Measuring Quarterly Labor Productivity by Industry

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I. INTRODUCTION

Timely statistics on output, employment and productivity are essential to understanding the performance of the U.S. economy. Labor productivity indicates how effectively labor inputs are converted into output and provides information to assess changes in technology, labor share, living standards, and competitiveness. The U.S. Bureau of Labor Statistics (BLS) produces labor productivity measures quarterly for broad sectors of the U.S. economy[2] and annually for industry-level measures.[3] The quarterly labor productivity data are analyzed as indicators of cyclical changes in the economy and are widely watched by the financial community, nonfinancial businesses, government policymakers, and researchers.[4] Industry level productivity statistics provide a means for comparing trends in efficiency and technological improvements across industries, and indicate which industries are contributing to growth in the overall economy. Although the annual industry productivity data can be used to analyze past performance and long-term trends, they are not frequent enough to provide indicators of current industry performance or to identify which industries are driving current aggregate economic performance. Though industry labor input data are available on a quarterly basis, the corresponding quarterly industry-level output data for nonmanufacturing industries, necessary for constructing labor productivity measures, have not been available until recently.

[1] The authors thank Mark Dumas, John Glaser, Christopher Kask, Paul Kern, Steven Rosenthal, John Ruser, Jay Stewart, Erich Strassner, Victor Torres, and David Wasshausen for helpful comments. All views expressed in this paper are those of the authors and do not necessarily reflect the views or policies of the U.S. Bureau of Labor Statistics.

[2] Major sectors include: business, nonfarm business, manufacturing, and nonfinancial corporations. See U.S. Bureau of Labor Statistics, Productivity and Cost News release, http://www.bls.gov/lpc/#news

[3] Annual industry measures are calculated for 2-, 3-, 4-, 5-, and 6-digit industries as defined by the North American Industry Classification System (NAICS). See U.S. Bureau of Labor Statistics, Productivity and Costs by Industry: Selected Service-Providing and Mining Industries, Productivity and Costs by Industry: Manufacturing Industries, and Productivity and Costs by Industry: Wholesale Trade, Retail Trade, and Food Services and Drinking Places Industries, http://www.bls.gov/lpc/#news

[4] For example, see Rich Miller, "Yellen's Economy Echoes Burns's More Than Greenspan's," Bloomsberg.com. , July 7, 2014.

The U.S. Bureau of Economic Analysis (BEA) began releasing GDP-by-industry on a quarterly frequency on April 25, 2014.[5] These new output measures were developed to be consistent with the annual industry accounts and appear to provide the data needed to construct more timely labor productivity measures. However, because complete output data are not yet available for all industries on a quarterly basis, these higher frequency data rely on assumptions about the relationships between industry inputs, outputs, and value-added from the annual and benchmark statistics. It is important to determine the extent to which BEA uses input measures, such as wages and employment, to supplement output data. While such techniques may be suitable to estimate output, they can be troubling for productivity measurement because independent input and output estimates are essential to producing meaningful information on economic growth.[6]

This paper will examine the new quarterly BEA GDP-by-industry statistics to determine if they can be used to produce reasonable quarterly labor productivity measures at the industry level. The study will develop quarterly labor hours and labor productivity measures for the 20 major private industry groups for which BEA is releasing GDP-by-industry.[7] Methods and data sources used by BEA to construct the quarterly output series will be examined to determine if output growth is **sufficiently** independent from the growth in measured labor inputs. The study will analyze the value of these labor productivity measures to better understand the sources of economic growth, and will present the limitations of the data.

II. BLS LABOR PRODUCTIVITY MEASURES

BLS began publishing quarterly data on the change in labor productivity in 1967. The preliminary and revised quarterly press release, "Productivity and Costs," includes measures of

[5] U.S. Bureau of Economic Analysis, "NEW QUARTERLY STATISTICS DETAIL INDUSTRIES' ECONOMIC PERFORMANCE: Statistics Span First Quarter of 2005 through Fourth Quarter of 2013 and Annual Results for 2013," news release (April 25, 2014), http://bea.gov/newsreleases/industry/gdpindustry/gdpindnewsrelease.htm. BEA will make Quarterly GDP by industry statistics available approximately 30 days after the release of the third estimate of GDP. The historical series begins in 2005 and is available through the current quarter.

[6] Input-cost measurement is frequently used to measure output for general government services, the nonmarket sector and nonprofit institutions. The trends in such output measures will, by definition, move with measures of input data and will tend to imply little or no labor productivity growth.

[7] The government sector is not included in this version of the study.

labor productivity for six major U.S. sectors: business, nonfarm business, manufacturing, durable and nondurable goods manufacturing, and nonfinancial corporations.[8]

Labor productivity measures are calculated as the growth of real output relative to the growth of labor hours worked. BLS calculates quarterly labor productivity for the business and nonfarm business sectors by combining real output from the National Income and Product Accounts (NIPA) produced by the BEA with measures of hours worked for all persons prepared by the BLS Office of Productivity and Technology (OPT). Output for the business sector is estimated as GDP less the output of general government, nonprofit institutions, and the household sector (including owner-occupied housing). [9] Nonfarm business sector output excludes the output of the farm sector, and the nonfinancial corporate sector further excludes the output of unincorporated businesses and those corporations classified as offices of bank holding companies, offices of other holding companies, or offices in the finance and insurance sector.[10] Although quarterly labor productivity measures are produced for the total economy, the methods of estimating output for some components of the economy are problematic for productivity measurement. Thus, measures of productivity for the total economy are considered less reliable than nonfarm business sector measures and are not included in the press release.

For the U.S. manufacturing sector, output is estimated by aggregating U.S. Census Bureau industry shipments data to obtain gross output and then removing transactions that occur within the sector or industry (intra-sector or intra-industry transfers). This creates a measure of sectoral output which excludes outputs that are produced and consumed within the sector or industry. To derive quarterly estimates from the annual manufacturing indexes, BLS adjusts the annual totals using a quarterly reference series and a quadratic minimization formula.[11] The

[8] The press release includes quarterly and annual indexes, and percentage changes, for output per hour of all persons and related measures, such as unit labor costs, real and current dollar compensation per hour, and unit nonlabor payments. See http://www.bls.gov/lpc/home.htm.

[9] The BLS excludes several activities from total economy output in order to remove potential sources of bias specific to productivity measurement. The measure of business sector output used by BLS to measure productivity excludes real gross products of general government, of private households, and of nonprofit institutions, as well as the gross product of owner-occupied housing and the rental value of buildings and equipment owned and used by nonprofit institutions serving individuals.

[10] Although the farm sector is small in the United States, it is highly volatile. For more information on BLS methods see "Technical Information about the BLS Major Sector Productivity and Cost Measures," February, 2008. http://www.bls.gov/lpc/lpcmethods.pdf.

[11] Denton, Frank T. "Adjustment of Monthly or Quarterly Series to Annual Totals: An Approach Based on Quadratic Minimization," *Journal of the American Statistical Association*, Vol. 66, No. 333 (March 1971), pp99-

quarterly reference series is constructed from the Federal Reserve monthly indexes of Industrial Production.[12]

Studies of output per hour in individual industries have been produced by BLS since the 1800s. The BLS industry productivity program has evolved from industry specific studies to the regular publication of annual measures of labor productivity for 197 unique 3- and 4-digit NAICS industries.[13] Industry output measures are constructed primarily using data from the economic censuses and annual surveys of the U.S. Census Bureau, U.S. Department of Commerce, together with information on price changes primarily from BLS. Real output is most often derived by deflating nominal sales or values of production using BLS price indexes and removing intra-industry transactions, but for a few industries it is measured by physical quantities of output.[14]

III. QUARTERLY OUTPUT BY INDUSTRY

A. BEA Quarterly GDP-by-Industry

The U.S. Bureau of Economic Analysis (BEA) began releasing quarterly GDP-by-industry on April 25, 2014. The new series begins in 2005 and extends forward, with data for the most current quarter released 120 days after the end of the reference quarter. BEA began working on the prototype for quarterly GDP-by-industry data in 2007 and the measures have evolved over the past seven years to reflect improved techniques.[15] The new quarterly data was developed to be consistent with the methodology used to construct time series estimates of the annual industry accounts, which are an extension of the annual Input-Output accounts (I/O). The

102. The Denton proportional first difference method preserves the pattern of growth in quarterly indicator series by minimizing the proportional period-to-period change while meeting the average annual level constraints.

[12] Due to a lag in the availability of the annual benchmark data, more recent quarterly and annual manufacturing output measures also are extrapolated based on the changes in the Indexes of Industrial Production.

[13] Industry measures produced include levels, annual indexes, and percentage changes for output per hour, output per employee, output, implicit price deflators for output, employment, hours of employees, labor compensation, and unit labor costs. Separate news releases are issues for selected services http://www.bls.gov/news.release/prin2.nr0.htm, manufacturing http://www.bls.gov/news.release/prin.nr0.htm, and trade http://www.bls.gov/news.release/prin1.nr0.htm.

[14] See Chapter 11 of BLS Handbook of Methods for more information on industry measures.

[15] For more information on the evolution and early phases of development of quarterly GDP-by-industry statistics, see Carol A. Robbins, Thomas F. Howells, and Wendy Li, "Experimental Quarterly U.S. Gross Domestic Product by Industry Statistics," Survey of Current Business, (90) February 2010, pp. 24–31.

I/O accounts consist of two basic national-accounting tables—a "make" table and a "use" table. The make table shows the production of goods and services by industry, and the sum of the entries across all industries is the total output of that commodity throughout the domestic economy. The use table shows the consumption of goods and services by each domestic industry and by final users. The use table also shows compensation of employees, taxes on production and imports less subsidies, and gross operating surplus. These three components sum to total value-added. The make and use tables are created using different data sources and are then balanced to align the estimates of industry inputs, outputs, and value-added across the economy.[16]

GDP-by-industry is a key component of the annual industry accounts, measuring each domestic industry's contribution to GDP.[17] BEA uses the annual I/O table and GDP-by-industry measures as the starting point for creating the quarterly GDP-by-industry estimates.

BEA describes five steps taken to estimate quarterly GDP-by-industry: develop domestic supply by commodity, construct value added by industry, prepare initial use tables, balance use tables, and estimate price and quantity indexes for GDP by industry.[18] Briefly:

1. Domestic supply by commodity – representing the value of goods and services produced by domestic firms, plus imports and government sales, less exports, and changes in inventory – are developed from various monthly and quarterly surveys, and tested and adjusted for seasonality.
2. Value added by industry – representing the costs incurred and the incomes earned in production – are estimated using compensation of employees by industry, taxes on production and imports less subsidies, and gross operating surplus.

[16] Annual I/O accounts are available for 1997–20012 and include data for 69 industries. Benchmark I/O accounts include more detailed information for about 400 industries. The benchmark I/O accounts are prepared roughly once every 5 years, and are based on detailed data from the Economic Census conducted by the Census Bureau. The 2007 benchmark was released in December, 2014. For more information see Kim, Donald D., Erich H Strassner and David B. Wasshausen, "Industry Economic Accounts Results of the Comprehensive Revision: revised Statistics for 1997-2012," Survey of Current Business, January 2014, pp.1-18.

