The key elements of a new architecture for the U.S. national accounts have been developed in a prototype system constructed by Dale W. Jorgenson and J. Steven Landefeld, director of the Bureau of Economic Analysis at the U.S. Department of Commerce. As the U.S. economy emerges from the most severe contraction since the Second World War, the focus of policy will shift toward enhancing the economy's potential for growth. A second motivation for the new architecture is to integrate the different components of the decentralized U.S. statistical system and make them consistent.

Keywords: national accounts; new architecture; integration; development; unification of methodology investment

Designing a New Architecture for the U.S. National Accounts

By
DALE W. JORGENSON

What do the national accounts do? They provide a kind of central nervous system for federal statistics. The accounts organize information from the population and business censuses to monitor current economic developments on a quarterly and annual basis. The national accounts generate key economic indicators, such as the gross domestic product (GDP) and the rate of inflation (the GDP price index). The accounts produce detail on foreign and domestic portions of the economy, individual industries, and regions of the country. Finally,

Dale Jorgenson is the Samuel W. Morris University Professor at Harvard University, teaching in the Department of Economics and Harvard Kennedy School. He was a founding member of the Board on Science, Technology, and Economic Policy of the National Research Council in 1991 and has served as chairman of the board since 1998. He is also a member of the Royal Swedish Academy of Sciences.

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the national accounts are frequently used to provide historical perspective on business cycles and trends in the U.S. economy.

Who produces the national accounts? America's economy is large and diverse. It is not surprising that accounting for the vast range of economic activities requires a decentralized statistical system. The core system of national accounts is maintained by the Bureau of Economic Analysis (BEA), an agency of the U.S. Department of Commerce. Important components of the accounts are developed by the Bureau of Labor Statistics (BLS) in the U.S. Department of Labor and by the Federal Reserve Board (FRB), the board of governors of the Federal Reserve System. The underlying data are collected by the Census Bureau in the Department of Commerce through its censuses and surveys of businesses and individuals. Many other public agencies and private sector organizations provide data for the national accounts.[1]

This article outlines a new architecture for the U.S. national accounts; in this context "architecture" refers to the conceptual framework. The purpose of such a framework is to provide a strategy for developing the national accounts. An example is the seven-account system that the BEA recently introduced.[2] A second example is the United Nations' System of National Accounts 1993 (1993 SNA).[3] Both provide elements of a complete accounting system, including production, income and expenditures, capital formation, and wealth accounts.

The next question to be addressed is, Why do we need a new architecture? The basic architecture of the U.S. national accounts has not been substantially altered in fifty years. The national accounts were originally constructed to deal with issues arising from the Great Depression of the 1930s.[4] Right now, U.S. economic policy is coping with the most severe contraction since the Second World War. As the economy emerges from this downturn, the focus of U.S. monetary and fiscal policies will shift from stabilizing the economy to enhancing the economy's growth potential.[5] In addition, the U.S. economy is confronted with new challenges arising from rapid changes in technology and globalization. Meeting these challenges will require a new architecture for the U.S. national accounts.

Development of a fully integrated and consistent system of accounts will require close collaboration among the BEA, the BLS, and the FRB, as well as coordination with the Census Bureau, the most important agency for generating primary source data. The first and most important objective is to make the national accounts generated by the BEA consistent with the accounts for productivity compiled by the BLS and the Flow of Funds Accounts constructed by the FRB. The boundaries of production, income and expenditures, accumulation, and wealth accounts must be made uniform to achieve consistency throughout the system.

1. The New Architecture

The key elements of the new architecture are outlined in a "Blueprint for Expanded and Integrated U.S. Accounts" by Jorgenson and Landefeld (2006; see also Jorgenson and Landefeld 2009).[6] They present a prototype system that

integrates the National Income and Product Accounts (NIPAs) with productivity statistics generated by the BLS and balance sheets produced by the FRB. The system features GDP, as do the NIPAs; however, GDP and gross domestic income (GDI) are generated along with productivity estimates in an internally consistent way. The balance sheet covers the U.S. economy as a whole and fills a gap in the existing Flow of Funds Accounts.

Issues in measuring productivity were considered by a statistical working party of the Organization for Economic Cooperation and Development (OECD) Industry Committee, headed by Edwin Dean, former associate commissioner for productivity and technology at the BLS. The working party established international standards for productivity measurement at both aggregate and industry levels. The results are summarized in Paul Schreyer's OECD *Productivity Manual*, published in 2001. Estimates of multifactor productivity in the prototype system developed by Jorgenson and Landefeld (2006) conform to the standards presented in Schreyer's *Productivity Manual*.

