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Economic Statistics, the New Economy, and the Productivity Slowdown

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From 1949-1973, the Bureau of Labor Statistics (BLS) estimates that nonfarm multifactor productivity grew at 1.9 per cent per year. Following 1973, the comparable number is 0.2 per cent, despite the economy's substantial investment in computing equipment, the growth of the information economy, and the many innovations that have come to be known as the "new economy." Many economists believe that productivity must be growing more rapidly than the government numbers suggest. This article reviews two reasons--one wrong, I contend, and one more plausible--for believing that inadequate measurement of output in our economic stastistics may be hiding essential developments in our economy.

I. The New Economy View of the Productivity Slowdown[1]

Many economists believe there *must* be a mismeasurement story in the productivity slowdown, because they see more technical changes, more new products, more changes in consumer service, in methods of delivery, and other innovations than is consistent with the modest rise in government productivity numbers. We are a "new economy," in this view, inundated with an unprecedented flow of innovations and new products, and none of this flow of the new is discernible in the productivity numbers.

This new economy view is repeated in the newspapers, in business publications and places such as Federal Reserve Bank reviews, and we hear it at conferences. It once was true, the story goes, that products were standardized and therefore easy to measure. Today, we are told there is an *unprecedented* stream of new products and quality improvements and customized products to meet market niches, product cycles are shortening to an *unprecedented* degree, new services from industries such as banking and finance are being introduced with a rapidity that is *unprecedented* historically, and the Chairman of the Federal Reserve Board has been quoted to the effect that the *unprecedented* current level of technological innovations is a once in a century phenomenon that will yield an enormous upward surge in productivity.

Although computers inevitably come into the story, this "new economy" view of the productivity slowdown is not directly related to computers. Rather, people are stacking up and cumulating anecdotes, whether from within their own companies or from what they read in the newspapers or hear other people saying. Those cumulated anecdotes do not seem consistent with the aggregate productivity numbers. Robert Solow's widely quoted aphorism: "*You can see the computer age everywhere but in the productivity statistics*" (Solow, 1987) was immediately preceded by a less-noticed sentence that makes the same point: "[The authors], like everyone

[1] This section is adapted from section VII in Triplett (1999).

else, are somewhat embarrassed by the fact that *what everyone feels to have been* a technological revolution, a drastic change in our productive lives, has been accompanied everywhere...by a slowing-down of productivity growth, not by a step up" (emphasis supplied). From this point of view, it is not so much a belief that the computer has increased productivity, but rather a belief that productivity has improved, based on other evidence.

Those anecdotes about new products, new services, new methods of distribution and new technologies are no doubt valid observations. Although no one knows how to count the number of these "new" things, I would not seriously dispute the proposition that there is more that is new today than there was at some time in the past. Yet, these anecdotes wholly lack historical perspective, and for that reason are misleading as evidence on the productivity slowdown and the hypothesis that mismeasurement explains it.

To have an impact on productivity, the *rate* of new product and new technology introductions must be greater than in the past, not just their number. A numerical example makes the point (table 1).

Suppose all productivity improvements come from the development of new products. Suppose, further, that in some initial period 100 products existed and that ten percent of the products were new, which produced a 10 percent productivity growth (from new products--see table 1). In the following period, there must be 11 new products just to keep the rate of productivity growth constant, and in the period after that 12 new products are required. At the end of 10 years, a constant productivity rate requires 26 new products per year, and after 20 years, 62 new products and so on, as the arithmetic of compound increases shows. As the economy grows, *an ever larger number of new products is required just to keep the productivity growth rate constant.*

Most of the anecdotes that have been advanced as evidence for the "new economy" amount to assertions that there are a greater *number* of "new" things. A greater *number* of new things is not necessarily a greater rate of new things. As an example, some economists have cited the number of products carried in a modern grocery store as evidence of increased consumer choice, of marketing innovations, and so forth.[2] One study reported that in 1994 there were more than twice as many products in the average grocery store than in 1972 (19,000, compared with 9,000). But in 1948, the number was 2,200. That means that the 1948-72 rate of increase (from 2,200 to 9,000, or 6.0 per cent per year) was nearly twice as great as the 1972-94 rate of increase (3.5 per cent per year). Thus it is true that in 1994 there were many more products in grocery stores than there were two decades before; but the rate of increase fell.