[17] See U.S. Bureau of Economic Analysis, "Measuring the Nation's Economy: An Industry Perspective, A Primer on BEA Industry Accounts," May 2011, http://bea.gov/industry/pdf/industry_primer.pdf.

[18] For a complete description of methods and source data, see Erich H. Strassner and David B. Wasshausen. "New Quarterly Gross Domestic Product by Industry Statistics," *Survey of Current Business,* May 2014, pp. 1-16.

3. Initial use table – showing the consumption of intermediate inputs and final uses – for each quarter is constructed using the available annual use table for the year and is revised during annual revisions.
4. A balancing procedure is used to ensure that each industry's output equals its intermediate inputs plus its value-added components, and that the sum of intermediate and final uses for each commodity is equal to its gross output.
5. Finally, the initial nominal industry and commodity gross output, intermediate inputs, and value-added results and corresponding quantity and price indexes are then interpolated (benchmarked) to the most recent published annual data, using the Denton proportional first difference method. A double-deflation method is used to allow relative prices to affect output and intermediate uses differently. Real value-added is computed as the difference between real output and real intermediate inputs.[19]

The new GDP-by-industry data provide more timely information on acceleration and decelerations in economic growth at the industry level. This data is an impressive and useful addition to the annual industry accounts that BEA publishes.

B. Output Concepts

Labor productivity can be computed using two different representations of output: value-added output or sectoral output.[20] As previously mentioned, GDP is a value-added measure of output equal to the total value of goods and services produced by an industry or sector – gross output – less all purchased intermediate inputs. Sectoral output is gross output less only those intermediate inputs that are produced within that industry or sector. For the broad sectors and aggregate industry groups discussed in this paper, there inevitably will be transactions of semi-finished goods and services produced and consumed within the same industry or sector. These

[19] The domestic and imported portions of intermediate inputs are deflated separately to account for the commodities purchased as inputs from domestic and from foreign sources.
[20] When measuring labor productivity, a gross output concept is not used because intermediate inputs made within an industry or sector will be counted by both the establishment producing the product and again as part of the output of the establishment consuming the product. This would double count these outputs.

intermediate inputs are removed so that output is not overstated relative to the labor hours used to produce that output.

BLS prefers to use the sectoral output concept when measuring economic growth. This approach acknowledges that changes in the price, quality, and availability of intermediate inputs will influence a firm's decision concerning its use of capital and labor.[21] As such, any changes in labor productivity can be due to technological progress, economies of scale, improved management techniques, skills of the labor force, as well as changes in the nonlabor inputs produced outside the industry or sector (i.e., capital services, energy, purchased intermediate materials, and purchased services).[22] Labor productivity based on a sectoral output concept will therefore increase with outsourcing and improvements in the quality of purchased intermediate inputs. If these purchased intermediate inputs are excluded from the value of output, they can no longer be a source of productivity growth.[23] The BLS labor productivity measures for the manufacturing sector and individual industries are constructed using a sectoral output approach.

That said, there may be circumstances when a value-added output approach to measuring labor productivity, relating output solely to the primary inputs in production, is beneficial.[24] For example, to study the relationship between growth in wages and labor productivity, an approach that removes outsourcing and the quality of intermediate inputs from the model may be preferred.[25] Unlike sectoral output, value-added output measures will decline with labor as a result of outsourcing and therefore labor productivity will be less affected.[26] The BLS business, nonfarm business, and nonfinancial corporate sector labor productivity measures are constructed

[21] Edwin R. Dean, Michael J Harper, and Mark S Sherwood, "Productivity Measurement with Changing weight indices of outputs and inputs, New Developments in Productivity Analysis, National Bureau of Economic Research, 2001, pp.183-215.
[22] Multifactor productivity (MFP) data give a more comprehensive picture of productivity change over time, and they provide a decomposition of labor productivity change into sources of growth. However, due to the complexities associated with constructing MFP measures, these data are not available on a quarterly basis. BLS publishes MFP for major sectors and select detailed industries on an annual basis; see http://www.bls.gov/mfp/.
[23] For more discussion, see Gullickson, William, "Measurement of productivity growth in U.S. manufacturing," *Monthly Labor Review*, July 1995, pp13-28.
[24] For a complete discussion to the advantages and disadvantages to the two output concepts, See "Measuring Productivity: Measurement of Aggregate and Industry-level Productivity Growth,"
OECD Manual, 2001, Chapter 3, pp23-33.
[25] If technical change within an industry does not affect all factors of production but operates primarily on the primary inputs, then value-added approach is preferable. (OECD Manual, 2001, p.28)
[26] Labor productivity measures using value-added are less sensitive to outsourcing, although the reverse is true when measuring multifactor productivity. Multifactor productivity measured using a sectoral output concept are less sensitive to outsourcing than value-added based measures.

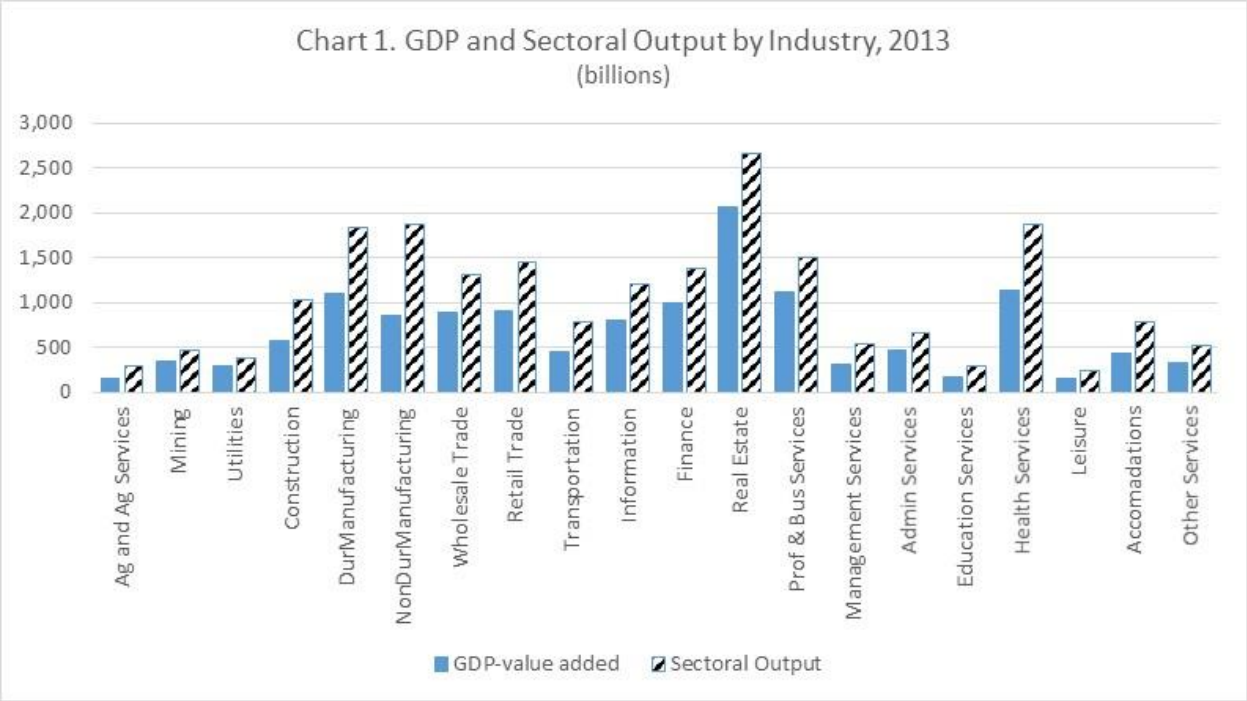
using a value-added approach. Because there are few intermediate inputs purchased from outside these aggregate sectors, the labor productivity measures based on value-added and sectoral output will be similar – the largest difference is due to purchased imported materials.[27]

Data users may want to use different output concepts for measuring labor productivity depending upon which questions they are interested in answering. Value-added productivity measures more closely reflect an industry's ability to translate technical change into final income, while sectoral output based labor productivity reflects the technical efficiency with which industries transform inputs into output. Because sectoral output and value-added output approaches will result in different accelerations and decelerations in measured labor productivity, it is important to be aware of which method is used when interpreting productivity data. For this study, we will present labor productivity measures using both the value-added and the sectoral output approaches.

To construct sectoral measures we removed intra-industry transactions from the BEA quarterly real gross output by industry measures. This was accomplished by estimating ratios of sectoral output to gross output using industry current dollar data from the BEA annual I/O use tables before redefinition.[28] Intra-industry transactions were calculated as the sum of all outputs that are produced and used within the same industry group. These transactions are subtracted from gross output and then a sectoral output to gross output ratio was constructed. These annual adjustment ratios for each industry group were transformed into a quarterly series using a moving average smoothing procedure. Estimates of real sectoral output by industry were calculated by multiplying the sectoral adjustment ratios and the BEA real gross output by industry.

Chart 1 presents the differences between GDP-by-industry and sectoral output for 2013. The difference between the two series represents the intermediate inputs that the industry is purchasing from outside its borders. The largest differences are in manufacturing and health services, while leisure services and utilities show the smallest differences.

[27] For more information on how imports affect productivity measures, see Lucy P. Eldridge and Michael J. Harper, "Effects of Imported Intermediate Inputs on Productivity," *Monthly Labor Review*, June 2010.
[28] In the future we would like to explore using the BEA quarterly I/O tables that underlie the quarterly GDP-by-Industry data to more precisely remove intra-industry transactions.



IV. QUARTERLY HOURS WORKED BY INDUSTRY

BLS does not currently publish quarterly hours worked for all persons by industry.[29] These data are constructed for this research study and closely follow the methods used by OPT to calculate quarterly estimates of hours worked for all persons in the nonfarm business sector.[30]

The primary source of hours data is the average weekly hours paid series for production workers in goods-producing industries and for nonsupervisory workers in service-providing industries from the BLS Current Employment Statistics program (CES).[31] The CES is a monthly payroll survey of establishments that collects employment and hours paid data for the pay period that includes the 12th of the month. OPT uses seasonally adjusted monthly data from the CES and constructs quarterly averages of employment and quarterly employment weighted averages

[29] BLS does produce quarterly hours for wage and salary workers on nonfarm payrolls for 15 major industry groups, available http://www.bls.gov/lpc/special_requests/tableb10.txt

[30] We will note where methods are different. Industry data from this study will aggregate to include private industries. This will differ from business sector by excluding the output of government enterprises and including the output of nonprofit institutions and farms.

