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Measuring the New Economy in the United States[1]

Supporting paper submitted by the United States*

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1. The "new economy" and the favorable economic conditions accompanying it have been the subject of considerable attention in the media, on Wall Street, among economists, at central banks, and in government agencies. Although some seem to take it on faith that there is a permanent change in the economy powering the strong performance of the U.S. economy over the last 5 years, many question this view and are scouring economic statistics for evidence on the importance of this new economy to economic performance and whether there really has been a fundamental and lasting change in the structure of the economy. This concern has been accentuated by the recent slowdown in the economy, leading many to ask if the change was simply cyclical; while others have speculated on the impact of just-

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in-time inventories and other aspects of the new economy on the depth and length of a possible downturn. This paper provides background information on the new economy and how it relates to BEA's economic accounts. It is designed to answer the following questions:

- What structural changes have occurred that define the new economy?
- Why is it important that these changes in the economy be captured in gross domestic product (GDP)?
- What do we know now about the size and impact of these changes on the economy?
- Where does the new economy show up in the accounts and how well is it recorded?
- What should be BEA's highest priority in improving the capacity of the accounts to measure the new changes in the economy?

What is the new economy?

2. Many have hypothesized that we are in a new economy that is the product of various structural changes occurring in the last two decades and that has contributed to the recent improvement in economic performance. The expansion that began in 1991 is characterized by unprecedented length, strong growth in real GDP and real GDP per capita, a pickup in productivity, higher profitability, higher rates of investment, low inflation, low unemployment, and a somewhat more equitable distribution of the gains in income.

3. The forces behind these changes include the effect of globalization and increased international competition on labor and management practices and the resulting reductions in costs and improvements in efficiency associated with these changes. But most prominently, the new economy is associated with the impact of technological innovation over the last several decades that appears to have begun to bear fruit by the mid-1990's. These include the impact of sharply lower prices and increased efficiency in computers, cell phones, and the Internet; a host of other new goods and services, innovation in financial markets, and new methods of payment; and reductions in costs and improvements in quality and efficiency associated with the use of these technologically based changes in other goods and services.

Why is it important?

4. Among the central questions being asked about the new economy are: Is it real, or is it an illusion of measurement?; Does it represent a fundamental and lasting change in the structure of the economy, or is it the result of a number of temporary phenomena?; Can we accurately measure the new economy? The answers to these questions are important because if it is real, structural, and likely to last, then there are major implications for:

- Tax and spending projections;
- The funding and allocation of Federal and State and local programs;
- Technology policy; regulations, laws, and tax rules affecting saving; investment in physical and human capital, R&D, financial markets, and the Internet;
- Understanding of long-term growth and productivity.

5. Accurate and up-to-date measurement of the economy is essential to providing an objective baseline for assessing the effects of a wide range of policies, regulations, laws, and tax rules; for assessing the relative contributions of various factors to economic growth; and for assessing the means by which technology is transmitted and appropriated by various industries. For example, one of the major issues highlighted by recent studies is the impact on economic growth of innovations in the computer, software, and telecommunications industries and in other high-tech industries. In particular, do the

benefits extend beyond the computer, software, and telecommunications industries making the new technology? Are there spillover effects to industries using the new technologies beyond those associated with direct returns from increased investment in these technologies?

6. Other issues relate to changes in the form of compensation and profitability of new technologies. That is, how are tax policies and changes in tax policies affecting, or likely to affect, the use of stock options? How widespread is the use of stock options? Are stock options moderating wage demands? What is the impact of changes in equity values on household consumption and saving behavior?

What do we know now about the size and impact of the new economy?

7. Researchers have attempted to measure the impact of the new economy using existing BEA estimates—mainly information from BEA's national income and product account (NIPA) estimates, its wealth accounts, its international transactions accounts, and its I-O and GDP-by-industry accounts—supplemented with other information and estimates from the Bureau of Labor Statistics (BLS), the Census Bureau, and other sources.