Some other illustrations enhance the point. The Boskin Commission, which reviewed the Consumer Price Index, cited welfare gains from the increased availability of imported fine wines, and so forth, which the CPI did not take into account. Because of the great reduction in transportation costs, we now get Australian wine in the United States at low prices (as low, in my experience, as in Australia). That is certainly an increase in the number of commodities available, and an increase in welfare. But is the increase in tradeable commodities a larger *proportionate* increment to choice and to consumption opportunities than the increments that

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[2] Reservations might be expressed about this interpretation of the number of products in supermarkets.

occurred in the past?

Diewert (1993) cites an example, taken from Alfred Marshall, of a new product in the 19th century: Decreased transportation costs, owing to railroads, made fresh fish from the sea available in the interior of England for the first time in the second half of the 19th century. Considering the very small number of consumption goods then available to the average worker, and even allowing for the fact that the fresh fish were undoubtedly initially consumed mostly by the middle class, was the introduction of fresh fish a smaller proportionate increase in the number of new commodities than is the availability of Australian wine and similar goods a century later? Perhaps the best answer to this question is: we do not know. But we also have looked at the decade of the 1990's with far too short a historical perspective.

In developing a related point, Mokyr (1997) refers to "the huge improvements in communications in the 19th century due to the telegraph, which for the first time allowed information to travel at a rate faster than people.... The penny post, invented...in the 1840s, did an enormous amount for communications -- compared to what was before. Its marginal contribution was certainly not less than Netscape's."

One could go on. My numerical example (table 1) implied that each new product had the same significance as earlier ones. If we simply count, then new products of the 1990's must equal the significance of automobiles and appliances in the 1920's and 1930's (home air conditioning first became available in the early 1930's, for example), and of television and other communications improvements in the 1940's and 1950's (mobile telephones, for example, were introduced in the 1940's). If the average significance of each new product in the 1990's is not as great as for individual new products from the past, then the number of them must be greater still to justify the new economy view of the productivity slowdown.

The same proposition holds for quality change. It is amazing to see quality improvements to automobiles in the 1990's, great as they have been, held up as part of the unprecedented improvement story, or—as in a press account I read recently—quality change in automobiles given as an example of the new economy, contrasted with a ton of steel in the old. Actually, the first thing wrong with that contrast is that quality change in a ton of steel has been formidable. Second, quality change in autos is a very old problem in economic statistics, it did not emerge in the 1990's as a characteristic of the new economy. Hedonic price index methodology was developed in the 1930's to deal with quality change in automobiles (Court, 1939). The study by Raff and Trajtenberg (1997) suggests that the rate of quality improvement in automobiles was greater in the first decade of the twentieth century than in its last decade. Again, much of what has been said about the new economy is true; what has been lacking is a proper historical appreciation for the magnitudes and significance of new product introductions and quality change in the past.

I believe that the number of new products and "new things" is greater than before. But that is not the question. The proper question is: Is the rate of improvement, the rate of introduction of new things, unprecedented historically? I do not believe we know the answer to that question. If "new things" are a measure or indicator of productivity improvement, then we must have an increase in the rate of introduction of new things, not just an increase in the number.

The idea that productivity growth has been hidden by mismeasurement in economic

statistics has gained acceptability partly because some economists have mistakenly been counting new innovations on an arithmetic scale, and—finding more of them—have thought they have evidence confirming it. They ought to be looking at a logarithmic scale, a scale that says you must turn out ever greater numbers of “new things” (or new things of greater and greater significance) to keep the current rate of "new things" up to the rates of the past. Anecdotes that have been cited in support of the "new economy" suggest that many economists have been looking at the wrong scale, they have been looking at the number of new things on an arithmetic scale, rather than the rate on a logarithmic scale.

We look at the new products and new technical changes at the end of the 20th century, and we are tremendously impressed by them. We should be. It is clear those new products are increasing consumer welfare, and the technical innovations are contributing to output. But are they increasing at an increasing rate? Is the number of new products increasing more rapidly on a logarithmic scale? That is not clear at all. For the "new things" to improve productivity, they must be increasing at an increasing rate, and there is no strong evidence that the rate is increasing.

II. Computers and Output: A Different Mismeasurement Story

Computers, of course, are nearly the essence of the technology of our time. Understanding the economic impact of computers is not the same thing as understanding the productivity slowdown, even though the two topics have often been linked.

