Monthly Labor Review

BLS

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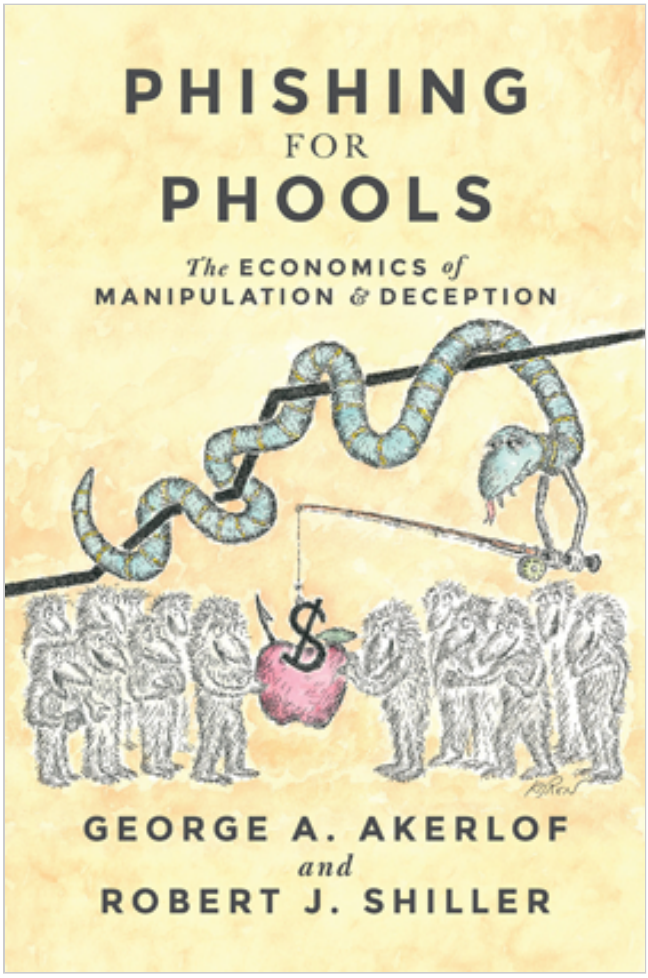
Are you being taken for a phool?

Phishing for Phools: The Economics of Manipulation and Deception. By George A. Akerlof and Robert J. Schiller. Princeton, NJ: Princeton University Press, 2015, 288 pp., $24.95 hardback.



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Take a stroll with me down memory lane, and let's remember our economics 101 class about decisionmaking and budget quandaries. If we were to go to the supermarket with a fixed budget to buy strawberries and blackberries, our goal would be to obtain a combination that makes us happiest (maximizing our utility function). This strategy is part of rational choice theory, according to which a person is believed to always be making logical choices that provide him or her the most satisfaction. However, there is a tendency to overlook irrational behavior in mainstream economic theory. What if I do not stick to that budget? Rather than doing what standard economics teaches us, suppose I pay with a credit card and exceed my fixed budget. In this scenario, the credit card industry exists as long as there is a profit to be made from providing credit because enough people demand to go beyond their budget. In the book *Phishing for Phools: The Economics of Manipulation and Deception*, George Akerlof and Robert Schiller dive deeper into the realm of behavioral economics. They make a case for why free markets that provide people what they want (as long as there are incentives in place) at an equilibrium level can be manipulated or distorted, thereby creating a new equilibrium that they call a "phishing equilibrium."

Let's start by defining the relevant terms found throughout the book. A *phish* is defined as the means by which a *phisherman* (the agent performing the phish) gets his or her target to do what the phisherman wants. (The phishing discussed in this book is not to be confused with that in the field of information and computer technology, whereby individuals attempt to acquire sensitive information, such as Social Security numbers and passwords, or even money by masquerading as a trustworthy source in an electronic

communication environment.) A *phool* is someone who has been successfully phished. There are two types of phools. The psychological phool can be phished by one of two methods: either by having a cognitive bias that is exploited or by giving in to emotions despite an awareness of the situation at hand. The information phool acts on facts that are purposely intended to be misleading. The authors also delve into four areas in which they believe that "NOBODY-COULD-POSSIBLY-WANT" to be phooled—areas where it makes no sense not to have optimal outcomes: our health, the quality of our government, market stability, and personal financial security. With all these terms, the authors relate stories in many settings, ranging from consumer and financial markets to congressional elections, to prove their theory of phishing equilibrium.

Taking us on a discovery ride into advertising, the authors provide ample examples from the minds of advertising "gurus" such as Albert Lasker and David Ogilvy. Crafting the right story and creating an accurate message that leads to customer engagement with a product is something marketers are able to master. So, how do they come to sell you that product? Simply by finding out what works and what doesn't, using trial-and-error statistical tests. Did you ever wonder why advertisements provide different redemption codes? The answer is that there is no better way to target an advertiser's audience than by testing which codes work and which do not. If the redemption code for a product touted in advertisement A was redeemed more often than the code for a product extolled in advertisement B, then a logical conclusion would be to run only advertisement A in the future. This consideration is one of many aspects of *phishing equilibrium*, meaning that, if there is a way to make a profit from our tastes, then the phisherman will keep trying until he or she finds it. In our era of big data, marketers have become increasingly knowledgeable about our preferences and are better capable of exploiting them. They are getting better and better at playing to our human nature of wanting a product rather than needing it. At its core, the book is trying to flesh out the idea that there is a narrative in our minds which leads us to make irrational decisions—an idea that standard economics misses. Akerlof and Schiller tie it back to the strawberries-and-blackberries example: Say the blackberry marketers crafted the narrative that blackberries are superior in taste to strawberries. Then, even though we wouldn't be maximizing our utility by purchasing only blackberries, we end up doing so because the monkey-on-the-shoulder tastes created by advertisers establish a new market equilibrium. In this regard, the authors conclude that free markets allow people to choose between their "real tastes" and "monkey-on-the-shoulder-tastes," and then people are freely available to be phished.

Certainly, Akerlof and Schiller do not attack the free market; rather, they argue that free markets have systemic flaws. They maintain that free markets are still the best economic means of raising living standards for all, but there are some unwanted externalities that the phishermen take advantage of in plying their "trade." For example, deregulation of the banking industry led to the savings-and-loan crisis of 1986–95, and that crisis in turn brought about the recession of 1990–91. In that scenario, the externality was the inflation-adjusted cost of $230 billion on the backs of taxpayers that was caused by the failure of the savings and loans, which became "tools for the phishermen."

The book offers various examples of phools being phished in many settings in a very easy-to-read way. With regard to phishing equilibrium, one may ask what the authors consider to be fair or unfair in the marketplace. The book does not define or explore what constitutes fair or wanted outcomes. Instead, it leaves the reader wanting resolutions of some issues. For example, is merely having an awareness that there are deficiencies in the market enough for people to modify their behavior so that they don't get taken for a phool? How do we go about solving the problem of companies getting around certain legislation? Moreover, does it really matter if I buy more blackberries than strawberries? I am the only person affected by that decision. However, in a different scenario,

one in which the player learns to phish in a way that affects us all (e.g., by crashing the financial markets), minimizing market inefficiencies does matter. And that is where the real lesson of this book comes into play: we should always be aware that we can get phished, and we must find ways to minimize that possibility.

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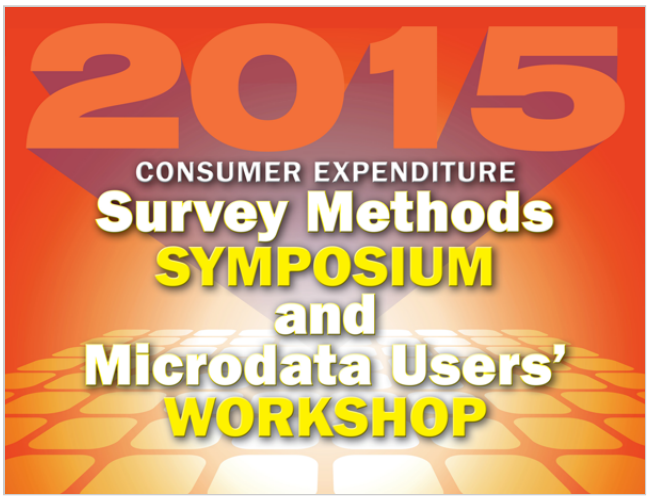
Consumer Expenditure Survey Methods Symposium and Microdata Users' Workshop, 2015

This report describes the fourth annual Consumer Expenditure Survey (CE) Survey Methods Symposium, which took place on July 14, 2015, and the 10th annual CE Microdata Users' Workshop, which took place on July 15–17, 2015.



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The CE is the most detailed source of expenditures, demographics, and income collected by the federal government. Every year, the Bureau of Labor Statistics (BLS) CE program releases microdata on the CE website from its two component surveys (the Quarterly Interview Survey and the Diary Survey), which are used by researchers in a variety of fields, including academia, government, market research, and other private industry areas.[1]

In July 2006, the CE program office conducted the first in a series of annual workshops to (1) help users better understand the structure of the CE microdata; (2) provide training in the uses of the survey data; and (3) promote awareness of the different ways in which the data are used and explore possibilities for collaboration through presentations by current users and interactive forums. Starting in 2012, the program office added an additional day to the event for a symposium to explore topics in survey methods research in support of the Gemini Project, a major effort to redesign the CE survey (more information here: https://www.bls.gov/cex/geminiproject.htm).