[31] For more information on the CES, see http://www.bls.gov/ces/.

of average weekly hours.[32] The CES average weekly hours for production/ nonsupervisory employees[33] (AWH_P^{CES}) are adjusted to an hours worked basis using an hours-worked to hours-paid ratio ($hwhp_P^{NCS}$) estimated from the National Compensation Survey (NCS).[34] The hours worked adjustment ensures that changes in vacation, holiday, and sick pay do not affect hours growth. Total hours worked by production/nonsupervisory employees (H_P) are calculated as:

$$H_P = AWH_P^{CES} * hwhp_P^{NCS} * N_P * 52 \quad (1)$$

where N_P is the CES employment of production/ nonsupervisory employees.[35]

Average weekly hours for nonproduction and supervisory workers are estimated by applying a ratio adjustment from the BLS Current Population Survey (CPS) to the production/non-supervisory hours data. The CPS ratio is equal to the average weekly hours worked by nonproduction/supervisory employees divided by the average weekly hours worked by production/ nonsupervisory employees.[36] This ratio is seasonally adjusted using an X-12-Arima program and combined with the OPT hours worked series for production/nonsupervisory employees and CES employment data.[37] Total hours worked by nonproduction/supervisory employees (H_{NP}) are estimated as:

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[32] Seasonally adjusted 3-digit NAICS level CES data are used for nonmanufacturing industries; 2-digit data are used for durable and nondurable manufacturing; National Compensation Survey data are used at a slightly higher level of aggregation for nonmanufacturing. Employee data are then aggregated to the 20 industries of interest.

[33] In goods-producing industries, workers are divided into production and nonproduction workers. Nonproduction workers include professional, specialty and technical workers; executive, administrative, and managerial workers; sales workers, and administrative support workers, including clerical. In service-providing industries, workers are divided into supervisory and nonsupervisory workers. Supervisory workers include all executives and administrative and managerial workers. The CES program began collecting data on earnings and hours for all employees in September 2005. OPT is currently evaluating whether to start using this new series.

[34] Quarterly hours-worked to hours-paid ratios are estimated from annual data at the 3-digit industry level using a Denton procedure. The BLS major sector productivity program (DMSP), makes use of ratios at a more aggregate level. For more information on the NCS see http://www.bls.gov/ncs/.

[35] To facilitate comparisons across various time periods, quarterly estimates are expressed as annualized levels and quarterly growth rates are expressed as annual growth rates using the following formula: $g_t = \left(\frac{X_t}{X_{t-1}}\right)^4 - 1$.

[36] In August 2004, BLS introduced this new method of constructing estimates of hours for nonproduction and supervisory workers. See Lucy P. Eldridge, Marilyn E. Manser and Phyllis F. Otto. "Alternative Measures of Supervisory Employee Hours and Productivity Growth," *Monthly Labor Review*, Vol. 127, No.4 (April 2004), pp. 9-28.

[37] Seasonal adjustment removes seasonal effects from a time series. The x-12-arima model was developed by the US Census Bureau and is the same adjustment technique that is used by the CES to adjust employment and awh, and the same program used by Census and BEA to adjust output. Indirect seasonal adjustment (seasonally adjusting the components of the hours calculation rather than the final value) is preferred when component series are suspected of having distinct seasonal patterns. See http://www.census.gov/srd/www/x12a/. Given the limited observations for some industry groups, the CPS data are seasonally adjusted quarterly rather than monthly.

$$H_{NP} = AWH_P^{CES} * hwhp_P^{NCS} * \frac{AWH_{NP}^{CPS}}{AWH_P^{CPS}} * N_{NP} * 52 \quad (2)$$

where AWH_{NP}^{CPS} and AWH_P^{CPS} represent CPS measures of average weekly hours for nonproduction/ supervisory and production/ nonsupervisory employees respectively, and N_{NP} is the CES employment for nonproduction/ supervisory employees. [38]

Total hours for all persons is the sum of all employee hours and the hours worked by the unincorporated self-employed and unpaid family workers. Hours worked for the unincorporated self-employed and unpaid family workers are estimated using self-reported weekly hours from the CPS for the 20 major industry groups that match the GDP-by-industry series. [39] There are too few observations from the CPS to construct data on self-employed and unpaid family workers for the management of companies and enterprises industry group. Therefore the self-employed and unpaid family worker data are created as the residual of all professional and business services less professional and technical services and administrative and waste management services. For the agricultural services industry group, the hours worked by all persons on farms is constructed using CPS data.[40] Although we feel comfortable with the use of the quarterly CPS data for 19 of the 20 industries of interest to this study, further industry detail on a quarterly basis may be beyond the limits of the available CPS data.

As previously mentioned, BLS does not include the output or hours worked for nonprofit institutions in the calculation of productivity for the business sector. BEA provides business sector output and BLS removes hours of nonprofits using data from the Economic Census and BEA.[41] The new quarterly BEA industry output data do not exclude the output for nonprofit institutions and therefore this study will not remove the hours worked by workers in nonprofit institutions from measured hours. For industries where a relatively large portion of

[38] For this study CPS ratios were constructed for the 20 different industry groups of interest; DMSP uses 14 industry categories. For more information on the CPS, see http://www.bls.gov/cps/.

[39] The published quarterly labor productivity statistics aggregates employee hours for 14 major industry groups and then adds an aggregate value of hours worked for the self-employed and unpaid family worker hours. This is done because the major sector is the only series of interest.

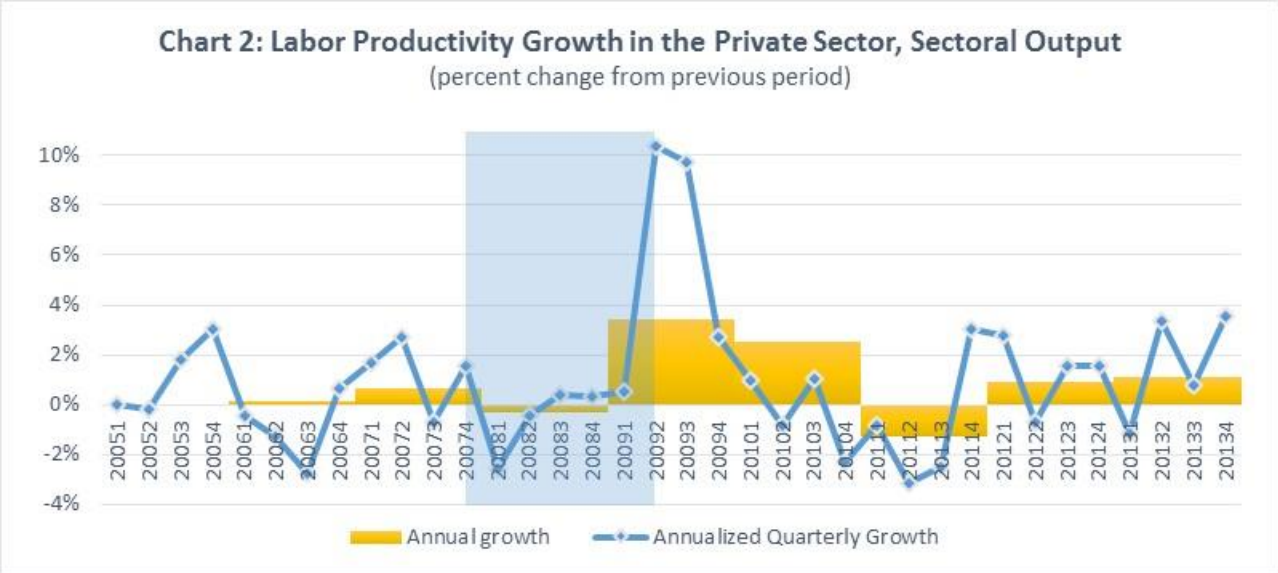
[40] The CES only collects employment and average weekly hours for the logging industry, so nonfarm agricultural services employment data from the BLS QCEW are combined with CES logging data to construct nonfarm employee hours.

[41] BLS labor productivity measures do not remove output and hours for nonprofits. BLS occasionally will make adjustments to hours to reflect weather events if an event resulted in discrepancies between measured monthly output and hours worked; that is, when the reference week no longer accurately represents employment and hours of the entire month. No such adjustments have been made during the 2005-2013 period relevant to this study.

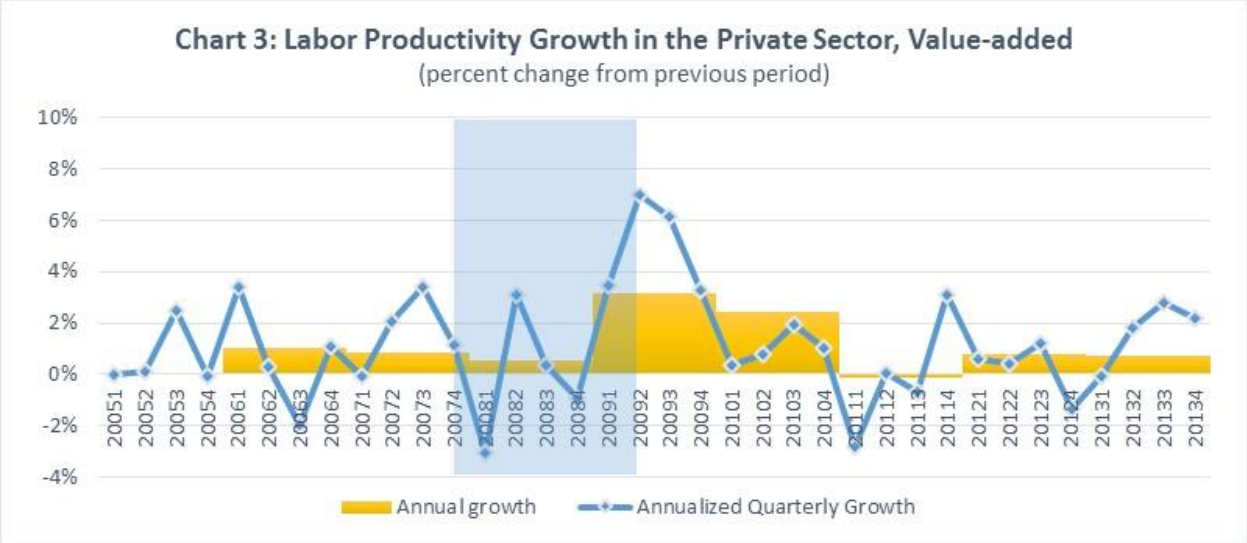
establishments are nonprofits, we will discuss the implications, including their output and hours, when we evaluate the productivity measures in Section V.

V. QUARTERLY LABOR PRODUCTIVITY BY INDUSTRY

Labor productivity compares the growth in output to the growth in labor input. Quarter to quarter growth in labor productivity is calculated as the quarter to quarter growth in output less the quarter to quarter growth in labor hours, and is expressed as an annual rate to facilitate comparisons to the annual growth rates. Charts 2 and 3 shows the annual average growth in labor productivity and the corresponding quarter-to-quarter growth rates using the sectoral output and the value-added output approaches.[42]



[42] All series presenting in this paper were constructed by the authors. Differences between these data and the published BLS productivity statistics are a result of a difference in coverage, as well as a slightly different vintage of output data.