In integrating the components of the U.S. national accounts, the first question to be addressed is, Why not use the 1993 SNA? BEA income and expenditures data and FRB flow of funds data have been integrated within the framework for the 1993 SNA by Albert Teplin et al. (2006). This initial effort has been followed by an annual update, published in the *Survey of Current Business*, BEA's monthly journal, and made available on the BEA website.[7] SNA-USA is not the only effort at BEA to provide the U.S. national accounts in the 1993 SNA format. The U.S. national accounts are reported annually to the OECD in this format, and the results are published in the OECD's internationally comparable national accounts.[8]

The 1993 SNA is part of the new architecture, since it embodies the collective experience of the national accounting community and is familiar to many people working on the U.S. national accounts. However, the 1993 SNA does not provide the production and income and expenditure accounts in current and constant prices that are required by the new architecture.[9] Also, consistency of the boundaries among the various component accounts is an unresolved issue. Wealth, for example, refers to a different set of economic units than income and product.

The prototype system of Jorgenson and Landefeld begins with the NIPAs and generates the production and income and expenditure accounts in current and constant prices. The production accounts provide a unifying methodology for integrating the NIPAs generated by the BEA and the productivity statistics constructed by the BLS. Adding productivity statistics to the national accounts remedies a critical omission in the NIPAs and the 1993 SNA. Similarly, the BEA's accounts for reproducible assets and the U.S. International Investment Position can be extended to encompass a balance sheet for the U.S. economy as a whole, now absent from the NIPAs and the Flow of Funds Accounts.

An important advantage of beginning with the NIPAs is that the impact of globalization on the U.S. economy is reflected in the BEA's system of international accounts. This system includes the Foreign Transactions Current Account, which records imports and exports, as well as receipts from the rest of the world (ROW), payments to the ROW, and the balance on current accounts. The international

accounts also include the Foreign Transactions Capital Account, which registers net U.S. lending to and borrowing from the ROW. Finally, the U.S. International Position includes U.S. assets abroad and foreign-owned assets in the United States. These accounts are generated by the BEA and incorporated into the Flow of Funds Accounts by the FRB.[10]

Two other important advantages of beginning with the NIPAs are that the existing U.S. national accounts can be incorporated without modification and that improvements in the NIPAs can be added as they become available. For example, the BEA is currently engaged in a major program to improve the existing system of industry accounts and accelerate the production of industry data.[11] This program will integrate the NIPAs with the Annual Input-Output Accounts and the Benchmark Input-Output Accounts produced every five years. Improvements in the source data are an important component of this program, especially in measuring the output and intermediate inputs of services. The Census Bureau has generated important new source data on intermediate inputs of services, and BLS has devoted a major effort to improving the service price data essential for measuring output in constant prices.

The most important innovation in the prototype system of national accounts developed by Jorgenson and Landefeld is the inclusion of prices and quantities of capital services for all productive assets in the U.S. economy. The incorporation of the price and quantity of capital services into the revision of the 1993 SNA was approved by the United Nations Statistical Commission at its February-March 2007 meeting. Chapter 20 of the revised SNA, "Capital Services and the National Accounts," was published in 2009 (Intersecretariat Working Group 2009). Paul Schreyer, head of national accounts at the OECD, has prepared an OECD manual titled *Measuring Capital* (2009). This provides detailed recommendations on methods for the construction of prices and quantities of capital services.

In chapter 20 of the revised 1993 SNA, estimates of capital services are described as follows: "By associating these estimates with the standard breakdown of value added, the contribution of labor and capital to production can be portrayed in a form ready for use in the analysis of productivity in a way entirely consistent with the accounts of the System" (United Nations et al. 2009, 415). The measures of capital and labor inputs in the new architecture for the U.S. national accounts are consistent with the revised SNA and the OECD manual *Measuring Capital*. The volume measure of input is a quantity index of capital and labor services, while the volume measure of output is a quantity index of investment and consumption goods. Productivity is the ratio of output to input.