In addition to the CE program staff, workshop speakers have included economists from BLS regional offices and researchers not affiliated with the BLS; similarly, symposium speakers have included CE program staff, other BLS National Office staff, and speakers from outside the BLS.

Survey methods symposium

As in previous years, the goals of the 2015 CE Survey Methods Symposium were (1) to provide an update on the status of the Gemini Project, including results from recent projects; and (2) to feature research related to the redesign, including imputation of assets and liabilities, testing the feasibility of collecting outlet data with expenditures, and building a respondent burden index. There were two sessions, one focusing on each topic.

Gemini Project to redesign the CE

Overview of the Gemini Project. As a continuation of the work presented at the 2013 and 2014 CE Survey Methods Symposium, Laura Erhard (CE) provided an overview of the multiyear Gemini Project, which was launched in 2009 to research and develop a redesign for the CE. Much research has been conducted, including recommendations from the National Academies' Committee on National Statistics (CNSTAT). Erhard shared an illustration of the 2013 survey redesign plan and explained the details of the new protocol that were being assessed in the Proof of Concept (POC) Test from July 2015–October 2015. The objectives of the POC Test were to address methodological issues and evaluate operational and experiential factors.

Following the POC Test, CE will be conducting two additional major field tests: an Incentives and Outlets Test in 2016 and a Large-Scale Feasibility Test in 2019. The Incentives and Outlets Test will be conducted in the CE production sample, follow the proposed Gemini Redesign structure of incentives, and look at both operational issues and effects on data quality and response rates. The Large-Scale Feasibility Test will include all the components of the redesign and incorporate lessons learned. It will be conducted much like the POC Test, but with a larger sample, and the instrument will closely resemble the final design.

Results from the Individual Diaries Feasibility Test. Ian Elkin (CE) shared preliminary results from the Individual Diaries Feasibility Test (IDFT), which was designed to inform the operational and data quality aspects of collecting expenditures from household members using personal electronic diaries. The IDFT tested two separate web instruments: a mobile version (via smartphone) and a desktop version. The test was fielded from August 2014–December 2014, and the sample targeted area mobile usage, Internet penetration, multiperson households, and English-speaking households (as a Spanish diary was not developed to reduce costs, although one will be developed for production and included in the Large-Scale Feasibility Test).

The preliminary results reinforced the benefits of electronic diaries from a performance and data quality standpoint. For example, diary keeping information that is automatically generated allows for protocols to be updated more rapidly, electronic diaries allow for the collection of data from paper diaries that are not successfully picked up, and access to up-to-date paradata allows for on-demand interviewer intervention. In addition, an examination of the characteristics of respondents showed that electronic diaries, specifically mobile diaries, do an effective job of targeting groups generally underrepresented in CE data.

Of note, development of CE's electronic diaries is an ongoing, iterative process, along which the IDFT was one milestone. In addition to substantive development milestones (e.g., instrument specifications), protocol milestones also exist, a number of which were omitted from the IDFT fielding. These include burden-appropriate login procedures, as well as specified monitoring and follow-up activities for field staff. Continued testing, into the Large-Scale Feasibility Test, will bring together the cumulative efforts of substantive development and protocol implementation.

Progress on the CE Electronic Diary. In 2013, CE began the process of building a mobile survey instrument to collect diary data. This work was done to build the instrument used in the IDFT, but extended past the IDFT into developments of later designs. The process began with rough drawings of instrument screenshots that were turned into formal written requirements and handed off to programmers. During the process, a series of usability tests were conducted. Brandon Kopp (Office of Survey Methods Research, OSMR) oversaw and conducted the usability tests and shared an overview of the process along with results and recommendations from the tests at the symposium. Most of the tests focused on the mobile version of the diary, but a subset of tests also looked at the desktop version.

The test results uncovered issues ranging from the login process and password change requirements to respondent difficulty in entering data that met data requirements. Many changes were made to the instruments, but because of limited time and resources, not all issues were addressed. Work to improve the electronic diary is ongoing. There is a plan to propose alternative designs for the desktop version of the diary and conduct usability testing. In addition, CE will be exploring alternate ways of simplifying the login process. Incremental changes will be made up until (and after) it is being used in production.

Gemini Redesign related research

Overview of CE Research. Branch of Research and Program Development (BRPD) Chief Adam Safir began the second session of the symposium with an overview of ongoing CE survey improvements since 2003 and summarized the current research agenda. The agenda, which BRPD updates annually, focuses on research issues within the context of the CE's long-term goals. It also communicates CE's research plans and priorities with respect to the redesign and reflects discussions with internal and external stakeholders. The agenda isn't set in stone and can change over time as new research findings and questions emerge.

Investigating the Imputation of Assets and Liabilities in the CE Interview Survey. Geoffrey Paulin (CE) spoke about the problem of nonresponse and how it affects the data collected on expenditures, income, taxes, and assets and liabilities. While there are methods in place for handling this problem with most of these data, nonresponse to questions that collect data on assets and liabilities is currently under investigation. The purpose of the project is to design a method to impute missing Interview asset and liability data, leveraging models from income imputation and other relevant procedures. The goal of the project is to implement this method into production with 2018 Quarter 2 data.

The team considered several methods, including: one used by the Survey of Consumer Finances, which utilizes an iterative, multiple imputation process; regression trees; and hot deck, but none were feasible. Ultimately, the team decided to investigate a system based on income imputation processing. Paulin described what that system entails and discussed the challenges involved in adapting it to assets and liabilities. The project is a work in progress.

Testing the Feasibility of Integrating Outlets into the CE Diary. Currently, CE and TPOPS (Telephone Point-of-Purchase Survey) collect complementary and potentially redundant information for the CPI (Consumer Price Index). As a result, the CE and CPI programs are interested in determining the impact on data quality and respondent burden of collecting outlet data in the CE Diary. Erica Yu (OSMR) conducted a small study looking at two ways of integrating outlets in the CE Diary and found that (1) the collection of outlet information did not substantively affect CE data quality, (2) participant ratings of burden showed no large effects due to the addition of

outlets, and (3) there was a possible increase in time taken to enter items in the diary. This was a small study, and further research is needed.

Developments in Building a Respondent Burden Index. Danny Yang (OSMR) discussed the work being done to develop a composite burden index for CE that would track perceived respondent burden over time. This would allow CE to detect and understand changes in burden following modifications to the survey, evaluate the association between the survey burden index and other survey measures of interest, and develop interventions that would reduce respondents' perception of burden. Burden scores could be integrated into the overall assessment of survey performance for CE management.

Conclusions: With many research projects underway involving the overall CE Gemini Project, the 2015 CE Survey Methods Symposium was a successful event focused on sharing recently completed and current work with data users and others interested in CE's survey research. These research projects help the program move toward achieving its overall redesign goals, and the symposium serves as a channel for discussion and the exchange of ideas.

The symposium drew a little over 50 attendees from areas such as universities, academic programs in survey methodology, nonprofit organizations, private companies, medical-related establishments, and other federal agencies.

Microdata users' workshop

Day one. The first day of the 2015 workshop opened with presenters from the CE program. Bill Passero provided an overview of the CE, featuring topics such as data collection and publication. Brett Creech then presented an introduction to the microdata, including an explanation of their features, including data file structure and variable naming conventions.

The morning concluded with presentations by researchers not affiliated with the CE program who have used the microdata for a variety of purposes. The first speaker, Stephen Brumbaugh, discussed automobile loans made to low-income consumers. The second speaker, Taylor Smith, related spending patterns to changes in housing wealth in recent years.

After the lunch break, CE economist Aaron Cobet described forthcoming changes in the Public Use Microdata (PUMD) website, and solicited comments from the attendees. The rest of the afternoon was dedicated to practical training, in which attendees had the opportunity to perform programming exercises using the microdata.

The day concluded with an information-sharing group session among workshop participants and CE program staff. This was an open forum in which attendees met informally to discuss their research and offered suggestions for improving the microdata. One recommendation was that the CE make information more readily available to users. Specifically, the CE needed to find a better way of presenting the documentation, highlighting key topics, and making online help tools more dynamic.

Day two. The second day opened with more advanced topics, with Brian Nix of the BLS Division of Price Statistical Methods presenting technical details about sampling methods and construction of sample weights. Meaghan Smith (CE) followed with a presentation on imputation and allocation of expenditure data in the CE.

