Designing a New Architecture for the U.S. National Accounts to Capture Innovation

By Dale W. Jorgenson

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 Steven Landefeld, Director of the Bureau of Economic Analysis. As the U.S. economy emerges from the most severe contraction since the Second World War, the focus of policy is rapidly shifting toward enhancing the potential for growth. An important motivation for the new architecture is to integrate the different components of the decentralized U.S. statistical system and make them consistent.

This paper outlines a new architecture for the U.S. national accounts to better capture innovation. In this context "architecture" refers to the conceptual framework for the national accounts[1]. The purpose of such a framework is to provide a strategy for developing the national accounts. An example is the seven-account system recently introduced by the Bureau of Economic Analysis (BEA).[2] A second example is the United Nations' *2008 System of National Accounts* (2008 SNA).[3] Both provide elements of a complete accounting system, including production, income and expenditures, capital formation, and wealth accounts.

The key elements of the new architecture are outlined in a "Blueprint for Expanded and Integrated U.S. Accounts" by Jorgenson and Landefeld.[4] They present a prototype system that integrates the national income and product accounts (NIPAs) with productivity statistics generated by the Bureau of Labor Statistics (BLS) and balance sheets produced by the Federal Reserve. The system features gross domestic product (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.[5]

The new architecture for the U.S. national accounts has been endorsed by the Advisory Committee on Measuring Innovation in the 21st Century Economy to the U.S. Secretary of Commerce.[6] The first recommendation of the Committee: "Develop annual, industry-level measures of total factor productivity by restructuring the NIPAs to create a more complete and consistent set of accounts integrated with data from other statistical agencies to allow for the consistent estimation of the contribution of innovation to economic growth."[7]

The Committee also endorsed the new architecture: "The proposed new 'architecture' for the NIPAs would consist of a set of income statements, balance sheets, flow of funds statements, and productivity estimates for the entire economy and by sector that are more accurate and internally consistent. The new architecture will make the NIPAs much more relevant to today's technology-driven and globalizing economy and will facilitate the publication of much more detailed and reliable estimates of innovation's contribution to productivity growth."[8]

Development of this fully integrated and consistent system of accounts will require close collaboration among BEA, BLS, and the Federal Reserve Board (FRB), as well as coordination with the Census Bureau, the most important agency for generating primary

1. The extensive documentation available for the U.S. national accounts, much of it online, is described in Jorgenson and Landefeld (2006, pp. 107–109). A recent summary is provided in Landefeld, Seskin, and Fraumeni (2008).

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

3. United Nations, Commission of the European Communities, International Monetary Fund, Organisation for Economic Cooperation and Development, and the World Bank (2009).

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

Dale W. Jorgenson is the Samuel W. Morris University Professor at Harvard University and Chairman of the Bureau of Economic Analysis Advisory Committee. More information about the author is available from www.economics.harvard.edu/faculty/jorgenson. *The author is much indebted to Steven Landefeld for his collaboration on an earlier phase of this research. Special thanks are due to Jon Samuels of Johns Hopkins University for excellent research assistance and very helpful comments. Financial support by the Alfred P. Sloan Foundation and the Donald B. Marron Fund for Research at Harvard University is gratefully acknowledged.*

5. The prototype system has been updated by Jorgenson (2009b).

6. Advisory Committee on Measuring Innovation in the 21st Century Economy (2008). The Committee was established on December 6, 2007, with 10 members from the business community, including Carl Schramm, President and CEO of the Kauffman Foundation and chair of the Committee, Sam Palmisano, Chairman and CEO of IBM, and Steve Ballmer, President of Microsoft. The Committee also had five academic members, including Jorgenson. The Committee met on February 22 and September 12, 2007, to discuss its recommendations. The final report was released on January 18, 2008.

7. The Advisory Committee on Measuring Innovation in the 21st Century Economy (2008, p. 7).

8. The Advisory Committee on Measuring Innovation in the 21st Century Economy. (2008, p. 8).

source data. The first and most important objective is to make the national accounts generated by BEA consistent with the accounts for productivity compiled by BLS and the flow of funds accounts constructed by FRB. The boundaries of production, income and expenditures, accumulation, and wealth accounts must be made uniform in order to achieve consistency throughout the system.

The new architecture

The first 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 50 years. The national accounts were originally constructed to deal with issues arising from the Great Depression of the 1930s.[9] But economic policymakers today are confronting different, modern challenges. U.S. economic policy is coping with the most severe contraction since the Second World War. As the economy emerges from the downturn, the focus of U.S. monetary and fiscal policies is shifting from economic stabilization toward enhancing the economy's growth potential.[10] 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.