8. The simplest estimates of the impact of changes in the economy are those that compute the contribution of high-tech goods and services to real GDP growth and to inflation as measured by the chain-price index for gross domestic purchases. The difficulties with this approach include the computational complexities of estimating contributions to growth in Fisher chain indexes, the lack of detailed product categories for high-tech goods and services, and the absence of measures of the impact of the IT revolution on the non-high-tech goods and services that are included in the final demand measure of GDP. As a result of these limitations, product-side measures focus on the direct contribution of broad groupings of high-tech goods and services included in GDP—such as computers, peripherals, and software—but do not capture the indirect contribution. These include the impact of computers and software used in designing, ordering, and manufacturing on the price (and output) of clothing, furniture, and other goods and services. Nor does it capture the relatively low-tech goods not included in broader high-tech categories or the high-tech goods included in low-tech categories. On the whole, such estimates of the impact of high-tech goods would seem to represent a lower bound estimate of the impact of the new economy. Based on BEA data, the direct contributions of high-tech products such as computers, software, and telecommunications—to real GDP growth in 1995–2000 averaged 29 percent or 1.20 percentage point of the 4.1-percent growth in real GDP (table 1).

9. Because of the limited nature of this "product-side" approach, other researchers interested in the impact of technical change—including Corrado and Slifman (1999), Gullickson and Harper (2000), Jorgenson and Stiroh (2000), and Department of Commerce (1999)—have used GDP-by-industry and gross output-by-industry data to analyze technical change. Corrado and Slifman and Gullickson and Harper used this industry data to focus on the implausibly low and negative rates of output and productivity growth in IT-using service industries and the potential impact of measurement problems on real GDP and productivity growth. Corrado and Slifman used real GDP-by-industry data, which are value-added, income-side estimates of industries' contributions to real GDP and labor productivity. They show that if all industries with negative productivity growth instead had zero productivity growth, productivity growth would be raised by 0.3 percentage point per year over the 1977 to 1997 period. Gullickson and Harper and Jorgenson and Stiroh used Domar weights to calculate the contributions of industry gross output (final and intermediate output) on real GDP and on labor and multi-factor productivity. Gullickson and Harper estimate that if all industries with negative productivity growth had zero productivity growth, annual productivity growth would be raised 0.38 percentage point over the 1977 to 1997 period; Jorgenson and Stiroh, using similar gross output data and weights but somewhat different adjustments, find a somewhat smaller increase in multi-factor productivity growth of 0.22

percentage point. All of these estimates found that those broad groupings of industries that were most closely associated with high-tech—with the exception of high-tech using industries— had above-average productivity growth. It should also be noted that all but the Gullickson and Harper estimates were made using at least some pre-1999 benchmark data and thus would be larger using post-benchmark data.

Table 1 Final Sales of Computers, Software, and Telecommunications

	Contributions to real gross domestic product growth						
	1995	1996	1997	1998	1999	2000	Average 1995-00
Percent change at annual rate:							
Gross domestic product	2.7	3.6	4.4	4.4	4.2	5.0	4.1
Contributions in percentage points:							
Computers and software[1]	.62	.74	.90	.94	1.04	1.10	.89
Telecommunications services[2]	.10	.14	.11	.13	.14	.13	.13
Communication equipment[3]	.19	.15	.17	.10	.24	.25	.18
Total	.91	1.03	1.18	1.17	1.42	1.48	1.20
	Contributions to gross domestic purchases prices growth						
Percent change at annual rate:							
Gross domestic purchases prices	2.2	1.8	1.6	0.8	1.6	2.4	1.7
Contributions in percentage points:							
Computers and software[1]	-.24	-.44	-.45	-.53	-.44	-.18	-.38
Telecommunications services[2]	.00	.02	.03	.01	-.02	-.03	.00
Communication equipment[4]	-.05	-.05	-.03	-.05	-.07	-.08	-.06
Total	-.29	-.47	-.45	-.57	-.53	-.29	-.43

[1] Includes computers, software, and audio and video products.
[2] Includes cable TV and local and long distance telephone.
[3] Includes PCE, GPDI, net exports, and government.
[4] Includes PCE, GPDI, and government.

10. The Department of Commerce industry estimates used Census Bureau sales and BEA GDP-by-industry data to produce more detailed industry breakdowns to better assess the impact of high-tech industries on real GDP and productivity growth. Based on these breakdowns, they estimated that high-tech industries accounted for more than one-third of real GDP growth in 1995–98.

