HARVARD UNIVERSITY
DEPARTMENT OF ECONOMICS

Dale W. Jorgenson
Samuel W. Morris University Professor
122 Littauer Center
Cambridge, MA 02138-3001

PHONE: (617) 495-4661
FAX: (617) 495-4660
EMAIL: djorgenson@harvard.edu
WEB: http://post.economics.harvard.edu/faculty/jorgenson

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A NEW ARCHITECTURE FOR THE U.S. NATIONAL ACCOUNTS:

by

Dale W. Jorgenson, Harvard University

Public Comment to the Measuring Innovation in the 21st Century Advisory Committee

Economics and Statistics Administration

U.S. Department of Commerce

April 18, 2007

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Description of the Proposal. This public comment is made in response to the Notice on "Innovation Measurement" by the Economics and Statistics Administration of the Department of Commerce, published on Friday, April 13, 2007.[2] The purpose of the comment is to support the efforts of the Measuring Innovation in the 21st Century Economy Advisory Committee to make recommendations to the Secretary of Commerce on new and improved measures of business innovation.[3] Innovation is defined as:

> The design, invention, development and/or implementation of new and altered products, services, processes, systems, organizational structures, or business models for the purpose of creating new value for consumers and financial returns to the firm.[4]

This comment presents a proposal for a New Architecture for the U.S. National Accounts. The proposal is addressed to the first of the four major categories identified by participants in the initial meeting of the Advisory Committee:

> Improvement of the underlying architecture of the U.S. System of National Accounts to facilitate development of improved and more granular measures of innovation and productivity.[5]

The key elements of the New Architecture have been developed in a prototype system of accounts, constructed by Dale W. Jorgenson,[6] the author of this public comment, and J. Steven Landefeld, Director of the Bureau of Economic Analysis. An important motivation for the new architecture is to integrate the different components of our decentralized statistical system and make them consistent. In addition, the focus must be changed from economic stabilization policy toward enhancing the U.S. economy's

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[1] This comment is from Academia. The comment expresses the personal opinion of the author; no endorsement, official or unofficial, by Harvard University is implied.
[2] "Innovation Measurement," Economics and Statistics Administration, U.S. Department of Commerce, *Federal Register*, Vol. 72, No. 71, pp. 18627-18628, Friday, April 13, 2007.
[3] The author is a member of the Advisory Committee. Further information about the Committee is given on the Economics and Statistics Administration website: http://www.innovationmetrics.gov/.
[4] *Federal Register*, Vol. 72, No. 71, p. 18627, Friday, April 13, 2007.
[5] *Federal Register*, Vol. 72, No. 71, p. 18627, Friday, April 13, 2007.
[6] Information about the author of this public comment is available from his home page: http://econweb.fas.harvard.edu/faculty/jorgenson/.

growth potential through stimulating business innovation.

Rationale for the Proposal. The first question to be addressed is, why do we need a new architecture for the U.S. national accounts? In this context "architecture" refers to the conceptual framework for the national accounts. An example of such a framework is the new seven-account system employed by the Bureau of Economic Analysis (BEA).[7] A second example is the United Nations' System of National Accounts 1993 (SNA93).[8] Both provide elements of a complete accounting system, including production, income and expenditure, capital formation, and wealth accounts. The purpose of such a framework is to provide a strategy for developing the national accounts. The existing systems of accounts are described in an Appendix to this public comment.

The conceptual framework for the national accounts must be carefully distinguished from a specific plan for improvements in the national accounts like the BEA's Strategic Plan.[9] The Strategic Plan focuses on BEA's plans for the future and is very important in laying out priorities for empirical implementation and eliciting responses from the user community. However, the Plan does not provide a rationale for the priorities in terms of the conceptual framework of the national accounts or relate BEA's plans to those of other statistical agencies with interests in the accounts. This is particularly important in the decentralized statistical system employed in the U.S.

The U.S. national accounts were originally constructed to deal with issues arising from the Great Depression of the 1930's, focusing on the current state of the economy. The basic architecture of the national accounts has not been substantially altered in fifty years. In the meantime, the success of U.S. monetary and fiscal policies has shifted the policy focus from economic stabilization to enhancing the U.S. economy's growth potential. In addition, the 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.