The remainder of the morning was dedicated to research presentations by non-BLS attendees. The first of these, entitled “The 2011 Payroll Tax Cut and Household Spending: Evidence from a Quasi-Natural Experiment” (Naveen Singhal), examined how expenditures made by consumers changed in different states in response to a cut in payroll taxes. The experiment became possible because one state, Illinois, raised income taxes by about the same percentage as the reduction in payroll taxes, yielding no net cut for residents of that state. The presenter of the second work, entitled “Household Consumption Smoothing between Monthly Housing Payments” (Li Zhang), had returned to the workshop for a second consecutive year, having presented a different paper (“The Effect of Casinos on Household Consumption”) in 2014. The third presentation, entitled “Income-Expenditure Elasticities of Less Healthy Consumption Goods” (Adam Hoffer), used data from the Diary Survey to analyze expenditures on foods like cola and donuts to estimate how tax increases might affect expenditures on these goods.

After a break for lunch, Carol Boyd Leon and Charlotte Irby, technical writer-editors of the *Monthly Labor Review (MLR)*, described the publication process, from submission to printing, for attendees interested in having their work appear in the *MLR*.

After this description of the *MLR* process, the technical instruction resumed with a presentation of a topic of perennial interest to CE microdata users: how to apply longitudinal weights to the interview data. Following this presentation, Evan Hubener (CE) led a discussion highlighting some of the limitations of the CE survey data and provided best practices for dealing with weights under these circumstances. Hubener detailed how the Interview Survey collects data from respondents for 4 consecutive calendar quarters. During each interview, the respondent is asked to provide information on expenditures for various items during the past 3 months. However, not all participants remain in the sample for all four of these interviews. Those who do remain have different characteristics (e.g., higher rates of homeownership and average age) than those who do not. Therefore, attempting to analyze average annual expenditures by only examining respondents who participate for all four interviews yields biased results.

Following the Hubener presentation, the workshop pivoted to a session explaining an important feature of certain variables in the microdata: topcoding. In a presentation entitled “Balancing Respondent Confidentiality and Data User Needs,” Arcenis Rojas (CE) explained that, in order to preserve the confidentiality of the data, values for some variables, such as income sources and certain expenditures (e.g., rent, among others), are topcoded. In this process, values that exceed a predetermined critical value are replaced with a new value. In each case, changed values are flagged for user identification.[2] At the conclusion of this presentation, practical training resumed for the rest of the afternoon.

Day three. On the final day, CE staff featured advanced topics, starting with Barbara Johnson-Cox explaining how sales taxes are applied to expenditure reports during the data production process. Next, Geoffrey Paulin described the correct use of imputed income data and sample weights in computing population estimates. The latter session noted that the proper use of weights requires a special technique to account for sample design effects that, if not employed, result in estimates of variances and regression parameters that are incorrect.[3] Researcher Walter Lake (Pew Charitable Trusts) followed, describing a user-friendly tool he was developing to allow researchers to obtain time-series estimates from microdata both for demographic groups and detailed expenditures not available in online formats through the CE website.[4] After a break, Aaron Cobet described the new methods in CE for estimating income taxes paid by consumer units, the amounts for which replace those reported by consumers during their interviews, as these data have been found to be extremely unreliable.[5] The CE uses the National

Bureau of Economic Research TAXSIM program to estimate federal and state income taxes. These new estimates were introduced with the publication of the 2013 annual tables. They represent a major improvement to the quality of the CE after-tax income data. The session concluded with a "sneak peek" of developments for CE microdata by Steve Henderson. In 2015, there were many changes made to the Interview Survey. These included the introduction of new health care questions, the dropping of the first interview or "bounding interview,"[6] and the implementation of a redesigned sample.[7] Regarding publications, Henderson noted that detailed data tables, which had been available only on request, would be published online, starting with one at the all-consumer-unit level. In addition, a new higher income table and a new table looking at spending by birth year of the reference person, divided into generations, would be released.[8]

After a lunch break, practical training continued, including a presentation of a computer program available with the microdata for use in computing correct standard errors for means and regression results when using (1) unweighted nonimputed data, (2) population-weighted nonimputed data, and (3) multiply imputed income data, both unweighted and population weighted (Paulin). Finally, attendees were debriefed in a feedback session designed to solicit opinion on how to improve future workshops, CE program outreach, and other topics of interest to attendees. Most of the suggestions were related to methods for raising awareness about future workshops. Some users provided additional outlets for us to post information about the 2016 workshop. Users also mentioned the need for additional sample programming codes.

2016 Symposium and workshop

The next Survey Methods Symposium will be held July 12, 2016, once again concomitant with the 11th annual Microdata Users' Workshop (July 13–15, 2016). While the symposium and workshop will remain free of charge to all participants, advance registration is required. For more information about these and previous events, visit the CE website (www.bls.gov/cex) and look for "Annual Workshop" under the left navigation bar titled "CE PUBLIC-USE MICRODATA." For direct access to this information, the link is www.bls.gov/cex/csxannualworkshop.htm. Additional details about previous symposia are available at https://www.bls.gov/cex/ce_workshop_archive.htm.

Highlights of workshop presentations

Following are highlights of the papers presented during the workshop, listed in the order of presentation. They are based on summaries written by the respective authors.

Stephen Brumbaugh, Ph.D. candidate, UCLA Department of Urban Planning, "Driven to Poverty? An Analysis of Automobile Expenditures in Low-Income Households" (Interview Survey), day one.

> Transportation is the second-largest expense category for American households after housing, and the financial burdens of transportation for low-income households—in particular, the costs of buying, operating, and maintaining a vehicle—are a prominent concern among policymakers and antipoverty advocates. Nonetheless, few researchers have directly examined vehicle expenditures in low-income households. In my dissertation, I attempt to fill this research gap by analyzing Consumer Expenditure Survey microdata. My research is guided by three major questions: whether consumer characteristics like race and education explain differences in vehicle expenditures among low-income households; how the nature of vehicle repair

expenditures for these households has changed as automotive technology improves; and whether transit expenditures explain differences in automobile expenditures.

Taylor Smith, Ph.D., Georgia Gwinnett College, “How Do Changes in Housing Wealth Affect Consumption Behavior?” (Interview Survey), day one.

Between 1997 and 2006, the price of the typical American house increased 124 percent. This housing boom and its resulting 2008 bust have been cited as major determinants of changes in household consumption over this period. Using more than 12 years of consumer data merged with several macroeconomic time series, we estimate the impacts of housing wealth on 13 specific expenditure categories and the overall budget formation of Americans. We find that housing market fluctuations during this period were indeed a determinant of consumption change, but only in certain sectors, and that the effects were smaller than some news media and previous literature have suggested. Additionally, we show that effect magnitudes vary greatly across young and old homeowners, and across the housing boom and bust periods.

Naveen Singhal, Ph.D. candidate, University of Illinois at Chicago, “The 2011 Payroll Tax Cut and Household Spending: Evidence from a Quasi-Natural Experiment” (Interview Survey), day two.

In 2011, the federal government reduced the payroll tax rate from 6.2 to 4.2 percent, while at the same time Illinois increased its state income tax rate from 3 to 5 percent. Consequently, Illinois workers were largely unaffected by these tax changes, but workers elsewhere experienced an increase in their take-home income. Using this variation in tax liability, I estimate that for every dollar of tax decrease, household spending increased by about 89 cents, especially on recreation, dining, vacations, clothing, and personal care. Additional analysis indicates that the estimates are unlikely to be biased from Illinois-specific shocks and may therefore be interpreted causally.

Li Zhang, Ph.D. candidate, University of Virginia, “Household Consumption Smoothing between Monthly Housing Payments” (Diary Survey), day two.

This paper studies consumption smoothing of households between monthly payments of mortgage or rent. The paper’s focus on regular payments contrasts with most of the literature, which finds excess sensitivity to regular receipt of income. Using the Consumer Expenditure Survey (CE) Diary Survey from 1998 to 2011, I find that spending on nondurable goods is $3.34, or 9.0 percent higher per day during the two weeks following the day when a housing payment occurs, compared with the two weeks prior to that day, which is inconsistent with the consumption smoothing predicted by the life cycle/permanent income hypothesis. This finding is robust to the coincident timing of households’ regular housing payments and their regular income arrivals, and suggests that findings in the previous literature of excess sensitivity of consumption to regular income arrivals may in part reflect excess sensitivity to the timing of making regular payments. The increase in biweekly average spending following a housing payment day is larger for households in which the household head has lower educational attainment, larger for households with lower income, and has a U-shaped profile in age of household head. My finding is not fully consistent with existing theories that explain departures from consumption smoothing between regular payments, including liquidity constraints and uncertainty about bank account balances.

Adam Hoffer, Ph.D., Assistant Professor, University of Wisconsin-La Crosse, “Income-Expenditure Elasticities of Less Healthy Consumption Goods” (Diary Survey), day two.

> There is a long-running policy debate regarding the use of tax policy to modify consumption choices and health outcomes. Specifically, should taxes be imposed on “unhealthful” foods to discourage their consumption and thereby reduce unhealthy outcomes? Objections to this policy include the positing that such goods are price inelastic (i.e., purchases are not sensitive to changes in prices), so the imposition of taxes (essentially equivalent to increasing prices) would be ineffective. This work examines expenditures for cola and donuts, and finds that the expenditures are income inelastic. Therefore, to the extent that taxes reduce income for purchasers of these goods (that is, if the goods cost more, purchasers have less income to allocate to other goods and services), they do little to discourage consumption of these goods.