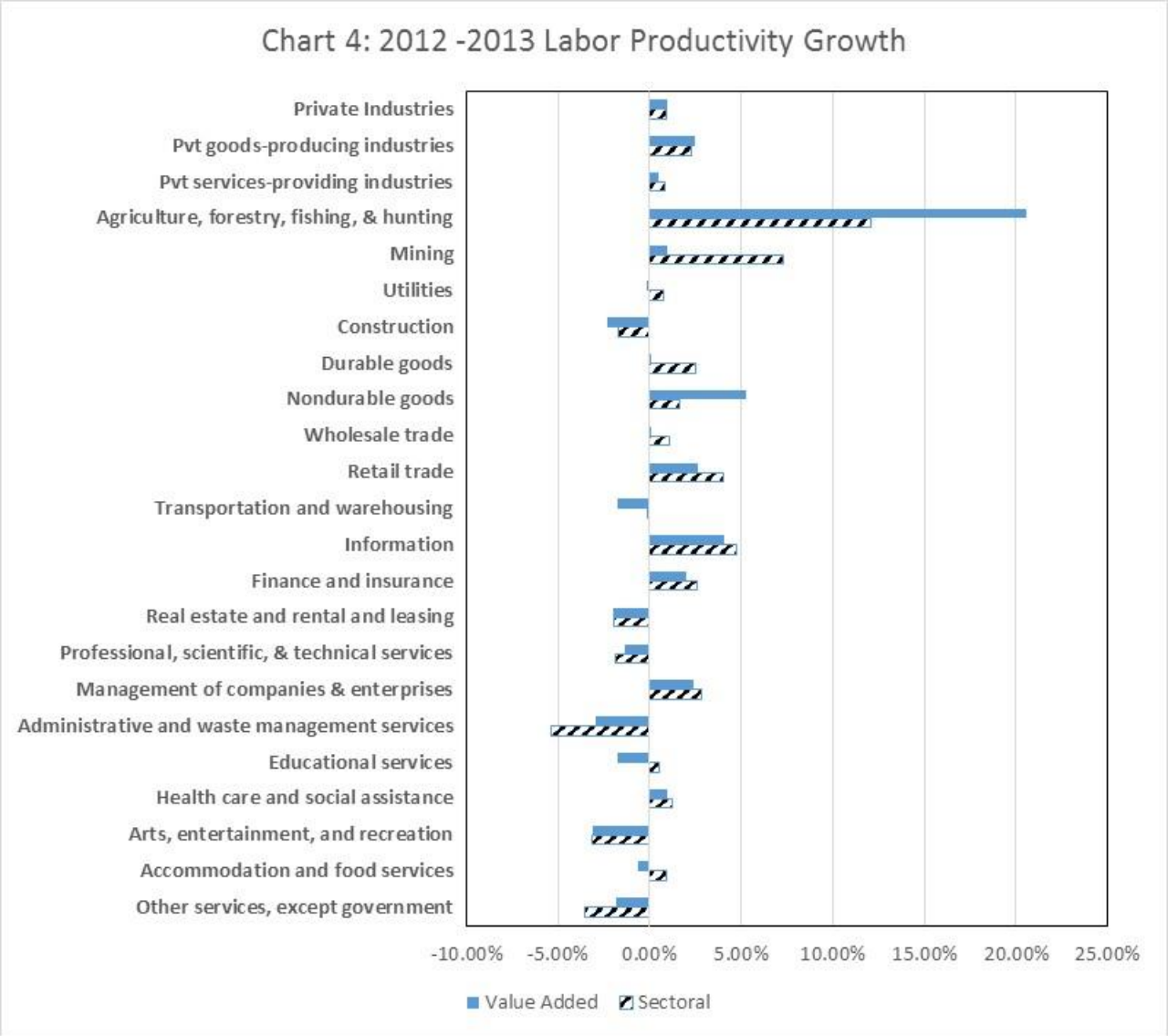


Notice that using both sectoral and value-added methodologies, the quarterly productivity growth rates provide additional information that is not apparent in the annual labor productivity growth; the quarter-to-quarter labor productivity growth rates show higher peaks and deeper troughs than what is observed from the annual growth rates. Examining the recessionary period between the last quarter of 2007 and the second quarter of 2009, we observe that the annual growth during this period hovers near zero (-0.6 percent in 2008 using value-added output; -0.3 percent using sectoral output), while quarterly data fluctuates considerably from period to period. Within this time period quarterly labor productivity growth rates range from -3.0 to 7.0 using the value added approach and range from -2.5 to 10.0 using the sectoral output approach.

A. Industry Labor Productivity Growth

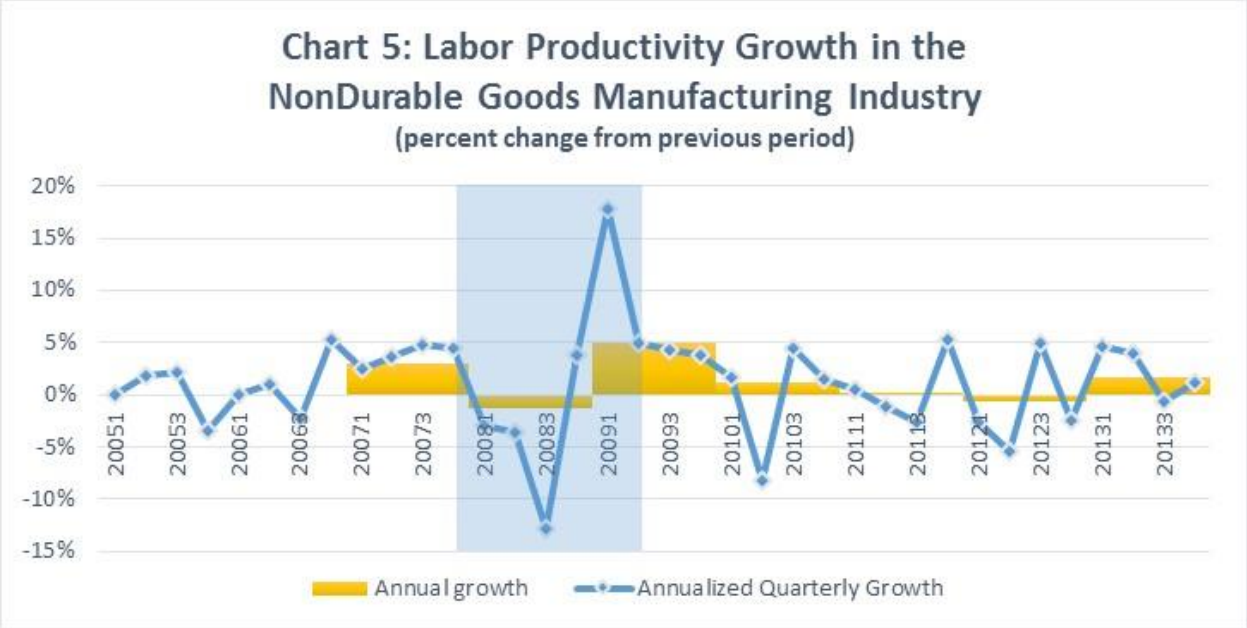
When comparing industry level detail to aggregate data, it becomes apparent that the heterogeneity among individual industries is minimized when the data are presented at the aggregate level. Chart 4 presents the annual 2012-2013 growth in labor productivity across all industries. Industry differences are similar using both sectoral and value-added output methodology, so we will focus our discussion on the sectoral results. Among individual industries, labor productivity growth between 2012 and 2013 varied from a decline of 5.3 percent (administrative and waste management services) to an increase of 12.1 percent (agriculture, forestry, fishing, and hunting). Total private labor productivity growth of 1.1 percent reflects the growth of service providing industries of 0.6 percent and the growth of goods producing

industries at 2.3 percent. Labor productivity for goods producing industries was higher than that of service providing industries, a result of strong growth in the agriculture, mining and nondurable manufacturing industries. Alternately, the slower growth of service providing industries was triggered by declines in administrative and waste services; arts, entertainment, and recreation; and other services, except government.



The heterogeneity in labor productivity growth among industries is more pronounced when we look at the quarterly data. Table 2 presents quarterly labor productivity growth rates for the last eight quarters of our reference period using the sectoral output approach. It is clear that these data are presenting a more dynamic picture. If we look at the nondurable manufacturing industry, (Chart 5) we see that the annual labor productivity growth of 1.6 percent

from 2012 to 2013 represents four quarters of moderate growth (range from 1.2 to 4.9 percent), interspersed among four quarters of considerable decline (range -0.7 to -5.4 percent). During this same period, the wholesale trade industry followed three consecutive quarters of decline with three periods of strong growth, not evident from the 1.1 percent annual growth rate, Chart 6. Such volatility occurs within each of the 20 industries, all lost when only examining annual trends.



B. Industry Contributions to Labor Productivity Growth using Value-added Output

To see how individual industries contribute to growth in the private sector, we can decompose aggregate labor productivity growth into industry contributions using the value-added labor productivity measures.[43] The industry contributions to growth in labor productivity is calculated as the individual industry's growth in labor productivity weighted by its share of value added, plus a measure of the reallocation of labor between industries that have different levels of labor productivity growth.[44] For ease of exposition, Chart 7 shows how the broad groups of private goods-producing and service-providing industries contribute to the growth in aggregate labor productivity measures. Notice that in most quarters service providing industries are contributing to most gains and declines in aggregate labor productivity. Charts 8-9 present the contributions to output growth and hours growth for the good-producing and service-providing industries. Contributions to output growth are calculated as an industry's share of aggregate output multiplied by that industry's output growth. Similarly, contribution to aggregate hours growth is calculated as an industry's share of hours worked multiplied by the industry's growth in hours worked. In the recessionary period, declines in hours growth seem to lag declines in output growth. Moreover, the initial declines in hours are attributable more to goods producing industries, however later in the recession we observe declines in aggregate hours influenced more by declining growth in hours among service providing industries.

[43] We explored several different approaches for estimating the contributions to labor productivity growth, including approaches used in Evsey D. Domar. "On the Measurement of Technological Change," *Economic Journal*, December 1961, pp.709-29. and in Marshal Reinsdorf and Robert Yuskavage, "Exact Industry contributions to Labor Productivity Change," Price and Productivity Measurement: Volume 6 – Index Number Theory, 2010, pp77-102. Both approaches produce similar results, although the Reinsdorf-Yuskavage methods more closely aggregated to total aggregate productivity, and is presented here. The authors will consider an contribution decomposition for sectoral output based labor productivity for a later version of the paper.

[44] Reinsdorf and Yuskavage 2010.

