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Productivity Measurement Issues in Services Industries: "Baumol's Disease" Has Been Cured

1. Introduction

It is now well known that after 1995, labor productivity (LP, or output per hour) in the United States doubled its anemic 1.3 percent average annual growth between 1973 and 1995 (see chart). Labor productivity in the services industries also accelerated after 1995.

As we documented in a longer version of this paper (Triplett and Bosworth forthcoming), labor productivity growth in the services industries after 1995 was a broad acceleration, not just confined to one or two industries, as has sometimes been supposed. Using the 1977-95 period as the base, we showed that fifteen of twenty-two U.S. two-digit services industries experienced productivity acceleration. Both the rate of LP improvement in services after 1995 and its acceleration equaled the economywide average. That is why we said "Baumol's Disease has been cured."[1]

We also examined the sources of labor productivity growth. The major source of the LP acceleration in services industries was a great expansion in services industry multifactor productivity (MFP) after 1995. It went from essentially zero in the earlier period to 1.4 percent per year, on a weighted basis. As MFP is always a small number, that is a huge expansion. Information technology (IT) investment played a substantial role in LP growth, but its role in the acceleration was smaller, mainly because the effect of IT in these services industries is already apparent in the LP numbers before 1995. Purchased intermediate inputs also made a substantial contribution to labor productivity growth, especially in the services industries that showed the greatest acceleration. This finding reflects the role of "contracting out" in improving efficiency.

2. Research Methodology

In the now standard productivity-growth accounting framework that originates in the work of Solow (1957)—as implemented empirically by Jorgenson and Griliches (1967) and extended by both authors and others—labor productivity can be analyzed in terms of the contributions of collaborating factors, including capital and intermediate inputs, and of multifactor productivity. To analyze the effects of IT within this model, capital services, K, are disaggregated into IT capital (K_{IT}) and non-IT capital (K_N), and the two types of capital are treated as separate inputs to production. Thus, designating

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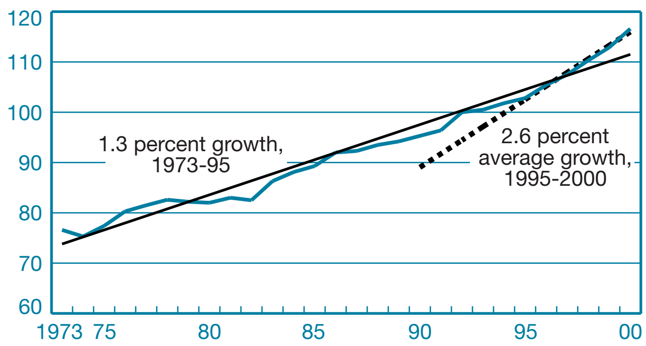
Nonfarm Labor Productivity



intermediate inputs—combined energy, materials, and purchased services—as *M*:

(1) $$\Delta ln LP = w_{K_{IT}} \Delta ln(K_{IT}/L) + w_{K_N} \Delta ln(K_N/L) + w_M \Delta ln(M/L) + \Delta ln MFP .$$

A number of researchers have calculated the contributions of IT and MFP to the post-1995 acceleration of labor productivity growth at the aggregate, economywide level (at the aggregate level, of course, the intermediate inputs net out, except for imports, which typically are ignored). The most prominent examples are Jorgenson and Stiroh (2000), Oliner and Sichel (2000), Gordon (2000), and Council of Economic Advisers (2000). Although there is broad agreement among these studies, a major issue concerns the degree of MFP improvement in IT-using industries, on which the aggregate-level studies reach different conclusions.

Because the most intensive IT-using industries are services industries, the impact of IT on IT-using sectors and the extent of MFP in IT-using sectors provide part of the motivation for our focus on services industries. In addition, we have been leading a Brookings Institution project on the measurement of output and productivity in the services industries (an earlier report on this subject is Triplett and Bosworth [2001]). Clearly, services industry productivity remains a challenging issue with many unresolved puzzles.

