



# Chronicling 100 Years of the U.S. Economy

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## Top Influencers

The Bureau of Economic Analysis (BEA) and its journal, the *Survey of Current Business*, are respected sources of data on the health of our national economy due in large part to the individuals who influenced BEA and its predecessor agencies over the past century. From economic theory to the mechanics of producing reliable statistics, their contributions helped make BEA and its accounts the reliable, authoritative sources of economic data they are today. The *Survey* has chronicled the evolution of BEA's output for almost a century.

As we have celebrated the centennial of the *Survey* over the past year, some of these top influencers have been profiled on the centennial website. This month, we conclude this series with profiles on economists [Selma Fine Goldsmith](#) and, presented here, **Dale Jorgenson**.

## Dale Jorgenson's Profound and Extended Influence on the National Economic Accounts

By Andrew D. Reamer

### The Jorgenson System of National Accounting—from Theory to Implementation

As the 20th century was about to become the 21st, knowledgeable economists took stock of the past, present, and future of the nation's economic accounting as maintained by the Bureau of Economic Analysis (BEA).

At the Commerce Department's annual awards ceremony in December 1999, Secretary William Daley recognized BEA's National Income and Product Accounts as the Commerce Department's "achievement of the century."

[S]ince [this awards ceremony] is the last one of the century, I wanted us to look back and select our greatest achievement. Let me tell you, it wasn't easy... [A]s we searched for... something the bright minds at Commerce created from scratch and that had the greatest impact on America, it was the invention of the national economic accounts—what we now call the gross domestic product, or GDP... Obviously, I don't have to convince our guests—Chairman [Alan] Greenspan and Chairman [Martin] Baily—or any economist or business leader that this is one of the greatest inventions of the 20th century.<sup>1</sup>

The next year, MIT Press published *Econometrics and the Cost of Capital: Essays in Honor of Dale W. Jorgenson*. To that edited volume, Barbara Fraumeni, BEA's chief economist at the time, contributed "the Jorgenson system of national accounting," in which she conferred her own award to Jorgenson for his contributions to the field and took a side-by-side look at her awardee's achievements and those of the Commerce Department's.

### Dale W. Jorgenson

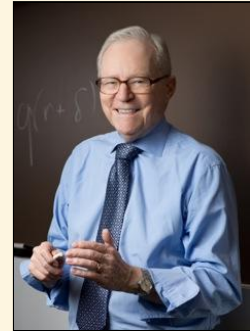
**Born:** May 7, 1933, in Bozeman, MT

**Education:** B.A. in economics, Reed College (1955); Ph.D. in economics, Harvard University (1959, [Wassily Leontief](#), academic advisor)

**Academic Position:** Samuel W. Morris University Professor, Harvard University

**Leadership Positions:** Chair, BEA Advisory Committee (2004–2011); President, American Economic Association (2000); Chair, Economic Sciences Section, National Academy of Sciences (2000–2003); Chair, Board on Science, Technology, and Economic Policy, National Research Council (1998–2006); Chair, Economics Department, Harvard University (1994–1997); President, Econometric Society (1987)

**Awards:** Julius Shiskin Award, Washington Statistical Society (2010); Adam Smith Award, National Association for Business Economics (2005); Outstanding Contribution Award, International Association of Energy Economists (1994); John Bates Clark Medal, American Economic Association (1971); "Capital Theory and Investment Behavior" (1963) chosen as 1 of 20 most outstanding papers in the first 100 years of *American Economic Review*.



**Dale Jorgenson**  
Image courtesy Dale Jorgenson

Fraumeni described the evolution of the Jorgenson system over four decades by Jorgenson and his many collaborators, including [Zvi Griliches](#) (1967, 1972), Laurits Christensen (1973), and Fraumeni herself (1989). As a result, she said,

The Jorgenson system of national accounting, with the cost of capital formulation at its core, has made a singular contribution to economic analysis... The Jorgenson system of national accounts is a complete and integrated set of national accounts with a production account, income and expenditure account, an accumulation account and a wealth account in current and constant dollars. This set of accounts taken together forms a complete and consistent set of accounts suitable for economic analysis...<sup>2</sup>

Fraumeni then suggested that, by articulating a national accounting framework as an integrated theoretical system, the Jorgenson system could guide the next phase in the development of BEA's system of national accounts. By implication, Fraumeni believed that the Commerce Department's "achievement of the century" could reach even greater heights.

