Research Spotlight

Integrated Industry-Level Production Account for the United States

Sources of the Ongoing U.S. Recovery

By Steven Rosenthal, Matthew Russell, Jon D. Samuels, Erich H. Strassner, and Lisa Usher

ECONOMIC GROWTH in the United States since 1995 has been characterized as containing several unique periods: the information technology (IT) investment boom in 1995–2000, the period of jobless growth over 2000–2005, and the Great Recession and Recovery period that began around 2007 and continues through today.[1] At the same time, ongoing structural trends that predate these periods have continued and remain a focal point for both economists and policymakers: increasing globalization of the marketplace, the ongoing spread of information and communications technology, and the continued effect of the skills gap on the U.S. labor market.

The ongoing changes to the U.S. economy have reinforced the need for an up-to-date decomposition of gross domestic product (GDP) to the industry-level sources of growth. This decomposition is important not only for analyzing historical growth and identifying industry contributions but also for evaluating the prospects for growth as the economy continues to recover from the financial crisis. For example, Jorgenson, Ho, and Samuels (2014) argue that due to IT, it is important to consider industry-specific sources of growth and to incorporate industry-specific analysis into aggregate projections of labor productivity and GDP growth.

In this *Research Spotlight,* we present a new industry-level data set for 1998–2012 that is useful for analyzing the underlying trends in aggregate economic growth.[2] The data set combines industry-level output and intermediate inputs from the GDP by industry accounts of the Bureau of Economic Analysis (BEA) with information on capital and labor inputs from the Bureau of Labor Statistics (BLS) Productivity Program to form an internally consistent industry-level production account. This account is consistent with the aggregate GDP estimates published with the 2013 comprehensive revision of the national income and product accounts (NIPAs) and the January 2014 comprehensive revision of the industry economic accounts.[3]

One of the most important features of this data set and analysis is that industry-level spending on intellectual property products—for example, research and development (R&D)—is included as an investment good.[4] Since the seminal contributions of Griliches (1979) and Romer (1994) economists have been stolidly focused on quantifying the role of R&D in economic growth and productivity. By treating R&D as an investment that yields a flow of capital services over time, the contribution of intellectual property products to growth and productivity can be analyzed using the same framework as other capital goods.

The following is a summary of the results:

- R&D capital input contributed about 0.09 percentage point to aggregate value-added growth between 1998 and 2012, about half as much as software.

1. Jorgenson, Ho, and Samuels (2014).

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2. The paper and the data set are available on BEA's Web site at www.bea.gov/industry/index.htm#integrated. This paper was prepared for the Third World KLEMS Conference, Tokyo, Japan, May 19–20, 2014. For more information, see www.worldklems.net/conferences.htm.

3. This industry-level production account is somewhat broader in scope than official GDP. It treats government capital symmetrically with private sector capital input. In particular, in addition to the depreciation cost, there is also a rate of return on government capital assets.

4. The data set presented in this paper is an update of estimates presented in Fleck, Rosenthal, Russell, Strassner, and Usher (2014). The incorporation of investment in R&D and in entertainment, artistic and literary originals expanded the boundary of U.S. GDP and its related measures. R&D capital includes both own-account investment and the R&D produced by industry that is sold to others. Investment in entertainment, artistic and literary originals only includes own-account.

- The incorporation of R&D as capital input reduces estimated aggregate multifactor productivity (MFP) growth from an average of 0.56 percentage point each year in 1998–2012 to 0.47 percentage point each year.
- The smaller contribution of both tangible- and intangible-capital input relative to the prerecession period more than accounts for the slower growth during the recovery.

The remainder of the article consists of an overview of the estimation framework, estimates of the sources of industry growth over the period 1998–2012, and results of an industry decomposition of aggregate growth and productivity. In the last section, the conclusions and next steps are presented.

Overview of the Framework

We use a growth-accounting framework to analyze the sources of growth across industries. The implementation of this framework requires data on outputs produced by industry, the prices received by the producer for these outputs, and the prices and quantities of intermediate and value-added inputs used in production by industry. Because an objective of this analysis is to produce estimates that are consistent with the NIPAs and the GDP by Industry accounts, the industry-level production account maintains the definitional and conceptual framework of the BEA economic accounts.

The industry-level production account and MFP measures presented here reflect output consistent with GDP for the U.S. economy, but they differ in concepts and coverage from the official BLS measures of MFP. For example, the use of a gross output concept for measuring MFP in this project contrasts with the sectoral industry output approach used in the BLS MFP measures for major sectors and industries.[5]

Specific industries are the fundamental economic entities in this analysis.[6] The economy is divided into 63 industries, each of which produces output using capital and labor inputs, intermediate inputs, and the available level of production technology. It is noteworthy that each of these major input groups at the industry level is, in fact, made up of many heterogeneous inputs, each with its own price and quantity index. For example, under intermediate input, there are all of the detailed commodities that are published in the benchmark input-output account. Intermediate inputs include items such as energy, materials, and purchased business services. Capital input includes estimates for approximately 90 assets within the categories of fixed business equipment, structures, inventories, land, and intellectual property products. Labor input is cross classified by gender, age, education, and class of worker.

Productivity is a measure of how efficiently inputs are converted to output. In the industry-level production account, outputs and inputs are measured in constant units exclusive of inflation and adjusted for compositional changes over time.

Using the growth-accounting framework, industry output growth is expressed as the sum of the share-weighted growth rate of industry inputs and the change in MFP. Within this framework, MFP growth measures embed underlying changes in the true economic technology, innovation, changes in production management as well as the effects of inputs that are not properly measured or that are unmeasured. For example, before the 2013 comprehensive revision of the NIPAs, spending on R&D was not measured as investment that could produce future capital services. Therefore R&D was missing as a capital input. The set of accounts presented in this article includes R&D spending as a capital input.

Sources of Industry Growth

The comprehensive results from the industry-level production account are presented in "Table 1. Sources of Industry Output Growth, 1998–2012." The results in table 1 demonstrate the heterogeneity in industry growth and its sources for that period. For example, the support activities for mining industry grew by

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5. For more details, see "Conceptual and measurement challenges" in Fleck, Rosenthal, Russell, Strassner, and Usher (2014).