11. Aggregate estimates by Gordon (1999), Whelan (2000), Macroeconomic Advisors (1999), Oliner and Sichel (2000), Jorgenson and Stiroh (2000), and others use variants of growth-accounting models to measure the direct and indirect contributions of high-tech to real GDP growth. The indirect contributions are measured by the capital services/rental value of investments in high-tech equipment. All of the authors find that the increase in trend growth in real GDP and productivity is largely due to IT. Table 2 summarizes the computer hardware findings of all but Gordon, whose analysis emphasizes departures from the trend growth rate. In all cases, the 1996–98 or 1996–99 contribution of computer hardware is at least twice the contribution of the earlier period. Gordon's results suggest that the impact is mainly

through the direct impact of high-tech products on GDP, rather than through an indirect effect. Jorgenson and Stiroh also do not find any empirical evidence of a significant indirect effect, but note that measurement difficulties may cloud the picture.

Table 2 Contribution of Computer Hardware to Annual Real Output or GDP Growth

	Previous Period		Current Period	
Study	**Years Covered**	**Annual Real Contribution**	**Years Covered**	**Annual Real Contribution**
Jorgenson & Stiroh (2000)	1991-95	.19	1996-99 1996-98	.49 .46
Macroeconomic Advisers (1999)	1994-95	.2-.3	1996-99 1996-98	.5-.7 .5-.6
Oliner & Sichel (2000)	1991-95	.25	1996-99 1996-98	.63 .59
Whelan (2000)	1990-95	.33	1996-98	.82

Sources: Jorgenson and Stiroh (2000), Table 2, p. 143; estimates reflect use of a broader definition of output than that used by the other researchers.

Macroeconomic Advisers (1999), Table 4, p. 85; annual numbers based on conditional projections of growth in potential GDP.

Oliner and Sichel (2000), Table 3, p. 31 for Oliner and Sichel, and Whelan.

12. The most recent results are consistent with those of the previously cited studies. Nordhaus (2001c) and Baily and Lawrence (2001) find significant acceleration in productivity growth in both new economy and other sectors; Gordon (2001) finds less acceleration outside new economy sectors and continues to emphasize the cyclical effect. Nordhaus, in a series of papers, utilized BEA income-side GDP-by-industry data to examine productivity for 1996–98 for three aggregates: Total output, business sector output, and well-measured output. Regardless of the aggregate considered, the increase in labor productivity growth in the most recent period over the period 1978–95 was significant in both new economy sectors and other sectors. Labor productivity growth in 1996–98 ranges from 1.2 percentage point to 2.1 percentage point. Use of income-side data during the second half of the 1990's raises output and productivity estimates; for example, Nordhaus' estimate of labor productivity growth in the business sector in 1996–98 is 0.65 percentage point higher than the comparable BLS product-side estimate. Baily and Lawrence and Gordon recently debated whether there is a new economy, both using the recently released BEA GDP-by-industry data through 1999. The Baily and Lawrence estimate of the post-1995 labor productivity revival at 1.43 percentage point is one-third higher than the Gordon estimate of 1.08 percentage point. Gordon attributes the differences to methodology, for example, use of income-side estimates instead of product-side estimates and employees in the denominator instead of hours, and the comparison for a shorter historical time period, but he agrees that there are remaining differences in their findings regarding the extent of the cyclical effect and the contribution of non-IT-producing sectors.[1]

Where does the new economy show up in the accounts and how well is it recorded?

13. The new economy shows up in many places in the accounts: in Gross Domestic Product, Gross Domestic Income, wealth stocks, personal income and saving, regional income, input-output accounts, GDP and gross output by industry, and international and balance of payments accounts. This paper only covers components of GDP; readers are referred to Landefeld and Fraumeni (2001) for a more complete

discussion.

14. *Consumer spending.*—The main impact of the new economy on consumer spending probably shows up in spending on computers and equipment, telecommunications services, software, and other high-tech goods. The accounts capture nominal spending on computers, peripherals, and software (NIPA table 2.6) fairly well. These products are deflated using hedonic indexes that adjust for the rapid technical change in those products.[2]

15. Nominal spending on telecommunications equipment and services—including Internet services—appears to be adequately covered, and BEA uses an index developed by Hausman (1999) to deflate cellular services, but there are other areas where the price indexes used for deflation do not fully capture the advances in quality, speed, convenience and the reductions in cost per minute associated with a number of communications products. Similarly, nominal spending on video and audio goods is relatively well represented, but the price indexes used are not hedonic indexes. However, recent research by Liegey and Shepler (1999) at BLS suggests that the use of a hedonic index for VCR's may have little impact.

