Information Technology Spending and Economic Productivity:
A review of *The Trouble with Computers* by Thomas K. Landauer

Yannis Bakos
University of California, Irvine

Journal of Economic Literature, September 1996

Information technology has become a significant component of new capital investment (some estimates put it at 30%) and several economists look to computers as the best hope for a sustainable increase in economic growth rates. Thus questions about the productivity of computer investment are a serious matter. In his book *The Trouble with Computers* (MIT Press, 1995), Thomas K. Landauer argues that computers have been unproductive because of poor design and deployment. To support this thesis, Landauer draws on economic data and analysis as reported by other researchers, and offers voluminous anecdotal evidence of computer shortcomings. He then proceeds to offer his own solution to this productivity problem, based on a set of "user-centered" principles for the design, development and deployment of computer systems.

Landauer makes an articulate argument that computers can be improved in ways that would make them more useful, usable and productive. Unfortunately he succumbs to the fallacy that since computers can be greatly improved, they must be unproductive. *The Trouble with Computers* is peppered with entertaining and often insightful anecdotes about the shortcomings of computer systems, such as poorly designed voicemail systems, ordering 15 items from a mail-order vendor which arrived in 15 separate shipments, increasing paper output rather than useful work, inflexible systems that try to seat him far from his 5-year old daughter, or systems that are counterintuitive and difficult to use.

In chapters 5, 6 and 7, Landauer suggests that getting value from computers is limited because of factors such as high total cost (when hidden costs such as user time spent dealing with system problems are included), systems that are difficult to learn and use, quick obsolescence, unreliability, rejection by workers, poorly structured organizations that do not use their computers effectively, mismanagement, poor software design, excessive complexity and the lack of standards. These chapters make a convincing argument for the evident fact that computer systems can be substantially improved; Landauer inappropriately offers this as evidence that computers are unproductive. He dismisses the ability of the invisible hand of the market to weed out firms that consistently make unproductive investments, and concludes (chapter 8) that we buy computers because "people like them", "we all get a kick", and computerization is "neat". The result, he claims, is that computers provide features without real value and make possible an increase in the scale of operations without improving economic productivity.

In part IV of the book, Landauer offers his solution for increasing the productivity of computer investments, in a set of "user-centered" principles for the design, development and deployment of computer systems. This is a set of principles emphasizing the needs and the cognitive limitations of computer users, promising to alleviate the problems that Landauer attributes to differences in personality, cognitive style and analytic ability between computer developers and computer users.

While Landauer's guidelines can be valuable, determining the productivity of computers is the province of econometric analysis rather than anecdotes. Studies have attempted to assess the productivity impact of information technology investments both at the macro level (economy / industrial sector) and at the firm level. At the macro level, the studies by Roach (1987, 1992) are typical, pointing out that (with the exception of the telecommunications sector), **measured** productivity gains have not substantially accelerated in the period 1960-1990, despite rapidly increasing investments in computers and other types of information technology. Landauer uses these studies as evidence that computers are not productive, but he fails to realize that these studies were exploratory, lacking a theoretical model necessary for positive analysis. Furthermore, although computer spending was rapidly increasing through the 1980s, computer capital represented a very small component of total capital stock during this period. Thus simple correlations, like Roach's, are unlikely to discern any impact of computers on productivity over factors such as oil prices, export growth and monetary policy, especially without an appropriate theoretical model.

Bresnahan (1986) derived a macro-level estimate of computer technology's benefits to the banking sector in 1972 by estimating the consumer surplus under an imputed demand curve. In a remark near the end of his paper Bresnahan projects these benefits to 1986 by adjusting for the dramatic reduction in the price of computing in the intervening years, but fails to take into account the reduced surplus contribution of incremental sales, as a result grossly exagerating the total consumer surplus. Landauer devotes much of chapter 4 illustrating the implausibility of Bresnahan's remark, but the fact remains that Bresnahan's methodology and early surplus estimates are valid. The question of consumer surplus in more recent years is addressed by Brynjolfsson (1995), who used a methodology similar to Bresnahan's to estimate an economy-wide demand curve, concluding that computers created approximately $50 billion of consumer surplus in 1987. Brynjolfsson points out that some of this surplus will not show up in productivity statistics because it takes the form of greater convenience, product variety, quality or timeliness, and these contributions are likely to be largely missed in GDP accounting.