6. The account is prepared on a 2007 North American Industry Classification System (NAICS) basis and is published at about the three-digit NAICS level of detail.

about 7.2 percent each year on average over the period (consistent with the expansion of fracking), mostly because of an expansion of labor input and MFP growth. The data processing, internet publishing, and other information services industry grew by a little over 8 percent each year as a result of capital investments and purchases of intermediate inputs that are consistent with anecdotal evidence of shifts to cloud computing. In contrast, the apparel industry shrank by about 10 percent each year over the period, which is consistent with increased purchases of apparel produced abroad, but it became slightly more productive in terms of MFP growth; growth in textile mills was similar. The motor vehicle industry grew by about 0.7 percent over the period; the growth was mostly driven by MFP growth because declines in labor input dampened growth by about 0.4 percent each year.

The contribution of MFP growth to industry output varied considerably by industry (chart 1 on page 8). In 1998–2012, the largest growth in MFP occurred in computer and electronic products, support activities for mining, water transportation, computer systems design and related services, and pipeline transportation. These productivity gains reflect ongoing innovation in IT and innovative practices in the mining and transportation industries. In contrast, productivity growth in rental and leasing, management of companies, legal services, and other services was negative over the same period. Negative measured MFP reflects decreased capability to manage resources and

Table 1. Sources of Industry Output Growth, 1998–2012

[Average annual growth rates]

	Growth	Contributions			Growth
	Output	Capital	Labor	Intermediate	Multifactor productivity
Farms	0.51	0.18	–0.08	–0.66	1.07
Forestry, fishing, and related activities	–0.20	0.36	0.49	–1.92	0.87
Oil and gas extraction	1.81	–0.16	0.16	0.53	1.28
Mining, except oil and gas	–0.17	0.35	–0.13	–0.68	0.28
Support activities for mining	7.18	0.37	2.34	0.96	3.51
Utilities	–0.36	0.57	–0.09	–1.19	0.35
Construction	–1.44	0.30	–0.11	–0.60	–1.03
Wood products	–2.10	0.00	–0.90	–2.02	0.83
Nonmetallic mineral products	–1.94	0.17	–0.51	–1.19	–0.41
Primary metals	0.39	–0.09	–0.58	0.24	0.82
Fabricated metal products	–0.31	0.06	–0.31	–0.07	0.02
Machinery	0.57	0.16	–0.47	0.33	0.56
Computer and electronic products	4.05	0.41	–0.82	–2.01	6.47
Electrical equipment, appliances, and components	–1.83	–0.06	–0.62	–2.05	0.90
Motor vehicles, bodies and trailers, and parts	0.67	0.06	–0.44	0.00	1.06
Other transportation equipment	1.26	0.11	–0.16	0.60	0.72
Furniture and related products	–2.60	0.12	–1.21	–1.44	–0.06
Miscellaneous manufacturing	1.62	0.43	–0.33	0.34	1.19
Food and beverage and tobacco products	0.17	0.16	0.01	–0.07	0.07
Textile mills and textile product mills	–5.25	–0.20	–1.55	–3.70	0.20
Apparel and leather and allied products	–9.99	–0.09	–2.80	–8.10	0.99
Paper products	–1.73	–0.18	–0.60	–0.87	–0.08
Printing and related support activities	–2.49	–0.02	–1.40	–2.58	1.50
Petroleum and coal products	0.77	0.09	–0.02	0.59	0.11
Chemical products	0.45	1.12	–0.15	–0.38	–0.14
Plastics and rubber products	–0.95	0.13	–0.43	–0.76	0.11
Wholesale trade	2.43	0.96	0.13	1.08	0.26
Retail trade	2.10	0.94	0.13	1.17	–0.14
Air transportation	–1.74	0.03	–0.38	–1.18	–0.22
Rail transportation	1.21	0.13	–0.40	1.00	0.48
Water transportation	3.17	–0.21	0.21	0.63	2.54
Truck transportation	0.85	0.36	–0.10	0.30	0.29
Transit and ground passenger transportation	1.15	0.39	0.52	0.57	–0.34
Pipeline transportation	–2.13	1.17	–0.16	–5.46	2.33
Other transportation and support activities	1.67	0.01	0.08	1.25	0.33
Warehousing and storage	6.58	0.49	1.25	3.69	1.15
Publishing industries, except internet (includes software)	1.35	1.28	–0.27	–0.30	0.64
Motion picture and sound recording industries	1.12	1.15	0.22	–1.77	1.51
Broadcasting and telecommunications	4.38	1.69	–0.24	1.64	1.30
Data processing, internet publishing, and other information services	8.36	3.16	–0.48	4.97	0.70
Federal Reserve banks, credit intermediation, and related activities	1.46	1.11	0.34	–0.27	0.29
Securities, commodity contracts, and investments	4.11	0.18	0.45	2.43	1.05
Insurance carriers and related activities	3.40	1.08	0.26	2.08	–0.02
Funds, trusts, and other financial vehicles	2.56	0.96	0.19	1.12	0.29
Real estate	2.52	1.42	0.05	0.60	0.44
Rental and leasing services and lessors of intangible assets	2.06	2.37	–0.10	1.32	–1.54
Legal services	–0.02	1.00	0.30	0.02	–1.35
Computer systems design and related services	4.98	0.19	1.86	0.57	2.36
Miscellaneous professional, scientific, and technical services	2.58	0.87	0.88	1.04	–0.21
Management of companies and enterprises	2.83	1.07	1.11	2.13	–1.47
Administrative and support services	2.23	0.75	0.59	0.21	0.68
Waste management and remediation services	1.47	0.19	0.44	0.41	0.44
Educational services	3.29	0.22	1.74	1.75	–0.43
Ambulatory health care services	3.19	0.22	1.54	1.11	0.32
Hospitals and Nursing and residential care	3.02	0.27	1.13	1.85	–0.23
Social assistance	3.52	0.11	1.49	1.99	–0.08
Performing arts, spectator sports, museums, and related activities	2.63	0.14	0.31	1.38	0.80
Amusements, gambling, and recreation industries	2.13	0.69	0.56	1.12	–0.25
Accommodation	0.82	0.95	–0.10	0.11	–0.14
Food services and drinking places	1.73	0.00	0.55	0.88	0.30
Other services, except government	0.00	0.46	0.11	0.78	–1.35
Federal government	2.28	0.71	0.01	1.44	0.12
State and local government	1.65	0.52	0.62	0.43	0.08

NOTE. A contribution is a share-weighted growth rate.

decisions to hoard inputs in uncertain times, but it also indicates potential issues in the measurement of outputs and inputs, including but not limited to quality.

