The Price of Capital Goods: An Investment Driver under Threat?

Weicheng Lian, Natalija Novta, Evgenia Pugacheva, Yannick Timmer, and Petia Topalova (team leader), with support from Jilun Xing and Candice Zhao, and contributions from Michal Andrle and Rafael Portillo
Falling relative prices of investment goods, strong capital deepening

Real Investment Rate and Changes in Relative Price of Machinery and Equipment (Percent)

1. Advanced Economies

Sources: Penn World Table 9.0; IMF, World Economic Outlook; and authors’ calculations.
Note: The figure plots the real investment rate in machinery and equipment and changes in the price of machinery and equipment relative to the price of consumption. Changes in relative prices are relative to their levels in 1970.
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Real Investment Rate and Changes in Relative Price of Machinery and Equipment
(Percent)

1. Advanced Economies

2. Emerging Market and Developing Economies

Sources: Penn World Table 9.0; IMF, World Economic Outlook; and authors’ calculations.

Note: The figure plots the real investment rate in machinery and equipment and changes in the price of machinery and equipment relative to the price of consumption. Changes in relative prices are relative to their levels in 1970.
Relative import penetration of capital goods producing sectors in emerging market and developing economies \((1995 = 100)\)

Relative import penetration is defined as the ratio of total imports to domestic value-added divided by that of the overall economy.

Sources: World Input and Output database; and authors’ calculations.

Note: Relative import penetration is defined as the ratio of total imports to domestic value-added divided by that of the overall economy.
Main questions

• Key drivers of the relative price of tradable capital goods (PK)?
  • Trade integration
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  • Trade integration

• How much does it matter for real investment rate?
What is new?

Real investment and relative price of capital goods

Debate on factors that affect relative price of capital goods
Real investment and relative price of capital goods


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In this paper, we

- Revisit the debate, using the 2011 ICP data
What is new?

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  - Examine the role of rising trade integration in the fall in PK over time
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In this paper, we

- Revisit the debate, using the 2011 ICP data
- Examine the role of rising trade integration in the fall in PK over time
- Quantify the contribution of the fall in PK to the rise in real investment rates
Main findings

Drivers of relative prices of capital goods

- Rise in trade integration was an important factor in the decline in the relative price of machinery and equipment in the past decades
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Drivers of relative prices of capital goods

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Macro implications of declining relative price of capital

- The decline in the relative price of investment goods can explain around 40 percent of the increase in real investment rates in an average economy since the 1990s
EMDEs still face higher prices of machinery and equipment, especially relative to the price of consumption.

Sources: International Comparison Program (ICP) 2011, and authors' calculations.

Note: The absolute price of Machinery and Equipment is the price level of Machinery & Equipment, derived by the ICP using a similar basket of products across countries, relative to its US level. The relative price is the price of Machinery & Equipment relative to the price of consumption.
Trade costs explain cross-sectional variation in relative price of capital goods

Cross-Country Variation in Relative Capital Goods Price Explained by Relative Productivity and Trade Costs (Percent)

Sources: International Comparison Program (ICP) 2011; and authors’ calculations.
Note: The relative price of machinery and equipment is the price level of machinery and equipment relative to the price of consumption, both derived from the ICP.
A regression analysis: over time changes

\[
\ln \left( \frac{P_{i,j,t}}{\bar{P}_{i,t}} \right) = \alpha_{i,j} + \mu_{i,t} + \beta \ln(\text{Relative import penetration}_{i,j,t-1}) + \gamma \ln(\text{Relative productivity}_{i,j,t-1}) + \epsilon_{i,j,t}
\]

\[
\ln(\text{Relative productivity}_{i,j,t}) = \tilde{\alpha}_{i,j} + \tilde{\mu}_{i,t} + \rho \ln(\text{Relative import penetration}_{i,j,t-1}) + v_{i,j,t}
\]
A regression analysis: over time changes

\[
\ln \left( \frac{P_{i,j,t}}{P_{i,t}} \right) = \alpha_{i,j} + \mu_{i,t} + \beta \ln(\text{Relative import penetration}_{i,j,t-1}) + \gamma \ln(\text{Relative productivity}_{i,j,t-1}) + \varepsilon_{i,j,t}
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\ln(\text{Relative productivity}_{i,j,t}) = \tilde{\alpha}_{i,j} + \tilde{\mu}_{i,t} + \rho \ln(\text{Relative import penetration}_{i,j,t-1}) + \nu_{i,j,t}
\]

Sector level import tariffs \( \tau_{i,j,t} \) as an instrumental variable for import penetration

Data: World Input-Output Dataset, 33 sectors 40 countries, 1995-2011
Deepening trade integration reduces PK directly

