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A Window of Opportunity Opens for Regional Economic Analysis: BEA Releases Gross State Product Data

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Introduction

One of the formidable challenges facing regional analysts has been overcoming data limitations. A paucity of data has often impeded rigorous economic analysis or resulted in findings that are burdened with caveats about data problems at the regional level. Of major concern has been the difficulty in accurately gauging regional economic activity using available data on output. With the release of the Bureau of Economic Analysis' (BEA) gross state product (GSP) estimates, the problems with measuring regional output have been alleviated significantly. These estimates have several major advantages in terms of coverage and accuracy over other regional data such as value-added and employment.

The purpose of this paper is to evaluate the GSP data. The paper is divided into five sections. The first section examines the problems associated with using traditional regional measures of economic activity. The second section provides a description of the GSP data and their components. The third section describes BEA's methodology, and the fourth section discusses the methodology's strengths and weaknesses and compares it to the Kendrick-Jaycox (K-J) methodology.[1] The final section presents the results of comparative analyses of the GSP data and other measures of output.

The deficiencies of traditional measures of regional economic activity

The important contribution of BEA's GSP data is that they provide a more accurate and comprehensive measure of regional output than other regional data. The regional data that have traditionally been used to measure economic activity (e.g., value-added, personal income, and employment) have proven to be either insufficient or misleading.

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Employment data are the most commonly used data in regional economic analysis, which is understandable given that they are available at a fine level of industry and geographic detail. They are not, however, an accurate proxy for economic activity, especially for goods-producing industries (i.e., agriculture, mining, construction, and manufacturing). For example, in the Seventh District (comprised of Illinois, Indiana, Iowa, Michigan, and Wisconsin), manufacturing's share of total employment has been declining gradually, though at an increasing rate, since World War II. In contrast, manufacturing's share of total output has been relatively stable. Thus, it would be misleading to interprete the relative decline in manufacturing employment as a decline in activity.[2] Most of the shift in employment from manufacturing to services does not reflect decline but rather reflects differences in labor productivity growth and the substitution of capital for labor in manufacturing.

The problem with Census value-added data is not so much one of accuracy but rather one of coverage. Census value-added data cover only the goods-producing sectors which account for just under a third of national output. Even though manufacturing is regarded as the engine of economic growth, manufacturing output paints only a partial picture of regional output and may not accurately reflect overall economic performance. Some regional analysts believe that tertiary sectors (e.g., transportation and services) have been becoming less dependent upon manufacturing activity. Thus, their performance has become less to tied to manufacturing output. Evidence supporting this view is seen in the diverging trends in manufacturing and services GSP.

The third regional data series, BEA's regional personal income, offers data on all two-digit SIC (Standard Industrial Classification) industries but is not comprehensive because it omits indirect business taxes and capital charges.[3] When only income data are used to gauge economic activity, significant distortions can occur. For example, measurement error would occur for industries in which earnings account for a relatively small share of total income (e.g., real estate, oil and gas extraction, and petroleum refining). This problem would be particularly pronounced in states where these industries are dominant such as Texas.

The definition of GSP

In order to understand why GSP data offer a better measure of regional economic activity than the three data series examined above, it is necessary to, first, define GSP and then discuss the methodology used to estimate it. Gross state product represents a state's contribution to gross domestic product (GDP) and is the most comprehensive measure of a state's output. It can be formally defined in alternative ways. It can be viewed as the gross market value of the goods and services produced by a state's labor, capital, and land net of purchases of intermediate products (i.e., materials) and services. Alternatively, it can be defined as the sum of factor and nonfactor charges incurred in producing these goods and services net of purchases of intermediate products and services.

It is important to note that there are fundamental and significant differences between the concept of GSP and that of Census value-added. Firstly, GSP data exclude intermediate purchases of both materials and services whereas Census value-added data only nets out intermediate purchases of materials. Secondly, the Census method does not estimate value-added directly but derives it as a residual of shipments less estimates of purchased materials. In contrast to Census methodology, BEA's methodology builds up GSP by component.

The GSP data are disaggregated into four components, corresponding to factor and nonfactor charges:

1. Compensation of employees (wages and salaries and supplements to them).
2. Farm and nonfarm proprietors' income with inventory valuation adjustment and capital consumption allowances.
3. Indirect business taxes (IBT) and nontax liability.
4. Capital charges, primarily corporate profits with inventory valuation adjustments and capital consumption adjustments, capital consumption allowances with capital consumption adjustments, and net interest.

The GSP data are annual and begin in 1963. They are available at the one and two-digit SIC code level for a total of 61 industries. For manufacturing, aggregates of durable and nondurable goods are available, and the transportation equipment industry is disaggregated into SIC 371 and SIC 37 less 371.

The GSP data are available in current and constant (1982) dollars. To calculate the constant dollar series, the current dollar series is deflated using national industry implicit price deflators (discussed in detail below). Both series are useful depending on the type of analysis to be undertaken. The current dollars series is useful in measuring relative regional strengths in factors of production and regional effects of changes in relative output prices. The constant dollar series provides the necessary data to calculate growth rates of total regional economic activity (i.e., output) and regional factor productivities.

BEA's methodology

The methodology that BEA developed to estimate the four components of GSP for the benchmark years (i.e., 1963, 1967, 1972, 1977, and 1982) is the focus of this analysis.[4] It is through this methodology that BEA has overcome many of the problems that have degraded the accuracy of previous methodologies. The methodology differs across sectors, depending upon raw data availability. Similar methodology, however, exists for major sectorial groupings such as goods-producing. Because of the differences in methodology by sectorial groupings, the clearest way to describe BEA's methodology is by GSP component and by industry.