Walter Lake, Senior Associate, Research Financial Security and Mobility, Pew Charitable Trusts, “Introducing KIWI: A Stata Package to Explore BLS Consumer Expenditure Data” (Interview Survey), day three.

> The BLS Consumer Expenditure Survey Public Use Microdata (PUMD) are a very rich, multifaceted set of data with a wealth of information surpassed only by the complexity of the procedures necessary to extract that information. The technical knowledge required to assemble the data prior to analysis creates a barrier for all but the most advanced users of statistical software packages. Lowering the barriers to entry will increase the number of researchers from a variety of fields that can access and utilize the data. To facilitate this, I have created an add-on package for STATA statistical software that streamlines the process for data aggregation and variable creation. Through the use of a graphical user interface (GUI) with drop-down menus and selection buttons, the user can assemble and analyze PUMD with just a few mouse clicks. The GUI allows the user to weight the variables, run crosstabs, and output basic graphs. Two versions of the algorithm that powers the GUI are available to accommodate different levels of statistical programming prowess. The STATA is very functional but still a work in progress and should be ready for public release within the next year.

BLS Speakers

Staff of the CE Program

Cobet, Aaron. Senior Economist, Branch of Information and Analysis (BIA), days one, two, and three

Creech, Brett. Economist, BIA, day one

Curtin, Scott. Supervisory Economist, Chief, Microdata Section, BIA, day one

Henderson, Steve. Supervisory Economist, Chief, BIA, days one and three

Hubener, Evan. Economist, BIA, day two

Johnson-Cox, Barbara. Economist, Branch of Production and Control (P&C), day three

Passero, Bill. Supervisory Economist, Chief, Processing and Analysis Section, BIA, days one and two

Paulin, Geoffrey. Senior Economist, BIA, day three

Rojas, Arcenis. Economist, BIA, days one and two

Smith, Meaghan. Supervisory Economist, Chief, Phase 3 Section, P&C, day two

Other BLS speakers

Boyd Leon, Carol. Technical Writer-Editor, Monthly Labor Review Branch, day two

Irby, Charlotte. Technical Writer-Editor, Monthly Labor Review Branch, day two

Nix, Brian. Mathematical Statistician, Division of Price Statistical Methods, day two

Speakers from outside BLS

Brumbaugh, Stephen, “Driven to Poverty? An Analysis of Automobile Expenditures in Low-Income Households” (Interview Survey), day one

Hoffer, Adam, “Income-Expenditure Elasticities of Less Healthy Consumption Goods” (Diary Survey), day two

Lake, Walter, “Introducing KIWI: A Stata Package to Explore BLS Consumer Expenditure Data” (Interview Survey), day three

Singhal, Naveen, “The 2011 Payroll Tax Cut and Household Spending: Evidence from a Quasi-Natural Experiment” (Interview Survey), day two

Smith, Taylor, “How Do Changes in Housing Wealth Affect Consumption Behavior?” (Interview Survey), day one

Zhang, Li, “Household Consumption Smoothing between Monthly Housing Payments” (Diary Survey), day two

SUGGESTED CITATION

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NOTES

1 The Quarterly Interview Survey is designed to collect data on expenditures for big-ticket items (e.g., major appliances, cars, and trucks) and recurring items (e.g., payments for rent, mortgage, or insurance). In the Interview Survey, participants are visited once every 3 months for 4 consecutive quarters.

In the Diary Survey, participants record expenditures daily for 2 consecutive weeks. The survey is designed to collect expenditures for small-ticket and frequently purchased items, such as detailed types of food (e.g., white bread, ground beef, butter, or lettuce).

The CE microdata may be downloaded on the CE website (https://www.bls.gov/cex/pumd.htm).

2 Details about topcoding are provided in the public-use microdata documentation for the year of interest. (See, for example, *Consumer Expenditure Interview Survey*, Public Use Microdata, 2013 User's Documentation, September 10, 2014, https://www.bls.gov/cex/.)

3 The CE sample design is pseudorandom. The proper use of weights requires the use of the method of balanced repeated replication.

4 Using the link to a BLS-maintained online tool (https://data.bls.gov/cgi-bin/dsrv?cx), users can obtain time-series data for published expenditure categories by predetermined demographic series (e.g., age of reference people under 25, 25 to 34, etc.). The new tool will allow users to select data both at detailed levels (e.g., floor coverings) for different groups (e.g., income quintile, age of reference person, or a cross-tabulation of these items) in nominal or real (i.e., inflation-adjusted) dollars. The new tool also allows users to choose whether to display means by calendar year (consistent with CE publications) or collection year (i.e., the year in which the expenditure information was collected, but not necessarily when the expenditures were made). For example, note that with its 3-month recall, Interview Survey respondents who are visited in January are reporting expenditures that took place in the prior year.

5 For details, see Geoffrey D. Paulin and William Hawk, "Improving data quality in Consumer Expenditure Survey with TAXSIM," *Monthly Labor Review*, March 2015, https://www.bls.gov/opub/mlr/2015/article/pdf/improving-data-quality-in-ce-with-taxsim.pdf.

6 The purpose of the bounding interview is to ensure that consumers interviewed more than once do not report expenditures in subsequent interviews for which data have already been collected. As an example, if a respondent in the first interview reports purchase of a refrigerator for $500 and does so once again in the second interview, the interviewer can make sure that the second-interview report is indeed a new refrigerator, different from the one reported 3 months earlier in the bounding survey.

7 The sample redesign occurs decennially, when certain cities or other areas enter the sample and others leave, based on changes in population or other factors.

8 These new tables were introduced in September 2015 and can be found at: https://www.bls.gov/cex/csxresearchtables.htm.

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June 2016

The first 50 years of the Producer Price Index: setting inflation expectations for today

To help mark the Monthly Labor Review's centennial, the editors invited several producers and users of BLS data to take a look back at the last 100 years. This article tells the story of the first 50 years of the Producer Price Index (PPI). During this period, the PPI established its reputation as a key economic indicator and set the precedents for future inflation expectations.

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The Producer Price Index (PPI) is our nation's primary measure of price changes in the domestic supply chain, allowing us to monitor how price increases or decreases are passed through from producers to consumers. This Principal Federal Economic Indicator marked its 125th anniversary in March 2016. Over its history, the PPI has set precedents for timely and accurate price index data. Its methodology and content evolved early on, as our economy was changing from one based on agriculture to one based on manufacturing. Today, the PPI continues to evolve as the service-providing sectors now contribute more to gross domestic product than the goods-producing sectors.

The PPI has also set precedents for helping inform the inflation expectations of economists and government leaders. It was the first economic indicator to show the macroeconomic effects of trade and war. It was the first measure to reveal the negative consequences that can arise from deflation and the impacts of fiscal and monetary policy on prices. Capturing a long history of price changes, the PPI continues to provide insights into bellwethers of economic turmoil and growth.

The PPI has been well documented since World War II, but its early history is less well known.[1] This article tells the story of the first 50 years of the PPI and how it established its reputation as a key economic indicator.

PPI origin

The U.S. Capitol on a winter day circa 1880.
Source: Architect of the Capitol.

March 3, 2016, marked the 125th anniversary of the PPI—one of the oldest economic time series compiled by the federal government. The index, known as the Wholesale Price Index (WPI) until 1978, was established as part of a U.S. Senate resolution on March 3, 1891, the last day of the last session of the 51st U.S. Congress.[2] This Congress was famously known as the “Billion-Dollar Congress,” because of its expensive initiatives, such as

expanding the Navy and creating pensions for families of military members who served in the Civil War. It operated in an era of industrialization, immigration, and economic growth.[3] Two of its most well-known bills were the Sherman Antitrust Act, which sought to protect consumers from certain anticompetitive business practices that tended to raise prices (e.g., monopolies and cartels),[4] and the McKinley Tariff Act of 1890, which raised duties on imports with the goal of protecting domestic industries from foreign competition.[5] Born out of the necessity to measure the impact of such economic policies, the resolution marking the origin of the PPI read thus:

> Resolved, The Committee on Finance be, and they are hereby, authorized and directed, by subcommittee or otherwise, to ascertain in every practicable way, and to report from time to time to the Senate, the effect of the tariff laws upon the imports and exports, the growth, development, production, and prices of agricultural and manufactured articles, at home and abroad….[6]

In response to this resolution, Senator Nelson W. Aldrich, who later played a role in the establishment of the Federal Reserve System, authored a report on *Retail Prices and Wages* in July 1892.[7] According to this report, the demand for price and wage data arose because the lack of reliable data had caused persistent disputes over economic facts. In addition, legislators realized it would be impossible to judge the relative economic progress of the United States and its people without measures of prices and wages. For these reasons, the Senate Committee on Finance made sure to establish a legacy of objective and accurate data:

> There was no expectation that the members of the committee would agree about the political or even the economic bearings of the facts ascertained; but all were desirous that hereafter there should be no reason to question the integrity of the facts.[8]

A Bureau of Labor Statistics (BLS) committee headed by Dr. Roland Falkner, a statistics professor from the University of Pennsylvania, was tasked with collecting prices and producing the original index data.[9] At the Senate committee's request, prices were collected from seven main distribution centers across the country:

- Baltimore
- Boston
- Chicago
- Cincinnati
- New Orleans
- New York
- San Francisco

Over a 28-month period beginning in mid-1889, BLS obtained 52,393 price quotations for 218 items purchased by wholesalers (commonly referred to as "jobbers" at the time).[10] In a rather informal collection process, experts in the field (today known as field economists) received the following instructions:

> As soon as you have completed the collection of wages and prices in [your city], please collect the quotations for wholesale prices….You can change the word "retail" to "wholesale" and make the blank conform. By "wholesale prices" I mean…the prices to jobbers.[11]

Once collected, these data were compiled by BLS into the first WPI, which was made up of eight equally weighted groupings of products:

- Food
- Cloths and clothing
- Fuel and lighting
- Metals and implements
- Lumber and building materials
- Drugs and chemicals
- House-furnishing goods
- Miscellaneous

The data produced by the BLS committee were published in Senator Aldrich's 1892 report, which showed that prices fell 0.3 percent from June 1889 to September 1891.[12] After this first publication, in 1893, the Senate committee and BLS completed their initial mission by publishing a report on historical prices for the years 1840–90.[13] This massive compilation was the first of its kind in U.S. history and was made possible only by the dedicated efforts of field economists and with cooperation from the business community.