In integrating the components of the U.S. national accounts, the next question to be addressed is, why not use the 2008 SNA? BEA income and expenditures data and FRB flow of funds data have been integrated within the framework for SNA by Albert Teplin, *et al.* This initial effort has been followed by an annual update, published in the Survey of Current Business, BEA's monthly journal, and available on the BEA Web site.[11] SNA-USA is not the only effort at BEA to provide the U.S. national accounts in the SNA format. The U.S. national accounts are reported annually to the Organisation for Economic Co-operation and Development (OECD) in this format, and the results are published in the OECD's internationally comparable national accounts.[12]

The 2008 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 2008 SNA does not provide the production and income and expenditure accounts in current and constant prices required by the new architecture. 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 BEA and the productivity statistics constructed by BLS. Adding productivity statistics to the national accounts remedies a critical omission in the NIPAs and the SNA. Similarly, 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 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, payments to the rest of the world and the balance on current account. The international accounts also include the foreign transactions capital account, which registers net lending and borrowing from the United States to the rest of the world. Finally, the U.S. international investment position includes U.S. assets abroad and foreign-owned assets in the United States. These accounts are generated by BEA and incorporated into the flow of funds accounts by FRB.[13]

Two other important advantages of beginning with the NIPAs are that (1) the existing U.S. national accounts can be incorporated without modification and (2) improvements in the NIPAs can be added as they become available. For example, BEA is currently engaged in a major program to improve the existing system of industry accounts and accelerate the production of industry data.[14] This program will integrate the NIPAs with the annual input-output

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

10. See National Economic Council (2009), "A Strategy for American Innovation: Driving Towards Sustainable Growth and Quality Jobs," NEC White Paper. Washington, DC: National Economic Council, September. See www.whitehouse.gov/administration/eop/nec/StrategyforAmericanInnovation.

11. The most recent annual update is presented by Bond, Martin, McIntosh, and Mead (2007). Application of the integrated income and expenditure account to the analysis of the financial and economic crisis is discussed by Palumbo and Parker (2009).

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

13. Additional detail on BEA's system of international accounts is provided in the international section of the BEA Web site at www.bea.gov/international/index.htm.

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

accounts and the benchmark input-output accounts produced every 5 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.

In response to the recommendations of the Advisory Committee on Measuring Innovation in the 21st Century Economy, BEA and BLS produced a first set of estimates integrating multifactor productivity with the NIPAs in 2009.[15] This is a crucial 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 has been a serious barrier to application of the national accounts in assessing the growth potential of the U.S. economy.

Issues in measuring productivity were considered by a statistical working party of the OECD Industry Committee, headed by Edwin Dean, former Associate Commissioner for Productivity and Technology of 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) and the BEA-BLS (2009) aggregate production account conform to the standards presented in Schreyer's *Productivity Manual*.

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 2008 SNA was approved by the United Nations Statistical Commission at its February–March 2007 meeting. This is discussed in detail in chapter 20 of the 2008 SNA, "Capital Services and the National Accounts." Paul Schreyer, head of national accounts at the OECD, has prepared an OECD Manual (2009) *Measuring Capital*. This provides detailed recommendations on methods for the construction of prices and quantities of capital services.

In chapter 20 of the 2008 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." The measures of capital and labor inputs in the new architecture for the U.S. national accounts are consistent with the 2008 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 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 United States produced by Teplin, et al., 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 critical for understanding the recent financial crisis as well as measuring the accumulation of wealth to meet future financial needs for both public and private sectors.

The first step in implementing the prototype accounting system described in the next section is to develop accounts in current prices for production, income and expenditures, accumulation, and wealth accounts for the U.S. economy for 1948–2006. 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.

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. This system must be carefully distinguished from the new system of seven accounts employed in presenting the NIPAs. 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

15. See Harper, Moulton, Rosenthal, and Wasshausen (2009). The new data set is available on the BEA Web site at www.bea.gov/national/integrated_prod.htm. These data will be updated annually.

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 chart 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.