The largest components, compensation and proprietors' income, pose no estimation problems because they can be derived from BEA's annual State personal income series (see footnote 3). Although the IBT estimates are not as easy to derive, the problems are surmountable. For the benchmark years and for years after 1982, IBT are estimated using data on state taxes by type from the census of governments and data on taxes by type and industry from BEA's National Income and Wealth Division.

Estimation of capital charges, the fourth component, poses the most difficult problems. For goods-producing industries, capital charges are derived as a residual of total GSP less compensation, proprietors' income, and IBT. Total GSP is estimated from Census value-added by industry data that have been adjusted to conform to the definition of value-added in the National Income Product Account.

Three major adjustments are made to Census value-added data. Firstly, adjustments are made to account more accurately for the geographical distribution of central administrative office (CAO) costs (e.g., payroll and nonpayroll value-added, and intermediate purchases). The need for this adjustment arises because the Census Bureau does not estimate separately CAO value-added and instead counts CAO costs as a component of value-added of the establishments that the CAOs operate.[5] In order to redistribute CAO costs correctly across states, BEA undertakes a two step process. Firstly, BEA estimates Census value-added (VA_{CB}) net of CAO costs, which results in VA_1 . BEA then adds its own estimates of CAO costs based on state location (CAO_{BEA}), resulting in VA_2.[6]

NOTE: All variables are by industry by state unless there is a *us* superscript.

1) $VA_1 = VA_{CB}$ * (ratio of VA less CAO costs to total VA)

where ratio $= [VA^{us} - (PCAO^{us} + NPCAO^{us}_{BEA} + ICAO^{us}_{BEA})]/VA^{us}$

2) $VA_2 = VA_1 + CAO_{BEA}$

where $CAO_{BEA} = PCAO + NPCAO_{BEA}$
$NPCAO_{BEA} = NPCAO^{us}_{BEA} \times (PCAO/PCAO^{us})$

Available from published sources:
VA^{us} = U.S. Value-added
$PCAO^{us}$ = U.S. CAO payroll
$PCAO$ = State CAO payroll

Estimated by BEA:
$NCAO^{us}_{BEA}$ = U.S. CAO nonpayroll

$ICAO^{us}_{BEA}$ = U.S. intermediate purchases

The second adjustment that BEA makes is to estimate the purchased services component (PSC_{BEA}) and subtract this cost from VA_2. To approximate PSC, BEA multiplies VA_2 by the ratio of BEA national value-added which excludes purchased services to the sum across all states of VA_2 which includes purchased services. The result is VA_3.

3) $VA_3 = VA_2 - PSC_{BEA}$

where $PSC_{BEA} = VA_2 \times (VA^{us}_{BEA}/\Sigma\ VA_2$ across all states)

There are two contrasting views on the importance of excluding purchased services. Although these two views bring up some important considerations, they do not come into play in the use of GSP data to examine overall regional economic activity or to determine sectorial contribution to total output. One viewpoint maintains that their exclusion in the GSP data make these data superior to Census value-added data. The reasoning behind this view is that manufacturing GSP estimates strictly reflect manufacturing output due to production as opposed to secondary activities such as services that are purchased externally. In addition, because purchased services output is distributed across the services industries, nonmanufacturing GSP is not underestimated and total GSP is purged of double counting. A contrary viewpoint states that inclusion of purchased services allows one to gauge the total contribution of manufacturing activities to regional output (i.e., all activity linked to manufacturing). Another advantage of this measure is that it may be more consistent over time, that is, it is not distorted by the recent trend to outsource more services. As manufacturing firms purchase an increasing amount of services from external sources, manufacturing GSP growth is negatively impacted whereas value-added growth is not.

The third adjustment of Census value-added is to account for differences between BEA and Census industrial classifications of payrolls. This adjustment involves two steps. First, VA_3 is multiplied by the ratio of BEA compensation (PAY_{BEA}) to Census payrolls (PAY_{CB}), resulting in VA_4. Second, VA_4 is multiplied by the ratio of BEA's Gross Domestic Product (GDP_{BEA}) in the industry to the sum of VA_4 across all states, resulting in VA_5:

4) $$VA_4 = VA_3 \text{ x } (PAY_{BEA} / PAY_{CB})$$

5) $$VA_5 = VA_4 \text{ x } (GDP_{BEA} / \Sigma\ VA_4 \text{ across all states})$$

For nongoods-producing industries, a less complex methodology is used to estimate capital charges. Capital charges are estimated directly for the benchmark years and indirectly for the non-benchmark years (excluding real estate GSP which is estimated directly for all years; see footnote 4). Benchmark year data are collected from several sources. For real estate, data from the population and housing censuses and the U.S. Department of Agriculture are used. For regulated distributive and service industries, data are obtained from financial reports filed by firms with regulatory agencies. For unregulated distributive and service industries, economic census data on business receipts/sales and on compensation are used to distribute capital charges. For government enterprises, capital charges are estimated in two different ways depending upon level of government. At the federal level, surplus or deficit data specific to each enterprise are assigned to capital charges. For state and local government enterprises, data from the census of governments on current revenues and expenses by type of enterprise (e.g., transit and water) are used to allocate the surplus or deficit.