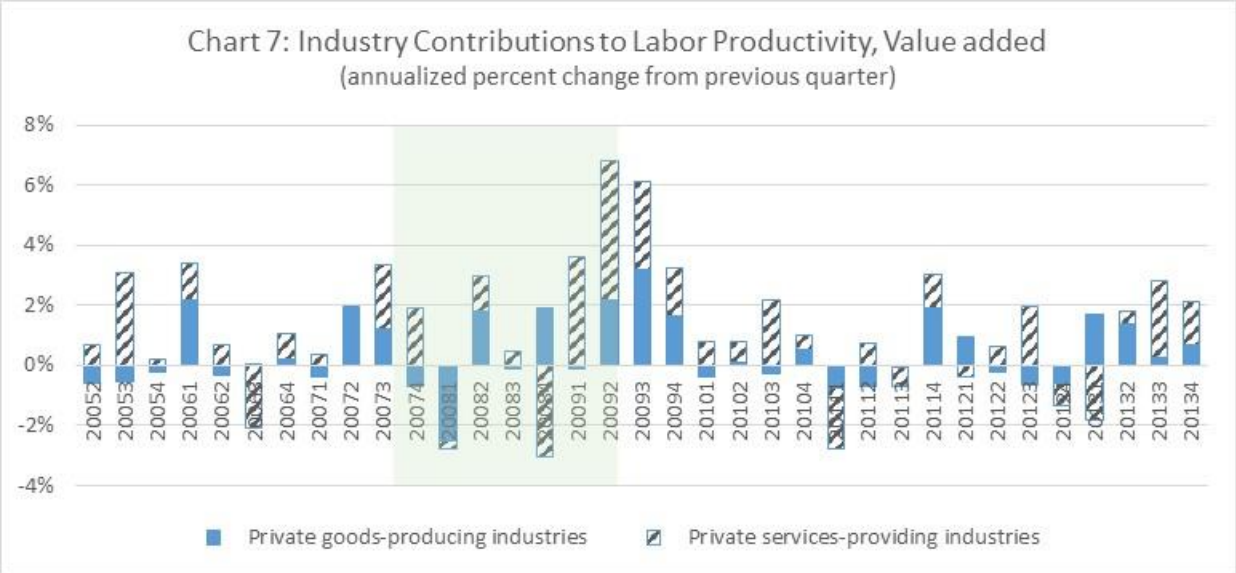


Chart 7: Industry Contributions to Labor Productivity, Value added
(annualized percent change from previous quarter)
8%
6%
4%
2%
0%
-2%
-4%
20052 20053 20054 20061 20062 20063 20064 20071 20072 20073 20074 20081 20082 20083 20084 20091 20092 20093 20094 20101 20102 20103 20104 20111 20112 20113 20114 20121 20122 20123 20124 20131 20132 20133 20134
Private goods-producing industries
Private services-providing industries

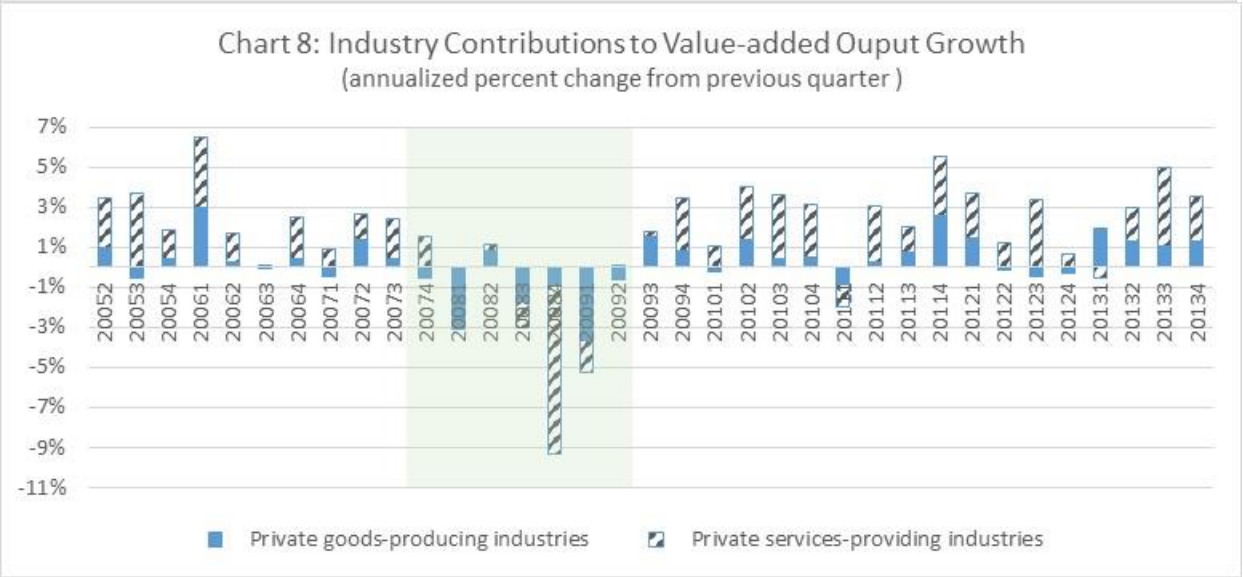


Chart 8: Industry Contributions to Value-added Ouput Growth
(annualized percent change from previous quarter)
7%
5%
3%
1%
-1%
-3%
-5%
-7%
-9%
-11%
20052 20053 20054 20061 20062 20063 20064 20071 20072 20073 20074 20081 20082 20083 20084 20091 20092 20093 20094 20101 20102 20103 20104 20111 20112 20113 20114 20121 20122 20123 20124 20131 20132 20133 20134
Private goods-producing industries
Private services-providing industries

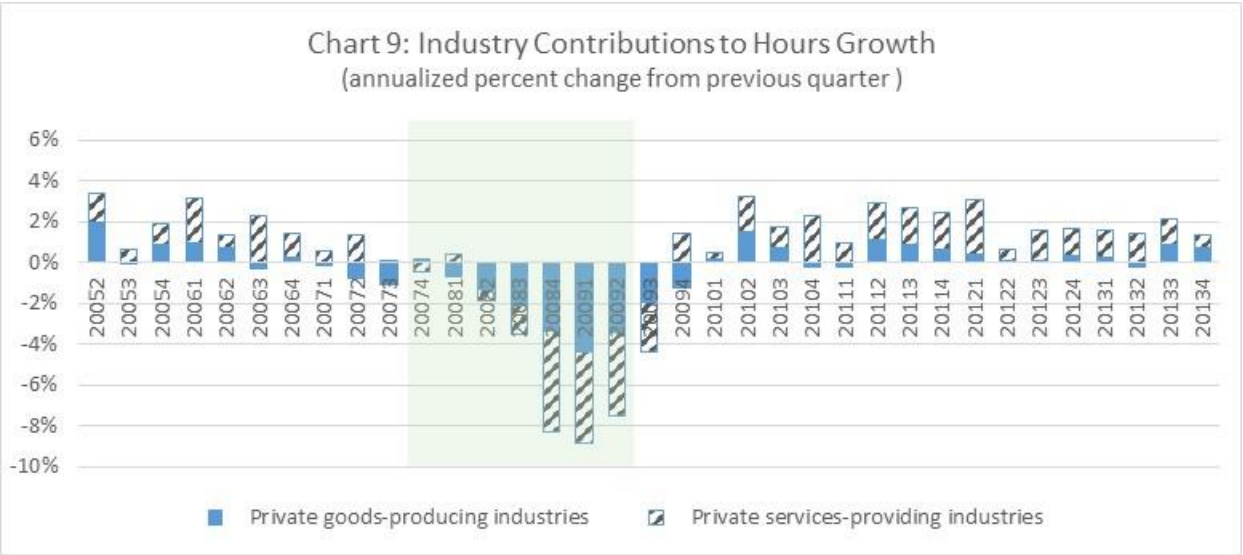
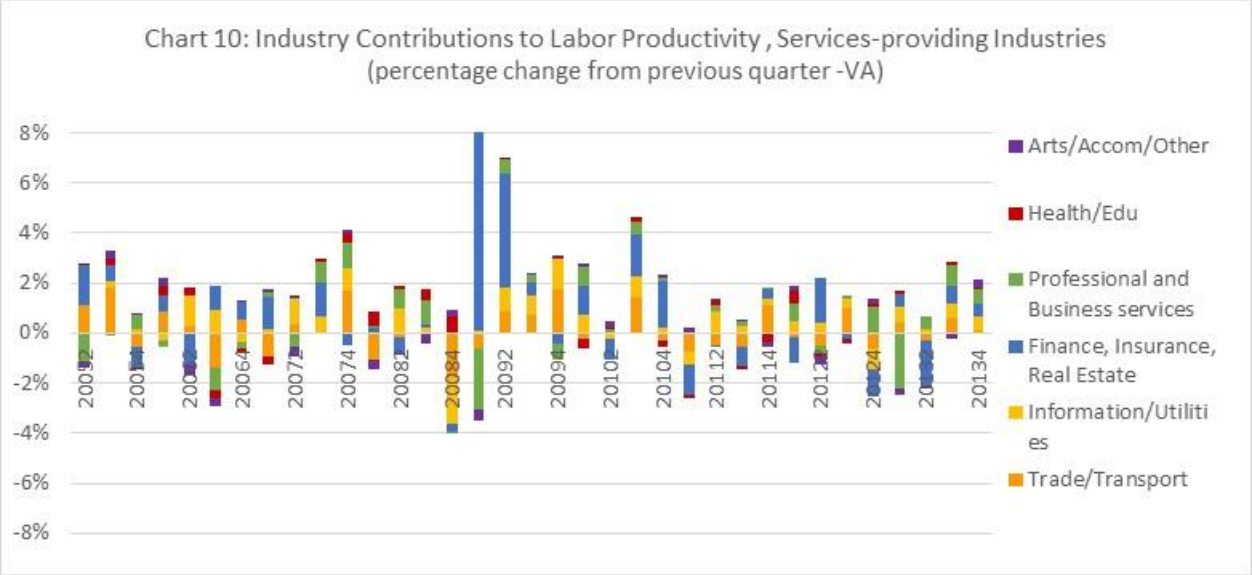
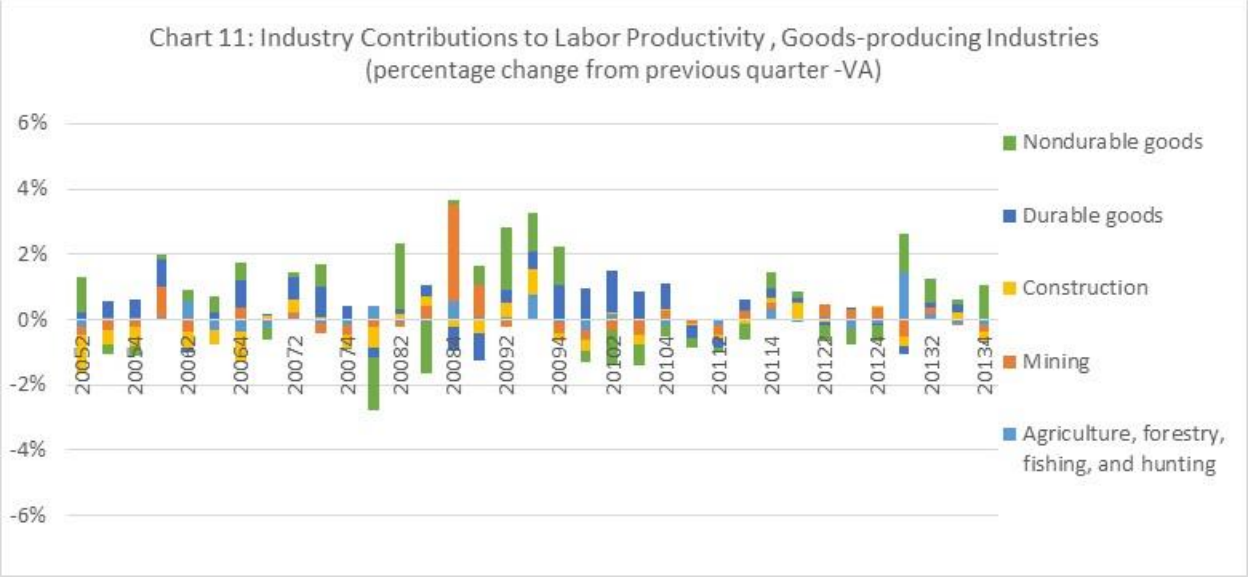