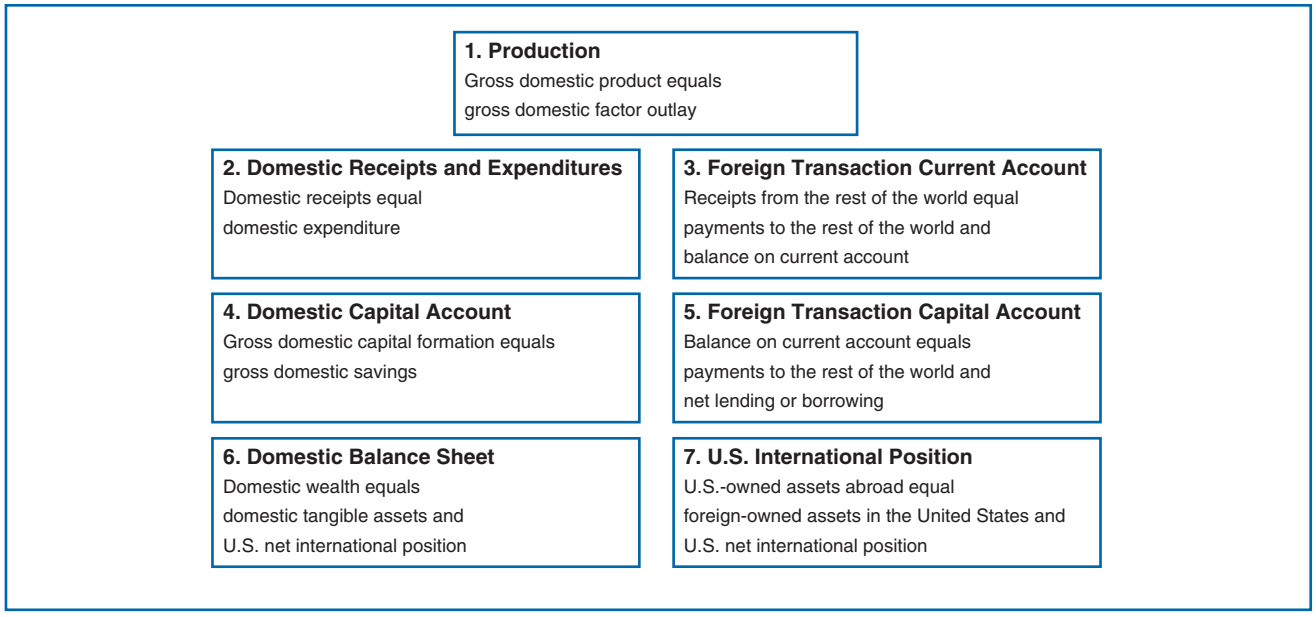
The structure of the prototype system is similar to the NIPAs. The key innovation in the new architecture and the BEA-BLS accounts for multifactor productivity is to present both outputs and inputs in current and constant prices. Constant price measures of inputs and multifactor productivity are essential in accounting for the sources of economic growth. The prototype system provides current and constant price measures of income and expenditures in order 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.[16] Chart 2 presents accounts for U.S. economic growth in 1948–2006 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.

For 1948–2006, the most important source of economic growth was capital services, which accounted for 49.4 percent of growth. Labor services accounted for 31.6 percent of growth. And multifactor productivity growth accounted for 19.0 percent of 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 1995–2000. This reflects the investment boom of the late 1990s,

16. The international standards for aggregate growth accounting presented in Schreyer (2001) are discussed in detail by Jorgenson, Ho, and Stiroh (2005, pp. 17–58). The demise of traditional growth accounting is described by Jorgenson (2009b).

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



as businesses, households, and governments poured resources into plant and equipment, especially computers, software, and communications equipment.

Chart 3 presents a decomposition of the uses of economic growth for 1948–2006. 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 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 1948–1973, 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 1948–1973, but this contribution eased to 0.30 percent per year during 1973–1995 before jumping sharply to 0.56 percent during the investment boom of 1995–2000. 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 2000–2006. Net saving remained positive, but declined in magnitude during this period.

Chart 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 post-war period foreigners have been accumulating assets in the U.S. faster than the U.S. has been accumulating assets abroad. In fact, the contribution of rest of the world investment was negative in all subperiods except 1973–1995, when it was very slightly positive. Rest of the world investment was essentially zero until the early 1980s, 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

