Moore's Law Goes Multicore:
The economic impact of a fundamental change in the way computers work

NBER Economics of Digitization Research Grant Proposal
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Research Questions

This research addresses two key questions:

i. How is the changeover to multicore computer processors impacting firms?
ii. Can this changeover be used to identify the impact of I.T. on firm productivity?

Background and Current Findings

In the 1990s and early 2000s, computer chip-makers Intel and AMD released a succession of ever-faster processors. This progression stalled in the mid-2000s, when engineering constraints caused them to abandon chip speed-ups. In their place, producers put multiple processors (or 'cores') on each chip. The impact of this change surrounds us: hardware manufacturers tout their multiple processors with tags like 'dual-core' or 'quad-core' and software packages, such as Stata, revise their main products or offer special multiprocessor versions. Despite the ubiquity of multicore computing, little has been written on the impact that it has for firms.

Where, previously, chip speed-ups made all software run more quickly, to the benefit of all firms, now only firms whose software is designed to take advantage of multiple processors can benefit. As a result, the switch to multicore impacted all firms, but provided much less benefit to those with software that was poorly adapted for the change (i.e., to software with little parallelism).

The paper, on which this grant is based, exploits this fundamental change in the complementarity between hardware and software to address a difficult causal question: how does information technology impact firm productivity? This question has been difficult to answer both because most analyses have not been at the level of the firm, and because those analyses that are at the level of the firm have plausible arguments for endogeneity or reverse causation. The paper argues that the switch to multicore hardware allows for a relatively clean estimation of this effect, and it does so for a panel of Swedish firms from 2001-2007. The analysis shows that firms with one standard deviation more parallelism in their software achieve productivity growth that is 0.3% - 0.7% higher per year in the post-multicore period. This finding is then contextualized with a discussion of the productivity slow-down in the U.S. economy in the mid-2000s. The paper also presents a number of checks, some non-parametric, to support the robustness of these findings.

Proposed Work

Currently this work is only exploiting variation in the software parallelism *across* software types. Thus, it considers, for example, the differences in parallelism between databases and spreadsheets, but not between Oracle databases and Microsoft SQLServer databases. This limitation focuses the analysis on inter-industry variation, since many firms within an industry use similar types of software.

This grant would be used for data collection. It would be used to gather data on the software parallelism in individual programs. This would produce much more variation in software parallelism within industries, allowing a comparison of software parallelism and productivity within industries. Having this data would allow a broad range of analyses to rule out industry-level confounds.

Budget

The $20,000 would be used for:

i. Funding for a research assistant to investigate this data
ii. Summer support for the author

The anticipated split would be roughly 50-50.

Conclusion

The switchover to multicore computing offers an excellent quasi-natural experiment for analyzing the effect of I.T. on firm productivity because it offers a surprise change in hardware that has important widespread, but asymmetric, impacts on firms. Taking advantage of this change requires extensive data-gathering. This grant will help make that possible.

In doing so, it will help to contribute to the important, but hard-to-identify, question of the impact of I.T. on firm productivity.

About the Researcher

Neil Thompson just graduated from the Berkeley Haas School of Business with a PhD in Business and Public Policy. Concurrent with the PhD he completed two Masters Degrees, one in Statistics and one in Computer Science. As part of the Computer Science Masters, Neil was part of the Berkeley Parallel Computing Lab, where he ran the Berkeley Software Parallelism Survey, which polled computer scientists about the parallelism in the software used by firms. Neil also held Robert Noyce Fellowship from the Intel Foundation as part of this work.

On the economics / business side of this project, Neil's principal advisors are Nicholas Bloom, Lee Fleming and David Mowery.