Relationship to Innovation. The purpose of the New Architecture is to describe the consequences of business innovation, as defined above. This is best captured by a

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[7] The BEA's seven-account system of summarized by Dale W. Jorgenson and J. Stephen Landefeld, "Blueprint for Expanded and Integrated U.S. Accounts: Review, Assessment, and Next Steps," in Dale W. Jorgenson, J. Stephen Landefeld, and William D. Nordhaus, eds., 2006. *A New Architecture for the U.S. National Accounts*, Chicago University of Chicago Press, pp. 13-112. An electronic version of Jorgenson and Landefeld is available in Blueprint for Expanded and Integrated U.S. National Accounts: Review, Assessment, and Next Steps, with J. Steven Landefeld, in D.W. Jorgenson, J.S. Landefeld, and W.D. Nordhaus, eds., A NEW ARCHITECTURE FOR THE U.S. NATIONAL ACCOUNTS, Chicago, University of Chicago Press, 2006, pp 13-112.

[8] United Nations, Commission of the European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, and the World Bank, 1993. *System of National Accounts 1993*. Series F. no. 2, rev. 4. New York: United Nations. Implementation of the SNA in Australia, Canada, and the United Kingdom is described by Karen Wilson, "The Architecture of the System of National Accounts: A Three-Way Comparison of Canada, Australia, and the United Kingdom, in Jorgenson, Landefeld, and Nordhaus, *op. cit*., pp. 113-142.

[9] The BEA's Final Strategic Plan for FY 2006-FY 2010 is available on the BEA website: **bea**.gov/

measure of Total Factor Productivity (TFP), defined as output per unit of input. This measure can be implemented at the economy-wide level, where the measure of output is Gross Domestic Product (GDP) and inputs include capital and labor services. It can also be implemented at the industry level, where the value of output includes the value of intermediate products and services, as well as capital and labor inputs.

What is the relationship between TFP and innovation? To answer this question it is useful to begin by considering economic growth without innovation. This can take place through expansion of the labor force as the population grows and expansion of capital services through investment in existing technologies. If there is no innovation, output will increase in proportion to the growth in capital and labor inputs. New or altered processes, systems, organizational structures or business models generate growth of output that exceeds the growth of capital and labor inputs. This produces growth of Total Factor Productivity.

Total Factor Productivity growth also captures innovation through new and improved products and services. These innovations create new value for consumers and generate financial returns for successful innovators. The new and improved products and services are included in the measures of output. Output expands more than in proportion to the growth of inputs. For example, new computers, telecommunications equipment, and software compete with existing products. If they are successful in penetrating markets for information technology, they are included in the gross domestic product, as well as in the outputs of the industries where the new products and services originate.

New Architecture for the National Accounts. The key elements of the new architecture are outlined in a "Blueprint for Expanded and Integrated U.S. Accounts," by Jorgenson and Landefeld.[10] They present a prototype system that integrates the national income and product accounts with productivity statistics generated by the Bureau of Labor Statistics (BLS) and balance sheets produced by the Federal Reserve Board (FRB). The system features GDP, as does the National Income and Product Accounts. GDP and domestic income are generated along with estimates of Total Factor Productivity in an internally consistent way. The balance sheet covers the U.S. economy as a whole and links investment in new assets to the saving required for financing this investment.

The prototype system of accounts developed by Jorgenson and Landefeld incorporates the cost of capital and the flow of capital services for all productive assets employed in the U.S. economy. This provides a unifying methodology for integrating the National Income and Product Accounts (NIPAs) generated by BEA and the productivity statistics constructed by BLS. The parallel flow of labor services is broken down by age, sex, education and class of employment. Hours worked for each category of labor services are weighted by total labor compensation per hour worked. The underlying source data on employment, hours worked, and labor compensation include public use data on individuals from the decennial Censuses of Population and the monthly Current Population Surveys generated by the Bureau of the Census.

[10] See Jorgenson and Landefeld, *op. cit.*

The production account for the prototype system of accounts is based on the gross domestic product (GDP) and gross domestic income (GDI) in current and constant prices. Total Factor Productivity (TFP) is the ratio of GDP to GDI in constant prices. This production account has been disaggregated to 85 industries, covering the period 1960-2004, by Jorgenson, Ho, Samuels, and Stiroh (2006), Industry Origins of the American Productivity Resurgence. The methodology follows that of Jorgenson, Ho and Stiroh (2005), Information Technology and the American Growth Resurgence. This conforms to the international standards presented in the OECD *Productivity Manual* (2001).[11] The European Union (EU) has recently completed systems of production accounts based on this methodology for the economies of the EU member states.[12]

In integrating the remaining components of the system of national accounts, the second question to be addressed is, why not use one of the existing conceptual frameworks, such as the United Nations' System of National Accounts (SNA93)? The SNA93 would be part of any 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, it does not provide the income and production accounts in current and constant prices needed in applications of the national accounts to measuring business innovation. Also, consistency of the boundaries among the various accounts is an unresolved issue in SNA93. Wealth, for example, refers to a different set of economic units than income and product.[13]