The BEA and the BLS have produced a first set of estimates integrating multifactor productivity with the NIPAs. The results were reported at a special session on economic statistics at the annual meeting of the American Economic Association in San Francisco on January 4, 2009 (Harper et al. 2009). This is an important step in implementing the new architecture. Estimates of productivity are essential for projecting the potential growth of the U.S. economy, as demonstrated by Jorgenson, Mun Ho, and Kevin Stiroh (2008). The omission

of productivity statistics from the NIPAs and the 1993 SNA is a serious barrier to application of the national accounts in assessing potential economic growth.

The next step in integrating the NIPAs with the Flow of Funds Accounts will be to extend the national balance sheet for the U.S. economy generated by Jorgenson and Landefeld to incorporate balance sheets for the individual sectors identified in the Flow of Funds Accounts. The Integrated Macroeconomic Accounts for the U.S. produced by Teplin et al. (2006) have focused on the income and expenditures accounts, rather than balance sheets and the wealth accounts. A comprehensive wealth account for the U.S. economy is currently unavailable. Such an account is essential for measuring the accumulation of wealth to meet future financial needs for both public and private sectors, as well as assessing the levels of domestic and national saving and their composition.

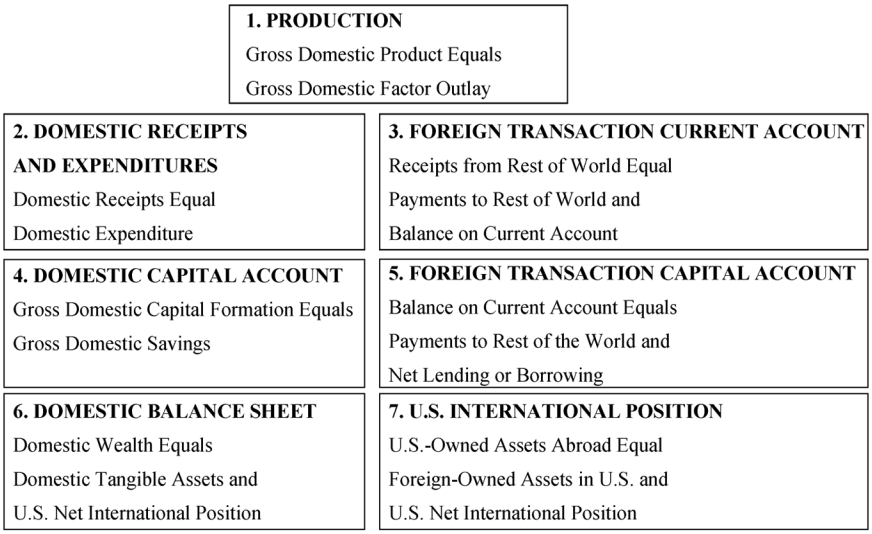
The first step in implementing the prototype accounting system described in section 2 is to develop accounts in current prices for production, income and expenditures, accumulation, and wealth accounts for the U.S. economy for 1948 through 2006. The accounts in constant prices begin with production. The product side includes consumption and investment goods output in constant prices. The income side includes labor and capital inputs in constant prices. Multifactor productivity is the ratio of real product to real input. Income and expenditures, accumulation, and wealth accounts in constant prices complete the system of accounts. We illustrate the application of the new architecture by considering the sources and uses of U.S. economic growth. Section 3 provides a conclusion.

2. Prototype Accounting System

This section lays out a prototype system of U.S. national accounts that builds directly on the NIPAs. The measurement of income and wealth requires a system of seven accounts. The Domestic Income and Product Account provides data on the outputs of the U.S. economy, as well as inputs of capital and labor services. Incomes and expenditures are divided between two accounts: the Income and Expenditures Account and the Foreign Transactions Current Account. Capital accumulation is recorded in two accounts: the Domestic Capital Account and the Foreign Transactions Capital Account. Finally, assets and liabilities are given in the Wealth Account and the U.S. International Position.

A schematic representation of the prototype accounting system for the new architecture is given in Figure 1. The complete accounting system includes a production account, incorporating data on output and input; an income and expenditures account, giving data on income, expenditures, and saving; and an accumulation account, allocating saving to various types of capital formation. A national balance sheet contains data on national wealth. Finally, the accumulation accounts are related to the wealth accounts through the accounting identity between period-to-period changes in wealth and the sum of net saving and the revaluation of assets.