<table>
<thead>
<tr>
<th>Relative Producer Prices, Trade Integration and Relative Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable: Relative Producer Prices</td>
</tr>
<tr>
<td>(1)</td>
</tr>
<tr>
<td>Relative Import Penetration(_{t-1})</td>
</tr>
<tr>
<td>(0.163)</td>
</tr>
<tr>
<td>Relative Import Penetration(_{t-1})\times Capital Goods Dummy</td>
</tr>
<tr>
<td>(0.322)</td>
</tr>
<tr>
<td>Relative Productivity(_{t-1})</td>
</tr>
<tr>
<td>(0.032)</td>
</tr>
<tr>
<td>Number of Observations</td>
</tr>
<tr>
<td>(R^2)</td>
</tr>
<tr>
<td>Relative Import Penetration for Capital Goods Sectors</td>
</tr>
<tr>
<td>(0.287)</td>
</tr>
</tbody>
</table>

Sample: All | AE | EMDE | Post 2000 | All\(^1\)

Source: Authors’ calculations.
Note: All regressions include country-year and country-sector fixed effects. Standard errors clustered at the country and sector level in parentheses.

\(^1\) Relative labor productivity\(_{t-2}\) is used as an instrument for relative labor productivity\(_{t-1}\).

\(*p < 0.1; **p < 0.05; ***p < 0.01\)
Deepening trade integration raises labor productivity

<table>
<thead>
<tr>
<th>Labor Productivity and Trade Integration</th>
<th>IV (1)</th>
<th>IV (2)</th>
<th>IV (3)</th>
<th>IV (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable: Relative Productivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative Import Penetration_{t-1}</td>
<td>1.363***</td>
<td>0.793***</td>
<td>2.403**</td>
<td>1.251***</td>
</tr>
<tr>
<td></td>
<td>(0.363)</td>
<td>(0.305)</td>
<td>(1.041)</td>
<td>(0.449)</td>
</tr>
<tr>
<td>Relative Import Penetration_{t-1} × Capital Goods Dummy</td>
<td>1.407**</td>
<td>1.965***</td>
<td>0.160</td>
<td>2.810</td>
</tr>
<tr>
<td></td>
<td>(0.671)</td>
<td>(0.665)</td>
<td>(1.648)</td>
<td>(1.751)</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>16,077</td>
<td>12,575</td>
<td>3,502</td>
<td>12,321</td>
</tr>
<tr>
<td>R²</td>
<td>0.91</td>
<td>0.92</td>
<td>0.88</td>
<td>0.92</td>
</tr>
<tr>
<td>Relative Import Penetration for Capital Goods Sectors</td>
<td>2.771***</td>
<td>2.758***</td>
<td>2.563***</td>
<td>4.061***</td>
</tr>
<tr>
<td></td>
<td>(0.564)</td>
<td>(0.624)</td>
<td>(1.089)</td>
<td>(1.686)</td>
</tr>
<tr>
<td>Sample</td>
<td>All</td>
<td>AE</td>
<td>EMDE</td>
<td>All, Post 2000</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations.

Note: All regressions include country-year and country-sector fixed effects. Standard errors clustered at

***p < 0.01; **p < 0.05; *p < 0.1
A significant fraction of the fall in PK was attributed to a rise in trade integration.

**Contributions to Changes in Relative Producer Prices of Capital Goods: 2000-11 (Percent)**

- **Source:** Authors’ calculations.
- **Note:** The figure combines the estimated elasticities of producer prices to trade integration and relative labor productivity, and changes in these factors for the capital goods sector between 2000 and 2011 to compute their contribution to the observed change in the producer price of capital goods relative to the price of consumption.
The long-run elasticity is smaller than 1

**Sectoral Real Investment Rate and Relative Prices of Machinery and Equipment**

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>IV</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Real Investment-to-GDP Ratio</td>
<td>(1)</td>
<td>(2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Log Relative Price</th>
<th>$-0.326^{***}$</th>
<th>$-0.528^{***}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$(0.078)$</td>
<td>$(0.068)$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Observations</th>
<th>971</th>
<th>971</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R^2$</td>
<td>0.94</td>
<td>0.93</td>
</tr>
<tr>
<td>First Stage F-Statistic</td>
<td>645</td>
<td>729</td>
</tr>
<tr>
<td>Period Fixed Effects</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Country-Period Fixed Effects</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Country-Sector Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations.

$^{***}p < 0.01;^{**}p < 0.05;^{*}p < 0.1$
Contributions of Relative Prices to Increases in Real Investment in Machinery and Equipment, 1990-94 to 2010-14 (Percent)

Source: IMF staff calculations.

Note: The figure presents the contribution to the observed increase in real machinery and transport equipment investment-to-GDP ratios between 1990-94 to 2010-14 from the relative price of machinery and transport equipment, various policies, and other controls.
Summary and policy implications

- The decline in the relative price of machinery and equipment was driven by rising trade integration and faster productivity growth in the capital goods producing sectors.

- The declines in relative investment prices have provided an important boost to real investment rates over the past three decades.

- Slowing trade integration and the possibility of its reversal could pose a threat to further declines in the relative price of capital goods and, hence, investment.

  ➢ Avoid trade barriers that could disrupt global supply chains and limit the spread of knowledge across borders.

  ➢ Support innovation that can fuel productivity gains in the capital goods producing sector.