The prototype system of Jorgenson and Landefeld begins with the U.S. National Income and Product Accounts (NIPAs) and generates the income and product accounts in constant prices as well as current prices. The production accounts can be generated at both aggregate and industry levels and provide the missing connection to the productivity statistics. Adding productivity statistics to the national accounts would remedy a critical omission in the NIPAs and SNA93. Similarly, BEA's accounts for reproducible assets and the U.S. International Investment Position could be extended to encompass a balance sheet for the U.S. economy as a whole, now absent from the NIPAs and the Federal Reserve Board's Flow of Funds Accounts. The NIPAs and the wealth accounts would then have the same boundaries, unlike SNA93.

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

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[11] See Paul Schreyer, 2001. *Productivity Manual: A Guide to the Measurement of Industry-Level and Aggregate Productivity Growth*. Paris: Organisation for Economic Cooperation and Development, May.

[12] The new industry-level production accounts for EU members were released on March 15,2007. The EU project is described by Marcel P. Timmer, Mary O'Mahoney, and Bart van Ark, "EU KLEMS Growth and Productivity Accounts: An Overview," *International Productivity Monitor*, No. 14, Spring 2007, pp. 71-85. For further details see: www.euklems.net/.

[13] A program to update the SNA93 is scheduled for completion in 2008. A report on the revision is presented by United Nations, *Report of the Intersecretariat Working Group on the National Accounts*, Series E. CN.3/7/2007, February 27-March 2, 2007.

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 Position includes U.S. Assets Abroad and Foreign-Owned Assets in the U.S. These accounts are generated by BEA and incorporated into the Flow of Funds Accounts by the Federal Reserve Board.[14] BEA's international accounts are undergoing substantial improvements intended to enhance the quality of information available to policy makers dealing with globalization.[15]

Another important advantage of beginning with the NIPAs is that the existing U.S. national accounts can be incorporated without modification. 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 by 2008. 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. This is the subject of important studies by Bosworth and Triplett.[16] The Census Bureau has generated important new source data on intermediate inputs of services and BLS has devoted a major effort to improving the price data for services essential for measuring service sector output.[17]

Schedule for Implementation. The first step in unifying the National Income and Product Accounts with the productivity statistics is to develop a more detailed version of the production account. This would incorporate BEA's new system of official statistics on output, intermediate input, employment, investment, fixed assets, and imports and exports by industry, when it becomes available in 2008. The system of industry production accounts would use the North American Industry Classification System (NAICS) employed in BEA's official statistics. The accounts would include capital and labor inputs for each industry, based on the methodology of Jorgenson, Ho, and Stiroh (2005). Industry outputs, as well as intermediate, capital, and labor inputs would be presented in current and constant prices along with Total Factor Productivity.

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[14] Additional detail on BEA's system of international accounts is provided in the international section of the BEA website: bea.gov/bea/dil.htm.

[15] See, for example, Ralph Kozlow, "Globalization, Offshoring, and Multinational Companies: What are the Questions and How Well Are We Doing at Answering Them," BEA Working Paper, January 6, 2006.

[16] See Jack E. Triplett and Barry P. Bosworth, *Productivity in the U.S. Services Sector: New Sources of Economic Growth*, Washington, Brookings Institution Press, 2004. An update is presented in Bosworth and Triplett, "The Early 21st Century U.S. Productivity Expansion is *Still* in Services, *International Productivity Monitor*, No. 14, Spring 2007, pp. 3-19. Recommendations for improvement in service sector metrics are presented in John Graham, "The Measure of a Nation: Quantifying Innovative Strength through Improved Service Sector Metrics," NBR Special Report, No. 11, Washington, D.C., National Bureau of Asian Research, February 2007, pp. 17-19.

[17] See the Panel Remarks by Thomas L. Mesenbourg of the Census and Kathleen P. Utgoff of BLS in Jorgenson, Landefeld, and Nordhaus, *op cit*., pp. 611-625.

The next step in integrating the NIPAs with the Flow of Funds Accounts would 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. BEA national income and FRB flow of funds data on income and expenditure are combined into the Integrated Macroeconomic Accounts for the U.S. by Teplin, *et al.* [18] However, this system of accounts is focused on the income and expenditure 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 needs for financing investment in both public and private sectors, as well as assessing the levels of domestic and national saving and their composition.

