Productivity Stagnation and Low Human Capital Investment in a Wealthy Economy: The Case of Italy

Carlo Milana
Birkbeck College, University of London
E-mail: c.milana@bbk.ac.uk

Invited presentation at the Third World KLEMS conference organized by RIETI and Harvard university, Department of Economics in Tokyo, 19-20 May 2014.
Overview

I. Defining the productivity problem in Italy

II. Measurement problems and proposed solution

III. Empirical results

VI. Concluding remarks
I. Defining the productivity problem in Italy

II. Measurement problems and proposed solution

III. Empirical results

VI. Concluding remarks
Table 1. Nominal tangible assets per capita

<table>
<thead>
<tr>
<th>Year</th>
<th>USA</th>
<th>Japan</th>
<th>U.K.</th>
<th>Germany</th>
<th>Italy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>100.0</td>
<td>158.0</td>
<td>73.5</td>
<td>105.0</td>
<td>113.1</td>
</tr>
<tr>
<td>2000</td>
<td>100.0</td>
<td>155.0</td>
<td>71.0</td>
<td>109.0</td>
<td>120.0</td>
</tr>
<tr>
<td>2005</td>
<td>100.0</td>
<td>154.0</td>
<td>69.6</td>
<td>119.6</td>
<td>133.5</td>
</tr>
<tr>
<td>2010</td>
<td>100.0</td>
<td>150.0</td>
<td>67.0</td>
<td>117.0</td>
<td>129.0</td>
</tr>
</tbody>
</table>

Gross internal rate of return (percent)

<table>
<thead>
<tr>
<th>Year</th>
<th>USA</th>
<th>Japan</th>
<th>U.K.</th>
<th>Germany</th>
<th>Italy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>6.3</td>
<td>4.2</td>
<td>5.7</td>
<td>4.6</td>
<td>3.6</td>
</tr>
<tr>
<td>2000</td>
<td>8.5</td>
<td>4.9</td>
<td>5.9</td>
<td>6.9</td>
<td>5.9</td>
</tr>
<tr>
<td>2005</td>
<td>11.8</td>
<td>6.0</td>
<td>6.7</td>
<td>7.7</td>
<td>5.3</td>
</tr>
<tr>
<td>2010</td>
<td>7.0</td>
<td>4.7</td>
<td>5.0</td>
<td>4.5</td>
<td>4.0</td>
</tr>
</tbody>
</table>
Figure 1. Net financial wealth/GDP ratio (median RMU = 100)
Figure 2. Financial liability on GDP (Median EMU = 100)

Source: Cinqueg
Figure 3. Ratios of high-skilled labour to total number of working hours (percent)

- Italy
- U.S.A.
- Canada
- U.K.
- France
Figure 4. High-skilled labor compensation relative to medium-skilled labor compensation in Italy and USA, 1991-2010

Italy

USA
Overview

I. Defining the productivity problem in Italy

II. Measurement problems and proposed solution

III. Empirical results

VI. Concluding remarks
Related contributions

Afriat’s minimum (maximum) path chained Laspeyers (Paasche) index numbers are very close to the following contributions combined together:


Dale W. Jorgenson and Zvi Griliches (1971), “Divisia Index Numbers and Productivity Measurement”, *Review of Income and Wealth*, pp. 227-229, who wrote: “The main advantage of a chain index is the reduction of errors of approximation as the economy moves from one production configuration to another. [...] The Laspeyres approximation to the Divisia index of total factor productivity was employed in our original study of productivity change (1967)”

Samuelson and Swamy (1974, pp. 576) where it is stated that “Fisher missed the point made in Samuelson (1947, p. 151) that knowledge of a third situation can add information relevant to the comparison of two given situations”

Kruskal’s Minimum Spanning Tree recently proposed. See


The upper bound of the aggregate input price index with two observations

Diagram:
- Factor input 1
- Factor input 2
- Point A
- Point B
- Line O

Diagram illustrates the relationship between the two factor inputs and their upper bound.
Keynes’ method of limits