This integrated production account is useful for analyzing the economic changes at the industry level that occurred during the time of the Great Recession and that are taking place during the ongoing recovery. In our analysis, the sample period was split into three periods: 1998–2007, 2007–2009, and 2009–2012. According to the National Bureau of Economic Research Business Cycle Dating Committee, the recession began in December 2007; however, because annual GDP growth was relatively strong during 2007, this year was included in the prerecession period of 1998–2007. The recession period covers growth between 2007 and 2009, and the recovery period covers growth between 2009 and 2012.[7]

To analyze how the ongoing recovery compares with the prerecession period, differences in industry output growth and its sources are compared for the period 2009–2012 and 1998–2007 (chart 2 on page 9). Of the 63 industries that are analyzed, 34 industries grew faster during the ongoing recovery period than during the prerecession period, even though GDP growth was slower during the recovery period. The largest relative differences occurred in apparel and leather products, motor vehicles, primary metals, machinery, oil and gas extraction, and support activities for mining. For each of these industries, the sources of growth was mostly attributable to labor input, intermediate input, and MFP growth; the contribution of capital does not show much difference compared with the earlier period. The industries with the slowest output growth relative to the early period were securities, credit intermediation, social assistance, construction, and farms. This slower growth was due to slower accumulation of inputs and MFP growth in all these industries, except for construction, which had higher MFP growth in comparison to the prerecession period, and farms, which had a small increase in capital. Overall, for the industries that grew faster during the recovery period of 2009–2012 relative to 1998–2007, the largest source of increased output growth was increased intermediate growth, followed by MFP growth, labor input growth, and then capital input growth. For those industries that declined during the recovery period relative to the precession period, the largest source, on average, was the decline in intermediate input, followed by capital input, MFP growth, and labor input. These results indicate that the ongoing recovery has not reverted the depth and breadth of the recession.

7. The unemployment rate peaked in October 2009. However, the Business Cycle Dating Committee recorded the end of the recession in the United States as June 2009; www.nber.org/cycles/recessions_faq.html

Decomposition of GDP Growth

GDP growth is decomposed to its sources across industries and factors of production using the direct aggregation of industry approach (Jorgenson, Ho, Samuels, and Stiroh 2007). With this approach, aggregate value-added growth is the share-weighted growth of industry value-added growth. The contribution of primary, or value-added, input growth by industry to aggregate value-added growth is the Domar-weighted input contribution, and the contribution of industry MFP to aggregate MFP is the Domar-weighted industry MFP growth rate.[8]

Between 1998 and 2012, the majority of aggregate value-added growth was due to the accumulation of inputs. Of the 2.01 percent average annual growth in value added, 1.18 percentage points were accounted for by capital (about 60 percent of growth), 0.36 percentage point by labor (18 percent), and 0.47 percentage point by MFP growth (22 percent) (table 2).

8. Each industry's Domar weight is the ratio of the industry's current-dollar gross output to aggregate current-dollar value added. The industry's contribution to aggregate MFP growth is the industry's MFP growth multiplied by its Domar weight. The contribution of industry intermediate input use drops out in the calculation of aggregate value added and its decomposition.

Table 2. Growth in Aggregate Value Added and the Sources of Growth

[Average annual growth rates]

	1998–2012	1998–2007	2007–2012	2007–2009	2009–2012	2009–2012 less 1998–2007
Value added	2.01	2.78	0.62	–1.62	2.11	–0.67
Capital input	1.18	1.55	0.52	0.71	0.40	–1.16
Information technology capital	0.31	0.40	0.14	0.20	0.10	–0.31
R&D capital	0.09	0.09	0.09	0.10	0.08	–0.01
Software capital	0.18	0.23	0.08	0.10	0.06	–0.17
Entertainment originals capital	0.03	0.03	0.02	0.02	0.02	–0.01
Other capital	0.59	0.80	0.19	0.28	0.14	–0.66
Labor input	0.36	0.60	–0.09	–1.31	0.73	0.13
College labor	0.52	0.63	0.34	–0.11	0.63	0.00
Noncollege labor	–0.16	–0.02	–0.42	–1.21	0.10	0.12
Multifactor productivity	0.47	0.62	0.18	–1.02	0.99	0.36

Notes. Aggregate value-added growth is the sum of the share-weighed industry value-added growth. The contribution of capital, labor, and total factor productivity is the domar-weighted industry contributions. Information technology capital is computer, communications and other information technology capital.

Within capital, about 40 percent of the capital contribution was due to IT equipment and software (0.49 percentage point), and about 8 percent was due to R&D capital (0.09 percentage point). The 0.09 percentage point contribution of R&D capital to aggregate value-added growth each year provides a measure of the bias of previously published estimates. If this contribution of capital was excluded, estimated MFP growth would have been higher by about 0.09 percentage point each year; that is, aggregate MFP growth would have been 0.56 percentage point each year instead of 0.47 percentage point. Within labor input, the contribution from workers without a college degree actually fell over the period.

The difference in GDP growth in 2009–2012 relative to the GDP growth in 1998–2007 was more than accounted for by the difference in the contribution of capital (table 2). Comparing the growth during the recovery period of 2009–2012 with the growth in 1998–2007 period, GDP grew slower, by 0.67 percentage point each year. Capital input, in particular, contributed 1.16 percentage points less to growth during 2009–2012 than during 1998–2007. This smaller contribution was split between IT-capital, which accounted for 0.31 percentage point, software capital which accounted for 0.17 percentage point, and Other capital which accounted for 0.66 percentage point.

Interestingly, all of the increase in the contribution of labor input during the recovery period was due to the increased contribution of workers without a college degree, reversing the decline in the contribution of noncollege workers that took place beginning in the late 1990s.

In an examination of structural changes at the industry level for 22 major industry groups at the two-digit NAICS-based level of detail, finance and insurance accounted for about 42 percent (0.28 percentage point) of the slower U.S. economic growth during 2009–2012, compared with 1998–2007 (table 3). Capital input accounted for the majority of this slowdown.