The strengths and weaknesses of BEA's methodology and a comparison to the K-J methodology

Before BEA estimated GSP by component, regional output was usually estimated using the K-J methodology, which is also known as the "blow up" technique (see footnote 1). The K-J methodology uses the ratio of state earnings to national earnings to distribute on a state by state basis national data on the non-earnings components of GSP. For example, to estimate IBT at the state level, the K-J methodology distributes national totals of state and local taxes using state earnings shares. National data on the non-earnings components come from BEA's GDP by industry series.

There are four major reasons why BEA's methodology is believed to be superior to that of K-J. First, a significantly greater percent of GSP is directly estimated by BEA than by K-J. According to BEA, about 96 percent of GDP (sum of total GSP across all states) for the benchmark years is directly estimated by BEA's methodology and allocated to a particular state and industry whereas only 70 percent is directly estimated by the K-J methodology.[7] Second, through the use of value-added at the two-digit SIC code level, the GSP estimates for the goods-producing industries reflect the particular industry mix of each state.

The third advantage of BEA's methodology over the K-J methodology is that BEA avoids making the K-J assumption that the relationship between the earnings and non-earnings components by industry at the national level is the same at the state level. The validity of this assumption has been challenged because significantly different relationships between earnings and non-earnings components at the state level have been found. For example, the distribution of IBT across states is often not at all related to the distribution of payroll, particularly for states with low or no corporate income tax. Under the pure K-J methodology, the IBT estimates for a state without corporate income tax (e.g., Florida) would be overestimated.

In analyzing their GSP estimates, BEA showed that the K-J assumption does not hold in many cases and can result in regional distortions (see footnote 4). Two of BEA's findings, in particular, support this conclusion. First, BEA found that there is a positive relationship between fast output growth and low per capita income, which is the result of location decisions based on minimizing costs. Second, BEA's results revealed a positive relationship between fast output growth and high share of capital charges to total GSP, which is the result of location decisions based on maximizing profit levels. The implication is that for economically expanding states and industries where earnings is a relatively small portion of GSP (e.g., real estate, oil and gas extraction, and petroleum refining), output will be underestimated by the K-J methodology. For example, when the price of oil was rising in the mid-1970s, which translated into increasing profits, the ratio of GSP to GDP for states with an important oil industry (e.g., Texas) was increasing at a faster rate than the ratio of these states' earnings to national earnings.

The fourth advantage offered by GSP data is that they expand the scope of regional economic analysis that can be undertaken. In addition to a more accurate measure of GSP by industry, the GSP estimates permit the analysis of differential growth rates in output and total factor productivity across states and industries attributable to factors of production outside of earnings such as profit rates. For example, BEA in its article "Gross State

Product by Industry, 1963-1986," presents an analysis of manufacturing activity in the Great Lakes region and finds that the poor performance of the Great Lakes' manufacturing sector stems partially from the relative decline in its manufacturing profit rates, as reflected by a fall in the capital charges component.[8]

Even though BEA's methodology overcomes many of the problems that undermine the accuracy of the K-J methodology, the GSP estimates have some faults as well. Several problems that arise in both the K-J and BEA methodology result from the deflators used to convert current dollars to constant (1982) dollars. The deflator problems can be categorized into two groupings. First, there are problems specific to the accuracy of the national industry implicit price deflators used (IPDs at the two-digit SIC code level). Second, there are problems specific to using national deflators at the regional level.

There are two concerns regarding the accuracy of the national deflators. Firstly, the accuracy of IPDs for certain service industries has been challenged (e.g., advertising and banking). Criticism has revolved primarily around the relatively steep rise in these IPDs.[9] The second issue concerns the constant dollar GSP estimates for goods-producing industries. As explained above, the current dollar GSP estimates are based on Census value-added data and are deflated using IPDs. The potential problem lies in the use of value-added data (derived by subtracting purchased materials from shipments) and the fact that the purchased materials component includes both imported and domestic inputs whose prices behave differently. The question is whether the constant dollar GSP estimates are distorted by not accounting for and separately deflating imported purchased materials when value-added data are used. Unfortunately, it is impossible to determine the extent to which this may be a problem in the GSP estimates. BEA has, however, been able to approximate the effect of this problem on its constant dollar gross product by industry series (see footnote 9). BEA has estimated that if separate import price deflators had been used during the 1980-1985 rise in the dollar (i.e., when import prices rose relatively slowly), the value of the constant dollar purchased materials component would have increased and as a result, growth in constant dollar manufacturing gross product would have decreased by half a percentage point or more per year.

The second category of deflator problems arise from the use of national deflators at the regional level. Because regional industry mix and prices often differ from the national figures, the use of national price deflators can result in two types of estimation errors. Firstly, regional cost differentials are not accounted for in the IPDs. This deficiency creates estimation errors for industries whose costs tend to vary regionally (e.g., energy, construction, and real estate) and for states dominated by these industries.

Secondly, region specific deflator problem stems from the use of IPDs at the two-digit SIC code level and differences in regional industry mix and in the price behavior of three-digit SIC industries. By using two-digit SIC IPDs, BEA assumes that the national three-digit SIC industry mix is constant across states. This is often not the case because many industries tend to be regionally concentrated. Two striking examples of this are electronic computing equipment (SIC 3573) and semiconductors (SIC 3674). Although BEA incorporates the drop over the past decade in computer and semiconductor prices into the IPDs for SIC 35 and 36, it assumes by using national IPDs that the three-digit SIC industry mix of SIC 35 and 36 is the same across all states.[10] This, of course, is not the case because SIC 3573 and 3674 are highly geographically concentrated. As a result, for states with relatively large computer and semiconductor industries, the 1980s two-digit IPDs for SIC 35 and 36 are overstated. Thus, the constant dollar series of SIC 35 and 36 in these states to be undervalued. GSP underestimation is likely to occur for states such as California whose computer industry accounts for 112 percent more of SIC 35 employment (1985) than it does in the nation and whose semiconductor industry accounts for 33 percent more of SIC 36 employment, Massachusetts whose computer industry accounts for 359 percent more of SIC 35 employment, and Texas whose semiconductor industry accounts for 205 percent more of SIC 36 employment. Conversely, the GSP for these two-digit SIC industries are overestimated in states without a large computer and/or semiconductor industry but with large nonelectrical and electrical machinery industry (e.g., Illinois and Michigan).