16. The largest difficulties in measuring the impact of changes in consumer spending are probably for services. For both goods and services, the problem with the digital economy, including E-business, is that it is mainly business-to-business, or intermediate transactions, with only a small share of it, such as household payments to Internet service providers, showing up as final demand. As a result, if you want to know E-businesses' and high-tech's net effect—not just substitution of sales from brick and mortar retailers to E-business firms (and much of E-business is accounted for by brick and mortar firms)—you need to measure its impact on real final product and productivity. Are the prices of the consumer goods and services using E-business and high-tech falling, and are we seeing greater efficiencies, for example, increases in real output per unit of input in production? For goods, many of the efficiencies of the new economy are likely to be captured in the estimates. However, for services, the absence of adequate price data makes it difficult, if not impossible, for measures to reflect higher measured output and productivity arising from new technologies.

17. This is a significant problem because owing to the absence of price indexes 23 percent of GDP is measured using either physical inputs as extrapolators (mainly labor hours) or as input-cost indexes, which produce zero or low growth in labor productivity and often negative growth in multi-factor productivity because of the rapid rate of growth in investment and capital stocks. Input-type deflation of personal consumption expenditures (PCE)—mainly of spending on services such as insurance, education, and medical care—alone represent 7 percent of GDP. Many of these services are major users of IT products and services. These include financial services such as insurance, as well as nonprofit hospitals, private education, and other services that are, or would be expected to be, beneficiaries of IT advances (table 3). In addition to these categories of PCE and other components of GDP estimated using input or cost-based indexes, there are other components, such as brokerage services, where real output is estimated using partial output measures that probably do not capture improvements in service quality associated with IT innovations.

Table 3 Use of Input Cost Deflators and Quality Extrapolation and Percent Share of GDP in 1999		
	Billions Of Dollars	Percent share
Gross Domestic Product	**9299.2**	**---**
Input-type deflation	**2134.7**	**23**
Input-cost deflation	**1289.0**	**14**
Input-based quantity extrapolation	**845.7**	**9**
Personal consumption expenditures	693.1	**7**
Input-cost deflation	693.1	**7**
Input-based quantity extrapolation	---	---
Gross private domestic investment	330.7	4
Input-cost deflation	330.7	4
Input-based quantity extrapolation	---	---
Net exports of goods and services	.0	0
Input-cost deflation	---	---
Input-based quantity extrapolation	---	---
Federal government consumption expenditures and gross investment	325.9	4
Input-cost deflation	105.5	1
Input-based quantity extrapolation	220.4	2
State and local government consumption expenditures and gross investment	785.0	8
Input-cost deflation	159.7	2
Input-based quantity extrapolation	625.3	7
Addenda:		
Compensation of general government employees	844.5	9

18. The last benchmark revision of the NIPA's made some progress on these issues through the replacement of a labor-hours extrapolator with a transactions-based measure of banking output and with the treatment of purchases of computer software as investment, both of which contributed to a 0.42-percentage-point upward revision in private nonfarm business real GDP over the 1992–98 period. While it is not clear that the introduction of hedonic or other output-based deflators would produce similar increases in productivity growth in other poorly measured goods and services, if one assumes an increase in output similar to that in banking services for these industries, the growth rate of real GDP for private business could be increased by as much as 0.3 percentage point for the 1990–99 period.[3]