Table 3. Contributions to Aggregate Value-Added Growth

[Percentage points]

	1998–2012				1998–2007				2009–2012				2009–2012 less 1998–2007			
	Value added	Capital	Labor	Multi-factor productivity	Value added	Capital	Labor	Multi-factor productivity	Value added	Capital	Labor	Multi-factor productivity	Value added	Capital	Labor	Multi-factor productivity
Total economy	2.01	1.18	0.36	0.47	2.78	1.55	0.60	0.63	2.11	0.40	0.73	0.98	–0.67	–1.16	0.13	0.36
Agriculture, forestry, fishing, and hunting	0.03	0.00	0.00	0.02	0.03	0.00	0.01	0.02	–0.01	0.02	0.00	–0.03	–0.04	0.01	0.00	–0.05
Mining	0.07	0.00	0.01	0.05	0.02	0.00	0.01	0.01	0.14	0.02	0.04	0.08	0.12	0.02	0.03	0.07
Utilities	0.02	0.02	0.00	0.00	0.01	0.02	0.00	0.00	0.07	0.01	–0.01	0.07	0.06	0.00	0.00	0.07
Construction	–0.07	0.03	0.00	–0.09	0.00	0.05	0.09	–0.14	–0.02	–0.02	–0.02	0.02	–0.02	–0.07	–0.11	0.16
Durable goods	0.25	0.03	–0.10	0.31	0.36	0.05	–0.11	0.43	0.44	0.01	0.09	0.35	0.08	–0.04	0.20	–0.08
Nondurable goods	0.01	0.06	–0.05	0.00	0.09	0.06	–0.05	0.09	–0.09	0.05	0.01	–0.15	–0.18	0.00	0.06	–0.24
Wholesale trade	0.11	0.08	0.01	0.02	0.22	0.12	0.03	0.08	0.13	0.04	0.04	0.05	–0.09	–0.07	0.01	–0.03
Retail Trade	0.09	0.09	0.01	–0.01	0.15	0.12	0.02	0.00	0.08	0.02	0.05	0.01	–0.07	–0.10	0.02	0.01
Transportation and warehousing	0.03	0.01	0.00	0.02	0.05	0.02	0.00	0.02	0.09	0.00	0.05	0.05	0.04	–0.02	0.04	0.02
Information	0.21	0.14	–0.02	0.09	0.28	0.17	–0.01	0.12	0.16	0.09	0.00	0.06	–0.12	–0.07	0.01	–0.06
Finance and insurance	0.20	0.12	0.04	0.04	0.31	0.18	0.07	0.05	0.03	–0.02	0.06	–0.01	–0.28	–0.20	–0.02	–0.07
Real estate and rental and leasing	0.30	0.26	0.01	0.04	0.37	0.39	0.02	–0.03	0.28	–0.01	0.00	0.29	–0.10	–0.40	–0.02	0.33
Professional, scientific, and technical services	0.17	0.08	0.09	0.00	0.20	0.10	0.11	–0.02	0.20	0.00	0.10	0.10	0.00	–0.10	–0.01	0.12
Management of companies and enterprises	0.02	0.03	0.03	–0.04	0.01	0.03	0.03	–0.04	0.11	0.02	0.04	0.05	0.11	0.00	0.01	0.09
Administrative and waste management services	0.08	0.03	0.02	0.03	0.11	0.04	0.04	0.03	0.12	0.01	0.08	0.02	0.01	–0.03	0.04	0.00
Educational services	0.02	0.00	0.03	–0.01	0.02	0.00	0.03	–0.01	0.01	0.00	0.02	–0.01	–0.02	0.00	–0.01	–0.01
Health care and social assistance	0.16	0.02	0.14	0.00	0.17	0.02	0.14	0.00	0.10	0.02	0.15	–0.07	–0.06	0.00	0.01	–0.07
Arts, entertainment, and recreation	0.02	0.01	0.01	0.00	0.02	0.01	0.01	0.00	0.03	0.00	0.01	0.02	0.01	–0.01	0.00	0.02
Accommodation and food services	0.04	0.01	0.02	0.01	0.06	0.01	0.02	0.03	0.09	0.00	0.04	0.05	0.03	–0.01	0.02	0.02
Other services, except government	–0.03	0.02	0.00	–0.05	–0.02	0.02	0.01	–0.06	0.00	0.00	0.01	–0.01	0.02	–0.02	–0.01	0.04
Federal government	0.07	0.06	0.00	0.01	0.06	0.05	–0.01	0.02	0.07	0.06	0.00	0.01	0.01	0.01	0.01	–0.01
State and local government	0.20	0.09	0.10	0.01	0.26	0.10	0.14	0.03	0.07	0.06	–0.02	0.03	–0.19	–0.04	–0.16	0.01
Addenda:																
Private economy components:																
Information technology-producing Industries	0.31	0.04	0.00	0.27	0.37	0.05	–0.02	0.34	0.24	0.03	0.07	0.14	–0.13	–0.02	0.08	–0.20
Information technology-using Industries	0.98	0.59	0.30	0.09	1.40	0.80	0.42	0.18	0.94	0.19	0.53	0.23	–0.46	–0.61	0.11	0.05
Noninformation technology industries	0.46	0.41	–0.04	0.09	0.69	0.56	0.07	0.06	0.79	0.06	0.15	0.57	0.10	–0.50	0.09	0.51

NOTES. A contribution is a share-weighted growth rate. The information technology classification is from Jorgenson, Ho, and Samuels (2014).

State and local government accounted for about 29 percent (0.19 percentage point) of the slower growth, mainly as a result of decreased labor input, and nondurable-goods manufacturing accounted for about 27 percent (0.18 percentage point) as a result of MFP.

In contrast, mining, management of companies, and durable-goods manufacturing exhibited stronger growth during the recovery period relative to the prerecession period. Mining contributed 0.12 percentage point more to growth during 2009–2012, relative to 1998–2007, mainly as a result of gains in MFP but also as a result of stronger contributions of labor and capital input. Management of companies was also led by stronger relative growth in MFP, while durable goods stronger relative growth was more than accounted for by stronger relative growth in labor input.

The framework and data permits an analysis of the industry sources of the aggregate sources of growth. Chart 3 (on page 10) shows the difference in industry contributions to aggregate value-added growth during the recovery period of 2009–2012 relative to the prerecession period of 1998–2007, and provides detail on the results from tables 2 and 3. As noted, aggregate value-added growth has been slower during the recovery period, but this is not the case for all industries. For example, motor vehicles, management of companies, machinery, utilities, oil and gas, and computer systems design are all growing more rapidly during the recovery period than during the prerecession period, as would be expected of most industries during a recovery from a cyclical downturn. Yet all industries are not recovering relative to 1998–2007. State and local governments, computers and electronic products, broadcasting and telecom, and credit intermediation are all growing significantly less rapidly than during the prerecession period.

