

# Technology and Productivity in the Firm

Discussion of Papers by  
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## Plan:

- Summarize major findings
- Raise several questions
- Suggest additional research

## Wolff: Summary

Paper examines whether or not computer investment is positively linked to TFP growth over the period 1950 to 1990, using pooled cross-section, time series data for 44 industries, decade by decade. Also examines if skill growth is positively linked with productivity growth and whether

computerization is positively associated with certain dimensions of structural change.

Major findings:

- No econometric evidence that computer investment is positively linked to TFP, over and above the inclusion of computer investment in normal capital equipment in TFP calculation.
- Modest evidence that skill growth is positively linked with productivity growth.

- Strong evidence that computerization is positively associated with certain dimensions of structural change.
- These dimensions of structural change include:
  - occupational restructuring and
  - change in the composition of intermediate inputs
  - evidence is a bit weaker for its effects on changes in the composition of industry capital stock

## Comments

R&D results are reassuring:

- In the TFP equation, regardless of specification Wolff finds the R&D variable to be significant—usually at the 5% level.

- In the labor productivity growth equations, Wolff finds the R&D variable to be significant regardless of specification—but this time at the 10% level.

### Skill variable is creative

- The findings with regards to skills are interesting, especially because Wolff does not use education level to measure changes in skills but instead uses the 1977 edition of the Dictionary of Occupational Titles (DOT) for the direct measures of workplace skills. (For some 12,000 job titles, DOT provides a variety

of alternative measures of job-skill requirements based upon data collected between 1966 and 1974.)

- Three measures of workplace skills are developed for each of 267 occupations.

Substantive complexity

Interactive skills

Motor skills

Composite skills variable is also created.

- Using the occupational make-up of each industry over each period, average industry skill scores are computed for each decade studied.

Question one: Are results convincing that computer investment, in terms of an “added kick,” is unrelated to TFP growth?

- Results are convincing for the time period 1950-1990, but is this really the right time period to be studying?

- Will the results be robust when the time period is expanded? Period studied includes years when computers were virtually absent from the workplace. Moreover, with but one exception, the time period does not include the 1990s—the period when computers were most widely adapted and the period when networking at the workplace began (see Shaw).
- In the one instance when Wolff expands the time period to 1997 there is still no evidence that computer investment is positively linked to TFP. As Wolff himself points out, this finding is not inconsistent with the papers presented by Stiroh and Sichel since the

late 1990s are beyond the time period studied by Wolff.

Question two: Are the results convincing that skills are only modestly linked with productivity growth?

- Wise decision not to use average school attainment, or some such variable, given all the problems related to these measures that are alluded to in the paper.
- DOT variable is creative. But is it appropriate for this study?

- Remember: the variable is created based on data collected between 1966 and 1974. May be helpful in explaining growth during the period.
- But, the variable has little relationship to IT literacy/capability. Few occupations during the period 1966 to 1974 were directly impacted by computers.
- Thus, variable gives us no indication of how skill mix may change as a result of introduction of adoption of IT technology.

- Thus empirical work gives us no indication of how IT skills, embodied in the workforce, may affect growth.

Question three: Are there other variables that reflect this embodied idea that could be used to measure skills?

- Need some measure of how facile the workforce is with computers and whether there is indication that variation occurs across industry and if so whether it impacts productivity.

- One way to get a fix on this ability is to recognize that a primary way in which the workforce becomes computer literate is through education—not by studying IT directly--but by being exposed to computer technology during the educational process.

## Vintage Effects

- This embodied hypothesis suggests that the vintage of the workforce matters.
- Workers who come of age when computers are prevalent in schools will be more comfortable with IT

technology—will be more facile with it—than those whose first exposure was as adults.

- When is the critical grade for exposure to begin?
- If it's first grade, then we will not begin to see the productivity effects of this new vintage for several more years.

- Reasoning: Computers have only been widely available in school since 1990. Workers exposed from first grade on will begin to enter the work force in the next five years.
- If first exposure is effective in high school, then we should have begun to see the effects during the past five years since workers exposed from high school on began entering the workforce in the mid-90s.

- Vintage hypothesis suggests we should see considerable more productivity growth from IT in the next decade.
- We can test vintage hypothesis, in the future, because the vintage of workers vary by industry.
- Modest example provided by looking at percent less than 25 and 55 and older by industry

Industry	% $\leq$ 25 years old	% $>$ 55 years old
Mining	6.7	12.1
Construction	14.1	10.2
Manufacturing: Durable Goods	9.8	12.3
Manufacturing: Nondurable Goods	10.1	12.9
Transportation & Public Utilities	9.5	12.1
Wholesale & Retail Trade	28.6	11.1
FIRE	10.3	14.5

Services	13.3	14.1
Public Admin	5.4	14.4

Source: *Employment and Earnings*, household data, annual averages, 2001.

## Shaw: Summary

Paper argues that an objective of firms today is to invest in problem-solving capacity of workforce and that IT is but one component of this investment. Other component

is investment in innovative human resource management (HRM) practices that lead to increased employee involvement (EI).

Shaw paper dovetails well with Wolff's in sense that it examines a specific change (HRM) that arguably makes investment in IT more effective.

Appropriate to end the conference with this paper.

- Reminds us that IT could be a necessary condition but certainly not a sufficient condition I affecting performance.

- Paper is also the first paper presented at the conference that uses data that the author actually gathered herself.

## Major findings/contribution

Shaw's line of research fills an important void:

- There is research on contribution of IT to performance

- There is research on contribution of HRM to performance
- Little research that looks at how the two combine to enhance performance.
- Shaw proposes to do this

Shaw is interested in problem solving capacity of workers.

Shaw sees this as dependent on

- Problem-solving aptitude and
- connective capital.

- IT enters in this capacity because it provides information and facilitates communication.
- HR practices also affect this.

Shaw's research indicates that individuals who work in steel mills on involvement-oriented lines have considerably more ties than individuals who work on control-oriented lines. (Table 4)

This provides convincing evidence that HR practices affect communication and thus, by inference, affect problem solving capacity and productivity.

Major concern with Shaw's paper is that while it provides rich hypotheses, it only provides empirical support for one piece of the picture.

What we need—for a starter—is a table where we look at ties as a function of IT infrastructure—not just as a function of HR practices.

Then we need a table that looks at ties as a function of IT and HR infrastructure combined.

We presume that that is where she is headed.

When Shaw gives us these, she will go a long way towards convincing us that HR practices are crucial in leveraging productivity effects from IT investments.

Moreover, Shaw's focus on the importance of people skills to be effective in communication—