We explored the impact of IT and of MFP on services industries by estimating equation 1 separately for each of twenty-seven two-digit services industries. Although our study uses the same level of two-digit detail employed by Stiroh (2001) and Nordhaus (2002) to examine LP, and also begins from the Bureau of Economic Analysis (BEA) database that they use, our research approach is most nearly similar to that of Jorgenson, Ho, and Stiroh (2002), who estimate labor productivity, MFP, and IT contributions for thirty-nine sectors. Their services sectors are much more aggregated than ours, and their data differ in a number of respects. Ours is the first study to report results for MFP and IT contributions for detailed services industries.

3. The Services Industries Productivity Database

As in our earlier paper, we rely primarily on data from the BEA's industry output and input program (often referred to as "GDP by industry"). This program contains industry data at the two-digit level of standard industrial classification (SIC) detail for: output (in national accounts language, often called "gross output"), with output price deflators; labor compensation; and purchased intermediate inputs, with intermediate input deflators. Of the industries in the BEA database, we exclude the membership organizations and the social services industries because of difficulties surrounding the treatment of capital in nonprofit organizations (in response to a discussion with Michael Harper of the Bureau of Labor Statistics [BLS]), and we exclude the "other services" industry because its data are sometimes combined with the other two. We also exclude the holding company industry because it has no natural definition of output under national accounts conventions (interest in national accounts cannot be a payment for a service, nor can interest received be income for a producing unit). We combine depository (banks) and nondepository financial institutions because, after examining the data, it appeared to us that a shift of savings and loan institutions to the depository institutions industry in the 1987 SIC revision was not handled consistently in all the data items; aggregating these two financial industries therefore increases consistency.

The BEA industry data have been improved substantially recently, and the improvements make them more suitable for industry productivity analysis. New at the industry level are measures of industry output and purchased intermediate inputs. Formerly, this BEA database contained only value-added, which is conceptually less appropriate for estimating productivity. The improvements are documented in Yuskavage (1996) and in Lum, Moyer, and Yuskavage (2000). Certain problems that are apparent only in the improved data are discussed in Yuskavage (2001); we consider these below.

For labor input, we take the BEA series on persons engaged in production, because it is consistent with the other BEA data. The BEA makes an adjustment for part-time workers and adds an estimate for self-employed labor.[2] The BEA database contains an estimate of compensation for employees, and an estimate of proprietors' income, but no estimate for the labor earnings of the self-employed.

For capital, the BEA database contains property income. However, we estimate the capital share by industry from the BLS estimate of capital income, which is adjusted to yield consistent estimates of the capital income of the self-employed. Labor compensation is then estimated as a residual in order to obtain a consistent allocation of capital and labor income for the self-employed.[3] The share of intermediate inputs is based on BEA data.

In our earlier paper, we used BEA data on capital stock at the industry level as a measure of capital input. It is of course well-established that the BEA "wealth" capital stock that is appropriate for national accounts purposes is not the appropriate capital input measure for productivity analysis. Productivity analysis depends on the concept of the "productive" capital stock, from which one can derive a measure of the capital services that the stock renders to production.[4] At the time of our earlier paper, the theoretically appropriate capital services measures were not available for the services industries we wished to explore.

Now, however, the BLS has computed capital services flows by industry that are consistent with the revised BEA capital stock data reported in Hermann and Katz (1997). (BLS capital services flow estimates for services industries are presently unpublished, and have been provided by Michael Harper of the BLS.) Thus, we combine the BLS series on capital services with the BEA data on output and other inputs.

We divide our capital share weight to separate IT and non-IT capital shares using BLS capital income proportions. The BLS capital services data also disaggregate IT capital to a lower level than has been available previously. Many studies have investigated the effect of IT, narrowly defined, which refers to computers and related (peripheral) equipment. Others have broadened the definition of IT to include software. In the United States, investment in software has in recent years been larger than investment in computer hardware. Yet other studies have further broadened the definition of IT to include communication equipment, leading to the term information and communication technology equipment, or ICT.