To understand the sources of slower aggregate value-added growth during the recovery period, charts 4–6 show the differences in industry contributions to aggregate capital, labor, and MFP in 2009–2012 and in 1998-2007. With respect to industry contribution to aggregate capital input, relative to the prerecession period, the contribution of capital input was significantly lower in real estate, credit intermediation, retail trade, rental and leasing, wholesale trade, and construction (chart 4 on page 11). In addition, the small increase in the aggregate contribution of labor input during 2009–2012 compared with the contribution in 1998–2007 was spread broadly across a subset of industries, including computer and electronic products, machinery, administrative support services, fabricated metals, and motor vehicles (chart 5 on page 12). In each of these industries, the contribution of noncollege workers outpaced that in the 1998–2007 period. Lastly, MFP accelerated over the recovery period relative to the prerecession period, with the strongest gains exhibited by real estate, construction, and motor vehicles, while computer and electronic products, petroleum and coal products, and broadcasting and telecom experienced the sharpest relative decrease in contribution (chart 6 on page 13).

Conclusions and Next Steps

During the ongoing recovery from the financial crisis and Great Recession, U.S. growth continues to be sluggish, compared with the period immediately before the recession. At the aggregate level, this analysis attributes the majority of this sluggishness to a decrease in the contribution of capital services. At the industry level, stronger value-added growth in motor vehicles, management of companies, machinery and utilities is offset by slower growth in state and local government, computer and electronic products, broadcasting, credit intermediation, and real estate. The large decline in capital services relative to 1998–2007 was driven mainly by real estate, credit intermediation, retail trade and wholesale trade.

The purpose of this paper is to lay out a framework for a set of industry-level production accounts that are consistent with GDP and to provide industry detail to analyze the sources of growth. The current update includes an expansion of the scope of the accounts to include investments in R&D and entertainment originals as capital. For the 1998–2012 period, R&D capital input accounted for about 0.09 percentage point of aggregate growth, about half as much as software capital. Entertainment originals capital input accounted for about 0.03 percentage point. Thus, incorporating R&D lowered MFP growth estimates from about 0.56 percentage point each year to about 0.47 percentage point.

This analysis is limited by the time series availability of the industry-level production account. Future work on the integrated BEA-BLS industry level production account includes investigating approaches to extend the account backwards in time following Jorgenson, Ho, and Samuels (2014) and improving estimates of labor composition by incorporating results from the American Community Survey. In any case, the

groundwork for future updates to the industry-level production accounts is now in place, and work is under way to plan for these future updates.

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Chart 1. Industry Multifactor Productivity Growth for 1998–2012

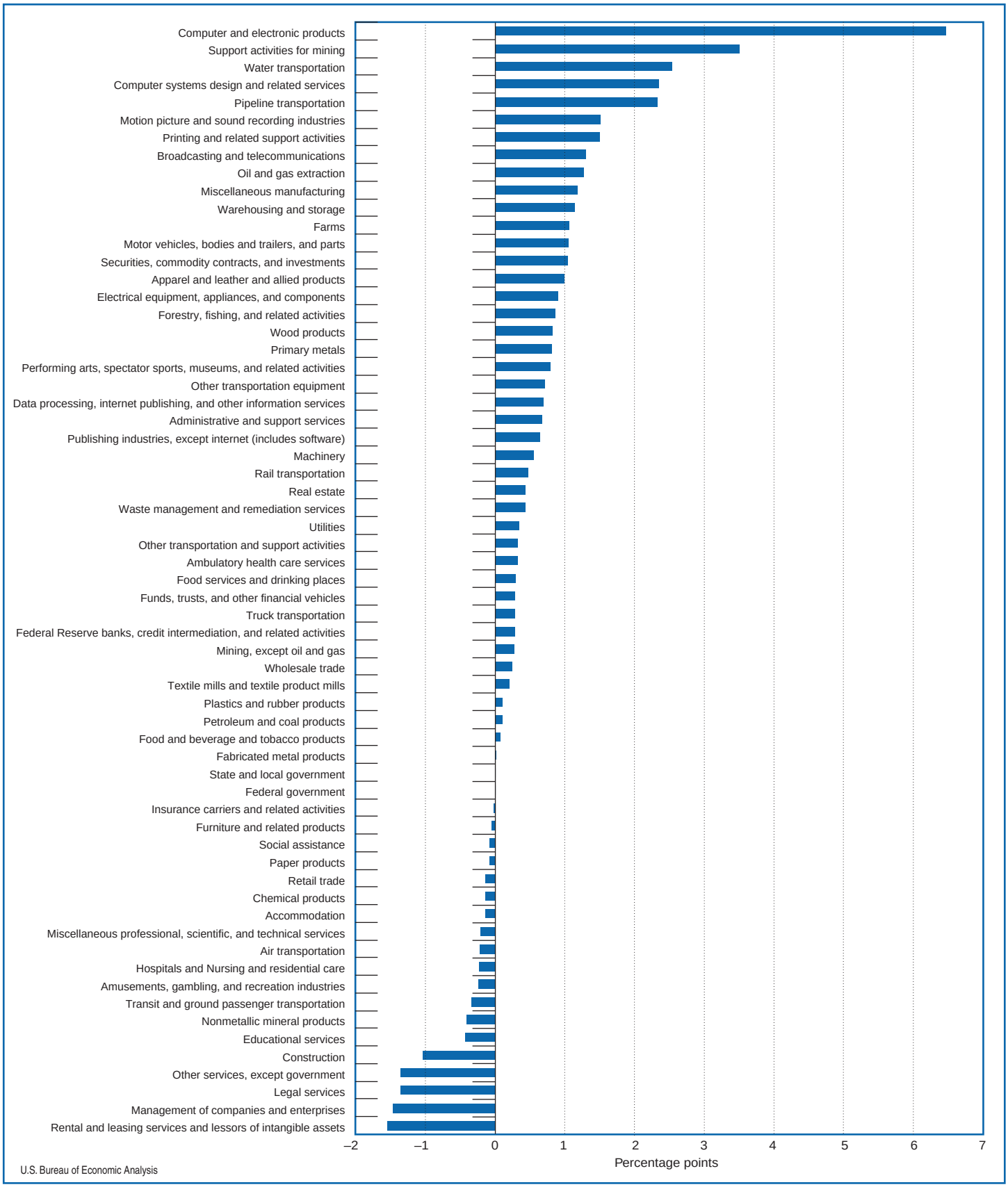

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Chart 2. Industry Output Growth Differences for 2009–2012 Less 1998–2007