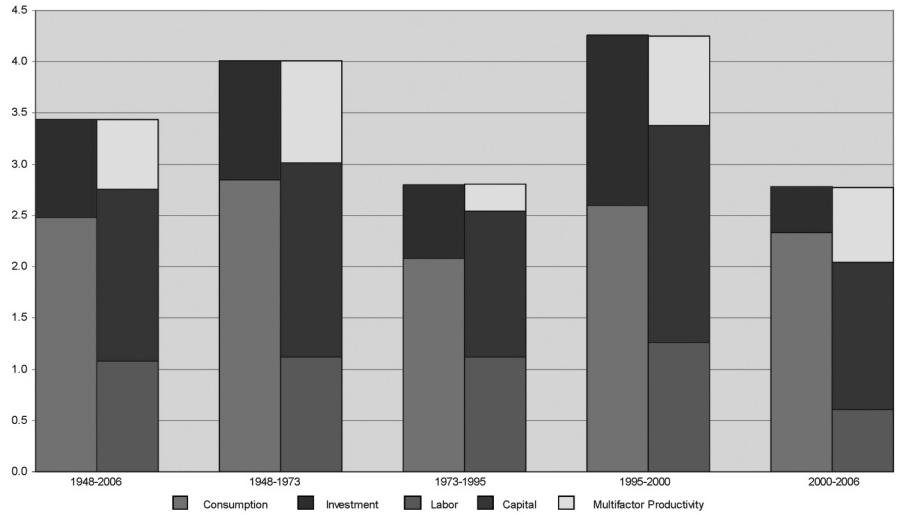
Figure 1
New Architecture for an Expanded and Integrated Set of National Accounts for the United States



The structure of the prototype system is similar to the NIPAs. However, the NIPAs present current price measures for outputs and inputs but constant price measures only for outputs. The key innovation in the new architecture and the BLS accounts for multifactor productivity is to present both outputs and inputs in current and constant prices. Constant price measures of inputs and multifactor productivity are essential in accounting for the sources of economic growth. The prototype system provides current and constant price measures of income and expenditures to account for the generation of income and its disposition as uses of economic growth. Finally, the system presents current and constant price measures of saving and capital formation to provide the necessary link between current economic activity and the accumulation of wealth.

An important application of the prototype system of accounts, essential for assessing the growth potential of the U.S. economy, is the analysis of sources of U.S. economic growth.[12] Figure 2 presents accounts for U.S. economic growth during the period 1948 through 2006 and various subperiods, following Jorgenson (2001). The earlier subperiods are divided by the business cycle peak in 1973. The period since 1995, the beginning of a powerful resurgence in U.S. economic growth linked to information technology, is divided in 2000, the start of the dot-com crash. The contribution of each output is its growth rate weighted by the relative value share. Similarly, the contribution of each input is its weighted growth rate. Growth in multifactor productivity is the difference between growth rates of output and input.

Figure 2
[AQ: 1]

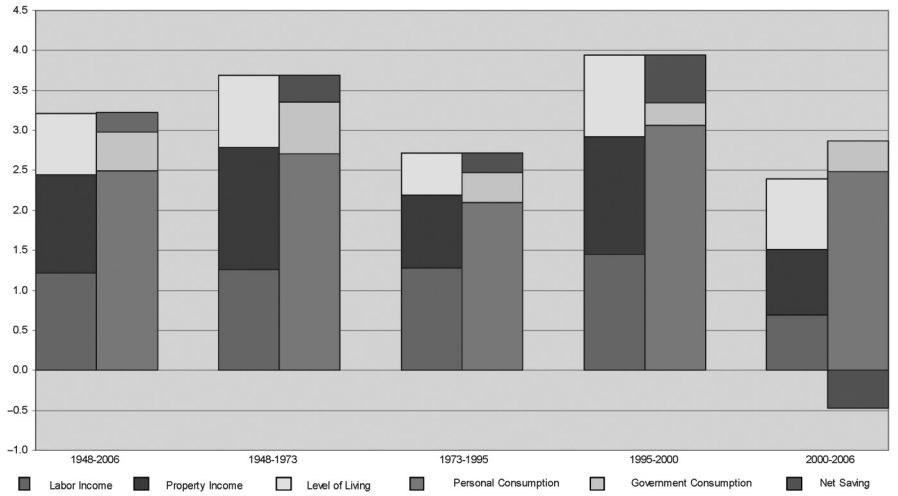


For the period 1948 through 2006, the most important source of economic growth was capital services at 49.4 percent, while labor services contributed 31.6 percent. Multifactor productivity growth contributed 19.0 percent of economic growth. After strong output and productivity growth in the 1950s, 1960s, and early 1970s, the U.S. economy slowed markedly from 1973 through 1995. U.S. economic growth surged to 4.09 percent during the period 1995 through 2000. This reflects the investment boom of the late 1990s, as businesses, households, and governments poured resources into plants and equipment, especially computers, software, and communications equipment.