Consider where computers go, and where they are most used. The 1992 Capital Flow Table has just been published (Bonds and Aylor, 1998). The Capital Flow Table is already out of date (data lags are a big problem for analyzing dynamic sectors of the U.S. economy), but it is the latest information we have. Additionally, the 1992 distribution of new computer investment is not the same thing as an inventory of the installed stock of computer equipment (but the results are not that much affected).

Table 2 shows that four industrial sectors--financial services, wholesale trade, miscellaneous equipment renting and leasing, and business services--account for over forty percent of computer investment. Add in two more sectors--insurance and communications--and the share exceeds fifty percent. Only in miscellaneous renting and leasing does the share of computer investment in total equipment investment approach half; these computer using sectors are not necessarily computer intensive, but I will use that language in the following, anyway.

These computer-using industries share four important characteristics.

First, they are all services industries, broadly defined. I come back to that.

Second, a very important point: *Measured* productivity in these computer-using industries has been declining. Table 3 presents the available numbers. Statistical information for services industries is often less complete than for the goods-producing sectors, which the “n.a.” entries in Table 3 indicate. Two kinds of information, both fragmentary, are available.

New multifactor productivity estimates for services industries are in a BLS study by Gullickson and Harper (forthcoming). Multifactor productivity is the ratio of gross output to capital and labor inputs. Additionally, value added per hour can be computed from BEA’s gross product originating (GPO) series.

Gross output multifactor productivity and value-added labor productivity do not always agree, and indeed, they shouldn't. But the general picture for these computer-intensive services industries is the same, no matter which measure is used: Productivity growth has slowed remarkably since 1973, compared with the earlier post-war years.

Additionally, table 3 is filled with negative productivity numbers. In fact, among the computer-intensive services industries, only communications and wholesale trade show upward trends.

Negative productivity numbers are always puzzling. However, the next characteristic of these computer-intensive services industries makes the negative productivity numbers especially attention getting, and one might even say suspicious.

Third, with the possible exception of communications, the outputs of all these computer-intensive services industries are hard to measure. How does one measure the output of banking and finance? This is an old, contentious issue in national accounts (see Triplett, 1992 for a summary). A similar controversy concerns the output of the insurance industry. And how do we measure the output of business services? For example, what is the output of an economics consulting firm? What is its price index? How would we compute its productivity?

As Zvi Griliches (1994, 1996) has repeatedly emphasized, if we do not know how to measure the output of an industry, then we do not know how to measure its productivity. And if the available productivity numbers, measured as best the statistical agencies can, show negative productivity, perhaps the reason is that economic statistics are missing part of the output that these industries produce.

The relevance of this mismeasurement point is underscored by Communications, which is an exception in the group (in that its productivity growth is positive). Communications output is probably measured better (which is not the same thing as saying that it is totally adequate) than is the output of the computer-using services industries that have negative productivity. For example, economic statistics are probably better at measuring telephone calls than consulting services, even though evidence suggests that new communications products, such as cellular phones (Hausman, 1997), do not get into the data fast enough. It may be no coincidence that communications is the computer-intensive industry with the strongest positive productivity growth.

Even if computer-intensive services industries are mismeasured, however, this is not evidence for mismeasurement of *aggregate* productivity. The reason is the final common characteristic of these computer-intensive industries.

Fourth, most of the output of these computer-using industries is intermediate, not final. By definition, all of business services (except for exports) and all of wholesale trade are intermediate products. Equipment renting and leasing is also largely an intermediate activity (consumer renting is in the retail sector in the old U.S. SIC system, and computer, aircraft and vehicle leasing are not classified in this industry). Although finance, as well as insurance and communications, contribute to final output in their sales to consumers (and in contributions to net exports), much of their output goes to other business--for example, roughly two-thirds of communications and half of insurance are intermediate. Thus, half of computer investment in the U.S. goes into six industries that primarily produce intermediate output.

The outputs of intermediate products net out in aggregate productivity measures, such as

BLS' private nonfarm multifactor productivity. Aggregate productivity is computed across final demand categories, it is not computed by aggregating across industries--just as U.S. Gross National Product is computed by aggregating C+I+G+X (where X=net exports), and not by aggregating the BEA's gross product originating by industry (GPO).

