AGGREGATE DYNAMICS AND MICROECONOMIC HETERGENEITY: THE ROLE OF VINTAGE TECHNOLOGY

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After the Great Recession slow recovery of Southern European countries

- Prolonged slump in aggregate investment
- Stagnant aggregate productivity

Lack of investment often blamed for the poor performance of productivity

- Logic: technology adoption through investment

Empirical evidence on vintage technology is scant
We study the role of investment for productivity dynamics

- **Microeconomic** evidence on vintage effects
  - Census of incorporated Italian firms

- **Macroeconomic** implications: structural model
  - Firm heterogeneity à la Khan and Thomas (ECMA, 2008)
  - Technology adoption decision
This Paper

Results

- **Investment leads to TFP gains at the firm level**
  - Firms with lower investment age have higher productivity
    investment age is the time elapsed since the last large investment episode
  - Investment age/vintage effects account for $\sim 15\%$ of productivity heterogeneity across firms

- **Macroeconomic relevance of the link investment-productivity**
  - Vintage technology amplifies dynamics following aggregate shocks
  - Investment slowdown accounts for over $1/3$ of missing productivity growth in the Italian economy
Empirical Analysis

Microeconomic Data

- Census of incorporated Italian firms
  - Balance-sheet data from 1986 to 2015 (~80% of total value-added)

- Investment is a large and infrequent, or *lumpy*, episode
  - In an average year, 18% of firms exhibits an investment rate over 20% (or spikes, 61% of total investment)

- Empirics: Spikes as a signal of technology adoption
**Vintage Effects in the Data**

**Empirical Specification**

\[
\log(TFP_{f,t}) = \alpha + \sum_{j=1}^{7+} \beta_j \text{Inv.Age}_{j,f,t} + \text{Controls}_{f,t} + \epsilon_{f,t}
\]

- \(\text{Inv.Age}_{j,f,t}\): time elapsed since the last investment spike \((ik_{f,t} \geq 0.20)\) computed using:
  - All spikes in the sample
  - Controlling for reverse causality: using only spikes predicted by Logit Model (Two-stage approach)

- **Controls**: firm-, industry-, year-effects, firm’s age and size dummies
**INVESTMENT LEADS TO TFP GAINS**

TFP GAP RELATIVE TO THE FRONTIER: ESTIMATED $\beta_j$’S

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**A. All Spikes**

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**B. Two-Stage Approach**

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RBC with Endogenous TFP Dispersion

◊ **Firms:**

- TFP has two components $\varepsilon z$
  
  - $\varepsilon$ exogenous temporary idiosyncratic shock
  
  - $z$ permanent productivity vintage

- Adopting latest technology $z$ is subject to a fixed cost
  
  - $(S, s)$ technology adjustment rules - action/inaction region
  
  - Different TFP vintages coexist (distribution is non-degenerate)
  
  - Aggregate TFP is *endogenous* to firms’ adoption decision

- The model disciplined by microeconomic data on capital accumulation

◊ **Standard Representative household**
APPLICATION TO ITALY: MODEL VS DATA
SHOCKS THAT DEPRESS INVESTMENT LEAD TO STAGNANT TFP

Financial Shock - TFP Response

<table>
<thead>
<tr>
<th>Year</th>
<th>TFP DATA</th>
<th>TFP VINTAGE</th>
<th>TFP RBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>-1.27%</td>
<td>-0.42%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2013</td>
<td>-1.08%</td>
<td>-0.57%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2014</td>
<td>-1.15%</td>
<td>-0.31%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2015</td>
<td>-0.89%</td>
<td>-0.26%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

Notes: TFP responses following an increase in the price of investment goods. Each entry is in percent relative from trend values.