After several years of planning, in 1900, BLS published *Wholesale Prices, 1890 to 1899*, the first publication produced without congressional oversight.[14] But it wasn't until March 1902 that the regular annual publication of *Course of Wholesale Prices* (hereafter referred to as *Wholesale Prices*) began.[15] Each annual publication contained monthly data for the previous calendar year and analysis of the data both for that year and from the base period, 1890.

Early PPI publications

Since the initial annual publication of *Wholesale Prices,* which contained data for 1890–1901, BLS made routine methodological improvements. For example, in that publication, items were sorted into groupings based on origin, rather than end use, which was how they were organized in the original reports prepared in coordination with Congress. In addition, farm products were separated from the category of food, forming a ninth major grouping.[16]

Each annual WPI publication—typically published in March—included a comprehensive analysis of price movements in the U.S. economy from the base period of 1890 through the most recently completed calendar year.[17] Monthly prices were usually from the first day of each month, and data sources included trade journals, manufacturers, and, to a lesser extent, boards of trade and other government bureaus. Average nominal prices for all items were published alongside the index data. Later, the publication also featured price data for up to 26 foreign countries.

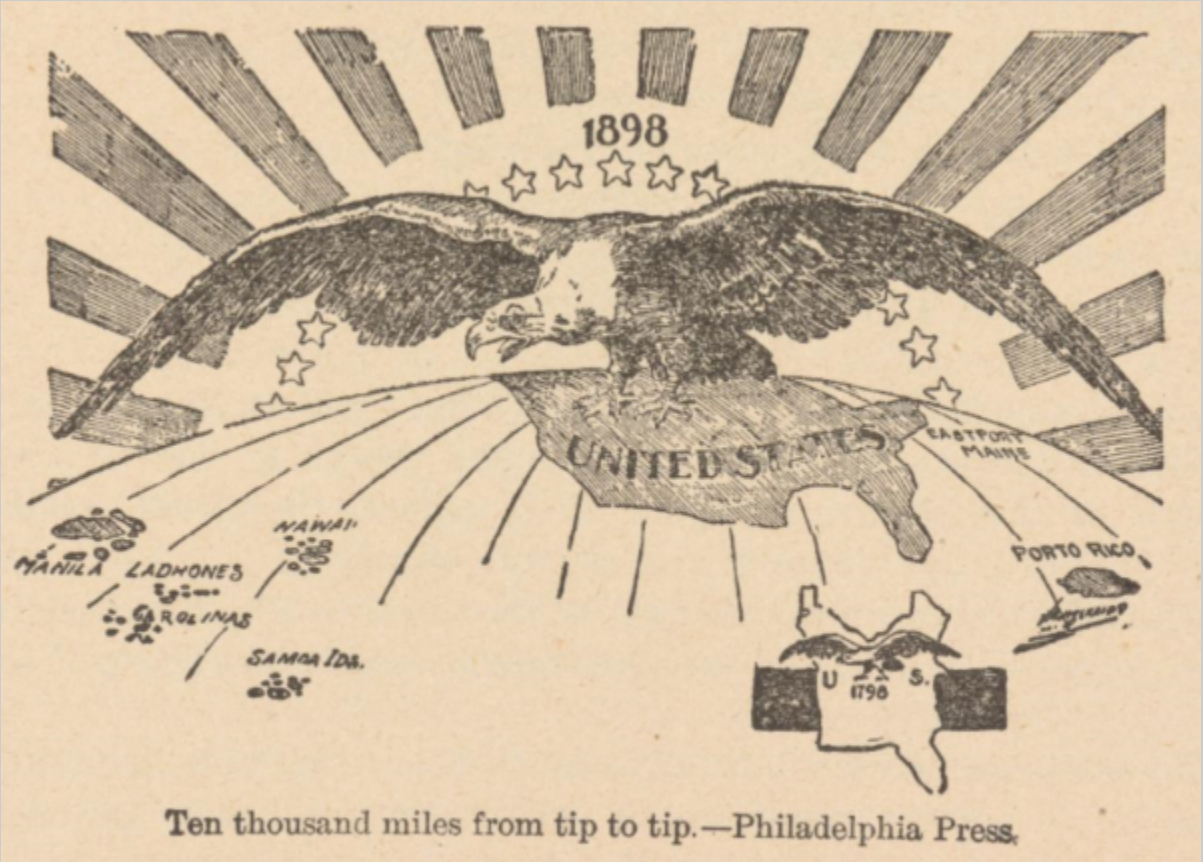
The first principal indicator of wholesale price changes, or *headline* index, was the WPI for All Commodities, which combined indexes for about 250 select items from all nine major groupings. Although weighting was not yet used to combine indexes, the choice of index for inclusion in the aggregate WPI was based on the "relative importance" of that index's product in the U.S. economy. The term "relative importance" was carried over to describe weights once they were implemented in 1914. To this day, PPI tables of weights continue to be referred to as relative importance tables.

Most of the original products remain in the current survey in some variant, although a few, such as wool broadcloth, granite plates and teacups, and wooden pails and tubs, have become obsolete.[18] In contrast, a

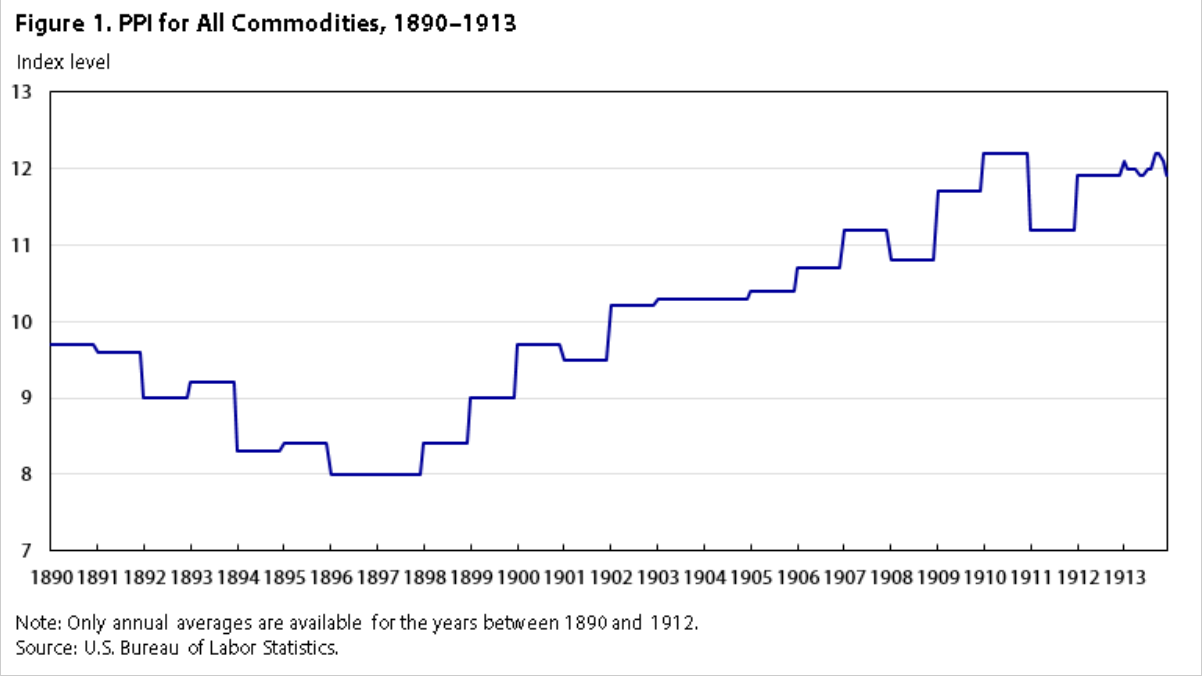
number of manufactured products covered in the PPI today—products such as processed foods, consumer goods, plastic products, most chemicals, and machinery—are noticeably absent from the original index.