Input 1

Upper bound (Laspeyres-type)

Lower bound (Paasche-type)
Extending a bilateral comparison to a multilateral context (Afriat, 1981)
Samuelson-Afriat tight bounds

\[ M_{ij} \equiv \min_{k\ldots m} L_{ik} L_{kl} \ldots L_{mj} \]

Upper bound (Laspeyres-type)

\[ H_{ij} \equiv \max_{k\ldots m} K_{ik} K_{kl} \ldots K_{mj} = \frac{1}{M_{ji}} \]

Lower bound (Paasche-type)
Misallocation within industry reduces productivity
Between industry misallocation causes output loss
The inefficiency parameter \( e^t \) is found in the interval \( 0 \leq e^t \leq 1 \).
Laspeyres and Paasche matrices with Afriat’s tight upper and lower bound matrices

\[
L \equiv \begin{bmatrix}
1 & L_{12} & L_{13} & L_{14} \\
L_{21} & 1 & L_{23} & L_{24} \\
L_{31} & L_{32} & 1 & L_{34} \\
L_{41} & L_{42} & L_{43} & 1
\end{bmatrix}
\]

\[
P \equiv \begin{bmatrix}
1 & \frac{1}{L_{12}} & \frac{1}{L_{13}} & \frac{1}{L_{14}} \\
\frac{1}{L_{21}} & 1 & \frac{1}{L_{23}} & \frac{1}{L_{24}} \\
\frac{1}{L_{31}} & \frac{1}{L_{32}} & 1 & \frac{1}{L_{34}} \\
\frac{1}{L_{41}} & \frac{1}{L_{42}} & \frac{1}{L_{43}} & 1
\end{bmatrix}
\]

\[
M \equiv \begin{bmatrix}
1 & L_{12} & L_{12}L_{23} & L_{12}L_{23}L_{34} \\
L_{21} & 1 & L_{23} & (L_{23}L_{34}) \\
(L_{32}L_{21}) & L_{32} & 1 & L_{34} \\
(L_{43}L_{32}L_{21}) & (L_{43}L_{32}) & L_{43} & 1
\end{bmatrix}
\]

\[
H \equiv \begin{bmatrix}
1 & \frac{1}{L_{12}} & \frac{1}{L_{12}L_{21}} & \frac{1}{L_{12}L_{21}L_{23}} \\
\frac{1}{L_{12}} & 1 & \frac{1}{L_{23}} & \frac{1}{L_{23}L_{34}} \\
\frac{1}{L_{23}L_{34}} & \frac{1}{L_{23}} & 1 & \frac{1}{L_{43}} \\
\frac{1}{L_{23}} & \frac{1}{L_{43}} & \frac{1}{L_{43}} & 1
\end{bmatrix}
\]

So that we have the following range of possible values:

\[
P_{rs} \leq H_{rs} \leq \text{True measure} \leq M_{rs} \leq L_{rs}
\]
Scale elasticity and misallocation effect

Finding Afriat efficiency index $e_{ij}$:

\[ \frac{L^X_{ij}}{e_{ij}} \geq \hat{X}_{ij} \geq \tilde{X}_{ij} \geq \tilde{X}_{ij} \geq K^X_{ij} \cdot e_{ij} \quad \text{for every } i \geq j \]

where $L$ and $K$ are respectively the Laspeyres and Paasche indexes

Finding the scale elasticity $\varepsilon_t$:

\[ \varepsilon_t \equiv \frac{\partial y_t}{\partial \phi(x_t)} \cdot \frac{\phi(x_t)}{y_t} = \frac{W_t}{p_t(1-m_t)} \cdot \frac{X_t \cdot e_t}{y_t} = \frac{1}{p_t(1-m_t)} \cdot \frac{W_t \cdot X_t \cdot e_t}{y_t} = \frac{1}{MC_t} \cdot AC_t \]

where $p$ is the output price and $m$ is the pure profit margin
Scale effects on TFP

\[ EX_{1,0} = \frac{\phi(x_1)}{\phi(x_0)} = \frac{e_1}{e_0} \cdot X_{1,0} \]

\[ SE_{1,0} = (EX_{1,0})^{\varepsilon_{1,0}-1} \]