19. Medical services is another product affected by technology, but the effects are more complex. There have been significant improvements in the producer and consumer price indexes used in deflating several components of medical services, including public hospitals. These new BLS indexes track the price of treatment and presumably reflect the value of improvements in technology that reduce cost or the reduce the length of treatment. However, as pointed out by Shapiro and Wilcox (1997) in their study of

cataract surgery, by Cutler, McClellan, and Newhouse (1999) in their study of heart attacks, and by Berndt, Busch, and Frank (1998) in their study of depression, there are significant benefits in terms of quality of life and length of life that are not reflected in these indexes. The difficulty with measuring the economic value quality of life aspects of medical interventions is that in addition to the problems in objectively measuring the value of life, use of measures such as quality-adjusted life years from medical interventions would require an expansion of the production boundary for the accounts to include time-use and other willingness-to-pay estimates. This would be a useful exercise but one better suited to a set of satellite accounts. This would not be the case if the value was associated with a hedonic index that was based on market-clearing prices. However, the prevalence of third-party payments, physician-directed demand, administered prices, and other problems with medical markets suggest that the results of hedonic work may not represent the market value that consumers place on the various quality changes associated with advances in medical care.

20. *Fixed investment.*—The main impact of high-tech within investment is on computers, peripheral equipment, and software. While computers and peripheral equipment use hedonic indexes for all components, only approximately one-half of computer software uses such indexes. As noted above, prepackaged software is deflated with a hedonic index. However, in-house software is deflated with an input-cost index, and custom software is deflated with a price index that is a weighted average of the prepackaged index and a cost-based price index. Although advances in technology have undoubtedly affected a broad range of types of equipment and structures in a manner that is unlikely to be picked up by conventional price indexes, the largest probably relate to investments in telecommunications and imbedded chips and other technology embodied in equipment and structures. Other than switching equipment, there are no quality-adjusted indexes used for telecommunications. In addition to the evidence on cell phones, advances in telecommunications equipment that significantly expand the carrying capacity of fiber optic cables suggest rapid declines in other areas of telecommunications. As Jorgenson and Stiroh note, if the price deflators currently used for the other components of telecommunications were replaced by indexes that showed moderate-to-rapid price declines, real product and productivity growth could be raised between 0.16 and 0.34 percentage points.

21. An interesting and related issue is the impact of the increasingly short-lived high-tech equipment and software on real GDP growth verses net domestic product (NDP) growth. NDP is often used as a measure of sustainable growth, in the sense that it subtracts depreciation from GDP to indicate the amount of current product/income that should be set aside for the using up of capital stock in production during the current period. Over the 1947–73 period, both real GDP and real NPD grew at an annual rate of 4.0 percent. In contrast, with a pickup in investment and shorter lived investment, including software, over the 1973–2000 period, real GDP grew 3.1 percent, verses 2.8 percent for NDP, and over the 1995–2000 period, real GDP grew 4.3 percent, verses 4.0 percent for NDP. This is important because as Gordon has pointed out, continuation of the current pickup in real GDP and productivity growth may require sustained high rates of real investment.[4]

22. *Inventory investment.*—Although advances in technology have been essential to "just-in-time" inventory-control methods, to increased direct sale by manufacturers to the public, to the use of courier services, and to other changes in the distribution system, most of these will be captured by the existing data-collection system. One area where changes are not well captured is the inventories of "nonmerchant" wholesalers. These are essentially non-brick-and-mortar wholesalers that do not take physical possession of goods and essentially act as agents or intermediaries who put together buyers and sellers and arrange for shipment, temporary storage, financing, and billing. In some respects, the Internet may be reducing use of these intermediaries, but in other respects, it may be increasing them. Unfortunately, information on these intermediaries is collected only once every 5 years in the quinquennial census.

23. *Exports and imports.*—The largest impacts of high-tech and E-business are likely to be in low-value exports of computers, peripherals, software, semi-conductors, and aircraft. Further enhancements in price indexes for software and communications equipment will probably raise the measured impact of high-tech on trade in goods, as will replacement of cost-based deflators for services trade components. The largest impact, however, may be omitted from the estimates. According to the Census Bureau, total exports may be underestimated by between 3 and 7 percent. A significant share of this understatement may be in low-value exports, which are exempt from direct reporting and are indirectly estimated using out-of-date information. The increase in direct transactions between overseas customers and U.S. companies associated with globalization and the IT revolution has presumably contributed to the undercount of exports.