BLS also published composite indexes, to compare changes in prices for raw materials in the WPI with those for manufactured goods. Such indexes, which grouped goods by level of processing, would later become the focus of PPI reports. Since the initial publication of *Wholesale Prices*, the history of the PPI—just like that of the U.S. economy—has been one of constant improvement and growth.

Early industrialization



In 1898, the Spanish-American War shifted political and economic power to the United States, propping up its future trade and industrialization.
Source: Philadelphia Press.



The stock market crash and the bank failures that set off an economic downturn in 1893[19] were reflected in WPI declines in the first 7 years for which data exist. In 1898, the Spanish–American War shifted political and economic power to the United States, propping up its future trade and industrialization.[20] The WPI reflected this upturn in 1898 and increased by more than 8.0 percent in 1899 and 1900. This was the first recorded pickup in inflation during wartime, an occurrence that would become a trend. From 1901 to 1913, the index rose moderately, at an annual average rate of 1.6 percent.[21] (See figure 1.)

At a time marked by advances in assembly line manufacturing and the U.S. acquisition of the Panama Canal, which further opened the nation's economy to trade, BLS in 1908 added new products to the WPI.[22] Among the 1908 additions were horses, dressed poultry, and canned food. Concerns about accurate techniques for substituting old with new products into aggregate WPIs led to the introduction of two indexes: one with the list of products included before additions or substitutions were made and one with the new list of goods.[23] This labor-intensive practice continued as new products were added again in 1914, 1915, and 1921, so customers could compare price changes between any two years with WPIs made of identical goods.

In 1914, war was declared in Europe, the U.S. Federal Reserve banks opened for business, and the WPI underwent its first major revision. Most significantly, weights were applied to WPIs for the first time on the basis of 1909 U.S. Census of Manufacturers value-of-shipments data. To conform to the new weighting system, all indexes were retroactively calculated back to 1890. The base dates for all WPIs were also updated to 1914, to use the latest and most trustworthy data as a base and to accommodate the addition of new goods. The number of series published increased to 340, and BLS began publishing WPI data for all commodities and major commodity groupings in the *Monthly Labor Review* in 1915. WPI data were included in the first issue of the *Review* alongside data for the Consumer Price Index, which had just appeared in 1914.[24]

World War I to the Great Depression

The annual publication of *Wholesale Prices* was suspended in 1918 because of the U.S. entry into World War I. Resuming publication in 1921, BLS issued a report with WPI data for 1917–19, to highlight price changes during the war.[25] Although a major revision had taken place as recently as 1914, the data were revised once again, this time with a prewar base year of 1913. As in the previous rebasing, index numbers were revised all the way back to 1890. This recalculation accommodated the addition of indexes for goods introduced in the 1919 data and the revision of previous data with more pricing information. Further, weights for several home furnishings were obtained for the first time, and a new aggregate index for furniture was added. The number of series published now totaled 371. A useful highlight of this bulletin were charts printed on perforated translucent paper, which allowed data users to tear out and overlay charted data for easy comparison.

A poster used during World War I to indicate compliance with price controls. Exceptions to the typical wartime inflation trend occurred in the WPIs for fuels, metals, and chemicals as a result of the introduction of government price controls.
Source: U.S. National Archives and Records Administration.

Data during World War I revealed unprecedented price increases between 1917 and 1919, with the all-commodities index rising 56 percent. Historically, to that point, the headline index had moved most closely with the WPI for farm products, which rose 65 percent during the 1917–19 period. Other notable increases were seen in the indexes for cloth and clothing, house furnishings, and building materials, which more than doubled during the war. Exceptions to the typical wartime inflation trend occurred in the indexes for fuels, metals, and chemicals, because of the introduction of government price controls. In addition to the usual analysis, data for 1919 were supplemented with extensive commentary on how the war affected price changes for certain important food commodities.[26] Before resuming publication of *Wholesale Prices*, BLS also assisted with a special report, *History of Prices During the War*, published by the U.S. War Industries Board in 1919.[27]

In 1922, BLS published a number of bulletins to bring WPI data completely up to date. Beer, whiskey, and liquors were dropped from the index because of the 18th amendment prohibition on the sale of alcoholic beverages. Overall, the total number of WPI series grew to 450.[28] For the first time, BLS had enough data to create new subgroupings under the existing nine major groupings. For example, under the farm products grouping, subgroupings were created for grains and for livestock and poultry. Subgroupings for drugs and pharmaceuticals, paper and pulp, and iron and steel were also among the more notable additions.

Along with the addition of new subgroupings, significant changes in methodology were implemented. BLS returned to grouping products by end use (as in the original indexes produced in coordination with Congress), as opposed to by origin. This resulted in some products falling into multiple categories; for example, steel and nails fell under both building materials and metal products, and potatoes fell under both food and farm products. However, each product was still weighted only once in the WPI for All Commodities.[29] The relative-importance weights were also updated with data from the 1919 Census of Manufacturers.[30]

The last WPI revision before the Great Depression occurred with the release of 1927 data. Data were rebased from 1913 to 1926 and revised with weights updated from the 1923 and 1925 biennial censuses.[31] With more than 100 newly introduced indexes, the total number of series went up to 550. Notable additions to the WPI survey were automobiles, tires, and sewing machines. New aggregate WPIs were also introduced for nonagricultural goods, raw materials, semi-manufactured articles, and finished products.

Because of the high volume of indexes added by 1927, the revision was completed in stages, and the final report with revised data back to 1890 was published in January 1929.[32] Table 1 presents a list of the major product groupings and subgroupings in this report.

Table 1. WPI product groupings and subgroupings, 1927

Major grouping	Subgroupings
Farm products	Grains, livestock and poultry, other farm products
Foods	Meats; butter, cheese, and milk; other foods
Hides and leather products[(1)]	Hides and skins[(1)], leather, boots and shoes, other leather products[(1)]
Textile products[(1)]	Cotton goods, silk and rayon[(1)], woolen and worsted goods[(1)], other textile products[(1)]
Fuel and lighting	Anthracite coal, bituminous coal, coke[(1)], manufactured gas[(1)], petroleum products[(1)]
Metals and metal products	Iron and steel, nonferrous metals, agricultural implements[(1)], automobiles[(1)], other metal products[(1)]
Building materials	Lumber, brick, Portland cement[(1)], structural steel, paint materials[(1)], other building materials

See footnotes at end of table.

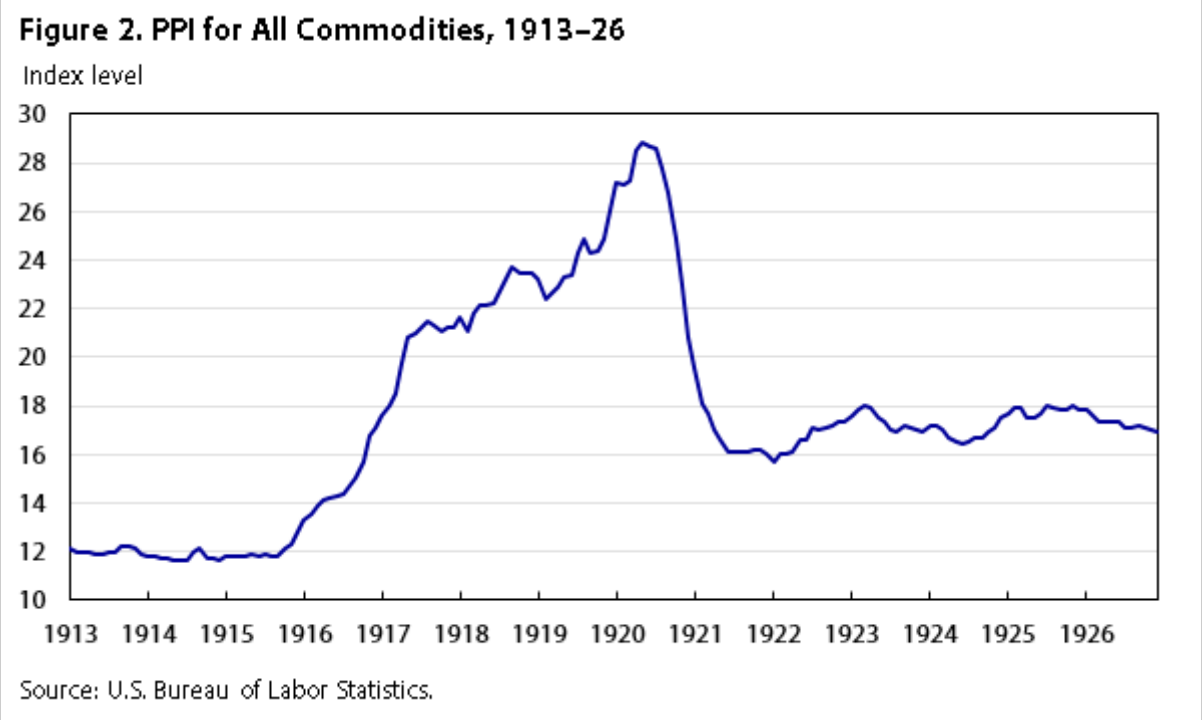
Table 1. WPI product groupings and subgroupings, 1927

Major grouping	Subgroupings
Chemicals and drugs	Chemicals, drugs and pharmaceuticals, fertilizer materials, mixed fertilizers[(1)]
House-furnishing goods	Furniture, furnishings
Miscellaneous	Cattle feed, paper and pulp, rubber[(1)], automobile tires[(1)], other miscellaneous

Notes:

[(1)] New category introduced in 1927.

