The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.
Hypothesis: low TFP from misallocation of capital flows

1. Manufacturing firm-level data:
   - dispersion of return to capital increases over time
   - productivity losses from misallocation increase over time

2. Model with financial frictions and investment adjustment costs:
   - tie misallocation to micro-level financial and production decisions
   - decline in real interest rate $\implies$ decline in TFP
Data

- ORBIS-AMADEUS database from Bureau van Dijk (BvD).

- Focus on manufacturing industries (4-digit).

- Main features of data:
  1. 75% coverage relative to Eurostat (Census)
  2. Balance sheet information (advantage over Census)
  3. Many small/private firms (advantage over Compustat/Worldscope)
<table>
<thead>
<tr>
<th>Source</th>
<th>Employee Size Class</th>
<th>Share of Wage Bill</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORBIS-AMADEUS</td>
<td>1-19 employees</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
<td>20-249 employees</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>250+ employees</td>
<td>0.34</td>
</tr>
<tr>
<td>Eurostat (SBS)</td>
<td>0-19 employees</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>20-249 employees</td>
<td>0.43</td>
</tr>
<tr>
<td></td>
<td>250+ employees</td>
<td>0.37</td>
</tr>
</tbody>
</table>
- Monopolistic competition, CD production, CES demand.

- Returns to factors for firm $i$:

\[ MRPL_i := \left( \frac{1 - \alpha}{\mu} \right) \left( \frac{p_i y_i}{\ell_i} \right) = \left( 1 + \tau_i^\ell \right) w. \]  

\[ MRPK_i :\left( \frac{\alpha}{\mu} \right) \left( \frac{p_i y_i}{k_i} \right) = \left( 1 + \tau_i^k \right) (r + \delta). \]  

- Sectoral TFP is the highest when there is no dispersion in MRPL and MRPK.
I. Dispersion of Returns to Factors (Spain)

(a) Permanent Sample

(b) Full Sample
II. Evolution of TFP Relative to Efficient Level (Spain)

The graph illustrates the evolution of TFP (Total Factor Productivity) relative to its efficient level for Spain from 1999 to 2010. The x-axis represents the years (2000, 2005, 2010), while the y-axis represents the logarithm of the difference between the log of TFP and the log of its efficient level, with 1999 set as the base year (log(TFP) - log(TFP^e) [1999=0]).

Two samples are compared:
- **Permanent Sample** (black line)
- **Full Sample** (orange line)

The graph shows a gradual decrease in the difference between TFP and its efficient level over the years, indicating progress towards efficiency.
Summary of Facts

1. The dispersion of log (MRPK) increases over time.

2. The dispersion of log (MRPL) does not exhibit a trend.

3. TFP declines relative to its efficient level.
1. Borrowing constraint that depends on firm size.

2. Risky capital accumulation (standard time-to-build technology).

3. Investment adjustment costs.
Define net worth as $a = k - b$, where $k$ is capital and $b$ is debt.

$$V(a, k, z^P, z^T) = \max_{a', k', \ell, p} \left\{ \frac{c^{1-\gamma} - 1}{1 - \gamma} + \beta \mathbb{E} V(a', k', z^P, (z^T)') \right\}.$$ (3)

$$c + a' + \frac{\psi (k' - k)^2}{2k} = p(y)y - w\ell - (r + \delta)k + (1 + r)a.$$ (4)

$$y = \underbrace{Z}_{Z^A z^P \exp(z^T)} k^\alpha \ell^{1-\alpha} = p^{-\varepsilon}.$$ (5)

$$k' \leq \begin{cases} \infty, & \text{if } k' > \kappa \\ a', & \text{if } k' \leq \kappa \end{cases}.$$ (6)
What We Do

1. Estimate productivity process from the data.

2. Calibrate $\psi$ (adjustment cost) and $\kappa$ (financial friction) using model and micro data.

3. Show that model successfully reproduces many other micro implications.

4. Show aggregate patterns generated by the decline in the real interest rate.
Calibration of $\psi$ and $\kappa$


$$\frac{k_{ist+1} - k_{ist}}{k_{ist}} = d_i + d_{st} + \beta_z \log(Z_{ist}) + \beta_a \log(a_{ist}) + \beta_k \log(k_{ist}) + u_{ist}^k.$$

2. Simulate the model under a decline of the real interest rate.


4. Pick $\psi = 3.1$ and $\kappa = 4.2$ to match $\beta_z = 0.10$ and $\beta_a = 0.09$.

   - With $\psi = 0$, $(k_{ist+1} - k_{ist})/k_{ist}$ too responsive to $\log Z_{ist}$.
   - With $\kappa = 0$, $(k_{ist+1} - k_{ist})/k_{ist}$ too unresponsive to $\log a_{ist}$. 
## Other Cross-Sectional Moments