Chart 9: Industry Contributions to Hours Growth
(annualized percent change from previous quarter)
6%
4%
2%
0%
-2%
-4%
-6%
-8%
-10%
20052 20053 20054 20061 20062 20063 20064 20071 20072 20073 20074 20081 20082 20083 20084 20091 20092 20093 20094 20101 20102 20103 20104 20111 20112 20113 20114 20121 20122 20123 20124 20131 20132 20133 20134
Private goods-producing industries
Private services-providing industries

A closer look at individual service providing industries reveals that strong gains in early 2009Q3 are coming from finance, insurance and real estate. (Chart 10). In 2013 Q4, the gains in labor productivity are primarily from professional and business services, and information/utilities. In 2008 Q4, we observe positive growth in labor productivity among goods-producing industries minimizing the decline in aggregate labor productivity for the private sector. Among goods producing industries, mining is contributing most to these sector gains.





In the first three quarters of 2008, nondurable manufacturing industries are contributing the most significantly to fluctuations in labor productivity growth for the goods producing sector

(chart 11). These quarterly labor productivity by industry data provide new insights into economic activity and highlight the heterogeneity among industries, complementing the existing aggregate labor productivity measures.

C. Independence of Output and Hours Data

Because complete data are not available to construct the quarterly input-output tables, BEA relies on assumptions about the relationships between industry inputs, outputs, and value-added from the annual and benchmark statistics to estimate the higher frequency output data. Input measures, such as wages from the Quarterly Census of Employment and Wages (QCEW) or employment from the CES, are available more frequently than measures of output. Thus it is important to determine the extent to which BEA uses these input measures to supplement output data. As previously mentioned such techniques may be suitable for output measurement, but they can be troubling for productivity measurement if input and output measures are not sufficiently independent. If inputs and outputs are measured using similar source data, labor productivity will be biased toward zero by definition.

We reviewed BEA output methodology and found that most output measures are constructed using data from the U.S. Census Bureau: value of shipments are used for mining and manufacturing, revenues for utilities, sales for wholesale and retail trade, and commissions for commodity brokerage. BEA makes strong use of the Census Bureau's Quarterly Services Survey (QSS) and the Service Annual Survey (SAS).[45] Industry coverage within the QSS and SAS has been significantly expanded over the past ten years, resulting in decreased dependence on input-based data for BEA output measures. Since its initial publication of quarterly revenue and expenses for select information industries in 2003 Q4, the QSS has added data for selected detailed industries within the following industries: health services (2004 Q4, 2009 Q1), professional and business services (2006 Q3), administrative services (2006 Q3), transportation (2009 Q1, 2010 Q1), leisure (2009 Q1), other services (2009 Q1), finance (2009 Q3), utilities (2010 Q1), real estate (2010 Q1), educational services (2010 Q1), and accommodations (2012

[45]See Bureau of Economic Analysis. "Concepts and Methods of the U.S. National Income and Product Accounts." February, 2014.

Q3).[46] The SAS experienced a similar expansion to annual statistics.[47] Notice that many of these data have only become available since 2009.

The use of input-based output data is found, to some extent, in 11 service-providing industries, either directly or indirectly. Direct use occurs within portions of seven industries, where input data are either used to estimate the initial annual series or used as an extrapolator to construct the quarterly series. The primary source of input-based output data for estimation of quarterly current dollar statistics is the BLS QCEW. The information, real estate, management services, administrative services, and other services industries all make use of QCEW data for quarterly output estimates. In addition, BEA uses indexes of labor inputs to construct output estimates for nonprofit institutions serving households (NPISH's). Industries that contain NPISH's include information, professional and business services, educational services, health services, leisure, accommodations, and other services.[48] Because BEA only needs the input data to fill in where there are gaps in the data, it is difficult to quantify the extent to which the input data are used without more detailed information from BEA.

We have information on the presence of NPISH's within each industry group that allows us to estimate the portion of each industry's output that is made up of nonprofits and its corresponding share of GDP. Table 5 shows that NPISH are heavily concentrated in education, health services (hospitals and social assistance – 38% of health services), leisure services (museums and historic sites – less than .1% of leisure services) and other services (religious and grant-making organizations – 25% of other services). From these estimates we note that input-based methods are impacting roughly five percent of measured GDP. Most notable .9 percent from education, 3.2 percent from combined health services, and .7 percent from religious and grant making organizations.

It is more difficult to quantify the impact of input-based data that is used indirectly, because it is often for a small portion of the industry measure. Input-based data are used to estimate some price indexes in the professional and business services and educational services industries. Indirect use of input-based data is also noted when estimates are based on NIPA

[46] U.S. Census Bureau. "Annual Report for Services: Fourth Quarter 2003 to Fourth Quarter 2013," June, 2014.
[47] For more detail, annual SAS reports are available at http://www.census.gov/services/sas/historic_data.html
[48] Charles Ian Mead, Clinton P. McCully, and Marshall B. Reinsdorf. "Income and Outlays of Households and of Nonprofit Institutions Serving Households." April 2003.
http://www.bea.gov/scb/pdf/2003/04April/0403household.pdf

Personal Consumption Expenditures that have been constructed using input-based data. These industries include finance and insurance, real estate, professional and business services, educational services, health services, leisure, and accommodations.[49]

While the gross output for the majority of service sector industries is derived from data published within the Census Bureau's QSS, it is important to note that for those industries where input data are used to construct output measures, the resulting labor productivity measures should be viewed with caution. We will note that service industries are labor intensive, and thus correlation between labor hours and output will likely be apparent regardless of the data quality.

D. Sustained Negative Labor Productivity Growth

BLS research (Gullickson and Harper 1999, 2002 and Harper et al. 2010) details concerns about measuring productivity in the nonmanufacturing sector. The 1999 Gullickson-Harper study analyzed long-term trends in multifactor productivity (MFP) as a way to highlight industries where measurement issues may exist, because long-run productivity declines are not sustainable.[50] Their study focused on nonmanufacturing industries and demonstrated how productivity measures calculated with available BEA data resulted in negative MFP trends for most service-providing industries. Service-providing industries present a wide range of conceptual difficulties in measuring what each industry produces, such as the existence of a variety of alternative output measures, intangible or difficult-to-quantify outputs, bundled services, consumer involvement in the production process, or services that are consumed collectively. In addition, the use of input data sources or the use of input-based price indexes for deflating output can bias productivity toward zero. Gullickson and Harper 2002 revisited this research using improved BEA NIPA data. They found that the conceptual barriers to measuring the output of some sectors remained, failing to capture quality improvements. However, it is also possible that growth trends for high tech inputs have been overestimated.[51] The 2010 Harper, et. al study updated the findings of the previous studies and found negative MFP trends continuing, most notably, in real estate, professional & technical services, construction, health services, and

[49] Information on BEA data sources comes from Strassner and Wasshausen, 2014 or BEA Concepts and Methods of the U.S. National Income and Product Accounts, February 2014.
[50] William Gullickson and Michael J Harper, "Possible measurement bias in aggregate productivity growth," *Monthly Labor Review*, February 1999, pp47-67.
[51]William Gullickson and Michael J. Harper, "Bias in aggregate productivity trends revisited," *Monthly Labor Review*, March 2002, pp 32-40.

ground transportation industries.[52] This study found fewer instances of negative MFP growth among nonmanufacturing industries, which is consistent with the acceleration in productivity growth in the private sector over this period, as well as improvements in the source data.[53]

Corrado and Slifman also analyzed long-term negative productivity trends through both sectoral and industry decomposition and offer an alternative cause. The results of their analysis indicated that while the profitability of noncorporate businesses was maintained, productivity declined over a period of two decades, raising concerns over problems with the economic statistics used in these measures. The authors suggested that mismeasurement of nominal output due to an income-based measure of nonfarm-business sector productivity is unlikely to account for the declines, but rather problems in measuring prices is more likely to blame. This problem suggests that actual inflation in the economy is less than that shown by the published data, thus actual growth of output and productivity may be understated.[54]

Negative trends in labor productivity occur when labor is growing at a faster rate than output. Such trends may be present when workers are kept on during cyclical downturns, in industries experiencing declines in demand, if economies of scale are lost, or may be indicative of the availability of newer technologies or competition from imports. Because negative productivity growth is not sustainable over the long-run, we will look at long-run trends in labor productivity when evaluating the possible measurement issues.

Using the value-added methodology, labor productivity growth rates were negative in the construction, management services, educational services, accommodations, and other services industries. Under the sectoral output methodology, the mining, utilities, construction, professional and business services, accommodations, and other services industries all experienced declining productivity.