An additional category of IT equipment exists in the BLS capital services flow data: "other IT equipment." This category includes copy machines and so forth, whose use is integral to the management of information. The electronic-driven technological change that characterizes much computer and communications equipment is also evident in such equipment. For this reason, we also work with an IT category that we call ICOT (information, communication, and other information technology) equipment.

Capital services for all of these definitions of IT (that is, narrow IT, ICT, and ICOT) are available in the BLS data for our twenty-seven services industries. We separate capital services (and capital shares) alternatively into IT, ICT, and ICOT, and into other (non-IT) capital. We settle, however, on the ICOT definition of IT.

Regardless of the definition of IT and the definition of IT-intensity (we explore alternative definitions in our full paper), the most intensive IT industries in the U.S. economy are overwhelmingly services industries. Indeed, for our broadest measures of IT, the chemicals industry is the only nonservices industry in the top ten. Many of these IT-intensive industries are in the segments of the services sectors where measurement problems are severe, and they have been the subjects of Brookings Institution economic measurement workshops.[5]

4. Labor Productivity Growth in the Services Industries

Labor productivity in our study is output per person engaged in production. Table 1 summarizes the labor productivity changes in the twenty-seven industries.

The unweighted average of the twenty-seven industries exhibits an average labor productivity growth rate post-1995 of 2.5 percent per year, nearly identical to the economywide average of 2.6 percent. Table 1 also weights these twenty-seven industries using output, value-added, and employment.[6] Whatever the weights, the average labor productivity growth rate for the twenty-seven services industries is a bit higher than the unweighted average, and accordingly equal to or a bit higher than the economywide average.[7] Labor productivity growth in services is considerably greater after 1995 than before, which means that the services industries are consistent with the economywide scenario (see chart).

The right-most columns of Table 1 show that services industries labor productivity on average accelerated after 1995, in step with the economywide acceleration in labor productivity. Using the longer 1977-95 interval as the base, we see that labor productivity growth in the twenty-two industries for which output data extend to 1977 accelerated by 1.4 percentage points (unweighted) post-1995, which approximately equals the aggregate acceleration (see chart). On a weighted basis, services industries acceleration is greater: 1.7 points to 2.0 points.[8]

Although our results have been anticipated by Sharpe (2000), strong services industry labor productivity growth is nevertheless news, because services sector productivity has long been regarded as the laggard in industry productivity measures. Our earlier paper

Table 1
Average Services Industry Labor Productivity

Category	1977-95	1987-95	1995-2000	Acceleration in 1995-2000 Relative to 1977-95	Acceleration in 1995-2000 Relative to 1987-95
Unweighted average					
Twenty-seven industries		1.6	2.5	NA	0.8
Twenty-two industries	1.0	1.4	2.4	1.4	1.0
Weighted by output					
Twenty-seven industries		1.9	2.9	NA	1.0
Twenty-two industries	1.0	1.6	3.0	2.0	1.4
Weighted by value-added					
Twenty-seven industries		2.0	2.9	NA	0.9
Twenty-two industries	1.1	1.6	3.0	1.9	1.4
Weighted by employment					
Twenty-seven industries		1.5	2.6	NA	1.1
Twenty-two industries	0.8	1.3	2.5	1.7	1.2

Notes: The group of twenty-seven industries includes all two-digit services industries, except for those deletions and combinations described in the text. Trade two-digit industries are aggregated for this paper. The group of twenty-two industries includes all industries for which output data extend before 1987. The industries are listed in Triplett and Bosworth (forthcoming).

For each paired years t and t+1, the output weight for industry i is the average share for industry i in the two years, where the share in t equals the output (excluding IBT) of industry i in year t over the sum of all services outputs (minus IBT) in year t. For each paired years t and t+1, the value-added weight for industry i is the average share for industry i in the two years, where the share in t equals the value-added (excluding IBT) of industry i in year t over total services industries value-added (minus IBT) in year t. For each paired years t and t+1, the employment weight for industry i is the average share for industry i in the two years, where the share in t equals persons engaged in production in industry i in year t over persons engaged in production in all services industries in year t.