These numbers highlight the importance of having an internally consistent set of accounts similar to those provided by the new architecture. In the absence of an integrated production account, the analysis of sources of economic growth at the aggregate and industry level would have to rely on a mixture of BEA industry account estimates and BLS productivity estimates, combined with an analyst's estimates of missing information, such as growth in labor input per hour worked. With inconsistent source data, different analysts could produce inconsistent results during periods of higher or lower growth, such as the post-1973 productivity slowdown and the more recent spurt in productivity growth since 1995.

Figure 3 presents a decomposition of the uses of economic growth for the period 1948 through 2006. The growth rate of expenditures is a weighted average of growth rates of personal consumption expenditures, government consumption expenditures, and net saving. The contribution of each category of expenditures is the growth rate weighted by the relative share. Similarly, the contributions of

Figure 3
[AQ: 2]



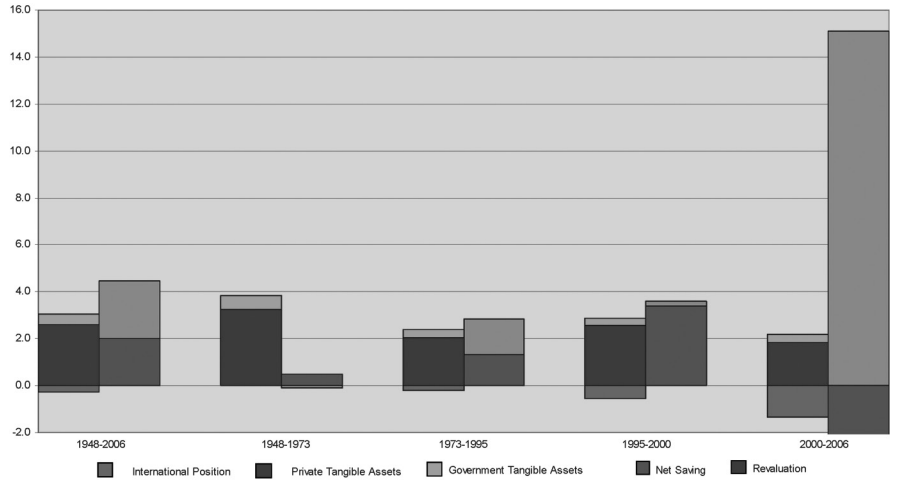
labor and property incomes are the growth rates weighted by the relative shares. Growth in the level of living is the difference between growth rates of expenditures and incomes.

The growth of net expenditures largely reflects the pattern of output growth, with strong growth of expenditures during the period 1948 through 1973 followed by a slowdown after 1973, a sharp revival after 1995, and a further slowing after 2000. Net saving added a healthy 0.35 percent to growth of net expenditures during 1948 through 1973, but this contribution eased to 0.30 percent per year during 1973 through 1995 before jumping sharply to 0.56 percent during the investment boom of 1995 through 2000. The most arresting feature of the uses of economic growth is the precipitous drop in the contribution of net saving to –0.43 percent per year in 2000 through 2006. Net saving remained positive but declined in magnitude during this period.

Figure 4 presents decompositions of gross investment and saving. The contribution of each component is its growth rate, weighted by the relative value share. Throughout the postwar period foreigners have been accumulating assets in the United States faster than the United States has been accumulating assets abroad. In fact, the contribution of ROW investment was negative in all subperiods except 1973 through 1995, when it was very slightly positive. ROW investment was essentially zero until the early 1980s, then dipped into negative territory until 1991, when it was positive for a single year, and then plunged deeper and deeper into the negative range through 2006.

By definition, gross saving perfectly parallels gross investment. A different perspective on net saving is presented in Figure 4, where the contributions of net

Figure 4
[AQ: 3]



saving and revaluation are combined to generate the change in wealth. The contribution of revaluation was relatively modest until 2000, when the rapid asset price inflation in real estate led to a stunning leap to an average annual rate of 15.52 percent per year. The magnitude of this asset price inflation did not appear in the NIPAs.