Chart 2. Contributions to Output and Growth, 1948–2006

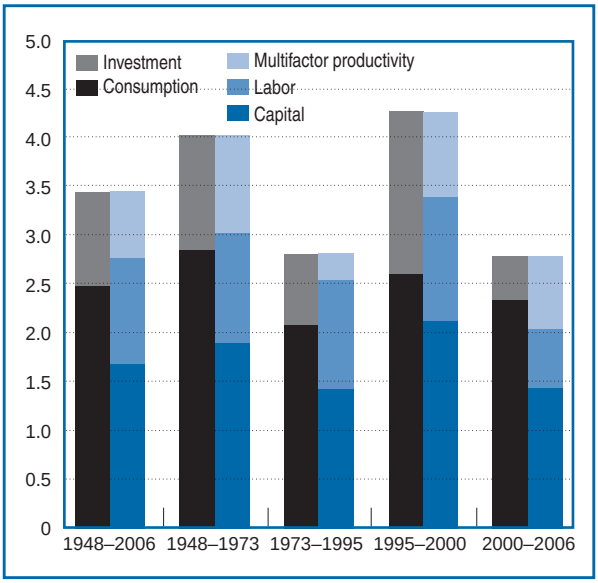


Chart 3. Contributions to Net Expenditures and Income, 1948–2006

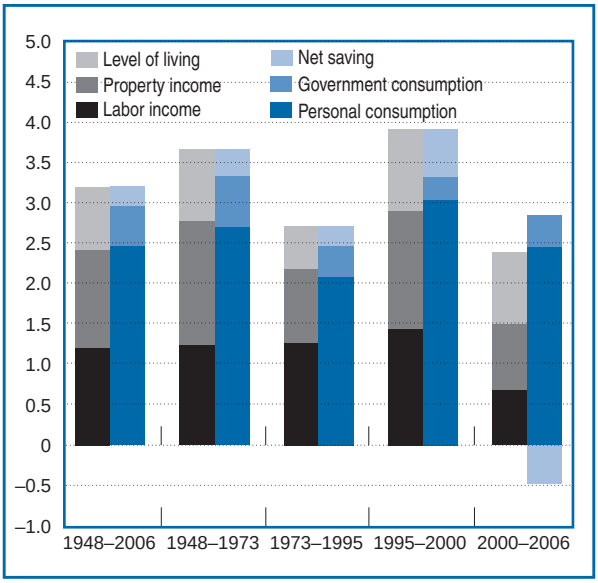
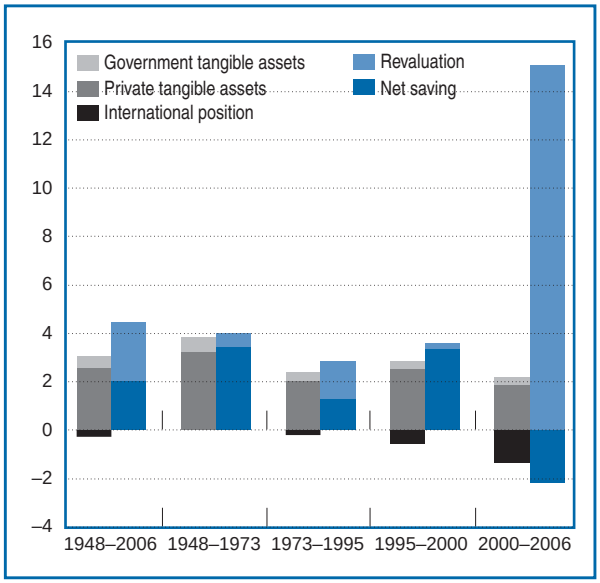


Chart 4. Contributions to Wealth and Change in Wealth, 1948–2006



presented in chart 4, where the contributions of net 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, chart 4 provides a decomposition of the growth of domestic wealth. The growth rate of domestic wealth attained a post-war high of 3.74 percent during 1948–1973, before declining to 2.17 percent during 1973–1995. Wealth grew at 2.40 percent during 1995–2000, but dipped to 1.04 percent in 2000–2006. The contribution of the U.S. international investment position was essentially zero from 1948–1973 before moving into the negative range, ultimately declining at 1.42 percent in 2000–2006. Private tangible assets increased in relative importance throughout the period.

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 relative modest contributor to economic growth. Second, the precipitous drop in net saving after the dot-com crash of 2000 is the 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 (NRC), 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.[17]

Finally, the EU KLEMS project has generated industry-level production accounts, like those presented by Jorgenson, Ho, and Stiroh (2005) for the U.S., for the economies of 25 EU members and other major U.S. trading partners, such as Australia, Canada, Japan, and Korea.[18] For major European Union countries this project includes accounts for 32 industries, covering the period 1970–2007. These data will greatly facilitate international comparisons and research into the impact of globalization on the major industrialized economies. Efforts are also underway to extend the EU KLEMS framework to important developing and transition economies, including Argentina, Brazil, Chile, China, India, Indonesia, Mexico, Russia, Turkey, and Taiwan. This will open new opportunities for research on the impact of globalization.

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18. The EU KLEMS project was completed on June 30, 2008. The data have recently been updated and are available at www.euklems.net. A summary of the findings is presented by O'Mahony and Timmer (2009).

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