The weighted average annual growth rate of labor productivity is $100*\left[\left\{\prod_t exp(\sum w_{it}*[ln(Q_{it}/Q_{i,t-1}) - ln(L_{it}/L_{i,t-1})]\right\}^{1/T} - 1\right]$, where w_{it} is the weight of industry i in year t, Q_{it} is industry i's output in year t, and L_{it} is the number of persons engaged in production in industry i in year t.

(Triplett and Bosworth 2001) was consistent with the idea of slow growth in services productivity: we calculated implied nonmanufacturing productivity numbers and showed that the post-1973 productivity slowdown was greater in the nongoods-producing parts of the economy than in manufacturing. Slow growth in the earlier period is also indicated by the entries in Table 1 that show, for example, labor productivity growth rates of 1 percent or less for the interval from 1995 back to 1977.

In the most recent period, services industries on average have done about as well as the rest of the economy, both in their average rate of labor productivity growth and in their post-1995 acceleration. This finding is likely to change a great deal of thinking about productivity and productivity measurement. The remainder of this paper provides an initial exploration of the new developments in services industry labor productivity.

5. Contributions to Labor Productivity Growth in the Services Industries

We now analyze accelerations and decelerations of labor productivity using the growth-accounting model, that is, each industry's change in labor productivity is explained by capital deepening, both from IT capital and from non-IT capital; by increased use of purchased materials and purchased services (intermediate input deepening); and by MFP—see equation 1. We perform the contributions-to-growth exercise for each of the twenty-seven industries; the results are presented in our full paper (Triplett and Bosworth forthcoming).

Research on the U.S. productivity acceleration has examined the contributions of the labor productivity growth of IT and of MFP at the aggregate level (see the citations noted in

Section 2). In the services industries, is it MFP or IT capital that accounts for labor productivity growth? We provide some summary measures in Table 2.

Table 2 shows the average contributions to labor productivity acceleration across the twenty-two industries for which data exist going back to 1977. To economize on space and calculations, we show contributions to the unweighted average labor productivity acceleration. Note that, as shown in Table 1, weighted averages uniformly give higher post-1995 labor productivity accelerations than the unweighted averages in Table 2.[9]

MFP is the major contributor to acceleration—well over half, whether or not the brokerage industry is excluded. Naturally, both the acceleration itself and the MFP contribution to the acceleration are lower when brokerage is excluded, as noted earlier.

Increased use of IT capital services also plays a major role in boosting labor productivity, and IT provides a larger relative portion of the acceleration when brokerage is excluded. The reason that IT does not play a larger role in the analysis of post-1995 labor productivity *acceleration* is that its contribution to labor productivity in these services industries was already prominent before 1995. Investment in IT is not new, and it has long been known that much of the IT investment occurred in services (Griliches 1992; Triplett and Bosworth 2001). McKinsey Global Institute (2001) offers a compatible result in its detailed examinations of a small number of services industries: it was often not new IT, or new IT investment, that was associated with rapid productivity change, but IT capital technology that had been around for a decade or two. Our analysis supports this part of the McKinsey conclusion: IT capital was a major contributor to LP growth post-1995, but its effects are visible well before then.

Table 2 also presents contributions to labor productivity acceleration for the fifteen industries that actually experienced acceleration. For those industries, the average labor productivity acceleration is of course considerably larger than it is for the entire group of twenty-two. Again, MFP is the main contributor to acceleration, accounting for well over half. All of the other factors also play a role, but IT actually follows intermediate deepening in the size of its contribution. As before, this is not because IT does not contribute to growth, rather, its contribution to growth was already evident in the services industry data before 1995.

We also performed the same calculations for the full set of twenty-seven industries, where we were constrained by data availability to analyzing the post-1995 acceleration relative to the shorter 1987-95 base. These results are presented in our longer paper (Triplett and Bosworth forthcoming). Although the unweighted average acceleration is lower for the shorter period, the results of the contributions exercise are similar: accelerating MFP is the major engine of labor productivity acceleration, with increased use of IT capital services trailing increased use of intermediates as a tool for accelerating labor productivity growth.