Two decades later, Fraumeni edited another substantial volume dedicated "To Dale W. Jorgenson, who taught many of us and inspired all of us in our research." *Measuring Economic Growth and Productivity: Foundations, KLEMS Production Models, and Extensions*, with 58 contributors and 22 chapters, strongly showed that the once-extensive gap between actual national economic accounting practices and those recommended by Jorgenson and his many collaborators had very considerably narrowed.<sup>3</sup>

The multiple accomplishments to the accounts since the Commerce Department's 1999 awards ceremony were described by Steven Landefeld, former BEA director, in the book's second chapter, "Expanding the Conceptual Foundation, Scope, and Relevance of the U.S. National Accounts: The Intersection of Theory, Research, and Measurement."

[A] key set of developments since 2000 has been interest in, and work on, better integrating and extending the U.S. National Accounts currently produced by BEA, BLS, and the Federal Reserve within the decentralized statistical system...

Jorgenson, Landefeld, and Nordhaus' *A New Architecture for the National Accounts* (2004) presented a framework and methods for a system of integrated market and nonmarket accounts. Jorgenson and Landefeld presented a blueprint for expanded and integrated U.S. economic accounts (2004). Nordhaus (2004) and Abraham and Mackie (2004) presented principles and a framework for nonmarket accounts. The volume also included a number of papers that presented methods and estimates for extending and integrating the national accounts.

Most of the changes for the national accounts proposed by Jorgenson and Landefeld were a summary of the extensions and suggestions in the integrated frameworks put forth earlier by Jorgenson, Fraumeni, and others. (Footnote: See, for example, B. F. Fraumeni (1999).) The *New Architecture*, Jorgenson's chairmanship of the BEA Advisory Committee, and his work with BLS and the Federal Reserve, helped to foster long-term work that evolved from prototypes to the regular production by BLS and BEA (Integrated aggregate production MFP accounts (2006–16), Integrated industry-level production MFP accounts (2012–15) and by FRB and BEA of estimates of integrated financial and production accounts (2007–16).<sup>4</sup>

The final quoted sentence makes clear that Jorgenson, the master conceptualizer of the “Jorgenson system” of National Economic Accounts over the 20th century's last four decades, played a lead hands-on role in enabling the application of his concepts in federal government practices in the first two decades of the 21st.

Jorgenson played a similar out-sized role over the same period in the international realm. As one indicator, of the 58 contributors to the 2020 Fraumeni volume, 37 were based outside the United States.<sup>5</sup>

Landefeld describes Jorgenson's impact on international macro-accounting rules:

The continued importance of growth accounting in economic policy, especially in explaining the recovery of productivity growth and the Great Recession were also important factors in harmonizing the various international macro-accounting rules. Over and over since the 1960s, the highly integrated production and welfare accounts developed by Dale Jorgenson had demonstrated their value and were doing so again...

[I]nternational interest [in integrating and extending national accounts]... resulted in the United Nations *Guidelines on Integrated Economic Statistics* (2013). Also, the 2008 version of the *SNA [System of National Accounts]* made a step forward in the integration of national accounts into a complete and consistent system of accounts by recommending the development of supplemental estimates of capital services.<sup>6</sup>

In 2010, Jorgenson collaborated with Marcel Timmer and Bart van Ark to establish the World KLEMS Initiative to promote the adoption and analysis of, in Fraumeni's terminology, the Jorgenson system.<sup>7</sup> Six World KLEMS conferences have been held, the last virtually in March 2021. Jorgenson describes the effort:

In 2010 Jorgenson, Timmer, and van Ark established the World KLEMS Initiative. The purpose of this Initiative is to generate industry-level data sets with outputs, inputs of capital (K), labor (L), energy (E), materials (M), and services (S), and productivity for analyzing the sources of economic growth for countries around the world. The growth of industry-level outputs, inputs, and productivity is employed in analyzing the sources of economic growth and the nature of structural change. Regional organizations in Asia and Latin America joined the European Union in supporting research on industry-level data sets and extended the new framework to emerging and transition economies, such as Brazil, China, India, Mexico, and Russia...