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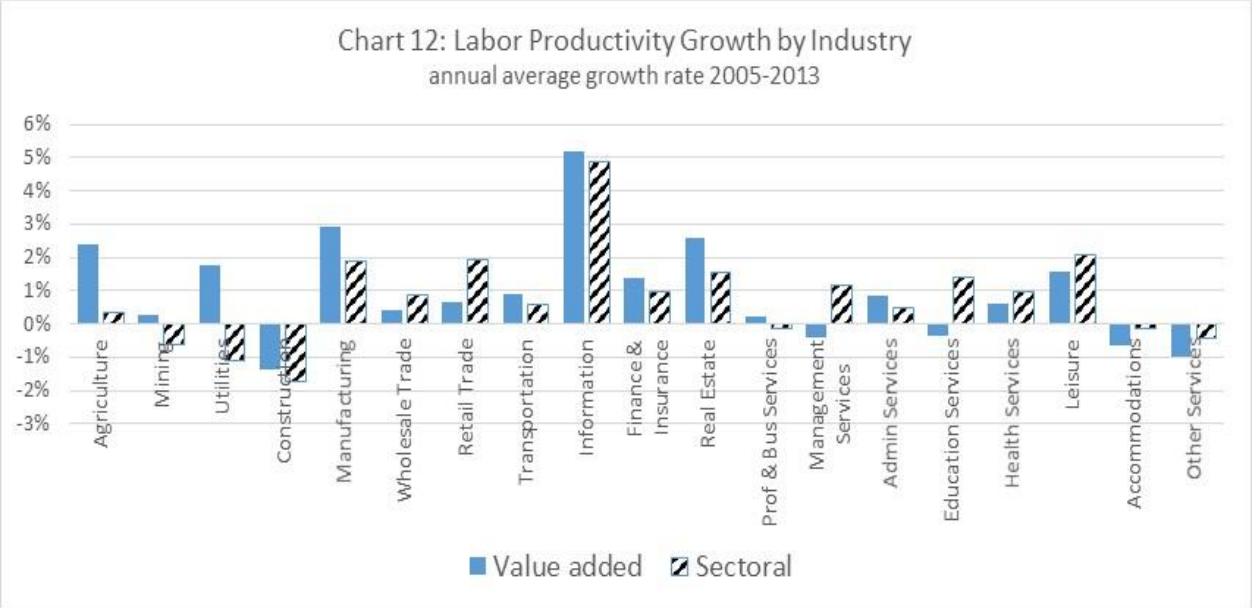
[52] Michael J Harper, Bhavani Khandrika, Randal Kinoshita and Steven Rosenthal, "Nonmanufacturing industry contributions to multifactor productivity, 1987-2006," *Monthly Labor* Review, June 2010, pp.16-31.

[53] In 2001, BLS received additional funding specifically for the improvement of service sector price and productivity statistics. The Services Annual Survey and the Quarterly Survey of Services have also expanded coverage since 2001.

[54] Carol Corrado and Lawrence Slifman, "Decomposition of Productivity and Unit Costs," *The American Economic Review,* Vol. 89, No. 2, May 1999, pp. 328-332.



We see negative productivity trends in several industries where input-based data are used to construct output. Professional and business services experienced a slight decline of 0.03 percent per year using sectoral output methodology. Management services experienced an average annual decline of 0.30 percent using the value-added output method. The educational services industry experienced a 0.41 percent average annual decline using the value-added output methodology. The accommodations industry suffered average annual declines using both the value-added and sectoral output methodologies of 0.65 percent and 0.14 percent, respectively. Lastly, the other services industry saw average annual declines using both value-added and sectoral output approaches of 0.94 percent and 0.37 percent, respectively.

Several industries experience labor productivity declines between 2005 and 2013 even though input data are not used to estimate output. Mining (-0.49 percent), and utilities (-1.2 percent) experienced average annual declines in labor productivity using a sectoral output methodology. If we look at data for the recessionary period 2007-2009, we notice that the negative productivity trend for the utilities industry is primarily due to an almost 8 percent decline in labor productivity during the recession, with positive labor productivity growth afterwards. Therefore, we do not consider the negative trend in this industry to be a result of measurement issues. The construction industry experienced an average annual decrease in productivity of 1.38 percent using the value-added output approach and 1.75 percent using the sectoral output approach. Labor productivity measures for construction industries have long been

viewed as problematic due to negative productivity trends, a lack of reliable price deflators, and differences in building characteristics and quality.

VI. Concluding Remarks

Sustained growth in labor productivity enables an economy to produce additional goods and services without an increase in labor resources, providing the potential for higher standards of living. We examined the new quarterly BEA GDP-industry statistics to determine if they can be used to produce reasonable quarterly labor productivity statistics at the industry level. We developed quarterly labor hours and productivity measures for the 20 major private industry groups for which BEA is releasing GDP-by-industry. Methods and data sources used by BEA to construct the quarterly output series were examined to determine if output growth is **sufficiently** independent from the growth in measured labor inputs.

The study found that input-based measurement techniques are used in seven of the 20 industries. The industries where we have the greatest concern are education, health services and other services, where there is a heavy concentration of NPISHs. In order to better understand the impact of the input data for other industries we plan to work with BEA to obtain more detailed data for a future version of the paper. In addition, we will consider the viability of generating industry measures for education and health services excluding the output and corresponding labor inputs for NIPSHs. Because long-run productivity declines are not sustainable, negative productivity trends are helpful in highlighting industries where measurement issues may exist. However, although we see negative productivity trends in several industries where input-based data are used to construct output, there is no discernible evidence that the input data are causing the negative trends. The largest declines in productivity occurred in the construction and utilities industries, with no evident use of input-based data for estimation of output. Conversely, the largest increase occurred in the information industry with documented use of input-based output measures.

Table 1: Labor Productivity Growth for all Private Industries (annualized percent change from previous quarter)		
	Value-added Output	Sectoral Output
2005-Q2	0.1%	-0.2%
2005-Q3	2.5%	1.8%
2005-Q4	-0.1%	3.1%
2006-Q1	3.4%	-0.5%
2006-Q2	0.3%	-1.3%
2006-Q3	-2.0%	-2.8%
2006-Q4	1.1%	0.7%
2007-Q1	0.0%	1.7%
2007-Q2	2.1%	2.7%
2007-Q3	3.4%	-0.7%
2007-Q4	1.2%	1.5%
2008-Q1	-3.0%	-2.5%
2008-Q2	3.1%	-0.5%
2008-Q3	0.4%	0.4%
2008-Q4	-0.9%	0.3%
2009-Q1	3.5%	0.5%
2009-Q2	7.0%	10.3%
2009-Q3	6.1%	9.7%
2009-Q4	3.3%	2.7%
2010-Q1	0.4%	1.0%
2010-Q2	0.8%	-0.8%
2010-Q3	1.9%	1.0%
2010-Q4	1.0%	-2.3%
2011-Q1	-2.8%	-0.9%
2011-Q2	0.1%	-3.1%
2011-Q3	-0.7%	-2.5%
2011-Q4	3.1%	3.0%
2012-Q1	0.6%	2.8%
2012-Q2	0.4%	-0.7%
2012-Q3	1.2%	1.6%
2012-Q4	-1.4%	1.5%
2013-Q1	-0.1%	-1.2%
2013-Q2	1.8%	3.4%
2013-Q3	2.8%	0.8%
2013-Q4	2.2%	3.6%

Table 2: Labor Productivity Growth Using Sectoral Output										
	2012				2013				2011-2012	2012-2013
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
Agriculture, forestry, fishing, & hunting	-6.5%	3.7%	-10.6%	4.1%	54.8%	15.6%	-20.7%	-11.0%	-2.7%	12.1%
Mining	5.6%	6.5%	16.4%	23.5%	-9.4%	16.6%	11.8%	-26.7%	4.9%	7.3%
Utilities	6.2%	12.5%	-7.1%	1.1%	-1.2%	7.5%	-15.3%	27.5%	1.5%	0.7%
Construction	5.7%	-3.0%	0.8%	-0.4%	-13.8%	7.3%	7.3%	-2.3%	2.4%	-1.7%
Durable goods	4.5%	4.1%	2.0%	1.5%	-0.7%	8.1%	2.6%	1.2%	2.8%	2.5%
Nondurable goods	-2.7%	-5.4%	4.9%	-2.5%	4.6%	3.9%	-0.7%	1.2%	-0.7%	1.6%
Wholesale trade	-9.7%	1.7%	-3.0%	-3.4%	-1.4%	4.3%	7.8%	10.2%	0.2%	1.1%
Retail trade	10.2%	-0.8%	13.0%	-0.8%	5.7%	0.0%	7.3%	5.6%	4.3%	4.0%
Transportation and warehousing	-3.6%	-5.0%	-1.5%	-0.2%	0.2%	2.0%	-2.0%	6.0%	-0.9%	0.0%
Information	12.5%	-0.3%	7.4%	12.4%	-3.5%	2.0%	11.2%	11.6%	5.4%	4.8%
Finance and insurance	16.8%	-6.7%	2.8%	1.7%	4.9%	5.3%	-0.4%	4.2%	1.2%	2.6%
Real estate and rental and leasing	1.8%	4.7%	-6.8%	-2.1%	8.8%	-20.5%	-1.4%	4.4%	-1.2%	-1.9%
Professional, scientific, & technical services	-0.1%	-2.7%	-8.4%	-0.4%	-6.6%	4.1%	2.0%	2.9%	0.1%	-1.9%
Management of companies & enterprises	33.4%	-8.3%	2.6%	18.2%	-34.4%	30.7%	4.1%	6.1%	5.7%	2.8%
Administrative and waste management services	-0.6%	-5.4%	4.7%	-8.5%	-15.5%	5.2%	-5.8%	-1.1%	-1.5%	-5.3%
Educational services	4.3%	0.4%	1.6%	1.3%	-1.1%	-0.1%	-0.2%	5.6%	1.2%	0.5%
Health care and social assistance	2.4%	-1.1%	-2.9%	5.5%	-2.9%	3.9%	1.7%	7.8%	0.8%	1.3%
Arts, entertainment, and recreation	2.4%	4.6%	-1.0%	-18.8%	-5.1%	10.3%	-13.3%	12.3%	0.6%	-3.1%
Accommodation and food services	-3.1%	-1.7%	-1.5%	9.2%	0.8%	-3.3%	-1.8%	2.6%	-1.0%	0.9%
Other services, except government	7.2%	-2.8%	3.6%	3.4%	-11.7%	-5.0%	-8.7%	8.4%	0.9%	-3.6%
Private Industries	2.8%	-0.7%	1.6%	1.5%	-1.2%	3.4%	0.8%	3.6%	0.9%	1.1%
Pvt goods-producing industries	3.0%	0.2%	3.9%	0.4%	1.8%	7.0%	0.2%	-1.1%	1.7%	2.3%
Pvt services-providing industries	2.6%	-1.3%	0.4%	2.1%	-2.4%	2.1%	0.8%	5.4%	0.4%	0.6%