At the firm level, the productivity of information technology has been studied by fitting a production function (typically Cobb-Douglas) to firm level data about inputs (typically computer and non-computer capital stock, information systems labor, other labor, and R&D) and outputs (typically sales or value-added). Estimating the coefficients of the production function yields estimates of the contributions of the included input factors. Landauer mentions an early study with this methodology by Loveman (1988) which failed to identify positive returns to computer capital or labor; this study, however, was based on data from 20 firms in the PIMS database for the 1978-1983 period, and as a result, obtained only very imprecise estimates of computers' output elasticity and marginal product. Studies with much larger and more recent data sets have conclusively found positive returns to investments in information technology capital and labor. In particular, Brynjolfsson and Hitt (1994, 1996) analyzed data from 367 firms over the period 1988-1992 with 1,248 total data points, and found no evidence of productivity shortfall, and if anything, evidence of *excess* returns to IT capital and IS labor. Their results were robust to different specifications of their production function, and have been replicated by Lichtenberg (1995) and others with data from different sources. Landauer acknowledges the Brynjolfsson and Hitt study, but dismisses its findings as one positive study among many negative ones.

A second approach used at the firm level attempts to identify the relationship between investments in information technology and financial performance. Landauer reviews a number of Strassmann's (1990) scatter plots of measures of computerization (e.g., computer spending per revenues, computer spending per employee per year) *vs.* financial performance measures such as ROA, ROI and stockmarket returns. These graphs fail to

show a connection between computer spending and financial performance. Here Landauer stands on firmer ground, as it will be difficult to establish a relationship between information technology investments and financial performance, given the large number of confounding variables. But even if it could be shown that computer investments do not improve financial performance, the likely explanation is not that information technology is unproductive, but that its benefits are competed away to the benefit of consumers, thus further increasing consumer surplus. Actually, if firms are rationally investing in information technology, then an economist would *not* expect to see a correlation between this investment and profits or stock returns, as any positive correlation would be evidence of excess, not normal, returns.

Computers can be improved, and we know it. Attention to user needs and capabilities is very important, and companies like Apple and Microsoft have incorporated usability labs in their design process to address the issues raised by Landauer. But when it comes to economics, Landauer misses the mark: his anecdotes an economic analysis do not make. *The Trouble with Computers* could be valuable to system designers, information systems managers and frustrated computer users. However, as the economic impact of information technology continues to grow, it will become increasingly important for more economists to address the economic issues raised, and communicate our findings to the lay audience. If we don't, the topics won't go undiscussed, but we risk ceding the debate to those with less expertise in the necessary methodology.

REFERENCES

Bresnahan, T. F., "Measuring the Spillovers from Technical Advance: Mainframe Computers in Financial Services", *The American Economic Review*, 76 (4): 742-755, (1986).

Brynjolfsson, E., "Some Estimates of the Contribution of Information Technology to Consumer Welfare", MIT Sloan School of Management Working paper (September 1995).

Brynjolfsson, E. and L. Hitt, "Paradox Lost? Firm-level Evidence on the Returns to Information Systems Spending", *Management Science*, April (1996).

Lichtenberg, F. R., "The Output Contributions of Computer Equipment and Personal: A Firm-Level Analysis", *Economics of Innovation and New Technology*, 3 201-217, (1995).

Loveman, G. W. An Assessment of the Productivity Impact of Information Technologies. MIT Management in the 1990s Working Paper #88-054, July (1988).

Roach, S. S. America's Technology Dilemma: A Profile of the Information Economy. Memorandum. Morgan Stanley, 1987

Roach, S. S. *Technology Imperatives*. Morgan Stanley, New York, 1992

Strassmann, P. A. *The Business Value of Computers*. Information Economics Press, New Canaan, Connecticut, 1990