Source: U.S. Bureau of Labor Statistics.



After the end of World War I in 1918, the WPI continued its upward trend through mid-1920, but, in early 1921, it abruptly returned to its pre-1918 level. From 1922 to 1925, the index displayed volatility, although in a tight range. (See figure 2.)

The Great Depression to World War II

The WPI demonstrated its potential as a leading economic indicator with broad-based declines beginning in 1926. On October 24, 1929, a day known as “Black Thursday,” the stock market crashed, precipitating the Great Depression.[33] By October 1930, the WPIs for all major commodity groupings had dropped below their 1926 base, and declines continued through 1932. According to WPI data, it took until 1943 for prices to recover to their predepression levels, partly because of a midrecovery recession in 1937. In comparison, during the 2007–09 Great Recession, the PPI for All Commodities turned down in July 2008 but recovered within 6 years.

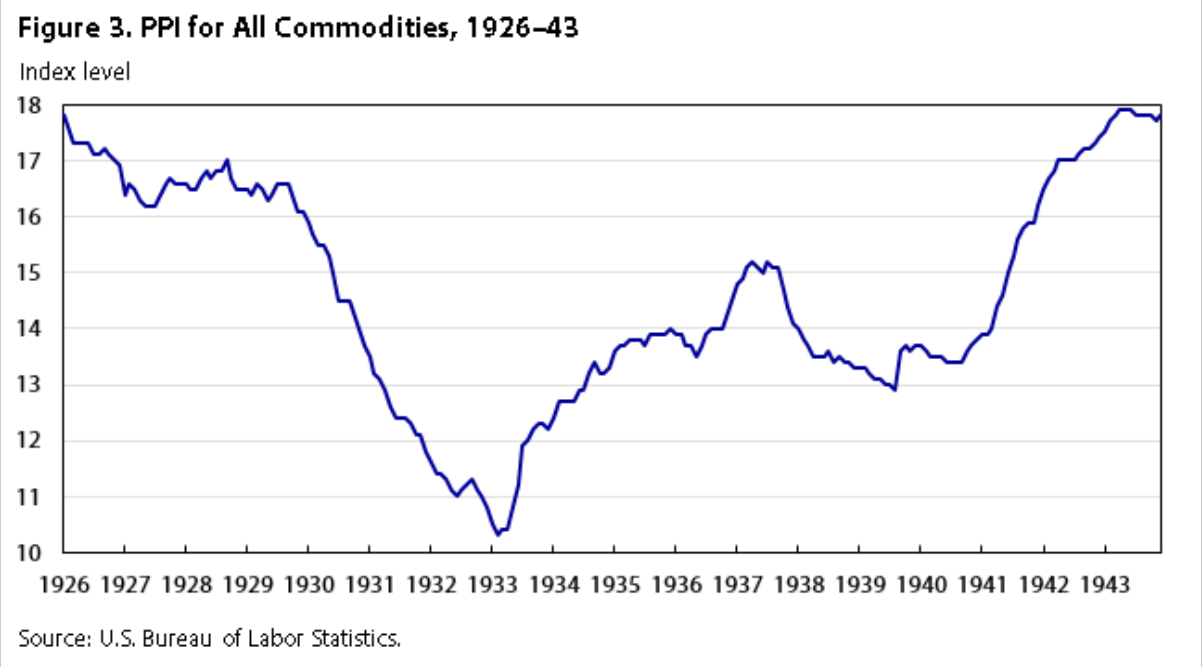
Businesses displayed the symbol of the Blue Eagle to indicate participation in the National Industrial Recovery Act, which put upward pressure on prices following its adoption in 1933.
Source: U.S. National Archives and Records Administration.

Before 1925, shorter periods of deflation had occurred periodically, but the 1925–33 deflationary period was, and remains, the longest streak of year-over-year declines reflected in the all-commodities index. In the 1930s, it became widely accepted that long-run price declines had intensified the Great Depression,[34] and deflation attained its unsavory status. Seeking to get deflation under control, the federal government passed two new pieces of legislation in 1933, both of which contributed to an upturn in the WPI. The first, the Agricultural Adjustment Act, levied new taxes on certain farm products. This measure, combined with a major drought that led to the 1934 "Dust Bowl," put upward pressure on farm and food prices.[35] The second legislation, the National Industrial Recovery Act, created inflation pressure in nonfood prices by deregulating industries, allowing them to fix prices and create production quotas.[36]

With the beginning of the Great Depression, the need for economic data became more urgent than ever. BLS responded to this need in 1930, when it began publishing monthly bulletins with WPI data to supplement the comprehensive annual issue of *Wholesale Prices*. The new bulletins presented analyses on price movements for the most recent year, for the most recent month, and for selected weeks. These short-term analyses contrasted with those included in the annual publication, which emphasized historical price movements in the WPI from the base date.

The economic volatility of the 1930s also encouraged experimentation with the content of the WPI publication. In 1932, the number of WPI price series expanded from 550 to 784. The new series were almost entirely for fully manufactured goods. Some commodities were rearranged, and new subgroupings were added. Weights were updated in 1932 with the most recent Census of Manufacturers data, but revised figures were only calculated back to 1926, rather than 1890, as had been done in past revisions. Notices touting improvements in sample coverage, transaction descriptions, and weights for specific WPI groupings (such as farm machinery and cement) began appearing in the reports as well.[37] These notices resemble today's PPI notices of resampling of industries. The focus of the written analysis in the monthly WPI reports also began to shift, from the all-commodities index to both the aggregates excluding food and the indexes for goods by level of processing. In addition, the emphasis frequently shifted between short- and long-term price changes. For a time in 1935 and 1936, weekly analysis led the headline paragraph. During the same period, the WPI program switched from publishing international prices and average nominal prices on a monthly basis to publishing them only a few times a year.

In mid-1936, the monthly WPI report announced methodological improvements that would ensure increased WPI coverage, more detailed descriptions for sampled transactions, and better accuracy of prices and item classifications.[38] In January 1937, the program moved from calculating WPIs as chain-type indexes to calculating them with a fixed-base formula. No immediate difference between the two types of indexes was noticeable for overlapping data in 1936; however, in the long run, it was expected that the new methodology would be crucial to maintaining accurate inflation data as product substitutions were made. With nearly 800 series being published in 1937, products were constantly growing obsolete or being replaced by newer alternatives.[39]



The WPI for All Commodities finally broke its depression slump in mid-1933, finishing the year with a double-digit advance. Bolstered by the impacts of the Agricultural Adjustment Act and the Dust Bowl, farm and food price increases led the broad-based rise in WPIs through 1936. In the midst of economic recovery, however, came the recession of 1937–38. This downturn has recently gained the attention of researchers, because of its parallels with the slow recovery from the 2007–09 Great Recession. Several factors have been cited as causes for the 1930s "recession within depression," including higher taxes, rollbacks in government stimulus spending, and an increase in reserve requirements for banks by the Federal Reserve. These policies were implemented when the economy was not quite ready to absorb them.[40] Since this time, measures of inflation, such as the PPI, have gained recognition as crucial indicators for policymakers.

After falling to a 5-year low in mid-1939, the WPI turned upward again, mainly because of the outbreak of World War II. The subsequent production increases to support the war effort boosted the economy through the duration of the war. (See figure 3.)

PPI today

Since World War II, the PPI has grown to cover nearly all output in the goods-producing sectors and much of the output in the construction, utilities, and service sectors. In total, the PPI now tracks prices for over three-quarters of private domestic production, from raw materials to final-demand goods and services. In addition, indexes measuring price changes are available by industry, end use, and stage of production. Each month, the PPI program publishes nearly 10,000 individual indexes, which are used commonly by private businesses and the government as indicators of inflation. As evidence of its ongoing leadership in price-index development, the program has issued more than a dozen notices of expansion or methodology improvement in the last 5 years alone. The most prominent of these notices has been on the shift in focus of the PPI news release—a shift from the index for finished goods to the index for final demand.[41]

Lana Conforti, "The first 50 years of the Producer Price Index: setting inflation expectations for today," *Monthly Labor Review,* U.S. Bureau of Labor Statistics, June 2016, https://doi.org/10.21916/mlr.2016.25.

NOTES

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8 Aldrich, *Retail prices and wages*, p. II.

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11 Ibid., p. CXXIII.

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Monthly Labor Review

BLS

June 2016

Does the place you grew up in shape your future as an entrepreneur? Evidence from Italy

Yavor Ivanchev

Entrepreneurs, especially successful ones, have always been a mystery, if not an envy, for many of us bystanders. We often surrender, perhaps conveniently so, to the argument that these individuals possess talents that we don't—innate abilities unattainable through formal or informal learning. That this view has taken hold is not surprising. The business empires of Microsoft and Apple—two obvious examples—were built by college dropouts, and many other enterprises have spawned and thrived under the watch of people with little managerial training.