Average MFP growth for services industries is shown in Table 3. MFP shows a marked acceleration in services industries after 1995, whether judged by unweighted or weighted averages. On a weighted basis (all weighting systems give similar results), MFP was close to zero in the earliest period (1977-95), it picked up a bit for the 1987-95 interval (0.4 percent per year for the broadest group of industries), and exceeded 1 percent per year

Table 2

Contributions to Labor Productivity Acceleration
1995-2000 Relative to 1977-95

		Contribution to Labor Productivity Acceleration			
Category	Labor Productivity Acceleration	MFP	IT Capital	Non-IT Capital	Intermediate Inputs
Unweighted average, twenty-two services industries	1.4	0.9	0.2	0.1	0.2
Unweighted average, twenty-one services industries (excluding brokerage)	0.8	0.5	0.2	0.1	0.0
Unweighted average, fifteen accelerating industries	3.0	1.7	0.3	0.1	0.9
Unweighted average, fourteen accelerating industries (excluding brokerage)	2.2	1.1	0.3	0.2	0.7

Notes: For each industry i, acceleration is calculated as $accel\ i = AAGR_{i,\,95-00} - AAGR_{i,\,77-95}$. Group accelerations are the average of each industry's acceleration in the group: $\sum_i accel\ \ i/n$—that is, the labor productivity acceleration is the difference in the average annual labor productivity growth rates in the two time periods, or $\frac{100}{n} * \sum_i \left\{ \left[\prod_t exp[\, ln(Q_{it}/Q_{i,\,t-1}) - ln(L_{it}/L_{i,\,t-1})] \right]^{1/T} - 1 \right\}$, where for the 1995-2000 period, t = 1996, 1997,...2000, and T = 5. Likewise, for the 1977-95 period, t = 1978, 1979,....1995, and T = 18. MFP is multifactor productivity; IT is information technology.

Table 3
Average Services Industry Multifactor Productivity (MFP)

Category	1977-95	1987-95	1995-2000
Unweighted MFP average			
Twenty-seven industries		0.1	0.7
Twenty-two industries	-0.1	0.0	0.8
MFP weighted by output			
Twenty-seven industries		0.4	1.2
Twenty-two industries	0.1	0.2	1.4
MFP weighted by value-added			
Twenty-seven industries		0.4	1.2
Twenty-two industries	0.1	0.2	1.4
MFP weighted by employment			
Twenty-seven industries		0.1	1.2
Twenty-two industries	-0.1	0.1	1.4

Note: Industry groups and weights are constructed as in Table 1.

after 1995 (on a weighted basis). Exclusion of the brokerage industry (not shown) gives similar results.

MFP growth is thus a major contributor to post-1995 services industry labor productivity growth. MFP is also the major source of the post-1995 acceleration of LP in services industries.

6. Caveats and Questions

In the analysis for this paper, we have "pushed" the industry data very far. Even though the production function paradigm applies best to industry data, concern has long been expressed that the inconsistency of U.S. industry-level data creates formidable problems for carrying out productivity analysis at the detailed level (Baily and Gordon 1988; Gordon 2001). Our data are at the "subsector" level (two digits of the old SIC system), rather than at the "industry" level (four digits). Nevertheless, the concern has validity.

We should first note, however, that the concern applies to any use of the industry data, not solely to our estimation of contributions to labor productivity. It also applies, for example, to attempts to group industries into "IT-intensive" and "non-intensive" industries, a popular approach to analyzing the impact of IT. If the industry data do not prove consistent, then an analysis of the industry data grouped in some way or other suffers from the same data deficiencies.

Earlier, we noted that the BLS industry labor productivity program prepares estimates that differ from ours in some aspects of methodology. BLS output measures are different from those of the BEA. BLS computes output per labor hour instead of output per worker (as we do) and other differences occur in certain industries. We use the BEA database mainly because it provides comprehensive coverage of industries. The BLS data are available only for selected industries, so it is impossible to get from them an understanding of economywide or sectoral labor productivity trends.