In addition to the deflator problems, another problem with the GSP estimates occurs in the adjustment for cost of purchased services. Again, the problem stems from using aggregated data at the two-digit SIC code level. Some subindustries of the two-digit industries are geographically concentrated and have different patterns of purchased service inputs than the industry overall. The example given by BEA is the printing and publishing industry (see footnote 4). The book and magazine publishing subindustry tends to be geographically concentrated and purchases a significant amount of services whereas the printing subindustry tends to be spatially dispersed and purchases relatively fewer services. The result is that states with publishing centers such as New York tend to have an overestimated capital charges component for their printing and publishing industry.

A third problem arises from the use of Census value-added data to estimate total GSP for the goods-producing sectors and stems from the way these data are geographically allocated. Census value-added data are derived from shipment data which are spatially allocated according to location of final production. As long as the production and nonproduction activities of an establishment are located in close proximity, there is no problem with this allocation procedure. Studies have shown, however, that headquarters and R&D and tech-intensive activities tend to locate in northern urban areas while production activities tend to locate in southern areas.[11] Thus, if these findings are accurate, implying that spatial separation of production and nonproduction activities exists, value-added may not be correctly allocated across regions. For example, value-added for regions that tend to specialize in nonproduction activities could be underestimated. BEA accounts for part of this problem when it adjusts Census value-added by redistributing CAO costs by location as explained above. Its algorithm, however, has a few deficiencies. Firstly, by using national CAO costs and value-added data (see p. 6), it assumes that the ratio of the operating establishment cost of maintaining CAOs to the operating establishment value-added does not vary by state. The ratio for manufacturing overall, however, does vary by state because it reflects each state's industry mix (i.e., the ratio is an aggregate across the state's two-digit SIC industries). Another problem with BEA's algorithm is that it neglects the nonproduction activities of non-CAOs.

Comparing GSP to other estimates of output

In order to do a quantitative analysis, the GSP data are compared with other measures of output. Two different comparisons are made: the first is between GSP estimates for New England and the Federal Reserve Bank of Boston's New England K-J estimates, and the second is between manufacturing GSP and Census value-added. The objective of these comparisons is to examine the trends of these estimates and check whether they are displaying similar growth patterns. The purpose is not to gauge whether or not the levels differ, which is to be expected given the different methodologies applied.[12] The results of these comparisons reveal the important differences between GSP estimates and other measures used to track regional output. In addition, the findings point out that these other measures can be misleading indicators of regional economic growth.

In order to capture any differences in trends across regions, the value-added comparisons were conducted for five BEA regions: New England, Mid-Atlantic, Great Lakes, Plains, and Pacific.[13] In addition, the Seventh District and the five states that comprise it were included (i.e., Illinois, Indiana, Iowa, Michigan, and Wisconsin).

The first comparative analysis was made between New England GSP estimates and the Federal Reserve Bank of Boston's New England K-J estimates for the period 1969 to 1986.[14] This analysis allowed the evaluation of the K-J methodology vis-a-vis the BEA methodology. Comparisons were made for total GSP and the GSP of four sectors: manufacturing, nonmanufacturing, services, and finance, insurance and real estate (FIRE). The results reveal that the K-J methodology produced output estimates that are highly correlated with BEA estimates for every sector under study except FIRE. For both the constant and current dollar series, the correlations were .99 (the correlation for FIRE was .96).

In terms of trends in the constant dollar series, the K-J estimates tracked GSP estimates relatively closely at the total, manufacturing, and nonmanufacturing levels. Graph 1 displays the trends for manufacturing which are comparable to those of the two other aggregates. It is not surprising that the K-J total and manufacturing estimates moved in lock step with the GSP estimates because New England's industry mix tends to be composed of industries for which earnings is a relatively large share of GSP. Thus, manufacturing earnings are a good proxy for manufacturing GSP.