The creation 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 included in the Gross Domestic Product. 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 non-market accounts.[19]

BEA has recently extended the NIPAs to include a satellite account for investment in research and development. Carol Corrado, Charles Hulten, and Daniel Sichel (2006) have proposed a system of accounts for intangible forms of investment, including research and development.[20] They have proposed to include investments in scientific research and development, as well as minerals exploration, training of workers, advertising, and non-scientific research and development, such as the development of intellectual capital in the form of movies, music, and the like. Investment in software has been included in the core system of accounts since 1999. Other than software and scientific research and development, these forms of intangible investment are not included in the NIPAs or in a satellite system of accounts.

Finally, the EU KLEMS project has generated industry-level production accounts, like those described above for the U.S., for the economies of EU members and other major U.S. trading partners such as Canada, Japan, and Korea. 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

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[18] Albert M. Teplin, Rochelle Antoniewicz, Susan Hume McIntosh, Michael G. Palumbo, Genevieve Solomon, Charles Ian Mead, Karin Moses, and Brent Moulton, "Integrated Macroeconomic Accounts for the United States: Draft SNA-USA," in Jorgenson, Landefeld, and Nordhaus, *op. cit.*, pp. 471-541.
[19] The NRC report in summarized by Katharine G. Abraham and Christopher Mackie, "A Framework for Nonmarket Accounting," in Jorgenson and Landefeld, *op. cit*., pp. 161-192. The conceptual framework for non-market accounts is presented by Nordhaus, "Principles of National Accounting for Nonmarket Accounts," in Jorgenson, Landefeld, and Nordhaus, *op. cit.*, pp. 143-160.
[20] See Carol A. Corrado, Charles R. Hulten, and Daniel E. Sichel, "Intangible Capital and Economic Growth," NBER Working Paper 11948, January 2006.

framework to important developing and transition economies, such as Brazil, China, India, and Russia. This will open new opportunities for research on the future impact of globalization on the U.S. economy.

Impact of the Proposal. Implementation of a New Architecture for the U.S. National Accounts would make measures of business innovation an integral part of the U.S. national accounts. Growth of Total Factor Productivity corresponds to the output of innovative activities in the form of new products and services and new processes, systems, organizational structures, and business models. This would be reported on a regular basis along with measures of economy-wide output, such as the Gross Domestic Product. Industry-level measures of innovation would be reported along with the industry-level outputs that will be generated by BEA's new system of industry accounts to be released in 2008.

The most important limitation of the existing official measures of Total Factor Productivity, generated by BLS, is that they are not integrated with the national accounts. Also, the BLS industry-level measures of Total Factor Productivity are not consistent with the economy-wide measures; for example, industry-level measures of labor input are based on hours worked, while economy-wide measures reflect changes in the composition of hours worked by age, gender, and education that result in enhanced inputs of labor services. As a consequence, the industry-level measures fail to conform to the international standards established by the OECD *Productivity Manual*.

Business innovative activity at the economy-wide level can be monitored on an on-going basis with the New Architecture for the U.S. National Accounts. This will provide signals to policy-makers of changes in business innovation as these changes occur. In addition, by extending the new architecture to the level of individual industries, business innovation can be traced to the industries where innovation is taking place. For example, if the new architecture had been in place during the 1990's, the surge of innovative activity in information technology-producing industries could have been observed as it occurred. It was only after the resulting boom in investment in information technology products had ended that the sources of this wave of innovation were identified. Policy-makers in the late 1990's were left without the guidance they needed to formulate appropriate monetary and fiscal policies to deal with the enhanced potential for U.S. economic growth.

More recently, the primary locus of innovative activity in the U.S. economy has shifted from information technology-producing to information technology-using sectors, such as communications services, wholesale trade, and business and financial services. While all of these sectors have utilized information technology products intensively, innovative activity has shifted toward new business processes, systems, organizational structures, and business models. Fortunately, empirical research on economic growth based on the prototype accounting systems described above has made it possible to identify this dramatic shift as it is proceeding. However, the information is not part of our national accounts and is not reported on a regular basis, so that policy-makers are again confronted by bewildering changes in the growth potential of the U.S. economy.

The program outlined above involves two major sets of priorities. The first is to develop industry production accounts within the framework of the prototype system of national accounts developed by Jorgenson and Landefeld. This is designed to be consistent with the new system of industry accounts that will be completed by BEA in 2008. The prototype industry production accounts will use the methodology developed by Jorgenson, Ho, and Stiroh (2005) to generate measures of capital and labor services. The resulting accounts will adhere to the international standards proposed in the OECD's (2001) *Productivity Manual* and employed in the EU KLEMS project.