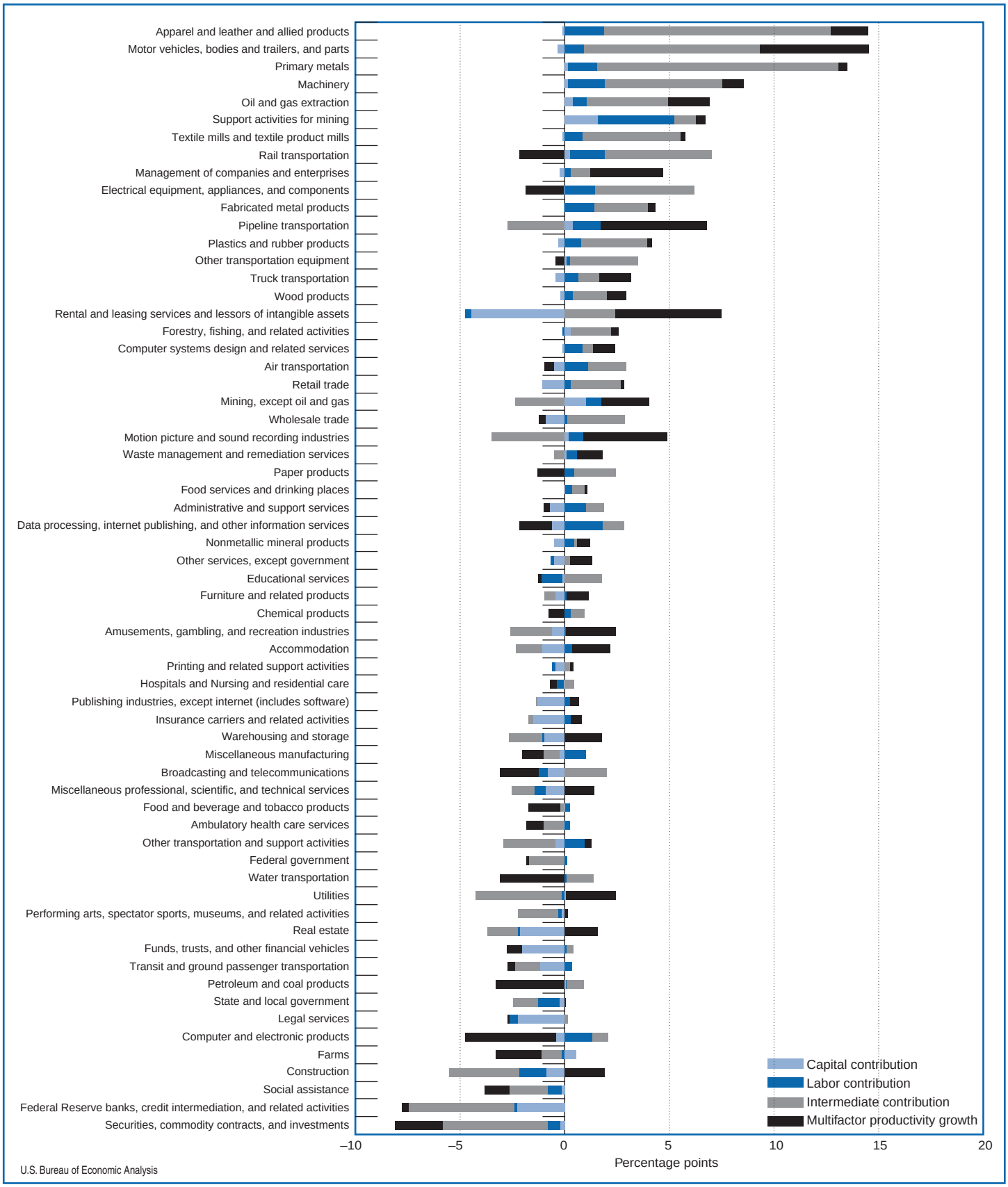

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Chart 3. Industry Contributions to Economy-Wide Value-Added Growth for 2009–2012 Less 1998–2007