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Model</th>
<th>Permanent</th>
<th>Full</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MRPK</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corr (log MRPK, $\ell/L$)</td>
<td>-0.19</td>
<td>-0.05</td>
<td>-0.03</td>
</tr>
<tr>
<td>Corr (log MRPK, $k/K$)</td>
<td>-0.57</td>
<td>-0.31</td>
<td>-0.28</td>
</tr>
<tr>
<td><strong>Financial</strong></td>
<td></td>
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<tr>
<td>Corr (log Z, log $a$)</td>
<td>0.81</td>
<td>0.75</td>
<td>0.65</td>
</tr>
<tr>
<td>Corr (log MRPK, log $a$)</td>
<td>-0.20</td>
<td>-0.14</td>
<td>-0.14</td>
</tr>
</tbody>
</table>
Decline in Real Interest Rate

(a) Firm Lending Rate (Up to 1 year)

(b) Government (3 month)
Real Interest Rate Decline in the Model

- Real Interest Rate
- Capital
- Debt
- Fraction Constrained
- SD of log(MRPK)
- log(TFP)−log(TFP_e)
\[ \frac{k_{is,07} - k_{is,99}}{k_{is,99}} = d_s + \beta_z \log (Z_{is,99}) + \beta_a \log (a_{is,99}) + \beta_k \log (k_{is,99}) + u_{is}^k. \]

\[ \frac{b_{is,07} - b_{is,99}}{k_{is,99}} = d_s + \beta_z \log (Z_{is,99}) + \beta_a \log (a_{is,99}) + \beta_k \log (k_{is,99}) + u_{is}^b. \]

<table>
<thead>
<tr>
<th>Model</th>
<th>( \beta_a ) in ((k_{07} - k_{99})/k_{99})</th>
<th>( \beta_a ) in ((b_{07} - b_{99})/k_{99})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>0.12</td>
<td>0.35</td>
</tr>
<tr>
<td>Permanent Sample</td>
<td>0.17</td>
<td>0.20</td>
</tr>
<tr>
<td>Full Sample</td>
<td>0.15</td>
<td>0.11</td>
</tr>
</tbody>
</table>
MRPK and MRPL Dispersion (Full Sample)

(a) Spain  
(b) Italy  
(c) Portugal  
(d) France  
(e) Germany  
(f) Norway
Evolution of \( \log(\text{TFP}) \) Relative to Efficient Level

- (a) Spain
- (b) Italy
- (c) Portugal
- (d) France
- (e) Germany
- (f) Norway
Key Takeaways

1. Since the introduction of the euro, productivity growth between northern and southern Europe diverged.
   - Misallocation of capital inflows due to financial frictions is a possible explanation.

2. Correlation between capital and firms’ TFP decreased over time.
   - Capital is increasingly directed towards less productive firms.

3. Firms face idiosyncratic productivity shocks and borrowing constraints keep smaller firms from taking out loans.

4. A decline in real interest rate associated with capital inflows going to largest but not most productive firms, increasing dispersion to returns to capital and losses to aggregate TFP.
EXTRA SLIDES
TFP in Data vs. Model (1999-2007)

$$\Delta (\log (\text{TFP}) - \log (\text{TFP}^e))$$

(percentage points)

<table>
<thead>
<tr>
<th>Model ((\psi, \kappa))</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>-3.1</td>
</tr>
<tr>
<td>Model ((\psi, \kappa) = (3.1, 4.2))</td>
<td>-1.8</td>
</tr>
<tr>
<td>Model ((\psi, \kappa) = (0.0, 0.0))</td>
<td>0.0</td>
</tr>
<tr>
<td>Model ((\psi, \kappa) = (0.0, 4.2))</td>
<td>-0.2</td>
</tr>
<tr>
<td>Model ((\psi, \kappa) = (3.1, 0.0))</td>
<td>-0.1</td>
</tr>
<tr>
<td>Model ((\psi, \kappa))</td>
<td>((k_{07} - k_{99})/k_{99})</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>((0.0, 0.0))</td>
<td>-0.03</td>
</tr>
<tr>
<td>((0.0, 4.2))</td>
<td>-0.19</td>
</tr>
<tr>
<td>((3.1, 0.0))</td>
<td>0.00</td>
</tr>
<tr>
<td>((3.1, 4.2))</td>
<td>0.12</td>
</tr>
<tr>
<td>Permanent Sample</td>
<td>0.17</td>
</tr>
<tr>
<td>Full Sample</td>
<td>0.15</td>
</tr>
</tbody>
</table>
Evolution of Corr \( \log k_{ist}, \log \hat{Z}_{ist} \)

Correlation of \( \log(k) \) with \( \log(Z) \)

- Permanent Sample
- Full Sample

\[ \text{Correlation of log(k) with log(Z)} \]

\[ \begin{align*}
&2000 & & 2005 & & 2010 \\
&.4 & & .45 & & .5 \\
&.5 & & .55 & & .6 \\
&.6 & & .65 & & .7 \\
\end{align*} \]