ICT, organizational change and firm performance: Some reflexions from Argentinean Innovation Surveys

V Taller sobre la Medición de la Sociedad de la Información en América Latina y el Caribe
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Introduction

• **ICT uptake** in the business world means the continuous drive to exploit it in order to support and improve business processes in enterprise and between enterprises. This comprises developing processes, modifying organizations, acquiring better skill sets for managers and workers, obtaining necessary ICT solutions and modifying business methods, as well as products and services to support more streamlined and effective new business models.

• **ICT** are rapidly changing global production, work and business methods and trade and consumption patterns in and between enterprises and consumers. ICT enables a radical change in structures of organizations and means of learning, researching, developing, producing, marketing, distributing and servicing digital and traditional goods and services. It also has a great potential to enhance the quality of life.
GPTs: Technologies that cause dramatic economic changes by stimulating new applications and industries and revitalizing existing sectors ⇒ Strengthens the rationale for government intervention.

Examples of GPTs: Steam Engine, Electric Dynamo, Lasers, Computers

Computers/Internet as a GPT

Creation of New Industries:

- Internet Service Providers
- Network Communications Equipment
- Consulting Services
The importance of having microdata evidence

- ICT impact have been deeply studied in aggregate frameworks
  - Countries
  - Industries

But...
ICT and its appliances vary a lot among firms within industries...

Recently, impact studies start focusing on firm level data (specially in developing countries), what allows to identify firms characteristics (heterogeneity) that are main elements in determining innovation behavior and identifying the differences between sectors in relation to ICT usage, ICT effects, etc. (policy implications)
A pair of questions…

- What are ICT effects’ on firm performance (labour productivity) in the manufacturing sector of developing countries?

- Does exists any kind of complementarity between ICT, skills and non technological changes?
• ICT reduces coordination costs, communication and information processing

• ICT could be associated with a “Cluster” of Complementary Organizational Changes/Practices

  ➢ Transition from mass production to “flexible” manufacturing technologies
  ➢ Changing interaction With Suppliers and customers
  ➢ Transforming the firm characteristics
    ❑ Replacing back-office jobs and increasing the Importance of front-office skills and leadership
  ➢ Decentralized decision making and enhanced Communication
Background: some examples of ICT and organizational implications

- ICT: an important tool for firms competitiveness (improve business processes, reduce costs, broaden market reach locally and globally, etc.).

- Individual SME competitiveness collectively translate into positive results for the national economies: more job creation, more revenue generation and overall country competitiveness.

- There are several factors, either at firm or at environmental level, that are important to help firms fully realizing the potential of their ICT investments:
  - At environmental level, regulatory framework, availability of power, quality and extent of networks use are important.
  - At firm level, the importance of organizational change and skilled staff is widely documented in the literature.
  - Organizational change = re-organization of planning, order processing, controlling, logistic as well as internal and external connection of computers.
The aim of this research is to investigate evidences of positive impact of ICT on firm performances. Hopefully, such evidences might be useful to convince SME that accessing ICT, investing in appropriate ICT and related organizational changes are ways to improve their competitiveness. We follow an econometric approach to estimate the sensibility of output to an increase in ICT-Capital.
To analyze this...

- We concentrate on National Innovation Surveys carried out in Latin American countries (Argentina: Encuesta Nacional de Innovación y Conducta Tecnológica).
- Data covers the period 2004-2006

**MODEL:**

- **Dependent variable**: Ln (Sales/Employment)
- **Control variables**: size, export, group, ownership, capital, tech intensity
- **Independent variables**: skill, R&D investment, machinery and equipment expenses, hardware and software expenditure, and others ICT variables
Some descriptive data (the importance of measuring intensity)


<table>
<thead>
<tr>
<th>Year</th>
<th>Propotion of firms with computers</th>
<th>Propotion of firms with internet</th>
<th>Propotion of firms with web presence</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>80</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>2005</td>
<td>85</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>2006</td>
<td>90</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>

ICT equipped labour share

<table>
<thead>
<tr>
<th>Year</th>
<th>Computer equipped labor share</th>
<th>Internet equipped labor share</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>2005</td>
<td>35</td>
<td>20</td>
</tr>
<tr>
<td>2006</td>
<td>30</td>
<td>15</td>
</tr>
</tbody>
</table>
• IT investment is included considering not only hardware and software but also to estimate IT investment we consider computer and Internet equipped labor share (Maliranta and Rouvinen (2002)).

• Different This measures could also indicate some kind of work organization and skills performance (related to ICT). This better reflects ICT and organizational transformation complementarity than considering organizational innovation and ICT investment, in a multiplicative way.