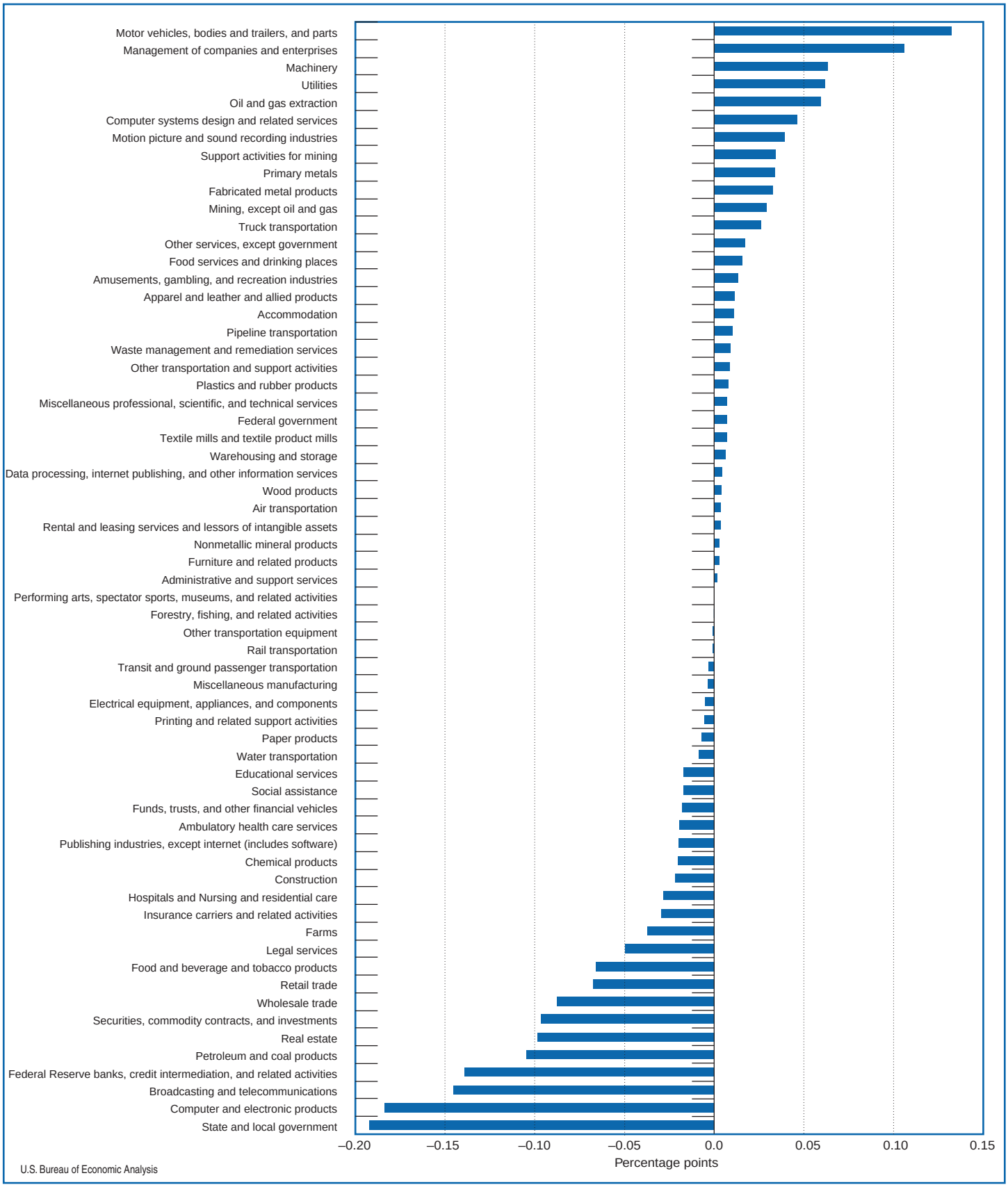

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Chart 4. Industry Contributions to Economy-Wide Capital Contribution for 2009–2012 Less 1998–2007

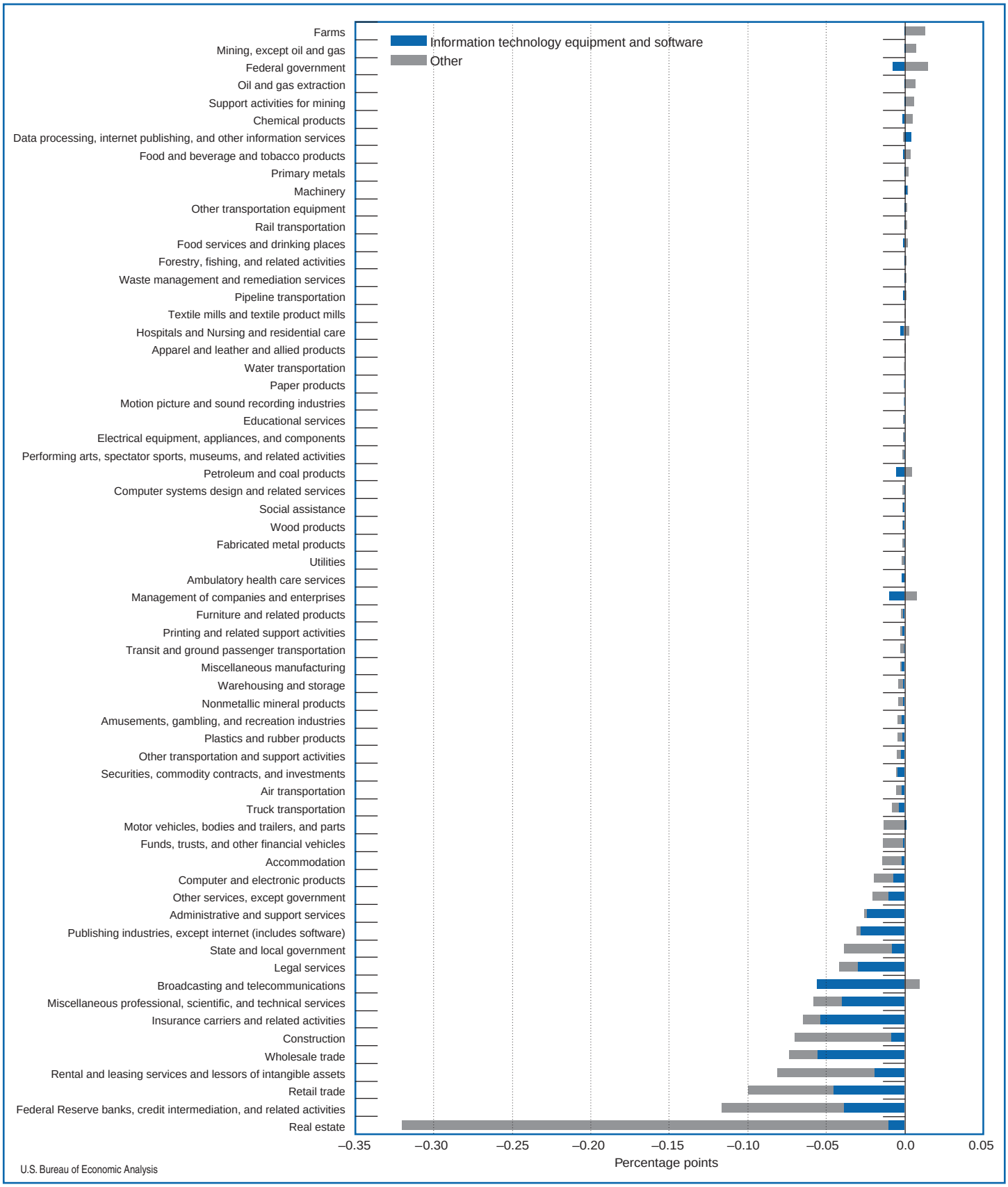

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Chart 5. Industry Contributions to Economy-Wide Labor Contribution for 2009–2012 Less 1998–2007

