacturing share: Malaysia

Investment Rate

(d) Investment Rate

Manufacturing share: Philippines

Investment Rate
Countries with problematic fit

1997 crisis: sharp drops in investment and imports

(a) Investment Rate
(b) Investment Rate
(c) Investment Rate
(d) Investment Rate

Manufacturing share: Thailand
Investment Rate
Net Imports

Manufacturing share: South Korea
Investment Rate
Net Imports

Manufacturing share: Malaysia
Investment Rate
Net Imports

Manufacturing share: Philippines
Investment Rate
Net Imports
Open economy extension

- Sectoral output uses: consumption ($c$), investment ($x$), net exports ($o$)
Open economy extension

- Sectoral output uses: consumption ($c$), investment ($x$), net exports ($o$)

- Hence, we can obtain

$$
\frac{p_my_m}{y} = \frac{p_m(y^x_m + y^c_m + y^o_m)}{y} = \frac{p_my_m^c}{p_cc} + \frac{p_xx}{y} \left( \frac{p_my_m^x}{p_xx} - \frac{p_my_m^c}{p_cc} \right) + \frac{p_o^o}{y} \left( \frac{p_my_m^o}{p_o^o} - \frac{p_my_m^c}{p_cc} \right)
$$
Open economy extension

- Sectoral output uses: consumption \((c)\), investment \((x)\), net exports \((o)\)

- Hence, we can obtain

\[
\frac{p_m y_m}{y} = \frac{p_m \left(y^x_m + y^c_m + y^o_m\right)}{y} = \frac{p_m y^c_m}{p_c c} + \frac{p_x x}{y} \left(\frac{p_m y^x_m}{p_x x} - \frac{p_m y^c_m}{p_c c}\right) + \frac{p_o o}{y} \left(\frac{p_m y^o_m}{p_o o} - \frac{p_m y^c_m}{p_c c}\right)
\]

- The investment rate and the net export rate are measured in the data.
Open economy extension

- Sectoral output uses: consumption \((c)\), investment \((x)\), net exports \((o)\)

- Hence, we can obtain

\[
\frac{p_m y_m}{y} = \frac{p_m (y_m^x + y_m^c + y_m^o)}{y} = \frac{p_m y_m^c}{p_c c} + \frac{p_x x}{y} \left( \frac{p_m y_m^x}{p_x x} - \frac{p_m y_m^c}{p_c c} \right) + \frac{p_o o}{y} \left( \frac{p_m y_m^o}{p_o o} - \frac{p_m y_m^c}{p_c c} \right)
\]

- The investment rate and the net export rate are measured in the data

- The sectoral shares of \(c\) and \(x\) are given by the model
Open economy extension

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- Hence, we can obtain

\[
\frac{p_m y_m}{y} = \frac{p_m (y_m^x + y_m^c + y_m^o)}{y}
\]

\[
= \frac{p_m y_m^c}{p_c c} + \frac{p_x x}{y} \left( \frac{p_m y_m^x}{p_x x} - \frac{p_m y_m^c}{p_c c} \right) + \frac{p_o o}{y} \left( \frac{p_m y_m^o}{p_o o} - \frac{p_m y_m^c}{p_c c} \right)
\]

- The investment rate and the net export rate are measured in the data

- The sectoral shares of \(c\) and \(x\) are given by the model

- What to do with the sectoral share of \(o\)?
Open economy extension

- Sectoral output uses: consumption ($c$), investment ($x$), net exports ($o$)

- Hence, we can obtain

$$\frac{p_m y_m}{y} = \frac{p_m (y_m^x + y_m^c + y_m^o)}{y}$$

$$= \frac{p_m y_m^c}{p_c c} + \frac{p_x x}{y} \left( \frac{p_m y_m^x}{p_x x} - \frac{p_m y_m^c}{p_c c} \right) + \frac{p_o o}{y} \left( \frac{p_m y_m^o}{p_o o} - \frac{p_m y_m^c}{p_c c} \right)$$

- The investment rate and the net export rate are measured in the data

- The sectoral shares of $c$ and $x$ are given by the model

- What to do with the sectoral share of $o$ ?
  - use trade data on value of exports and imports by sector (WDI)
Open economy extension

- Sectoral output uses: consumption ($c$), investment ($x$), net exports ($o$)

- Hence, we can obtain

$$\frac{p_{m}y_{m}}{y} = \frac{p_{m}}{y} (y_{m}^{x} + y_{m}^{c} + y_{m}^{o})$$

$$= \frac{p_{m}y_{m}^{c}}{p_{c}c} + \frac{p_{x}x}{y} \left( \frac{p_{m}y_{m}^{x}}{p_{x}x} - \frac{p_{m}y_{m}^{c}}{p_{c}c} \right) + \frac{p_{o}o}{y} \left( \frac{p_{m}y_{m}^{o}}{p_{o}o} - \frac{p_{m}y_{m}^{c}}{p_{c}c} \right)$$

- The investment rate and the net export rate are measured in the data

- The sectoral shares of $c$ and $x$ are given by the model

- What to do with the sectoral share of $o$?
  - use trade data on value of exports and imports by sector (WDI)
  - impose an aggregator (as with $c$ and $x$) and estimate its parameters
Open economy extension

- Sectoral output uses: consumption \((c)\), investment \((x)\), net exports \((o)\)

- Hence, we can obtain

\[
\frac{p my_m}{y} = \frac{p_m (y^x_m + y^c_m + y^o_m)}{y} = \frac{p my^c_m}{pc c} + \frac{p x x (p my^x_m - p my^c_m)}{y} + \frac{p o o (p my^o_m - p my^c_m)}{pc c}
\]

- The investment rate and the net export rate are measured in the data

- The sectoral shares of \(c\) and \(x\) are given by the model

- What to do with the sectoral share of \(o\)?
  - use trade data on value of exports and imports by sector (WDI)
  - impose an aggregator (as with \(c\) and \(x\)) and estimate its parameters
  - use IO data on value added of exports and imports by sector
Conclusions

- We estimate important differences in sectoral composition between final investment goods $x$ and final consumption goods $c$ for most countries.

1. Changes in the investment rate are key for the trends of manufacturing in countries where the investment rates changed substantially over the period (China, Vietnam, Japan, Indonesia, India, South Korea, Sri Lanka, Argentina, Honduras, Paraguay, Colombia).

2. Since $p_m$ is larger in poor countries (and declining with development), higher manufacturing intensity of $x$ may explain why $p_x$ is larger in poor countries (and declining with development).

Conclusions

- We estimate important differences in sectoral composition between final investment goods $x$ and final consumption goods $c$ for most countries.

- This has important implications.
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- This has important implications.

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Conclusions

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- This has important implications:

  1. Changes in the investment rate are key for the trends of manufacturing in countries where the investment rates changed substantially over the period (China, Vietnam, Japan, Indonesia, India, South Korea, Sri Lanka, Argentina, Honduras, Paraguay, Colombia).

  2. Since $p_m/p_s$ is larger in poor countries (and declining with development), higher manufacturing intensity of $x$ may explain why $p_x/p_c$ is larger in poor countries (and declining with development).

Hsieh, Klenow (2007); Karabarbounis, Neiman (2014)