KLEMS-type data sets have been compiled for more than forty countries. Official systems of industry-level production accounts are now part of the national accounts in thirteen countries: Australia, Canada, Denmark, Finland, France, Italy, South Korea, Mexico, the Netherlands, New Zealand, Sweden, the United Kingdom, and the United States.<sup>8</sup>

In 2016, 39 members of the World KLEMS Initiative collectively published their descriptions and analyses of a new economic world order, by key nation, in *The World Economy: Growth or Stagnation?*, co-edited by Jorgenson, Kyoji Fukao, and Timmer.<sup>9</sup>

In essence, Jorgenson and one series of collaborators developed a complete “Jorgenson system of national accounting” in the 20th century and he and another (partially overlapping) set of collaborators facilitated its implementation in the 21st. As a result, he has had profound positive impacts on the nature and quality of national accounting, analysis, and policy at BEA, other federal statistical agencies, and worldwide. A multitude of nations have gained substantial economic benefits because of his efforts.

The following section offers a comprehensive view of Jorgenson’s remarkable output and impacts in terms familiar to national economic accountants.

## **Gross Jorgenson Product (GJP)**

The Gross Jorgenson Product (GJP) can be defined as the sum of Jorgenson's publications (goods) plus his efforts to guide the application of those publications into practice (services).

Jorgenson's output of publications (1960–2019) = 347 papers, articles, and books.<sup>10</sup> Mean annual output = 5.8. Output rate = 1 publication every 9.0 weeks for 60 years. A partial list of oft-cited Jorgenson publications is provided in the appendix.

Jorgenson's efforts to translate theory into practice include, but are not limited to:

- Member, Board on Science, Technology, and Economic Policy, National Research Council (1991–1998), Chair (1998–2006);
- President, American Economic Association (2000);
- Member, BEA Advisory Committee (2000–present), Chair (2004–2011);
- Chair, Section 54, Economic Sciences, National Academy of Sciences, (2001–2003);
- Member, Commerce Secretary's Advisory Committee on Measuring Innovation in the 21st Century Economy (2006–2008);
- Leadership, World KLEMS Initiative (2010–present).

The following table maps the components of GJP in a rudimentary architecture.

### Rudimentary Architecture for a System of Jorgenson Accounts

Category	A. Conceptualization in measurement of:	B. Analysis of sources of economic growth and productivity:	C. Implementation— involvement and impacts:
<b>1. Production</b>	<ul style="list-style-type: none"> <li>● Architecture for national accounts (KLEMS)</li> <li>● Key advances in measuring:               <ul style="list-style-type: none"> <li>● Production (including industry level)</li> <li>● Capital services (including cost, depreciation)</li> <li>● Labor services (including quality)</li> <li>● Intangibles</li> <li>● Quantities</li> <li>● Prices (for example, output, quality adjusted, purchasing price parities)</li> <li>● Human capital</li> <li>● Productivity (including total factor productivity)</li> <li>● Value added</li> <li>● By legal types of organizations</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>● By the various factors of production, most notably (and not limited to):               <ul style="list-style-type: none"> <li>● Dominant role of capital and labor services</li> <li>● Human capital characteristics</li> <li>● Information technology and software</li> </ul> </li> <li>● Country comparisons (for example, United States-Japan)</li> </ul>	<ul style="list-style-type: none"> <li>● United States               <ul style="list-style-type: none"> <li>● BEA National Economic Accounts</li> <li>● FRB-BEA finance and productivity account</li> <li>● BEA-BLS integrated MFP</li> <li>● Integrated industry-level production MFP</li> <li>● BEA “Beyond GDP”</li> <li>● BEA satellite accounts</li> <li>● Alignment with international standards</li> <li>● U.S. leadership in national economic accounting practice</li> </ul> </li> <li>● International               <ul style="list-style-type: none"> <li>● System of National Accounts</li> <li>● World KLEMS initiative</li> <li>● The Conference Board Total Economy Database</li> <li>● World Bank International Income Distribution Database</li> <li>● World Input-Output Database</li> <li>● United Nations System of Extended International and Global Accounts</li> </ul> </li> </ul>
<b>2. Social welfare</b>	<ul style="list-style-type: none"> <li>● National balance sheet</li> <li>● Individual/household welfare</li> <li>● Wealth</li> <li>● Income</li> <li>● Expenditures</li> <li>● Savings</li> <li>● Integration of production and welfare accounting</li> <li>● Income distribution</li> <li>● Consumption distribution</li> </ul>	<ul style="list-style-type: none"> <li>● Measures of social welfare and components based on proposed concepts, methods, and frameworks</li> <li>● Country comparisons</li> </ul>	
<b>3. Nonmarket</b>	<ul style="list-style-type: none"> <li>● Sustainability (real per capita wealth)</li> <li>● Lifetime labor incomes</li> <li>● Comprehensive wealth Level of living</li> <li>● Complete system of market and nonmarket accounts</li> </ul>	<ul style="list-style-type: none"> <li>● Measures of wealth and components based on proposed concepts, methods, and frameworks</li> <li>● Country comparisons</li> </ul>	