• We also consider e-commerce (buy/sell by Internet) to have a better idea of firms’ organization.
## Empirical Results

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Ln(SALES/EMP)</th>
<th>Ln(SALES/EMP)</th>
<th>Ln(SALES/EMP)</th>
<th>Ln(SALES/EMP)</th>
<th>Ln(SALES/EMP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export</td>
<td>0.5 ***</td>
<td>0.42 ***</td>
<td>0.37 ***</td>
<td>0.37 ***</td>
<td>0.39 ***</td>
</tr>
<tr>
<td>Unipersonal</td>
<td>-0.88 ***</td>
<td>-0.86 ***</td>
<td>-0.74 ***</td>
<td>-0.74 ***</td>
<td>-0.78 ***</td>
</tr>
<tr>
<td>Group</td>
<td>0.42 ***</td>
<td>0.39 ***</td>
<td>0.34 ***</td>
<td>0.34 ***</td>
<td>0.33 ***</td>
</tr>
<tr>
<td>For K</td>
<td>0.71 ***</td>
<td>0.69 ***</td>
<td>0.42 ***</td>
<td>0.41 ***</td>
<td>0.42 ***</td>
</tr>
<tr>
<td>Teck_intensity</td>
<td>0.09 ***</td>
<td>0.05 *</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Ln R&amp;D per employee</td>
<td>0.02 **</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Ln Maq y equipos per employee</td>
<td>0.02 *</td>
<td>0.03 ***</td>
<td>0.04 ***</td>
<td>0.04 ***</td>
<td>0.04 ***</td>
</tr>
<tr>
<td>Ln Hardware per employee</td>
<td>0.01 *</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
</tr>
<tr>
<td>Ln Software per employee</td>
<td>0.03 **</td>
<td>0.02 *</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Computer equipped labour share</td>
<td>0.01 ***</td>
<td>0.01 ***</td>
<td>0.01 ***</td>
<td>0.01 ***</td>
<td>0.01 ***</td>
</tr>
<tr>
<td>Internet equipped labour share</td>
<td>0.01 *</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skills</td>
<td>0.01 ***</td>
<td>0.01 ***</td>
<td>0.01 ***</td>
<td>0.01 ***</td>
<td>0.01 ***</td>
</tr>
<tr>
<td>Sales by internet</td>
<td></td>
<td></td>
<td></td>
<td>-0.16 ***</td>
<td></td>
</tr>
<tr>
<td>Buy by internet</td>
<td></td>
<td></td>
<td></td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>11.29 ***</td>
<td>11.36 ***</td>
<td>11.11 ***</td>
<td>11.1 ***</td>
<td>11.1</td>
</tr>
<tr>
<td>R square adjusted</td>
<td>0.29</td>
<td>0.32</td>
<td>0.39</td>
<td>0.39</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Dummy variables to consider size and technological intensity are included.
Empirical results

• Control variables show the expected signs (exporter, ownership (unipersonal), group, foreign capital, size, technological intensive)

• Equipment and machine expenditure matters to labor productivity

• Absorptive capacity is important to foster productivity (R&D significance disappears once skills is included)

• Hardware and software intensity expenditure show expected signs; soft more important than hard...

• Computer and Internet equipped labor share are highly significance (even considering hardware and software investments)

• e-commerce (e-selling) is significant and is negative associated to productivity (which could be associated to market transparency due to be in the net).
Preliminary Conclusions

• Due to this kind of organizational change associated to ITC usage, we find complementarity between ICT and organizational change what allows fostering firms’ productivity.

• There is a space to facilitate the ICT access to small and medium firms (i.e. financial support), which should be accompanied by some changes at organization level (skill improvement) to let them take all the ICT benefits ...

• And consider also non-technological intensive sector...
Preliminary Conclusions (cont.)

• So far, our empirical investigation has revealed that ICT does not only have a direct positive impact on firms’ productivity, but also an indirect impact through skills and organization restructuring in Argentina.

• It is clear that the impact of ICT on firm performance is mainly indirect, depending on how firms decide to use the technologies, and to what extent they take advantage of these technologies to introduce innovation in their business operations.

• This study is a first attempt to identify indirect ICT effect on firms productivity. Further and more rigorous researches are needed in the field, and also to develop better indicators to measure this relationship.

• Such results might be helpful to sensitize ICT-adverse firms and policy makers to take advantage of the new economy.
Preliminary Conclusions (cont.)

- ICT has transformed the workplace in many industries and increased the returns to education.

- Developing Countries should consider this at the time policymakers design their innovation policy.

- Increased demand for ICT workers may not be met in many developing countries (opening a space for Outsourcing).

- Something important for policymakers in developing countries is to invest in infrastructure.

- That complement/supports the use of ICT (physical and educational):
  - Low-Cost, High-Bandwith Internet Connections
  - Ensure that educational system addresses Skill deficiencies

- It is also important for developing countries to foster institutions that complement/support the use of ICT.
In this sense, Public-Private Partnerships in developing economies can be useful to have better access to financial market, enhance human capital and stimulate the development of networks what increase the returns of ITC investment in the productive sector.
Next steps

• Include others indicators into the analysis

• Develop others econometric studies that consider the possibility of endogeniety problems, collinearity and biased estimators.

• Extend the analysis to other LAC and consider also service sector
Gracias!!

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