24. *Government.*—The largest impact of IT in government shows up in purchases of computer equipment and software and of telecommunications equipment, which are treated symmetrically with consumer spending and private investment for these products. The overall impact of IT on government, however, is limited by the long-standing national accounts treatment of real output by government. Government output is measured by costs, and real output for a significant share of government is extrapolated by employee hours. Investment and other expenditures for goods and services are deflated by output price indexes, but for high-tech military and other noncomputer hardware, hedonic indexes are not employed. The services of government capital are partial cost-based estimates that use the value of depreciation to estimate the rental value of the capital rather than depreciation plus an imputed return to the asset (a treatment that BEA hopes to address in the future).

25. IT and other technological innovations, therefore, will show up in measured government output and real GDP through a) government investment in computers and other high-tech equipment; b) government purchases of goods; c) government's use of banking and other services not extrapolated by inputs or cost indexes; and d) the depreciation on high-tech equipment that it owns. However, for the 12 percent of government output measured by either output extrapolated using employee hours or purchased real services estimated by input extrapolation of cost deflation, there will be no increase in measured output from IT. In addition, to the extent that the full service value of government IT assets exceeds the depreciation on those assets, the capital services of government IT assets will be understated (which, based on Jorgenson and Stiroh and other estimates, is likely to be large).

Toward improved measures of the new economy

26, Although BEA received initial funding to begin work on a number of initiatives to update its GDP and related statistics and to update its IT systems, additional funding will be required to carry on the work outlined below:

27. Measuring E-Business and High-Tech in the GDP Accounts:

- This would be a new index of quarterly investment in E-business-related and high-tech equipment and associated measures of its contribution to real GDP growth and inflation.
- BEA would attempt to develop revised quarterly price and real GDP indexes for a number of major E-business/high-tech-using products/sectors.
- BEA would work to develop revised estimates of employee compensation, personal income, wealth, and saving that better reflect the impact of stock options and capital gains of workers in E-business-related and other high-tech industries.
- BEA would revise and expand its surveys of international trade in services and of direct investment to fill gaps in the coverage of E-business/high-tech-related transactions and to identify E-business-related direct investment in the United States and abroad.

- BEA would work to develop new aggregations using earnings by place of work for E-business/high-tech-related industries.
- BEA would attempt to develop updated and revised "input-output" and GDP-by-industry estimates to help disentangle the effects of E-business and high-tech on final demand versus on intermediate product.

28. Updating the GDP Accounts to Keep Up with the Changing Economy:

- BEA will conduct research on expanding the use of supplemental measures that use more up-to-date public and private source data to update BEA's estimates for the inaccuracies that result from the lags between when economic activity occurs and when the data on that activity is provided to BEA.
- BEA will attempt to develop new estimating methods that use more up-to-date public and private source data to correct the GDI estimates for lags in the availability of BLS, IRS, and other source data on the incomes earned by individuals and businesses. New supplemental income estimates will be developed.
- BEA will work with BLS on the development and incorporation of quality-adjusted price indexes and real GDP indexes for components of GDP that have significant measurement problems.
- BEA will work to develop and incorporate measures to better understand the interaction between the large changes in wealth and productive stocks on the one hand, and investment, saving, consumption, capital flows, trade, and productivity on the other.
- BEA would develop and incorporate updated and improved estimates of new and rapidly growing services, financial instruments, and direct transactions across U.S. borders.

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1. Elsewhere, such as in the 2001 *Economic Report of the Presiden*t, the Council of Economic Advisors used an average of the income-side and product-side estimates of labor productivity.

2. The consumption component of software is prepackaged software, which is deflated using a combination of hedonic and matched-model indexes through 1997 and the consumer price index for "computer software and accessories"thereafter.

3. For a review of the impact of hedonic indexes currently used in measuring real GDP, see J. Steven Landefeld and Bruce T. Grimm, "A Note on the Impact of Hedonics on Real GDP," SURVEY OF CURRENT BUSINESS 80 (December 2000): 17–22.

4. High rates of real investment will be required if, as Gordon suggests, most of the pickup is attributable to the increased rate of real investment in IT. However, if—as suggested above—the contribution to real GDP growth by IT-using industries is understated because of measurement problems, then higher real GDP growth—appropriately measured—might be possible with a lower rate of investment. Alternatively, if there is a lagged increase in productivity from the IT investment, higher real GDP growth may be possible, at least in the intermediate term, even if the rate of investment slows.

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