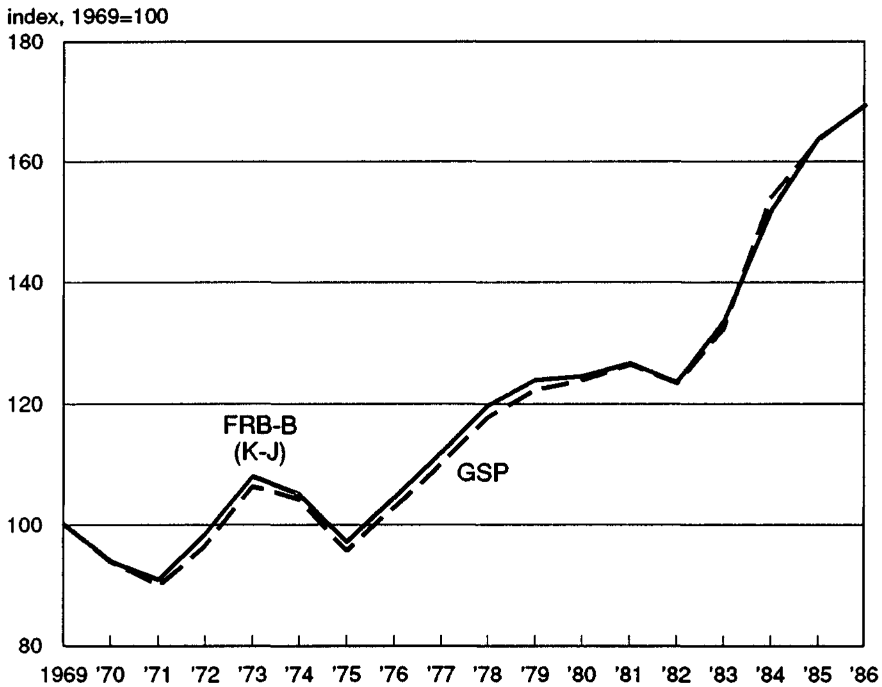
Trends in services output diverged rather dramatically over the double dip recession in the early 1980s, though for the other years they moved in tandem (Graph 2). Unlike the above sectorial trends, the trends in FIRE output diverged significantly (Graph 3). These results suggest that earnings are not an accurate proxy for services GSP and are particularly inaccurate for FIRE GSP. For services, the divergence between the K-J and GSP trends is most pronounced between 1980-82 when the K-J estimates show a drop in output while the GSP estimates show continued growth. This disparity exemplifies the errors in K-J estimates that arise from the assumption that the relationship of earnings to nonearnings at the national level holds at the state level, as discussed above. In the New England case, it appears that its share of national earnings in services took a dip whereas its share of national nonearnings rose. Because rises such as these are not captured by the K-J methodology, the value of IBT and capital charges for New England's services sector were underestimated by the K-J methodology and thereby resulted in an underestimation of services output.

For FIRE, the K-J estimates are off the mark across the entire 1969-1986 time period with the trend in GSP estimates significantly below the trend in the K-J estimates. The probable reason for this disparity is that the K-J methodology is weak at estimating real estate output because earnings comprise a relatively small portion of the total. In the New England case, it appears that the K-J methodology over "blew-up" the output estimate for real estate and thus the output estimate for FIRE as well.

Comparing manufacturing GSP to Census value-added allows one to compare direct manufacturing output estimated by manufacturing GSP to direct and indirect output (i.e., PSC) combined represented by Census value-added.[15] Because manufacturing GSP is based in part on Census value-added, it is not surprising that trends in both measures are highly