If computers are revolutionizing wholesale trade, and anecdotes suggest they are, their impact on wholesale trade will show up in the *aggregate* productivity numbers in the downstream industries that consume the output of the wholesale trade sector, mainly retail trade. If U.S. economic statistics measure correctly the price indexes and output of the retail trade sector (that is a big "if"), then the contribution of computer investment in wholesale trade will already be incorporated into the aggregate productivity numbers, no matter how wholesale trade output is measured. Similarly, the causes of the great expansion of business services in the U.S. economy are not clear; but if business services are doing something to raise aggregate productivity, then their contribution is to the downstream-using industries. Even if productivity growth in these computer-using industries were tremendous, it cannot affect aggregate productivity directly, because in aggregate productivity, as in GDP, the contributions of intermediate-producing industries cancel out in the totals.

Having no affect on aggregate productivity numbers does not mean, however, that possible mismeasurement in computer-intensive services industries is unimportant. Rather, I have concluded (see Triplett, forthcoming), that the impact of the computer is primarily a story about industry productivity, and not primarily a story about the post-1973 productivity slowdown. In this, I agree with Jorgenson and Stiroh (1999), and earlier work by Oliner and Sichel (1994). To understand the role of technology in a high-tech economy, to understand the impact of the computer on the U.S. economy, we ought to be looking at the impact of the computer at the industry level, to ask how computers have been contributing to industry growth and productivity, and how those industry growth patterns affect other industries and their use of resources.

But at the industry level, our economic statistics do not appear adequate to analyze the effect of the computer. A very high proportion of computer investment goes to sectors of the economy where even the concept of output is not well defined, and the measures of output in these computer-using sectors appear inadequate. If the output measures and the productivity measures are inadequate, we simply lack the statistical basis on which to determine the impact of the computer on industry performance. For a technological country, that is a great informational lacuna.

III Conclusion

I believe that the productivity slowdown is real, it is not *primarily* a chimera caused by mismeasurement. But inadequate measurement in economic statistics also exists and it is a problem for understanding exactly the portions of our economy--high technology and services--that are the rapidly expanding and dynamic sectors.

In the Brookings Institution's "Project on Measuring Output and Productivity in the Services Industries," we are working on the problems of measuring the output of "hard-to-

measure services industries." My co-director, Barry Bosworth, and I invite NABE members who are interested in this problem, to participate in a series of workshops on "problem" services industries that are underway at the Brookings Institution.

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Table 1
Productivity from New Products

Periods	0	1	2	3	10	...20
Number of products	100	110	121	133	259	...673
Number of new products	10	11	12	13	26	...67
Productivity change	10%	10%	10%	10%	10%	10%

Table 2

Top Computer Using Industries, 1992 Capital Flow Table

	Computers ($ millions)	Computers and Peripherals ($ millions)
Financial Services	2,270	6,677
Wholesale Trade	1,860	4,874
Business Services*	1,383	3,598
Miscellaneous Equipment Rental and Leasing	1,233	3,200
Communications Services	873	2,299
Insurance Services	738	1,875
Top Four Industries	6,746	18,349
% of Top Four Industries of Total	42.6%	42.1%
Top Six Industries	8,357	22,523
% of Top Six Industries of Total	52.8%	51.7%

*Excludes Miscellaneous Equipment Rental and Leasing

Source: Bonds and Aylor, 1998

Table 3

Computer Investment, Multifactor Productivity, and Labor Productivity, Selected Services Industries

	Computer Equipment as a Percent of Industry's Total Equipment Investment[1]	Multifactor Productivity[2]		Labor Productivity (GPO per hour)[3]	
	computers and peripherals	1947-63	1977-93	1960-73	1973-96
Finance, Insurance, and Financial Services					
Banks (SIC 60, 61)	20.7[a]	n.a.	-2.9[b]	0.2	-0.3
Insurance Services					
Insurance Carriers	23.3[c]	n.a.	-2.2	1.9	0.7
Insurance Agents	23.3[c]	n.a.	-2.7	0.2	-0.7
Wholesale Trade	19.0	n.a.	1.3	3.2	2.7
Business Services (SIC 73)	33.6	n.a.	-0.4[d]	-0.2[e]	-0.4[e]
Communications Services	5.2	2.5	1.8	5.0	3.9

[1] Source: Bonds and Aylor, 1998
[2] Source: Gullickson and Harper, forthcoming
[3] Source: Bosworth, 1998
[a] Financial Services
[b] Also includes Holding Companies
[c] Insurance Services (Carriers and Agents combined)
[d] Also includes Miscellaneous Repair Services (SIC 76)
[e] Also includes Professional Services (SIC 87)