- \( SE_{1,0} > 1 \) with \( EX_{1,0} > 1 \) and increasing returns to scale (\( \varepsilon_{1,0} > 1 \))
- \( EX_{1,0} < 1 \) and decreasing returns to scale (\( \varepsilon_{1,0} < 1 \))
- \( SE_{1,0} = 1 \) with any (positive) \( EX_{1,0} \) and constant returns to scale (\( \varepsilon_{1,0} = 1 \))
- \( EX_{1,0} = 1 \) and any returns to scale
- \( SE_{1,0} < 1 \) with \( EX_{1,0} > 1 \) and decreasing returns to scale (\( \varepsilon_{1,0} < 1 \))
- \( EX_{1,0} < 1 \) and increasing returns to scale (\( \varepsilon_{1,0} > 1 \))
Decomposing TFP growth

\[ TFP_{1,0} = \frac{Y_{1,0}}{X_{1,0}} = TC_{1,0} \cdot SE_{1,0} \cdot OC_{0} \cdot e_{1} \]

where

\[ Y_{1,0} = y_{1} / y_{0} \]

Output index

\[ X_{1,0} = \frac{\phi(x_{1})}{\phi(x_{0})} \cdot \frac{e_{0}}{e_{1}} \]

Actual input index = Efficiency input index

\cdot Afriat efficiency index

\[ TC_{1,0} = \frac{y_{1}}{y_{0}} \cdot \left[ \frac{\phi(x_{1})}{\phi(x_{0})} \right]^{\varepsilon_{1,0}} \]

Technical change index

\[ SE_{1,0} = \left[ \frac{\phi(x_{1})}{\phi(x_{0})} \right]^{\varepsilon_{1,0} - 1} \]

Scale effect index

\[ \varepsilon_{1,0} \equiv \alpha_{1,0} \cdot \frac{e_{0}w_{0}x_{0}}{p_{0}y_{0}} + (1 - \alpha_{1,0}) \cdot \frac{e_{1}w_{1}x_{1}}{p_{1}y_{1}} \]

Marginal elasticity of scale

\[ OC_{0} \equiv \frac{1}{e_{0}} \]

Potential gain in TFP level from removal of base-period “within” misallocation
TFP, TC, misallocation and scale effects
Overview

I. Defining the productivity problem in Italy

II. Measurement problems and proposed solution

III. Empirical results

VI. Concluding remarks
Figure 5. Relative levels of TFP (USA 1995 = 1.0)
Figure 6. Relative levels of technology (USA 1995 = 1.0)
Figure 7. Average annual rates of TFP growth and technical change in Italy, 1990-2010 (percent)
Figure 8. Mean and variance of relative levels of sectoral TFP in Italy and the US, 1991-2010

Mean of sectoral productivity levels in the US = 1.0

Mean of sectoral productivity levels in Italy

Variance of relative levels of sectoral productivity in Italy
Figure 9. TFP growth against scale effects on output in Italy, 1991-2010 (% p.a.)
Figure 10. TFP growth against output loss due to misallocation of resources within industries in Italy, 1991-2010 (% p.a.)
Figure 11. Average growth rates of TFP, TC, and output loss due to misallocation, 1991-2010 (% p.a.)
Overview

I. Defining the productivity problem in Italy

II. Measurement problems and proposed solution

III. Empirical results

VI. Concluding remarks
Concluding remarks

In intercountry comparisons, Italy appears to lag behind in productivity levels and growth rates notwithstanding its rich endowment of tangible assets.

In Italy, an underinvestment in human capital and other intangibles coupled with low rewards for high skilled labour had been part of misallocation of resources with a consistent output loss.

A growth strategy based on the acceleration of investments in intangibles and particularly in human capital through education and professional skills seems the most appropriate solution of the Italian productivity problem.