Table 4 compares our labor productivity estimates with a published BLS industry labor productivity series that presents output per worker, so it is conceptually closer to our Table 3. As Table 4 suggests, in many cases, the BLS data are published only for selected three- or four-digit industries that account for only a fraction of the two-digit industries to which they belong. After allowing for the differences in coverage, we note that the correspondence is reasonably close in some cases (trucking, telephone, radio-TV, and personal services) and less so in others. Many of these differences in productivity growth rates are no doubt due to coverage differences. However, methodological and data inconsistencies do exist between BEA and BLS databases, and in some cases, they affect the conclusions. Gordon (2001) emphasizes these inconsistencies; Bosworth (2001) contains a detailed discussion of data inconsistencies for transportation industries.

Some of the major inconsistencies in the industry data have been discussed quite openly by the statistical agencies themselves; Yuskavage (2001) provides an important analysis. One can estimate industry value-added in two ways. Industry purchases of intermediate inputs can be subtracted from industry gross output, leaving value-added as a residual. Industry labor compensation (usually considered the most accurately estimated input) can then be subtracted from value-added, leaving capital income as a residual. Alternatively, value-added can be estimated directly from labor compensation and information on capital income; intermediate input purchases are then obtained residually by subtracting value-added from gross output. These two methods, however, do not yield consistent results. Inaccuracy in the first method arises because intermediate input purchases collected from the economic censuses and other Census Bureau surveys are less accurate than the output information collected from the same surveys. The limitation in the second approach is the potential inaccuracy of measuring the capital input. Self-employed income creates another inconsistency, and our use of BLS capital shares (in order to use the BLS adjustment for self-employment income) creates an inconsistency with BEA capital and labor shares.

If labor input and gross output are measured well (and this includes the deflators for output), then labor productivity is measured accurately, regardless of inaccuracy in the other inputs. This is why many analyses at the industry level have considered only LP. If any of the other inputs are measured inaccurately, this inaccuracy creates mismeasurement in MFP. To the extent that purchased services are inaccurately measured in Census Bureau collections, for example, the result is mismeasured MFP, so input measurement problems inherently limit the accuracy of our industry MFP measures.

In addition, the productivity-growth model imposes by assumption the condition that capital earns its marginal product. If that assumption is incorrect, then capital's contribution to production is misstated and MFP is mismeasured. These errors would also bias our estimates of capital's contribution to labor productivity growth.

Moreover, the allocations of capital services across industries may be problematic. As described earlier, we use detailed IT capital services data for our twenty-seven industries, which are available for each year of our study. However, the basic information for allocating IT capital by industry is the BEA capital flow table, and the latest year for which this table is available is 1992 (Bonds and Aylor 1998). If IT capital flowed to different industries in the last half of the 1990s, our IT-intensity and IT capital services variables would be mismeasured. Even for 1992, the basis for allocating high-tech capital across IT-using industries is weak: Triplett and Gunter (2001), for example, point to the puzzling presence of medical scanners in agriculture and business services industries in the BEA capital flow table (apparently an artifact of balancing input-output tables), and similar anomalies may be present for IT capital. If so, IT capital is inaccurately allocated to IT-using industries in our data, which creates consequent errors in the contribution of IT capital services and MFP.

Michael Harper of the BLS has suggested to us that the allocation of capital across nonprofit organizations may create inconsistencies in some industries. We exclude the membership organizations industry from our analysis for this reason, but some other industries may also be affected by this data problem.

Then there is the age-old problem of deflators—not only for output but also for purchased inputs. How does one measure the price, and therefore the output, of a service industry? Or of the purchased services that are a growing part of intermediate inputs? These are not idle questions. The difficulties, both conceptual and practical, are many, and have long been considered thorny problems (see Griliches [1992] and Fuchs [1969]). Indeed, McGuckin and Stiroh (2001) contend that increasing mismeasurement of output in the U.S. economy amounts to half a percentage point in economic growth.[10,11]

Against all this, we feel that the U.S. statistical system has recently made substantial improvements to industry-level data. Yet these improvements have not been widely noticed. No doubt, measurement problems remain, but the situation today is far better than it was when Baily and Gordon (1988) reviewed the consistency of the industry data for productivity analysis.