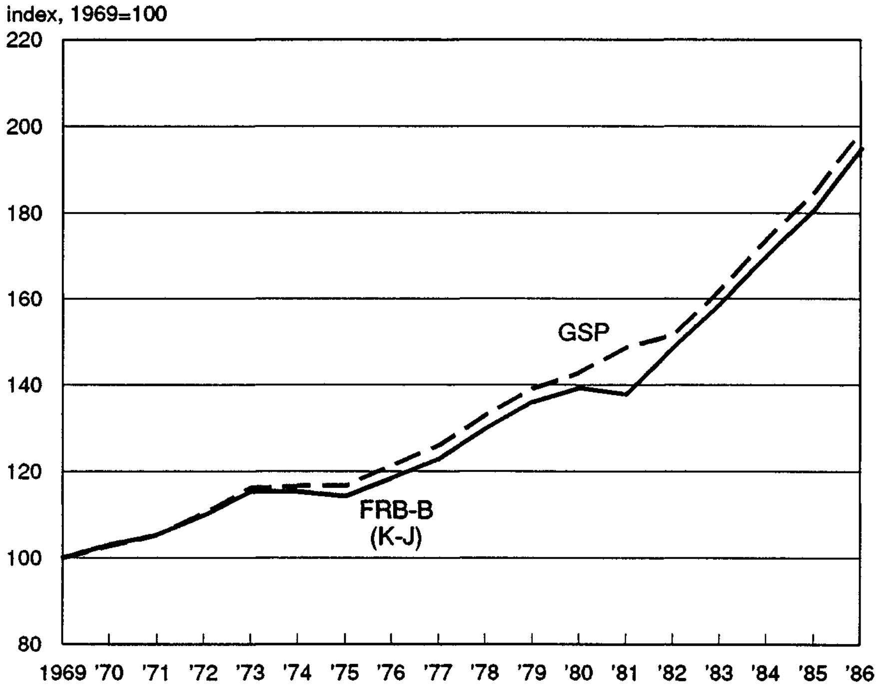
Graph 1

Comparison between New England GSP and K-J estimates -- Manufacturing



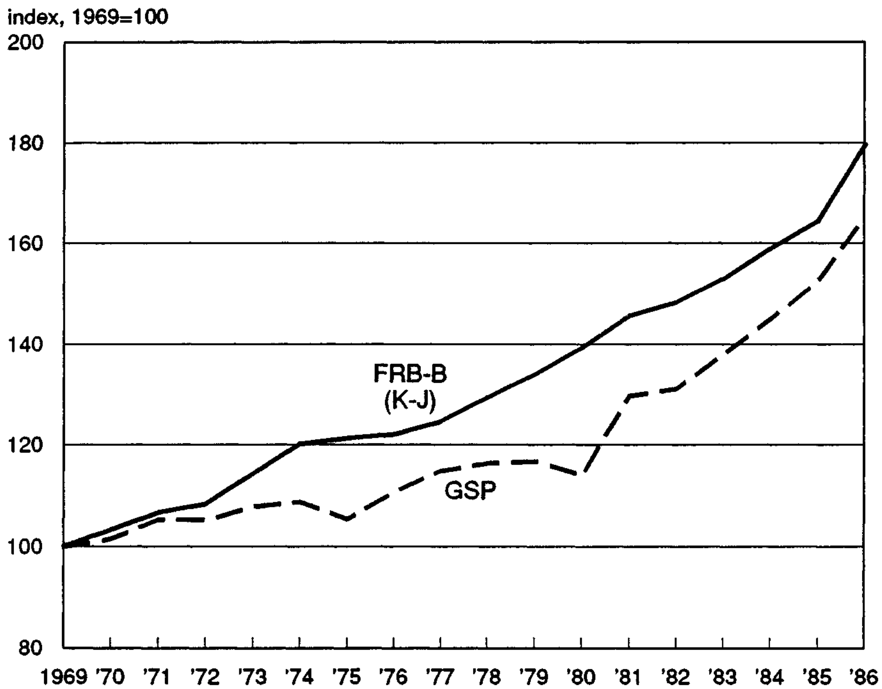
Graph 2

Comparison between New England GSP and K-J estimates -- Services



Graph 3

Comparison between New England GSP and K-J estimates -- FIRE



correlated (e.g., .93 and above for all the regions under study). The trend in Census value-added, however, has been outpacing the trend in manufacturing GSP, as exemplified at the national level (Graph 4). The spread between the two began around the early 1970s with the largest gap occurring in the late 1970's when manufacturing was at its historical peak.

The pattern of divergence seen at the national level is duplicated across all the regions and states under study. Regressions of manufacturing GSP on value-added with a 1974 dummy variable statistically confirm this divergence. For all the regions and states examined, the coefficient on the dummy variable is significant and negative while the value-added coefficient was on average below 0.75.

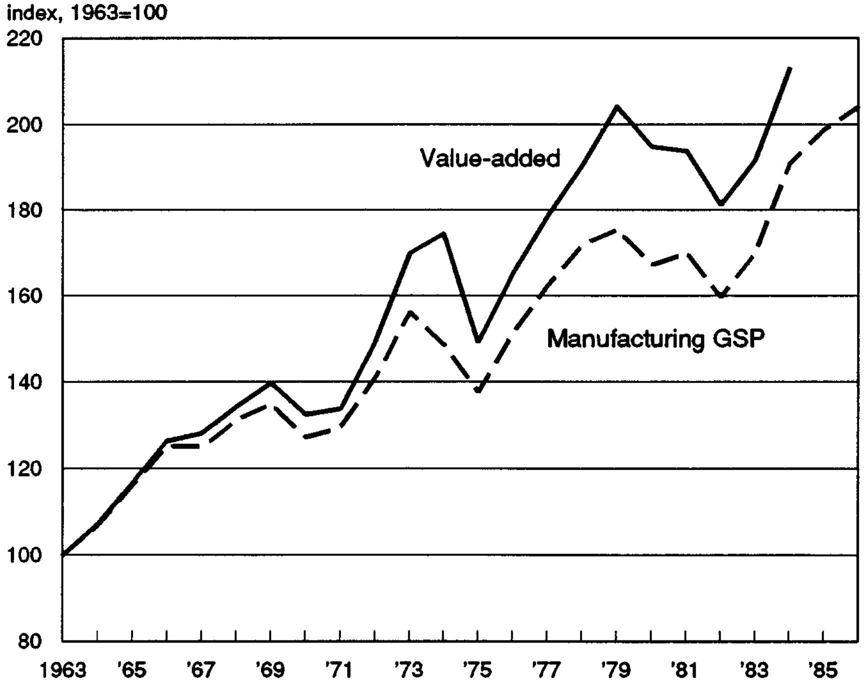
Differences in the trends are also evidenced by the differences in the annual growth rates of manufacturing GSP and value-added (Table 1). Annual growth rates were calculated for two periods: 1) 1963-1973, a period when manufacturing activity was expanding strongly with a minor dip in 1970 and 2) 1973-1984, a period during which manufacturing activity peaked and plunged. During both periods, value-added across all regions and states

Table 1
Trends in Manufacturing GSP, Value-Added, and Purchased Services: Annual Growth Rates

Area[1]	1963-1976			1973-1984		
	VA	GSP	PSC	VA	GSP	PSC
	(--------percent--------)			(--------percent--------)		
U.S.	4.9	4.1	9.1	1.6	1.7	2.8
New England	3.5	3.0	5.4	3.1	3.1	2.9
Mid-Atlantic	3.3	2.7	6.0	.5	.1	1.9
Great Lakes	4.6	4.0	8.5	.3	-.4	3.4
Plains	6.0	5.3	8.7	2.8	2.6	3.5
Pacific	4.5	3.5	9.3	3.1	3.6	1.3
Seventh District	5.2	4.1	14.5	.6	-.2	4.0
Illinois	4.4	3.9	6.7	-.2	-.7	1.5
Indiana	4.9	4.1	9.2	.4	-.5	3.6
Iowa	6.5	5.7	8.9	2.2	2.2	2.4
Michigan	6.0	4.1	(2)	.3	-1.0	(2)
Wisconsin	5.0	4.4	7.9	2.6	2.2	4.4

[1] See footnote 13 for definition of regions.
[2] See footnote 16 regarding Michigan data problem.

