Productivity, Spillovers from Intangibles, and Unmeasured Investments in Artificial Intelligence: Evidence from the EU and US

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Overview

Productivity slowdown:
- Much work shows there has been a slowdown in investment and TFP growth
- What might cause this? Can an “intangible” approach help?

From an intangible capital perspective, at least two possibilities:
- If intangible capital has spillovers, then investment slowdown suggests a TFP growth slowdown
- If unmeasured investments in data and ML have been sizeable (like intangible investments during the IT boom of the 1990s), there might be a data investment-driven "innovation J-curve" (Brynjolfsson, Syverson, and Rock, 2018)
Outline of remarks

- Present estimates of EU intangible investment updated through 2015.
- Compare with US.
- Present updated growth accounting results.
- Briefly interpret spillovers and investment mis-measurement in intangible framework.
Intangible investment, 1999 to 2015

Tangible and intangible shares of GDP
(NonFarm Business, averages, 1999-2015)

Note: Ranked by intangible share. GDP adjusted to include intangibles.


Note: Nonfarm business excludes real estate.
Comparison with United States

Tangible and intangible investment
(Share of intangible-adjusted GDP, US+EU11)

EU11

US

Note: non-farm business. Industry-specific value added PPPs for EU

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Year


0.05 0.1 0.15

0.05 0.1 0.15

Tangible share

Intangible share

Graphs by group_Country

Note: EU aggregation uses Eurostat's industry-specific production side PPPs.
TFP in EU grew very slowly from 2011 to 2015, intangible capital deepening slowed.

Graphs by xperiod and group_Country (EU&US, Non-farm Business, per hour)

Note: EU ICT deflators harmonized to U.S. deflators.
But there may be fewer spillovers than previously...
Many indicators suggest AI activity is growing rapidly...

Computing power used in AI training runs has been increasing exponentially with a 3.5 month-doubling time.

Bias in TFP growth $B$ due to unmeasured investment is given by:

\[ B = -\omega_V^Q (dn - dv) + \sigma_V^Q \delta r^V + (\sigma_X^Q - \sigma_X^V) dx . \]

Assume AI investment a multiple of nonNA intangible investment ...

**Total mismeasurement**

(Non-farm business sector, US+EU, ln changes per annum)

<table>
<thead>
<tr>
<th>Year</th>
<th>EU</th>
<th>US</th>
</tr>
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<tbody>
<tr>
<td>2000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2005</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
</tr>
<tr>
<td>2015</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: Positive bias indicates measured TFP is too big.
Concluding remarks

- Observations on contribution of nonR&D intangibles spillovers and unmeasured AI investments to productivity are preliminary
- Future work will better quantify relative contributions, including bias due unmeasured digital goods and services quality change
- INTAN-Invest© intangibles will incorporate methods improvements
  - Investments in data analytics
  - International flows of intangibles