First, the BEA's GDP-by-industry accounts now include a full accounting for inputs and outputs. That full accounting imposes the discipline of a check that was not present when the accounts focused only on value-added. Put another way, when only an estimate of value-added was available at the industry level, the problems discussed by Yuskavage (2001) were simply

TABLE 4

Comparison of Authors' Calculations and Bureau of Labor Statistics (BLS) Industry Labor Productivity Data

		Average Annual Growth Rates, 1995-2000	
SIC Number	Industry Name	Authors' Calculations	BLS
40	Railroad transportation	2.6	
4011	Railroad transportation		3.8
42	Trucking and warehousing	1.0	
4213	Trucking, except local		0.9
45	Transportation by air	1.3	
4512,13,22(PTS)	Air transportation		0.4
481, 482, 489	Telephone and telegraph	6.7	
481	Telephone communications		6.3
483-484	Radio and television broadcasting[a]	1.2	1.0
49	Electric, gas, and sanitary services	1.9	
491-493	Electric and gas utilities[a]		9.2
52-59	Retail trade[a]	3.5	4.0
60-61	Depository and nondepository institutions	3.1	
602	Commercial banks		2.6
70	Hotels and other lodging places	0.3	
701	Hotels and motels		0.8
72	Personal services	1.8	1.7
75	Auto repair, services, and garages	0.9	
753	Automotive repair shops		0.9
78	Motion pictures	-0.5	
783	Motion picture theaters		1.6

Note: BLS labor productivity is output per employee.

[a]BLS average annual labor productivity growth is the unweighted average of more detailed industry components. BLS retail trade labor productivity growth is the average growth rate of all two-digit standard industrial classification (SIC) retail trade industries.

unknown to researchers, unless they dug deeply beneath the veneer of the published statistics.

Second, the Census Bureau over the past decade has collected more penetrating information on purchased services than had been obtained from earlier economic statistics for the United States. Information on purchased inputs at the industry level is still a problem for productivity analysis, but the state of the statistics is much improved over earlier years.

Third, the Bureau of Labor Statistics, in its producer price index (PPI) program, has moved aggressively in the 1990s into constructing output prices for services industries. (A number of these initiatives have been discussed in the series of Brookings workshops on economic measurement.) All the problems of services sector deflation have not been solved, and for some services industries the difficulty of specifying the concept of output limits the validity of deflators. But the remaining problems should not obscure the progress. Tremendous improvement has occurred since the discussion of measurement problems in the services industries in Griliches (1994).

Does improved measurement account for the acceleration in services industry productivity? That is, is the productivity surge in services in some sense a statistical illusion? Perhaps the cure for Baumol's Disease was found years ago, only the statistics did not record it. Or perhaps the services industries were never sick, it was just, as Griliches has suggested, that the measuring thermometer was wrong.

A full answer to that question is beyond the scope of this paper. For one accelerating industry, however, the answer is clearly yes: the acceleration in medical care labor productivity (-0.5 percent before 1995, +0.7 percent after, with MFP "accelerating" from -1.5 to -0.4) is undoubtedly the effect of the new BLS medical care PPI industry price indexes that began in 1992 and replaced the old medical care deflators based on the consumer price index (CPI) in the national accounts (see Berndt et al. [2000]). The producer price indexes rose more slowly than the consumer price indexes that they replaced (an overlap period confirms that it was methodology, not health care cost containment, that accounts for the difference).

Medical care productivity was understated by a large amount before 1992. Triplett (1999) calculates an account for one portion of medical care (mental health care services) using a combination of the difference between the new PPI and the old CPI mental health care components, and new price indexes for depression from Berndt, Busch, and Frank (2001). The "backcasted" result increased the estimated rate of growth of mental health care services, which is -1.4 percent annually, calculated from available government data, to +5.0 percent for the 1990-95 period. If the results for mental health carried over to the entire medical care sector, they would imply a proportionate increase in medical care labor productivity (which we estimate as -0.5 percent annually for 1987-95, from Table 3) and MFP (-1.5 percent annually for the same period). Accordingly, the improvements in producer price indexes account for the improved measured productivity in medical care, but medical care productivity is probably still understated substantially. Negative MFP for the health care industry (-0.4 percent) may be one indication.