Graph 4
Comparison between U.S. manufacturing GSP and value-added



NOTE: Regional value-added data were available only up to 1984.

under study grew stronger than manufacturing GSP. Among the regions, the percentage point difference between the two rates ranged from 1.1 in the Seventh District to 0.5 in New England. Michigan recorded the largest difference of 1.9 percentage points.

The reason for these growth rate differentials is that the purchased services component (PSC) of value-added has grown at a faster rate than manufacturing GSP. The PSC can be estimated as a residual of value-added less GSP.[16] An examination of the trend in the PSC estimates reveals that purchased services have been growing at a much stronger pace than GSP. Over the 1963-1973 period, PSC's annual growth rate was twice that of GSP for the U.S. and four of the six regions under study (Table 1). During 1973-1984, PSC's growth continued to exceed that of GSP, though it slowed down significantly along with manufacturing GSP growth, reflecting the nationwide decline in manufacturing activity. Although PSC's growth decelerated, it did not turn negative as was the case with manufacturing GSP for some regions and states. Graph 5 displays the national pattern in manufacturing GSP and PSC trends which represents relatively well the regional and state patterns.

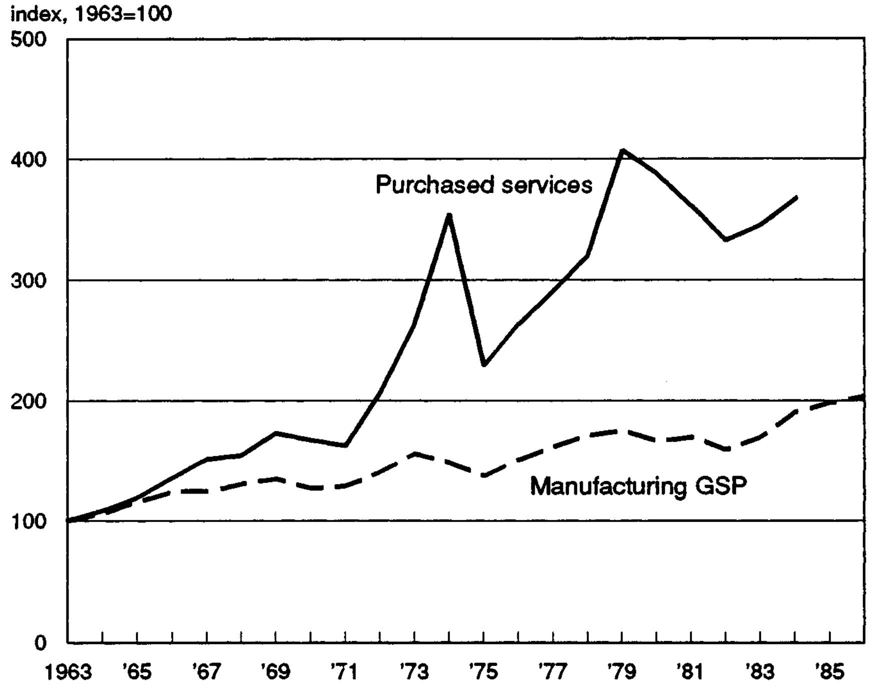
In summary, the comparisons between GSP and K-J estimates and value-added reveal that these various measures of output tend to track each other closely at the national level (to be expected given the level of aggregation) but tend to diverge at the regional and state level. The greatest divergence occurs between nonmanufacturing GSP and K-J estimates and illustrates the deficiencies of the K-J methodology. A relatively smaller divergence in trends exists between manufacturing GSP and value-added and can be explained by the exceptional growth in PSC. The results of these analyses suggest that caution should be used when interpreting trends in K-J estimates and value-added data.

Conclusion

Despite inherent problems, the GSP estimates are a substantial improvement over K-J estimates. By estimating directly a greater percentage of total GSP in terms of earnings and non-earnings components, BEA avoids making the erroneous assumption implicit in the K-J methodology that the relationships between the non-earnings and earnings components at the national level hold at the state level. Thus, GSP estimates account more accurately for the distribution across states of IBT and capital charges. In addition, the GSP estimates have advantages over other measures used to track regional economic activity. Firstly, they offer more comprehensive industry coverage than value-added data. Moreover, they net out purchased services from manufacturing output and distribute it across the ser-

Graph 5

Comparison between U.S. manufacturing GSP and purchased services



NOTE: Because the scale of the graph changed, the trend in manufacturing appears flatter than it did in Graph 4.

vices industries. Secondly, they provide a more accurate measure of regional economic activity than personal income and employment data. In sum, they open the door to more accurate statistical research on differential regional output growth, factor productivities, industrial restructuring, and deindustrialization. In addition, they allow the disaggregation of regional output growth into earnings and nonearnings components. As a result, regional growth differences in nonearnings components such as profits can be examined.

Footnotes

[1] John W. Kendrick and C. Milton Jaycox, "The Concept and Estimation of Gross State Product," *Southern Economic Journal,* October 1965, pp. 153-168.

[2] See Robert Schnorbus and Alenka Giese, "Is the Seventh District Deindustrializing?," FRB Chicago, *Economic Perspectives,* November/December 1987, pp. 3-10.

[3] See Bureau of Economic Analysis (BEA)(U.S. Department of Commerce), *State Personal Income: Estimates for 1929-82 and a Statement of Sources and Methods,* BEA REM 84-101, 1984.

[4] See BEA *Staff Paper* 42, "Experimental Estimates of Gross State Product by Industry," U.S. Government Printing Office, Washington, D.C., 1985.