**BEA** Bureau of Economic Analysis  
**BLS** Bureau of Labor Statistics  
**FRB** Federal Reserve Board  
**GDP** Gross domestic product  
**MFP** Multifactor productivity

## Conclusion

Dale Jorgenson has had an extraordinary influence on BEA and the larger realms of economic statistics and public policy in the United States and around the world. He constructed the foundation for that influence in the last four decades of the 20th century and guided the implementation of that foundation in the first two decades of the 21st. By any measure, Jorgenson’s scholarly outputs and practice and policy outcomes have been enormous. Ultimately, they are immeasurable.

## Notable Dale Jorgenson Publications: A Partial List

- Jorgenson, Dale. "Capital Theory and Investment Behavior." *American Economic Review* 53 (May 1963): 247–259.<sup>11</sup>
- Jorgenson Dale W., and Zvi Griliches. "The explanation of productivity change," *Review of Economic Studies* 99 (July 1967): 249–280.
- Jorgenson, Dale, and L.R. Christensen. "Measuring Economic Performance in the Private Sector." In *The Measurement of Economic and Social Performance, Studies in Income and Wealth* 37, edited by M. Moss, (New York: Columbia University Press, 1973) 233–351.
- Jorgenson, Dale W., Frank Gollop, and Barbara Fraumeni. *Productivity and U.S. Economic Growth*. (Cambridge and London: Harvard University Press, 1987).
- Jorgenson, Dale W., and Barbara M. Fraumeni. 1989. "The Accumulation of Human and Nonhuman Capital, 1948–84." In *The Measurement of Saving, Investment, and Wealth*, edited by Robert E. Lipsey and Helen Stone Tice, (Chicago and London: University of Chicago Press, 1989) 227–282.
- Jorgenson Dale W., and Kevin J. Stiroh. "Raising the speed limit: U.S. economic growth in the information age," *Brookings Papers on Economic Activity* 1 (August 2000): 125-211.
- Jorgenson, Dale W., Mun S. Ho, and Kevin Stiroh. *Productivity: Volume 3: Information Technology and the American Growth Resurgence*. (Cambridge and London: MIT Press, 2005).
- 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*, edited by Dale W. Jorgenson, J. Steven Landefeld, and William D. Nordhaus, (Chicago and London: University of Chicago Press, 2006) 13–112.
- Jorgenson, Dale W., J. Steven Landefeld, and William D. Nordhaus, eds. 2006. *A New Architecture for the U.S. National Accounts*. (Chicago and London: University of Chicago Press, 2006).
- Jorgenson, Dale W., and Paul Schreyer. "Industry-Level Productivity Measurement and the 2008 System of National Accounts," *Review of Income and Wealth* 59 (August 2012): 185–211.
- Dale W. Jorgenson, Richard J. Goettle, Mun S. Ho, and Peter J. Wilcoxon. *Double Dividend: Environmental Taxes and Fiscal Reform in the United States*, (Cambridge, MA: MIT Press, 2013).
- Jorgenson, Dale W., J. Steven Landefeld, and Paul Schreyer, eds. 2014. *Measuring Economic Sustainability and Progress*. (Chicago and London: University of Chicago Press, 2014).
- Jorgenson, Dale W., Kyoji Fukao, and Marcel P. Timmer, eds. *The World Economy: Growth or Stagnation?* (Cambridge and New York: Cambridge University Press, 2016).
- Jorgenson, Dale W., and Paul Schreyer. 2017. "Measuring Individual Economic Well-Being and Social Welfare within the Framework of the System of National Accounts." *Review of Income and Wealth* 63 (Special Issue 2): S460–77.
- Dale W. Jorgenson. "Production and Welfare: Progress in Economic Measurement," *Journal of Economic Literature* 56 (September 2018): 867–919