The industry classification for the industry production accounts will be consistent with NAICS (North American Industry Classification System), but could provide more detail than the BEA industry accounts. For example, a detailed breakout of information technology industries is essential for future projections of U.S. economic growth. The data sources will include public use data for individuals from the decennial Censuses of Population and the Current Population Survey generated by the Bureau of the Census, in addition to the BEA industry accounts.

The second set of priorities is to extend the national balance sheet constructed by Jorgenson and Landefeld to include the sector balance sheets from the FRB Flow of Funds Accounts. These are now available for financial and non-financial sectors, but not for the U.S. economy as a whole. As a consequence, estimates of domestic and national saving have not been reconciled with changes in wealth and its revaluation. This has led to inconsistencies between the NIPAs and the Flow of Funds Accounts. While much useful effort has been devoted to reconciling income and expenditure accounts in the two systems, no balance sheets consistent with this reconciliation are available. This leaves a critical gap in accounting for the accumulation of assets and liabilities to meet future investment needs.

Appendix: Existing Systems of 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 major agencies involved in generating the national accounts include the Bureau of Economic Analysis (BEA) in the Department of Commerce, the Bureau of Labor Statistics (BLS) in the Department of Labor, and the Board of Governors of the Federal Reserve System. The Census Bureau, also in Commerce, and the Statistics of Income (SOI) division of the Internal Revenue Service in Treasury are major sources of primary data. Many other agencies and private sector organizations provide data for the national accounts.

Without being exhaustive it is useful to enumerate some of the major assignments of the leading contributors to the national accounts. The BEA has responsibility for the core system of accounts, the National Income and Product Accounts (NIPAs). The BLS generates employment statistics, wage and salary data, and productivity statistics, as well as almost all of the underlying price information. The Board of Governors produces the Flow of Funds Accounts, including income statements and balance sheets for major financial and non-financial sectors. The Census Bureau collects and reports much of the primary information through its business and population censuses and surveys. The SOI

generates tax-based data on individual and corporate incomes.[21]

The national income and product accounts, the productivity statistics, and the flow of funds have different origins, reflecting diverse objectives and data sources. However, they are intimately linked. For example, the BLS productivity statistics employ data on output, income, and investment from the national income and product accounts. The FRB flow of funds incorporates BEA data on investment and stocks of tangible and reproducible assets and the U.S. International Investment Position. An important part of the motivation for developing a new architecture for the national accounts is to integrate the different components and make them consistent.

As an illustration, both BEA and BLS measure industry output.[22] BEA's estimates are used to allocate the gross domestic product to individual industries. BLS generates estimates of output in arriving at measures of industry-level productivity growth. Unfortunately, the BEA and BLS estimates of industry output do not coincide. An important objective of the new architecture is to integrate the data sources employed by BEA and BLS in order to arrive at a common set of estimates. This is a crucial ingredient in long-term projections of the U.S. economy that depend on the disparate trends in productivity in key industries, such as information technology producers and intensive users of information technology.[23]

As a second illustration, the Federal Reserve Board generates a measure of national saving from the income statements and balance sheets that comprise the Flow of Funds Accounts. BEA produces an estimate of national saving from the income and product accounts. Although both estimates agree that the saving rate has declined sharply over the past twenty years, they employ different data sources and sometimes arrive at conflicting results. An important goal of the new architecture project is to bring the flow of funds and the national income accounts into consistency in order to provide better data for anticipating future financing needs of both public and private sectors. A crucial step will be to integrate the income and expenditure accounts with a national balance sheet. [24]

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[21] The extensive documentation available for the national accounts, much of it on line, is summarized by Jorgenson, Landefeld, and Nordhaus, *op. cit.*, Appendix, pp. 107-109.

[22] BEA and BLS measures of industry output have been compared in detail by Barbara M. Fraumeni, Michael J. Harper, Susan G. Powers, and Robert E. Yuscavage, "An Integrated BEA/BLS Production Account: A First Step and Theoretical Considerations," in Jorgenson, Landefeld, and Nordhaus, *op. cit.*, pp. 355-439.

[23] An industry-level production account with a detailed treatment of information technology production and utilization is presented by Dale W. Jorgenson, Mun S. Ho, and Kevin J. Stiroh, Information Technology and the American Growth Resurgence, Cambridge, The MIT Press, 2005. This production account has been substantially disaggregated and extended in time by Jorgenson, Ho, Jon Samuels, and Stiroh, Industry Origins of the American Productivity Resurgence, October 2, 2006.

[24] BEA national income and expenditure data and FRB flow of funds data are compared by Teplin, Antoniewicz, McIntosh, Palumbo, Solomon, Mead, Moses, and Moulton, *op. cit.*, pp. 471-541. This comparison does not include balance sheets.