For the non-benchmark years, GSP estimates are calculated using both BEA's methodology and a form of the K-J methodology (excluding GSP estimates for agriculture, real estate, and 1983-1984 manufacturing, see below). To estimate the GSP components, BEA uses two approaches. Firstly, when there are raw data available, BEA's methodology—as described in the text—is used (raw data available include earnings, rental income, and post-1982 IBT). Secondly, when there are no raw data available, BEA uses a version of the K-J methodology and national control totals from gross domestic product (GDP) data. For example, IBT and capital charges estimates are interpolated using the K-J methodology based on movements in earnings components and on national totals from GDP data.

For agriculture, real estate, and 1983-1984 manufacturing, capital charges are estimated directly (i.e., without the use of the K-J methodology). For the real estate industry two types of data are used, depending upon year (benchmark or non-benchmark). For the benchmark years, data from the population and housing censuses and the U.S. Department of Agriculture are used. For the non-benchmark years, data on rental income from the State personal income series are used. For agriculture, estimates are approximated using U.S. Department of Agriculture data. 1983-1984 manufacturing estimates are derived from data from the Census' Annual Survey of Manufactures (ASM).

[5] The difficulty in distributing CAO costs correctly across states stems from the fact that data on these costs are only available at the firm level (i.e., firm meaning a legal entity such as a corporation) and not at the establishment level (i.e., eco-

nomic unit or single physical location). Thus, the problem is how to distribute CAO costs of multiestablishment firms. Questions that arise include whether profits arise at headquarters or at the producing establishments and how to allocate overhead. See BEA *Staff Paper* 42.

[6] Although BEA's methodology solves the problems with allocating CAO costs outlined in footnote 5, another problem remains regarding industry classification. The industry classification of CAO costs by state are based on the industry classification of the bulk of the operating establishments (across all states) that the CAOs serve. Problems arise when the industry classification of operating establishments in a certain state do not fall within the bulk industry classification or when CAOs serve non-manufacturing establishments.

[7] BEA *Memorandum*, "Status of the BEA Gross State Product Estimates," December 1987.

[8] Vernon Renshaw, Edward A. Trott, and Howard L. Friedenberg, "Gross State Product by Industry, 1963-86," *Survey of Current Business,* May 1988, pp. 30-46.

[9] "Gross Product by Industry: Comments on Recent Criticisms," *Survey of Current Business,* June 1988, pp. 132-133.

[10] The producer price indices for integrated circuits, the primary inputs of computers, began to spiral downward in the mid-1970s due to the learning curve effect. It was not, however, until around 1982 that the impact of the relative decline in their prices was reflected in a decline in the IPD of SIC 35.

[11] For a discussion of the spatial separation of front-end activities (e.g., administrative) and production-end activities see: Alenka S. Giese and William A. Testa, "Can Industrial R&D Survive the Decline of Production Activity: A Case Study of the Chicago Area," *Economic Development Quarterly,* November 1988, pp. 326-338.

[12] Significant level differences exist in several types of industries. Firstly, for those industries which are burdened with relatively higher IBT, K-J estimates tend to be significantly below BEA estimates. For example, underestimation occurs in the K-J estimates for the food and kindred products industry in Kentucky which is impacted by "sin" taxes on alcohol. Secondly, for those industries that are highly capital-intensive, K-J estimates tend to fall substantially short of BEA estimates. For example, in the oil production industry, when output increases due to completion of new construction or additions to capacity, employment and thereby payroll usually remain relatively flat (except for inflationary adjustments) whereas output increases, sometimes doubling or tripling. Thus, "blowing up" payroll data would result in a significant underestimation of the increase in output.

[13] Definition of the BEA regions are: New England = Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; Mid-Atlantic = New Jersey, New York, and Pennsylvania; Great Lakes = Illinois, Indiana, Michigan, Ohio, and Wisconsin; Plains = Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota; Pacific = Alaska, California, Hawaii, Oregon, and Washington.

[14] Anne E. Kinsella and Deanna M. Young, *Gross State Product New England 1969-1986,* Federal Reserve Bank of Boston, September 1988.

[15] Value-added data are from the Bureau of the Census: *Census of Manufactures* and the *Annual Survey of Manufactures.* Data were in historical dollars and were deflated using the IPDs for manufacturing by state that were used by BEA to deflate GSP. Externally purchased services (PSC) are assumed to be acquired primarily from establishments located in the same state as the manufacturer. Thus, PSC income is assumed to accrue to that state's GSP.

[16] The accuracy of these residual estimates of PSC needs to be qualified. Firstly, for the benchmark years, the definitions and calculations of manufacturing GSP and Census value-added differ. Manufacturing GSP is built up from data on each component whereas value-added is derived as the residual of shipments less purchased materials. A second reason why the two series differ is that GSP estimates are based on 1972 SIC code definitions while value-added for 1963-66 and 1967-71 are based on 1958 and 1967 definitions, respectively. Thirdly, BEA makes two other adjustments to value-added in addition to netting out purchased services (see text). Given these comparability problems, the level estimates of PSC may not be accurate. This is the case for the state of Michigan for which the difference between value-added and GSP is negative between 1963 and 1971. This problem is mitigated at higher levels of geographic aggregation.

A better way to estimate PSC would be to: 1) Take national BEA value-added data and distribute them across states and industries using regional shares of value-added by industry calculated from Census value-added data. 2) Subtract GSP from the state value-added by industry estimated in 1). Unfortunately, time constraints did not allow the undertaking of this procedure.