7. Conclusion

In their labor productivity and MFP performance, the services industries have long appeared unhealthy, especially since the great productivity slowdown after 1973. With some exceptions, they appear lively and rejuvenated today. We find that labor productivity growth in the services industries after 1995 has proceeded at about the economywide rate. Moreover, these industries have experienced an acceleration of labor productivity after 1995 comparable to the aggregate acceleration that has received so much attention.

With respect to the sources of labor productivity improvement in the services industries, growth in MFP, IT capital deepening, and increased use of intermediate inputs (especially in the fastest growing services industries) all played a role. With respect to the post-1995 acceleration of labor productivity, however, MFP is the dominant factor in the acceleration, because IT capital deepening was as prominent a source of labor productivity growth before 1995 as it was after.

Griliches (1992, 1994) has suggested that measurement difficulties—particularly conceptual problems defining and measuring output and price deflators—might have made these industries' productivity performance in the past seem less robust than it actually was. In our assessment, there has been much improvement in the U.S. industry database in the past decade, and the improved database makes us more confident in the industry productivity estimates, even though much measurement work remains to be done.

Endnotes

1. Baumol's Disease is the hypothesis that productivity improvements in services sectors are less likely than in the goods-producing sectors of the economy because of the inherent nature of services (Baumol 1967).

2. The BLS labor productivity and multifactor productivity programs estimate worker hours by industry, not just employment, and in principle, hours are a better measure of labor input. The BLS also adjusts for labor quality, an adjustment that is missing from our labor input data. Jorgenson, Ho, and Stiroh (2002) also estimate quality-adjusted labor hours.

3. Imputing capital returns and labor compensation to the self-employed from data on employed and employers in the same industry results in a total that exceeds proprietors' income. Thus, the BLS constrains capital and labor income of the self-employed so that it combines to reported proprietors' income.

4. The development of "productive stock" concepts for production analysis stems from the work of Jorgenson (1963) and the empirical implementation in Jorgenson and Griliches (1967). Reviews of national accounts and productivity concepts for capital are offered by Hulten (1990), Triplett (1996), Schreyer (2001), and Organisation for Economic Co-Operation and Development (2001).

5. See <http://www.brook.edu/dybdocroot/es/research/projects/productivity/productivity.htm>.

6. The correct *aggregation* of industry productivity uses Domar (1961) weights, which are the ratio of industry *i*'s output to final output—in our case, aggregate services sector output. We lack a measure of services industries output that excludes intraindustry transactions, so we do not use Domar weights in Tables 1 and 2.

7. We excluded the brokerage industry and its very large labor productivity growth and recalculated Table 1. The result, predictably, lowers all the average rates of services industry labor productivity to an unweighted average of 1.9 percent per year and an output-weighted average of 2.4 percent per year. Even without brokerage, services industries have weighted average labor productivity growth that is about equal to the national rate post-1995.

8. Without the brokerage industry, the weighted post-1995 acceleration is still around 1.4 points compared with 1977-95, again nearly equal to the aggregate acceleration (see chart).

9. We also calculated contributions excluding the brokerage industry, for the reasons given above.

10. However, McGuckin and Stiroh introduce the implicit assumption that improving the measurement of output will raise output growth rates. This has sometimes been the case empirically. But we are not convinced that services sector output was measured better in the United States in the 1950s and 1960s, as the authors' assumption must imply if it is applied to the 1973-95 era.

11. An assessment of output measurement in some IT-intensive services industries can be found in Triplett and Bosworth (2001). See also the various papers and workshop agendas on the Brookings Institution Program on Economic Measurement website (<http://www.brook.edu/es/research/projects/productivity/productivity.htm>) as well as the discussion of services measurement issues in Eurostat (2001).

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