Table 3: Labor Productivity Growth Using Value-added Output										
	2012				2013				2011-2012	2012-2013
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
Agriculture, forestry, fishing, & hunting	-5.2%	7.0%	-24.3%	-12.2%	145.6%	17.8%	-14.3%	-15.1%	-1.3%	20.6%
Mining	0.0%	17.5%	14.5%	16.6%	-20.6%	8.2%	-2.0%	-12.9%	7.1%	1.0%
Utilities	-8.0%	3.9%	1.3%	-4.0%	-2.1%	1.0%	1.1%	6.2%	4.1%	-0.2%
Construction	12.6%	-1.9%	0.1%	-1.8%	-7.6%	-0.9%	4.7%	-6.0%	2.8%	-2.3%
Durable goods	1.5%	-1.2%	0.9%	-0.1%	-3.4%	2.4%	3.4%	-0.7%	1.1%	0.0%
Nondurable goods	3.7%	-7.9%	-8.5%	-8.0%	20.5%	13.0%	2.4%	16.7%	-1.8%	5.3%
Wholesale trade	-5.7%	5.2%	-2.4%	-1.8%	-2.2%	2.0%	3.3%	2.2%	1.3%	0.0%
Retail trade	2.1%	-6.4%	16.1%	-3.8%	8.8%	-4.2%	4.2%	-0.3%	0.3%	2.6%
Transportation and warehousing	1.1%	-10.0%	3.3%	-7.0%	0.5%	-3.4%	2.9%	-0.5%	-1.5%	-1.7%
Information	15.3%	4.3%	7.2%	-11.8%	11.9%	2.5%	11.4%	8.8%	5.0%	4.1%
Finance and insurance	-5.8%	15.4%	2.4%	0.6%	-8.2%	12.6%	5.2%	-0.7%	1.0%	2.0%
Real estate and rental and leasing	-3.1%	5.2%	-4.8%	-8.7%	10.9%	-21.5%	2.6%	5.4%	-1.0%	-2.0%
Professional, scientific, & technical services	2.2%	0.0%	-2.5%	6.0%	-10.7%	-0.6%	5.4%	3.0%	1.9%	-1.4%
Management of companies & enterprises	28.0%	-16.7%	8.3%	33.9%	-48.4%	30.2%	10.9%	8.8%	4.9%	2.4%
Administrative and waste management services	-2.6%	-0.7%	3.2%	-5.7%	-8.7%	-1.7%	2.3%	1.3%	-0.3%	-2.9%
Educational services	5.2%	-5.0%	-0.9%	2.2%	-5.0%	-3.7%	0.5%	2.5%	-1.6%	-1.8%
Health care and social assistance	5.2%	-0.7%	-1.8%	1.5%	2.5%	0.0%	2.1%	1.2%	0.5%	1.0%
Arts, entertainment, and recreation	-2.1%	5.2%	-2.8%	-14.2%	-12.7%	17.0%	-11.9%	6.9%	-0.6%	-3.1%
Accommodation and food services	2.0%	-8.3%	-2.4%	9.1%	0.0%	-7.3%	-1.4%	2.3%	-1.5%	-0.6%
Other services, except government	6.9%	-5.1%	2.7%	2.3%	-7.2%	-2.8%	-4.4%	8.7%	0.2%	-1.9%
Private Industries	0.6%	0.4%	1.2%	-1.4%	-0.1%	1.8%	2.8%	2.2%	0.8%	0.7%
Pvt goods-producing industries	4.6%	-0.8%	-2.6%	-2.7%	7.8%	6.7%	0.7%	2.5%	1.7%	2.5%
Pvt services-providing industries	-0.6%	0.8%	2.4%	-1.0%	-2.3%	0.4%	3.4%	2.0%	0.5%	0.2%

Table 4: Industry Contributions to Labor Productivity Growth Using Value-added Output								
	2012				2013			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Agriculture, forestry, fishing, & hunting	-0.05%	0.07%	-0.26%	-0.15%	1.43%	0.17%	-0.11%	-0.16%
Mining	0.02%	0.41%	0.32%	0.37%	-0.52%	0.22%	-0.05%	-0.22%
Utilities	-0.25%	0.11%	0.05%	-0.09%	-0.02%	-0.01%	0.03%	0.09%
Construction	0.50%	-0.09%	-0.01%	0.00%	-0.30%	-0.01%	0.20%	-0.27%
Durable goods	0.13%	-0.08%	0.06%	-0.03%	-0.25%	0.13%	0.27%	0.00%
Nondurable goods	0.24%	-0.49%	-0.51%	-0.49%	1.20%	0.75%	0.13%	1.07%
Wholesale trade	-0.39%	0.30%	-0.12%	-0.18%	-0.12%	0.10%	0.25%	0.20%
Retail trade	0.16%	-0.50%	1.01%	-0.27%	0.52%	-0.26%	0.25%	-0.08%
Transportation and warehousing	0.06%	-0.31%	0.09%	-0.19%	0.02%	-0.11%	0.09%	0.00%
Information	0.73%	0.30%	0.32%	-0.71%	0.68%	0.13%	0.58%	0.46%
Finance and insurance	-0.42%	1.14%	0.19%	0.05%	-0.64%	0.91%	0.25%	-0.07%
Real estate and rental and leasing	-0.57%	0.64%	-0.45%	-1.14%	1.16%	-2.70%	0.44%	0.56%
Professional, scientific, & technical services	0.21%	0.01%	-0.12%	0.51%	-0.90%	0.02%	0.46%	0.28%
Management of companies & enterprises	0.53%	-0.30%	0.19%	0.69%	-1.04%	0.53%	0.30%	0.23%
Administrative and waste management services	-0.04%	-0.02%	0.11%	-0.16%	-0.30%	-0.04%	0.09%	0.07%
Educational services	0.06%	-0.05%	-0.01%	0.02%	-0.07%	-0.04%	0.01%	0.01%
Health care and social assistance	0.42%	-0.08%	-0.10%	0.13%	0.20%	0.00%	0.13%	0.09%
Arts, entertainment, and recreation	-0.01%	0.04%	-0.03%	-0.14%	-0.11%	0.14%	-0.11%	0.08%
Accommodation and food services	0.09%	-0.24%	-0.07%	0.28%	0.02%	-0.21%	-0.05%	0.10%
Other services, except government	0.14%	-0.10%	0.05%	0.04%	-0.17%	-0.06%	-0.09%	0.14%
Private Industries	0.60%	0.41%	1.22%	-1.37%	-0.08%	1.83%	2.82%	2.18%
Pvt goods-producing industries	0.95%	-0.20%	-0.64%	-0.61%	1.70%	1.37%	0.26%	0.67%
Pvt services-providing industries	-0.37%	0.63%	1.96%	-0.73%	-1.80%	0.43%	2.54%	1.47%

Table 5: Impact of Nonprofits on GDP				
Industry	Detailed Industry Impacted	Nonprofit % of Output	Industry Share of GDP	% of GDP Impacted
Information	Broadcasting and telecommunications	0.40%	2.76%	0.01%
	Information and data processing services	1.90%	0.65%	0.01%
Professional & Business Services	Professional, scientific, and technical services	1.90%	6.39%	0.12%
Educational Services	Educational Services	83.10%	1.14%	0.94%
Health Services	Ambulatory health care services	11.10%	3.17%	0.35%
	Hospitals	85.00%	2.55%	2.17%
	Nursing and residential care facilities	38.00%	0.76%	0.29%
	Social assistance	64.40%	0.59%	0.38%
Leisure	Performing arts, spectator sports, and related industries	8.80%	0.48%	0.04%
	Museums, historical sites, and similar institutions	89.00%	0.05%	0.04%
	Amusement, gambling, and recreation industries	11.10%	0.45%	0.05%
Accommodations	Accommodations	0.50%	0.72%	0.00%
Other Services	Religious, grant-making, civic, professional, and similar organizations	89.90%	0.74%	0.67%

Table 6: Labor Productivity Growth annual average percent change, sectoral output concept				
Industry Group	2005-2013	2005:1-2007:4	2007:4-2009:2	2009:2-2013:4
All Private	1.0%	0.5%	1.3%	1.2%
Agriculture Services	0.3%	-2.1%	2.3%	1.2%
Mining	-0.6%	-6.9%	7.5%	0.2%
Utilities	-1.1%	-0.5%	-8.4%	1.5%
Construction	-1.7%	-5.4%	2.2%	-0.9%
Manufacturing	1.9%	2.7%	-0.1%	2.1%
Durable Manufacturing	2.3%	3.1%	-3.4%	4.2%
Nondurable Manufacturing	1.1%	1.7%	1.0%	0.7%
Wholesale Trade	0.9%	1.1%	-9.6%	5.4%
Retail Trade	1.9%	1.5%	-2.7%	4.1%
Transportation	0.6%	2.3%	-3.1%	1.0%
Information	4.9%	4.4%	2.4%	5.9%
FIRE	1.5%	2.0%	1.3%	1.2%
Finance	1.0%	2.5%	-0.4%	0.4%
Real Estate	1.5%	2.3%	1.8%	0.8%
Prof/Mgmt/Admin Services	0.3%	-0.7%	1.7%	0.4%
Professional & Business Services	-0.1%	-0.9%	-0.8%	0.6%
Management Services	1.2%	1.5%	-8.3%	4.8%
Admin & Waste Mgmt Services	0.5%	-0.1%	5.5%	-1.4%
Education & Health Services	1.0%	0.8%	1.1%	1.1%
Education Services	1.4%	2.1%	0.6%	1.2%
Health Services	1.0%	0.6%	1.2%	1.1%
Leisure & Hospitality	0.3%	0.7%	-1.2%	0.7%
Leisure	2.1%	4.8%	0.6%	0.7%
Accommodations	-0.1%	-0.4%	-1.8%	0.7%
Other Services	-0.4%	0.4%	-2.5%	-0.1%
Goods	0.8%	-0.9%	2.1%	1.4%
Services	0.9%	1.1%	-0.2%	1.2%

Table 7: Labor Productivity Growth annual average percent change, value added output concept				
Industry Group	2005-2013	2005:1-2007:4	2007:4-2009:2	2009:2-2013:4
All Private	1.2%	1.0%	1.6%	1.1%
Agriculture Services	1.0%	-8.7%	14.8%	2.2%
Mining	0.4%	-5.4%	16.7%	-2.4%
Utilities	1.7%	1.4%	-5.3%	4.6%
Construction	-1.4%	-5.4%	1.3%	0.3%
Manufacturing	2.9%	4.6%	1.3%	2.3%
Durable Manufacturing	3.7%	5.7%	-0.2%	3.9%
Nondurable Manufacturing	2.0%	3.3%	2.1%	1.0%
Wholesale Trade	0.4%	2.3%	-5.3%	1.5%
Retail Trade	0.6%	0.5%	0.0%	0.9%
Transportation	0.8%	3.0%	-0.6%	-0.1%
Information	5.1%	6.5%	1.0%	5.6%
FIRE	2.0%	1.4%	4.8%	1.3%
Finance	1.4%	-1.3%	8.1%	0.6%
Real Estate	2.6%	4.0%	4.0%	1.0%
Prof/Mgmt/Admin Services	0.6%	-0.3%	1.7%	0.7%
Professional & Business Services	0.3%	0.1%	-0.4%	0.7%
Management Services	-0.3%	-1.9%	-9.4%	4.6%
Admin & Waste Mgmt Services	0.9%	0.3%	5.0%	-0.4%
Education & Health Services	0.4%	0.3%	2.1%	-0.2%
Education Services	-0.4%	0.3%	1.8%	-1.7%
Health Services	0.5%	0.3%	2.1%	0.1%
Leisure & Hospitality	-0.2%	-0.4%	-2.3%	0.9%
Leisure	1.6%	2.5%	0.2%	1.4%
Accommodations	-0.7%	-1.1%	-3.2%	0.8%
Other Services	-0.9%	-0.3%	-2.9%	-0.5%
Goods	2.4%	1.0%	4.5%	2.2%
Services	0.9%	1.0%	0.8%	0.8%