Finally, Figure 4 provides a decomposition of the growth of domestic wealth. The growth rate of domestic wealth attained a postwar high of 3.74 percent during 1948 through 1973 before declining to 2.17 percent during 1973 through 1995. Wealth grew at 2.40 percent during 1995 through 2000 but dipped to 1.04 percent in 2000 through 2006. The contribution of the U.S. International Investment Position was essentially zero from 1948 through 1973 before moving into the negative range, ultimately declining at 1.42 percent in 2000 through 2006. Private tangible assets increased in relative importance throughout the period.

3. Summary and Conclusions

The new architecture challenges conventional views of the U.S. economy. First, investment is the most important source of U.S. economic growth, and growth of labor input is next. Growth in productivity is a relatively modest contributor to economic growth. Second, the precipitous drop in net saving after the dot-com crash of 2000 is a cause of genuine concern about the future growth of U.S. living standards. This decline is all but invisible in the U.S. national accounts.

The change in wealth continued to grow at a substantial clip, even after the dot-com crash. However, this change has been a consequence of the revaluation of assets, especially asset price inflation in real estate, rather than net saving. Asset revaluation is not presented in the NIPAs, which do not include a national balance sheet.

The implementation of a new architecture for the U.S. national accounts will open new opportunities for development of the federal statistical system. The boundaries of the U.S. national accounts are defined by market and near-market activities. An example of a market-based activity is the rental of residential housing, while a near-market activity is the rental equivalent for owner-occupied housing. The new architecture project is not limited to these boundaries. Under the auspices of the National Research Council, the Committee on National Statistics has outlined a program for development of nonmarket accounts, covering areas such as health, education, household production, and the environment.[13]

Finally, the EU KLEMS project has generated industry-level production accounts, like those presented by Jorgenson, Ho, and Stiroh (2005) for the United States, for the economies of twenty-five European Union (EU) members and other major U.S. trading partners such as Australia, Canada, Japan, and Korea.[14] For major EU countries, this project includes accounts for seventy-two industries, covering the period 1970 through 2005. These data will greatly facilitate international comparisons and research into the impact of globalization on the major industrialized economies. Efforts are also under way to extend the EU KLEMS framework to important developing and transition economies, such as in Brazil, China, India, and Russia. This will open new opportunities for research on the impact of globalization.

Notes

1. The extensive documentation available for the U.S. national accounts, much of it online, is described in Jorgenson and Landefeld (2006, 107-9). A recent summary is provided in Landefeld, Seskin, and Fraumeni (2008).

2. The BEA's seven-account system is summarized in Jorgenson and Landefeld (2006).

3. United Nations et al. (1993).

4. See Landefeld (2000) on the origins of the U.S. national accounts.

5. See Jorgenson, Ho, and Stiroh (2008) for an application of the new architecture in assessing the potential growth of the U.S. economy.

6. See Jorgenson and Landefeld (2006). Implementation of the new architecture is discussed by Jorgenson and Landefeld (2009).

7. The most recent annual update is presented by Bond et al. (2007). The integrated income and expenditure account is discussed by Palumbo and Parker (2009).

8. Details on the U.S. national accounts in 1993 SNA format are presented by Mead, Moses, and Moulton (2004).

9. A program to update the 1993 SNA is scheduled for completion in 2009. A report on the revision is presented by the United Nations Statistical Commission (2007).

10. Additional detail on the BEA's system of international accounts is provided in the international section of the BEA website: www.bea.gov/international/index.htm.

11. Plans for the BEA industry program are presented by Moyer (2009).

12. The international standards for aggregate growth accounting presented in Schreyer (2001) are discussed in detail by Jorgenson, Ho, and Stiroh (2005, 17-58). The demise of traditional growth accounting is described by Jorgenson, Ho, and Stiroh (2005, 49-58).

13. The NRC report in summarized by Abraham and Mackie (2006). The conceptual framework for nonmarket accounts is presented by Nordhaus (2006).

14. The EU KLEMS project was completed on June 30, 2008. For further details see www.euklems.net. A summary of the findings is presented by Ark, O'Mahoney, and Timmer (2008).

References

Abraham, Katharine, and Christopher Mackie. 2006. A framework for non-market accounting. In *A new architecture for the U.S. national accounts*, ed. Dale W. Jorgenson, J. Steven Landefeld, and William D. Nordhaus, 161-92. Chicago: University of Chicago Press.

