The Digitalization of Modern Manufacturing

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About ITIF

- One of the world’s top science and tech policy think tanks.
- Supports policies driving global, innovation-based economic growth.
- Focuses on a host of issues at the intersection of technology innovation and public policy across several sectors:
  - Innovation and competitiveness
  - IT and data
  - Telecommunications
  - Trade and globalization
  - Life sciences, agricultural biotech, and energy
Today’s Presentation

1. The Digitalization of Manufacturing and Why It Matters

2. Policy Principles for Competitiveness in Digital Manufacturing

A Policymaker’s Guide to Smart Manufacturing

ITIF | INFORMATION TECHNOLOGY & INNOVATION FOUNDATION
Digitalization Driving the Global Economy

- Digital economy accounts for 25% of global GDP.

- Half of all value created in the global economy over the next decade will be created digitally.

- Value of cross-border data flows surpassed value of merchandise trade for first time in 2015.

“Smart manufacturing”: The application of a transformative set of ICTs to virtually every facet of modern manufacturing.

Digital services account for 25% of total manufacturing inputs.
“Smart” at Each Step of Modern Manufacturing

1. Digitally Enabled Product Design
2. Additive Manufacturing (3D Printing)
3. Digitally Empowered Factory Operations
4. Digitally Linked Supply Chains
5. “Smart Products” Beyond the Factory Floor
Digitally Enabled Product Design

- Generative design techniques and modern CAD software herald a new era for how products get designed.
3D Printing (Additive Manufacturing)

- Particularly suited to producing complex, high-value, lower-volume, highly customizable products.
AI and Industrial Robotics

- A study of 17 manufacturing industries across 13 countries from 1993 to 2007 found:
  - Robots accounted for 10% of GDP growth in studied countries.
  - Productivity in robot-enabled industries increased by 13.6%.

Robots at Work

Georg Graebe
Uppsala University

Guy Michaels
London School of Economics

February 27, 2015

Abstract

Despite ubiquitous discussions of robots’ potential impact, there is almost no systematic empirical evidence on their economic effects. In this paper, we analyse for the first time the economic impact of industrial robots, using new data on a panel of industries in 17 countries from 1993-2007. We find that industrial robots increased both labor productivity and value added. Our panel identification is robust to numerous controls, and we find similar results instrumenting increased robot use with a measure of workers’ replaceability by robots, which is based on the tasks prevalent in industries before robots were widely employed. We calculate that the increased use of robots raised countries’ average growth rates by about 0.35 percentage points. We also find that robots increased both wages and total factor productivity. While robots had no significant effect on total hours worked, there is some evidence that they reduced the hours of both low-skilled and middle-skilled workers.
Digitally Empowered Factory Operations

- Gives manufacturers a comprehensive, real-time view of status of production equipment, work cells, and systems.
Digitally Empowered Factory Operations

Explosion of low-cost sensor technologies has made every manufacturing process and component a potential data source.

- GM: Uses sensors to monitor humidity conditions during vehicle painting; if unfavorable, the work piece is moved elsewhere or ventilation systems adjusted.
- Pfizer: Developing small, modular, portable manufacturing platforms enabling it to manufacture vaccines in developing countries.
Digitally Linked Supply Chain Management

- Real-time visibility into every machine making every component across manufacturing supply chains.
Smart Products Beyond the Factory Floor

▪ “Product servicification”-Selling products as services.

▪ E.g. Rolls Royce’s “Power by the Hour” model.
  50% of Rolls Royce’s revenues come from services.

▪ “Digital twins” concept a key enabler.
The Benefits of Digital Manufacturing

Economic

- Increase global manufacturing productivity by 10 to 25%.
- Industrial Internet could add as much as $10 trillion to global GDP over the next 20 years.
- Anticipated 25% increase in revenues from new products and services at firms using smart manufacturing techniques.
Trade Impact of Digitalized Production Systems

Source: Courtesy Magnus Rentzhog, Swedish National Board of Trade, “Trade, digitalization, and the future of trade policy”
Today’s Presentation

1  The Digitalization of Manufacturing and Why It Matters

2  Policy Principles for Competitiveness in Digital Manufacturing
## Countries Aggressively Implementing Policies to Achieve Digital Manufacturing Leadership

<table>
<thead>
<tr>
<th>Country</th>
<th>Smart Manufacturing Policy/Program</th>
<th>Investment Level</th>
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<tbody>
<tr>
<td>Austria</td>
<td>R&amp;D projects associated with Industry 4.0</td>
<td>€250 million (approximately $280 million)</td>
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<td>China</td>
<td>Made in China 2025 Program; Implementation Plan for the 2016 Intelligent Manufacturing Pilots;</td>
<td>Specific funding line for this pilot unavailable, but China is investing more</td>
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<td></td>
<td>Special Project</td>
<td>than $3 billion in “advanced manufacturing”</td>
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<td>European Union</td>
<td>“Factories of the Future” program calls for “leadership in deploying key enabling and industrial</td>
<td>€7 billion ($7.8 billion) (total over seven years to 2020)</td>
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<td>technologies”</td>
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<tr>
<td>Germany</td>
<td>Efforts to help industry associations, research institutes, and companies create Industry 4.0</td>
<td>€500 million (approximately $550 million)</td>
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<td>implementation strategies</td>
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<tr>
<td>Sweden</td>
<td>The “Smart Industries” Strategy</td>
<td>163 million SEK (approximately $18 million) for various smart manufacturing</td>
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<td>support programs</td>
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<td>United Kingdom</td>
<td>High-Value Manufacturing Catapult, a network of seven advanced-manufacturing technology institutes,</td>
<td>£140/$220 million (over the next five years)</td>
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<td>includes a Manufacturing Technology Centre (MTC)</td>
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<td>United States</td>
<td>At least four related IMIs Digital Manufacturing and Design Innovation Institute (DMDII); America</td>
<td>Across those four institutes: public investment of $240 million; matched by</td>
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<td>Makes (additive manufacturing); Clean Energy Smart Manufacturing Institute; Institute for Advanced</td>
<td>$460 million from nonfederal sources, including private-sector consortium</td>
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<td>Composites Manufacturing Innovation</td>
<td>partners</td>
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Policy Recommendations

1. Avoid data localization policies; facilitate cross-border data flows.
2. Recognize services are a vital input to manufactured products, opening new opportunities to participate in global value chains.
5. Pursue an “attraction” not a “compulsion” strategy toward globally mobile FDI.
Thank You!

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