# Focusing on the C in ICT:
## Evidence from Canadian Technology Surveys

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# Outline

- Research program
- Analytical capacity
- Conceptual framework
- Estimation issues
- Main conclusions
  - Advanced technology use and business performance
  - Focusing on the C in ICT
- New analytical resources
- Possible directions

# Background

- Statistics Canada research on the economic impacts of advanced technology:
  - Macroeconomic studies on productivity that stress the growing importance of information and communications technologies
  - Microeconomic studies that investigate the relationship between advanced technology use and business performance

# Objectives: Microeconomic Studies

- To understand how investments in advanced technology affect the competitive process
  - What is the impact of technology use on changes in relative productivity and market share (after other correlates of business performance are taken into account)?
  - Do certain technologies matter more for plant growth than others?
  - Is there evidence that plants using advanced technologies use higher skilled workers and pay higher wages?

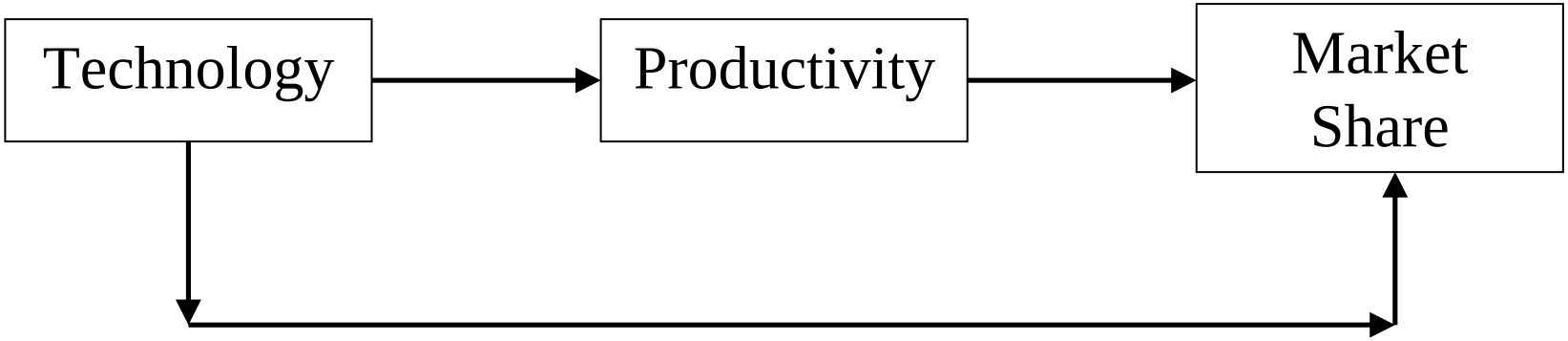
# Analytical Capacity

- Canadian technology surveys
  - 1989 Survey of Manufacturing Technology
  - 1993 Survey of Innovation and Advanced Technology
  - 1998 Survey of Advanced Technology in Manufacturing
  - 1998 Survey of Advanced Technology in the Canadian Food Processing Industry

- Database on plant performance derived from the Annual Survey of Manufactures
  - Longitudinal data on sales, employment, wages and value added
  - Covers all manufacturing plants from 1973 to 1999

# Conceptual Framework

The Performance Effects of Advanced Technology Use




- Productivity equation: $\Delta\left(LP_{t-\tau,t}\right) = f\left(TECH_t, \mathbf{X}\right)$
- Market share equation: $\Delta\left(MS_{t-\tau,t}\right) = f\left(TECH_t, \mathbf{Z}\right)$

# Estimation Issues

(1) Avoiding "technological determinism"

The issue: Unobserved fixed effects may be correlated with technology use, resulting in biased estimates (as models attribute the effect of a large number of activities to just technology use)

Estimation strategy: Control for a broad range of other characteristics related to "innovativeness"

- » R&D activities
- » Other business strategies related to innovation
- » Advanced business practices related to technology adoption
- » Overall capital intensity

Results: The performance effects of technology use are robust to the inclusion of these controls

# Estimation Issues

(2) Utilizing "end-period" technology use

The issue: Several studies use end-period technology use in year *t* to evaluate changes in performance over a previous period (from *t*-$\tau$ to *t*)

– Allows for better identification of technology users based on sorting that occurred during the period, but does not distinguish between initial-period technology use and changes in technology over the period

Estimation strategy: Baldwin and Sabourin (2004) use a panel constructed from the 1993 and 1998 technology surveys to disentangle initial-period effects and growth effects

Results: Changes in ICT use are positively associated with labour productivity growth, while initial-period technology use is not

# General Conclusions

- Plant-level differences in ICT use are associated with changes in relative productivity after controlling for other correlates of performance (including capital intensity and other innovation characteristics)

- ICT use influences market share growth primarily through changes in relative productivity (but some evidence that changes in technology affect market share growth directly)

- It matters (for performance) which technologies are adopted, and how these technologies are being applied to the production process

# Conclusion: “Focusing on the C in ICT”

- Communications technologies (e.g., local and wide area networks) are an integral part of comprehensive technology strategies
  - And comprehensive strategies are associated with superior performance
- The impact of these technologies on relative productivity growth extends beyond capital deepening (changes in capital intensity)
- The impact of these technologies on productivity growth is also apparent after controlling for R&D and other innovation characteristics

# Main Studies

- The productivity impacts of advanced technology use:
  - Baldwin, J.R., B. Diverty and D. Sabourin. 1995. Technology Use and Industrial Transformation: Empirical Perspectives. Analytical Studies Branch Research Paper Series. Catalogue no. 11F0019MIE1995075. Ottawa: Statistics Canada.
  - Baldwin, J.R. and D. Sabourin. 2001. Impact of the Adoption of Advanced Information and Communication Technologies on Firm Performance in the Canadian Manufacturing Sector. Analytical Studies Branch Research Paper Series. Catalogue no. 11F0019MIE2001174. Ottawa: Statistics Canada.
  - Baldwin, J.R., D. Sabourin and D. Smith. 2003. Impact of Advanced Technology Use on Firm Performance in the Canadian Food Processing Sector. Economic Analysis Research Paper Series. Catalogue no. 11F0027MIE2003012. Ottawa: Statistics Canada.
  - Baldwin, J.R. and D. Sabourin. 2004. The Effect of Changing Technology Use on Plant Performance in the Canadian Manufacturing Sector. Economic Analysis Research Paper Series. Catalogue no. 11F0027MIE2004020. Ottawa: Statistics Canada.

# New Analytical Resources

- Survey of Electronic Commerce and Technology
  - Annual, 2000 to 2007: Researcher database
  - Transition to new General Business Survey in 2008 with focus on E-business (pilot survey)
  - Plans to link to financial indicators database

- Advanced Technology Survey – 2007
  - Manufacturing industries
  - New focus on emerging technologies and innovators

# Possible Directions?

- Impact of broadband technologies
  - Are communications technologies still strongly correlated with performance outcomes?
  - How are new communications technologies being applied to the production process? Where are the productivity gains coming from?

- Assessing the impact of changing technology regimes
  - Panel models that investigate the “treatment effects” of major changes/improvements in technology

- Key consideration: The marginal costs and benefits associated with complex survey/research designs