Ark, Bart van, Mary O'Mahoney, and Marcel P. Timmer. 2008. The productivity gap between Europe and the United States: Trends and causes. *Journal of Economic Perspectives* 22 (1): 25-44.

Bond, Charlotte Anne, Teran Martin, Susan Hume McIntosh, and Charles Ian Mead. 2007. Integrated macroeconomic accounts for the United States. *Survey of Current Business* 87 (11): 14-31.

Harper, Michael J., Brent R. Moulton, Steven Rosenthal, and David B. Wasshausen. 2009. Integrated GDP-productivity accounts. *American Economic Review* 99 (2): 74-79.

Intersecretariat Working Group on National Accounts. 2009. Capital services and the national accounts. In *Revision 1, 1993 SNA*, chap. 20. New York: United Nations.

Jorgenson, Dale W. 2001. Information technology and the U.S. economy. *American Economic Review* 91 (1): 1-32.

Jorgenson, Dale W., Mun S. Ho, and Kevin J. Stiroh. 2005. *Information technology and the American growth resurgence*. Cambridge, MA: MIT Press.

Jorgenson, Dale W., Mun S. Ho, and Kevin J. Stiroh. 2008. A retrospective look at the U.S. productivity resurgence. *Journal of Economic Perspectives* 22 (1): 3-24.

Jorgenson, Dale W., and J. Steven Landefeld. 2006. Blueprint for expanded and integrated U.S. accounts: Review, assessment, and next steps. In *A new architecture for the U.S. national accounts*, ed. Dale W. Jorgenson, J. Steven Landefeld, and William D. Nordhaus, 13-112. Chicago: University of Chicago Press.

Jorgenson, Dale W., and J. Steven Landefeld. 2009. Implementation of a new architecture for the U.S. national accounts. *American Economic Review* 99 (2): 64-68.

Landefeld, J. Steven. 2000. GDP: One of the great inventions of the 20th century. *Survey of Current Business* 80 (1): 6-14.

Landefeld, J. Steven, Eugene P. Seskin, and Barbara M. Fraumeni. 2008. Taking the pulse of the economy: Measuring GDP. *Journal of Economic Perspectives* 22 (2): 193-216.

Mead, Charles Ian, Karin Moses, and Brent Moulton. 2004. The NIPAs and the system of national accounts. *Survey of Current Business* 84 (12): 17-32.

Moyer, Brian C. 2009. Future directions for the industry accounts. *Survey of Current Business* 89 (3): 29-32.

Nordhaus, William D. 2006. Principles of national accounting for non-market accounts. In *A new architecture for the U.S. national accounts*, ed. Dale W. Jorgenson, J. Steven Landefeld, and William D. Nordhaus, 143-60. Chicago: University of Chicago Press.

Palumbo, Michael G., and Jonathan A. Parker. 2009. The integrated financial and real system of national accounts for the United States: Does it presage the financial crisis? *American Economic Review* 99 (2): 80-86.

Schreyer, Paul. 2001. *Productivity manual: A guide to the measurement of industry-level and aggregate productivity growth*. Paris: Organization for Economic Cooperation and Development.

Schreyer, Paul. 2009. *OECD manual: Measuring capital*. Paris: Organization for Economic Cooperation and Development.

Teplin, Albert M., Rochelle Antoniewicz, Susan Hume McIntosh, Michael Palumbo, Genevieve Solomon, Charles Ian Mead, Karin Moses, and Brent Moulton. 2006. Integrated macroeconomic accounts for the United States: Draft SNA-USA. In *A new architecture for the U.S. national accounts*, ed. Dale W. Jorgenson, J. Steven Landefeld, and William D. Nordhaus, 471-540. Chicago: University of Chicago Press.

United Nations, Commission of the European Communities, International Monetary Fund, Organization for Economic Cooperation and Development, and World Bank. 1993. *System of national accounts 1993*. Series F, no. 2, rev. 4. New York: United Nations.

United Nations, Commission of the European Communities, International Monetary Fund, Organization for Economic Cooperation and Development, and World Bank. 2009. Capital services and the national accounts. In *2008 system of national accounts*, 415-26. unstats.un.org/unsd/nationalaccount/sna2008.asp.

United Nations Statistical Commission. 2007. *Report of the Intersecretariat Working Group on National Accounts*. Series E. CN.3/2007/7. February-March. New York: United Nations, Economic and Social Council.