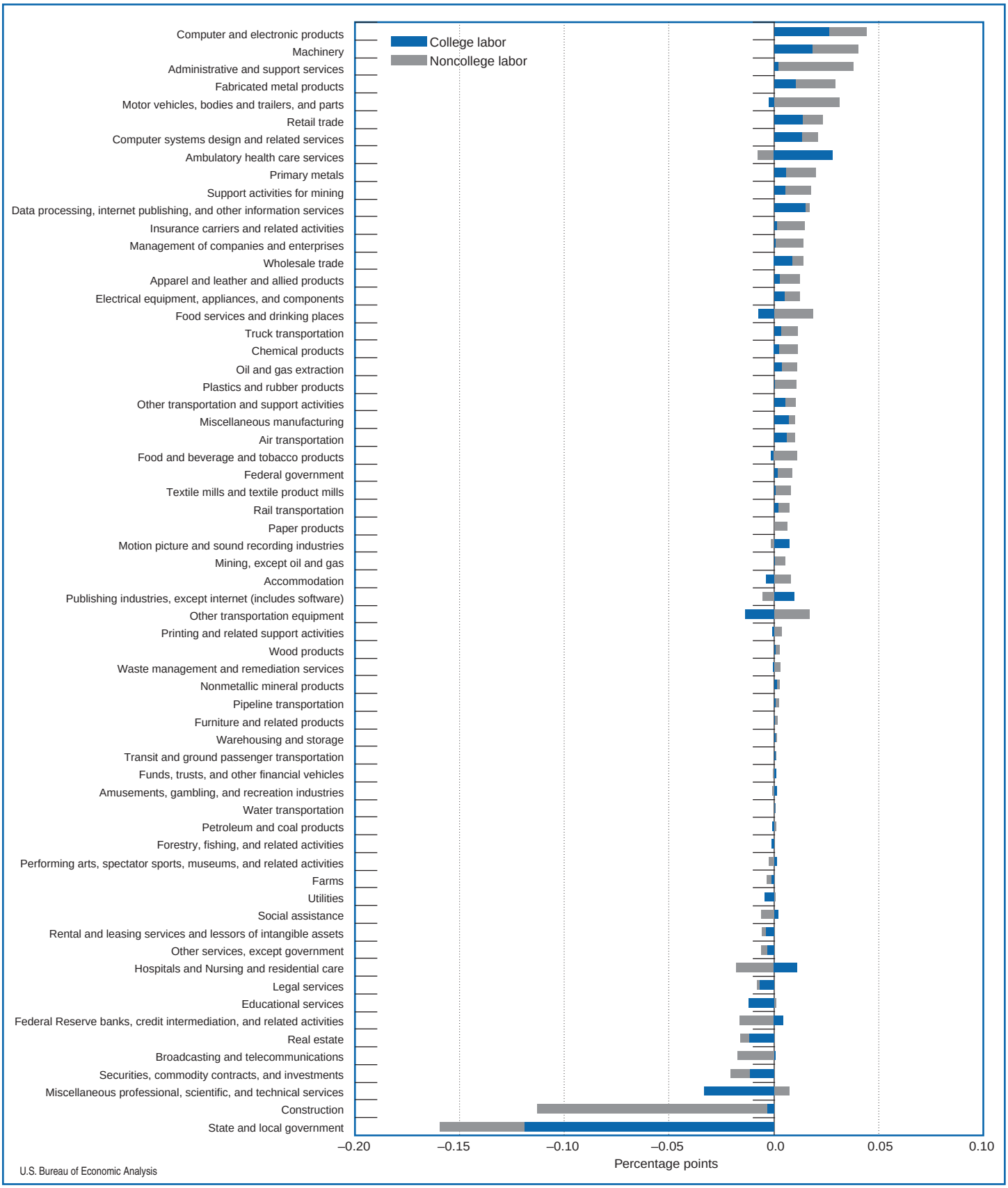

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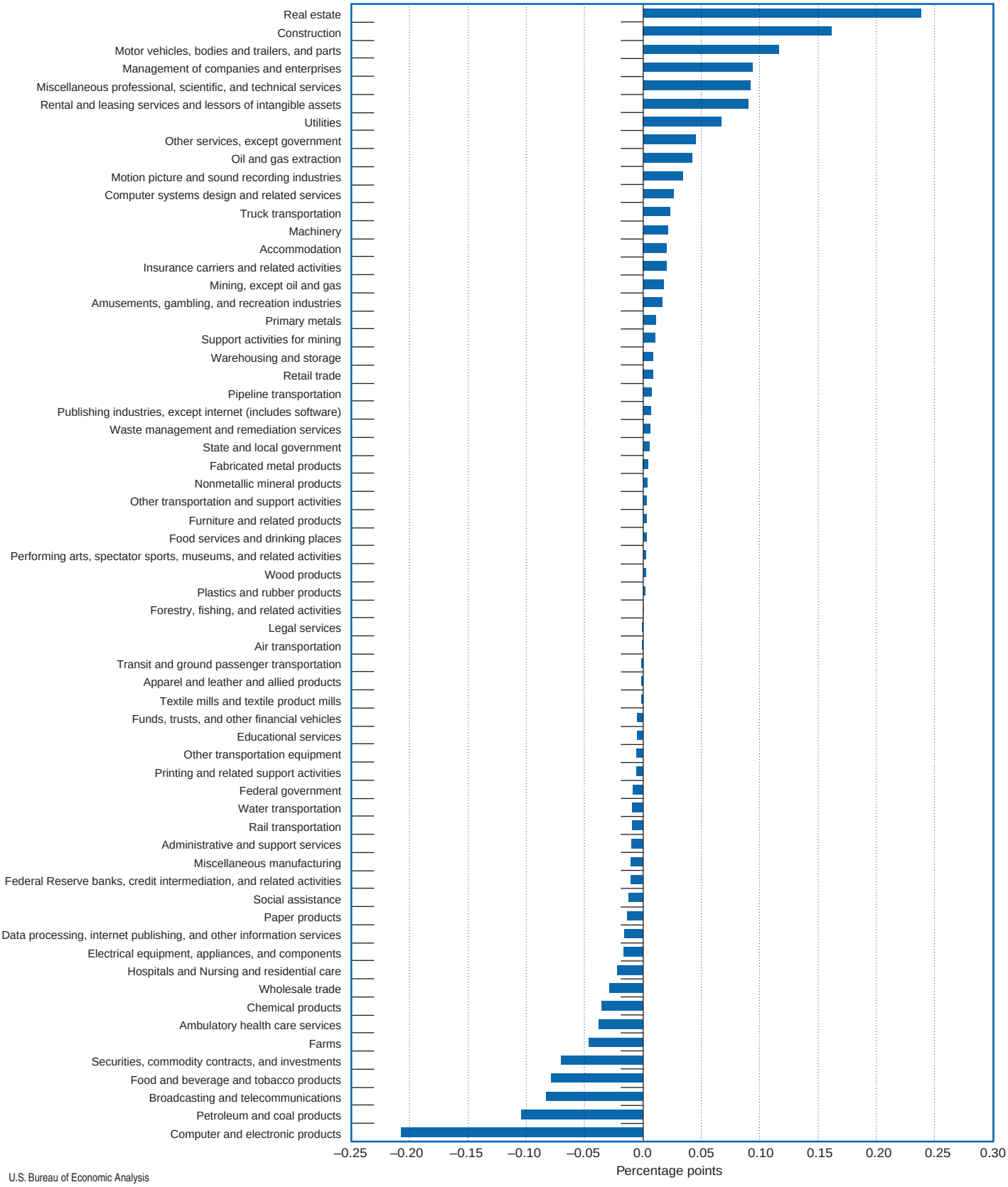
Chart 6. Industry Contributions to Economy-Wide Multifactor Productivity Contribution for 2009–2012 Less 1998–2007



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