## Summations of the Contributions of Dale Jorgenson

Lawrence J. Lau, ed., *Econometrics: Econometrics and the cost of capital: essays in honor of Dale W. Jorgenson*, (Cambridge, MA: MIT Press, 2000).

Barbara M. Fraumeni, ed., *Measuring Economic Growth and Productivity: Foundations, KLEMS Production Models, and Extensions*, (Cambridge, MA: Academic Press, 2020). “The chapters of this book demonstrate the significant influence of Dale W. Jorgenson on the research of many economists. Accordingly, this book is dedicated to him with thanks and appreciation...”

1. “[Press Conference Announcing the Commerce Department's Achievement of the Century](#),” *Survey of Current Business*, January 2000, pp. 10–14. Preceding the press conference transcript are “Notable Quotes” in support of the award from Paul Samuelson, William Nordhaus, Michael Boskin, Robert Eisner, Janet Norwood, James Tobin, Laura Tyson, and Paul Volcker. BEA Director Steven Landefeld provided an introduction and overview of the development of gross domestic product and the National Income and Product Accounts in “GDP: One of the Great Inventions of the 20th Century,” pp. 6–8. (Regarding national chronological accounting, Secretary Daley's identification of the last year of the century is off by one. As there was no year 0, each year ending in two zeros, for example, 2000, is the final year of the current century. See Ruth Freitag, “[Battle of the Centuries](#),” Library of Congress, 1995.)
2. Barbara M. Fraumeni, “6: The Jorgenson System of National Accounting,” in Lawrence J. Lau, editor, *Econometrics Volume 2: Econometrics and the Cost of Capital: Essays in Honor of Dale W. Jorgenson*, MIT Press, 2000, pp. 111–142. Quotes from pp. 111–113.
3. Barbara M. Fraumeni, editor, *Measuring Economic Growth and Productivity: Foundations, KLEMS Production Models, and Extensions*, Academic Press, 2020.
4. J. Steven Landefeld, “2: Expanding the Conceptual Foundation, Scope, and Relevance of the U.S. National Accounts: The Intersection of Theory, Research, and Measurement,” in Fraumeni, *Measuring Economic Growth and Productivity: Foundations, KLEMS Production Models, and Extensions*, pp. 17–35. Quotes from pp. 31–32.
5. Non-U.S.-based contributors are located at the Organisation for Economic Co-operation and Development (Paris) and in 15 countries—Australia, Austria, Chile, China, India, Italy, Japan, Korea, the Netherlands, Norway, Russia, Singapore, Spain, Taiwan (R.O.C.), and the United Kingdom.
6. Landefeld, *op. cit.*, pp. 30–31.
7. “KLEMS-type production models were popularized by Dale W. Jorgenson.” Fraumeni, *Measuring Economic Growth and Productivity: Foundations, KLEMS Production Models, and Extensions*, p. xv. Fraumeni indicates that 10 chapters in the book analyze KLEMS data.
8. Dale W. Jorgenson, “Production and Welfare: Progress in Economic Measurement,” *Journal of Economic Literature* 2018, 56(3), 867–919. Quotes from pp. 879 and 887.
9. Dale W. Jorgenson, Kyoji Fukao, and Marcel P. Timmer, editors, *The World Economy: Growth or Stagnation?*, Cambridge University Press, 2016.
10. <https://scholar.harvard.edu/jorgenson/publications>
11. This paper was chosen as one of the top 20 papers published in the first 100 years of the *American Economic Review*. Kenneth J. Arrow, B. Douglas Bernheim, Martin S. Feldstein, Daniel L. McFadden, James M. Poterba, and Robert M. Solow (2011), “100 Years of the *American Economic Review*: The Top Twenty Articles,” *American Economic Review*, Vol. 101, February, pp. 1–10.