Notwithstanding anecdotal support for the innate nature of entrepreneurship, economists have started to afford greater importance to nurture. In a recent article titled "Learning entrepreneurship from other entrepreneurs?" (National Bureau of Economic Research, Working Paper 21775, December 2015), Luigi Guiso, Luigi Pistaferri, and Fabiano Schivardi report that adolescents growing up in areas with high concentration of firms are more likely to become entrepreneurs and to be successful at their jobs. The authors see geographical firm density as a learning opportunity: "for a young individual growing up in Silicon Valley," they contend, "it should be easier than elsewhere to learn how to set up and run a firm."

To test this hypothesis, Guiso et al. rely on two complementary data sources from Italy—the Bank of Italy Survey of Households Income and Wealth, which provides demographic and income data for a representative sample of Italian households, and a sample of entrepreneurs and their firms from a survey conducted by the Italian National Association of Insurance Companies (ANIA). Data from ANIA are supplemented with measures that capture various managerial skills and help isolate learned from innate abilities. Firm concentration is recorded at the provincial level, and variation in outcomes—likelihood of becoming an entrepreneur and entrepreneurial success—is examined both across Italian provinces and over time within a province.

Consistent with theory, variation in outcomes does exist, and it is sizable. The authors' regression analysis indicates that an increase of one standard deviation in firm density in one's location at "learning age" (age 18, according to the study) is associated with an 8-percent increase both in the likelihood of sorting into entrepreneurial occupation and in personal income. The businesses of individuals exposed to this environmental channel also stand out in terms of performance, boasting significantly higher total and per-worker productivity. These results remain robust in the presence of various statistical controls, including local availability of capital (which could affect firm concentration) and coming from a household with entrepreneurial parents.

Guiso et al. are careful not to overstate their case, however, and while they highlight the importance of learning in one's formative years, they do not attempt to underplay the role of innate abilities. Indeed, marrying measures of skill with ANIA data shows that the effect of firm density during adolescence is largely limited to the cultivation of better managerial skills and practices. The authors surmise that other personal traits normally viewed as

preconditions for successful entrepreneurship—traits such as greater risk tolerance and hunch for business and product innovation—likely remain in the domain of the innate.

Monthly Labor Review

BLS

June 2016

Labor market will shape U.S. economy in years to come

Editor's note: This essay is part of a series being published to help commemorate the Monthly Labor Review's centennial (July 1915–July 2015). The essays—written by eminent authorities and distinguished experts in a broad range of fields—cover a variety of topics pertinent to the Review and the work of the Bureau of Labor Statistics. Each essay is unique and comprises the words and opinion of the author. We've found these essays to be enlightening and inspirational. We hope you do as well.

Mark M. Zandi

Mark M. Zandi is chief economist of Moody's Analytics, where he directs economic research.

In its 100 years in publication, the *Monthly Labor Review* has remained relevant and insightful through many labor markets. This includes the boom times of the 1920s, 1960s, and 1990s, and the dark times of the 1930s, 1970s, and the past decade. It includes the World Wars, the Korean War, Vietnam, Iraq, and Afghanistan. It includes the surge in female labor force participation in the second half of the 20th century, and the rapidly shifting fortunes of industries, occupations, and regions of the country.

The next 25 years will surely be no different. There will be good and bad times, wars, and large demographic changes. Some industries, occupations, and regions will rise in importance, and others will decline. Through it all, the Monthly Labor Review will continue to provide the information vital to understanding every development.

Among the most important coming changes to the labor market, and arguably among the most certain, is that the nonwhite population will become the majority. Twenty-five years from now, rapidly growing Latino, Black, Asian, and other minority groups will together account for more than half the population.

The economy's success thus critically depends on raising the educational and skill levels of these groups so that they can fill the jobs of the future. This poses significant challenges, as many are from lower income households with fewer educational opportunities. Our property tax system does a poor job financing K-12 education in many poor communities, and the current strategy of using student loans to finance the higher education of these financially pressed households is failing.

Heightening the importance of raising the skill levels of minority groups is the prospect that labor will be in perennial short supply over the next quarter-century. This is in stark contrast to the past quarter-century, when there was more or less a surfeit of labor. Unemployment was generally higher than that consistent with full employment, and not surprisingly, wage growth and the share of national income going to labor declined.

Behind this dismal performance is the concerted effort by the Federal Reserve to wring out inflation, which was the economy's overwhelming problem a quarter-century ago. The Fed managed interest rates so that the economy more often than not operated below full employment, weighing on wages.

The overriding problem today is disinflation, and the specter of deflation hangs over some parts of the world. Global central banks, including the Fed, are working hard to support stronger job growth and reduce unemployment in order to lift wage growth and inflation. The Fed will likely manage interest rates so that the economy generally operates above full employment.

Adding to the coming tight labor market is the inexorable aging of the large baby boom generation into retirement. Labor force participation rates are set to steadily decline over the next quarter-century as the boomers leave the workforce, and labor force growth will come to a virtual standstill at times. Businesses will need to raise wages more aggressively to attract workers on the fringes of the labor force. The labor share of income should rise, and the long-running skewing of income distribution may even unwind somewhat.

Given the tight labor market and the growing minority share of the population, the politics around immigration reform are likely to shift. A path to citizenship for the undocumented seems likely, with more legal immigrants allowed into the country, particularly the highly skilled and educated. The U.S. labor force will grow increasingly more diverse, not just in global gateway cities, but in farther-flung places across the nation.

American businesses will also look to cultivate a more global workforce. They will be selling more of their goods and services more broadly across the world, and they will want workers in those places. They will also tap the talents of those workers and forge truly global workforces, bringing the world closer together economically, politically, and socially.

Businesses will also need to invest more aggressively in new technologies. Without that investment, productivity growth will languish as it has in recent years, and the tight labor market will translate into slower overall economic growth. Middle and lower income households will struggle with this the most, and the nation's long-term fiscal challenges will become even more daunting.

Faster innovation and productivity growth will pose other issues for the labor market. High-skilled workers will be enabled by the new technologies, and low-skilled workers will be relatively untouched, as their tasks are more idiosyncratic and thus less susceptible to technology's effects. However, many middle-skilled workers are vulnerable, and unless they can upgrade their skills, new technologies will push them down the income ladder.

The U.S.'s comparative economic advantage is embodied in its workers. Our economic success depends on our ability to attract the best and brightest from across the globe and to empower all those who are here to become the best they can be. This won't be easy, but the *Monthly Labor Review* will be there to guide us.

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June 2016

The Monthly Labor Review at 100—part III: inflation, employment, and the labor force since 1980

To help mark the Monthly Labor Review's centennial, the editors invited several producers and users of BLS data to take a look back at the last 100 years. This third article in a series of four recounts the Review's history since 1980, focusing on its coverage of inflation, employment, and the labor force.

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Throughout its history, the *Review* has striven to maintain the high quality of the articles it publishes and to keep the public abreast of both the kinds of economic issues that perennially affect the nation and new issues that arise as the nation itself changes economically, demographically, and culturally. This installment and the next present some of the pressing issues, the timely issues, and the enduring issues that have occupied the pages of the *Review* over the last 35 years. Both contain what is hoped to be a representative sample of the articles that have filled the pages of the journal during that period. This installment examines three of the most important topics the *Review* has brought before its readers since 1980: inflation, employment, and the composition and dynamics of the labor force. Both BLS and non-BLS authors contributed amply to these "bread-and-butter" issues making up the *Review*'s content over the decades.

Inflation

The double-digit inflation of the late 1970s persisted into the early 1980s. The years 1979, 1980, and 1981 were bleak economically, with inflation averaging 11.3 percent, 13.5 percent, and 10.3 percent, respectively.[1] The *Review* continued to track the rising inflation numbers coming in month after month, reporting them to concerned readers in "Current labor statistics." Throughout this period of high inflation, articles, reports, and summaries appeared periodically, analyzing and explaining the numbers and offering reasons for their persistence. John F. Early, Craig Howell, and Andrew Clem began things in May 1980 with a penetrating article titled "Double-digit inflation today and in 1973–74: a comparison." In it, they pointed to energy and housing prices, as well as the cost

of materials, as leading causes of the acceleration of inflation to double digits in both periods. Then, invoking this similarity, they observed that one of the major factors—if not *the* major factor—that ended the double-digit inflation of the earlier period was the recession from November 1973 to March 1975. Noting that that recession picked up steam only in late 1974, the authors suggested that economists watch for another severe recession as the chief (though not the only) way the high inflation of 1979–81 would end. That they were correct in their assessment, radical though it was, is attested to by the arrival of a severe recession that brought inflation down from a peak of 10.8 percent in July 1981 to a trough of 3.8 percent in November 1982.

Other articles appearing in 1980 that addressed the inflation scenario of 1979 were “Wage gains in 1979 offset by inflation,” by Joan D. Borum (July), a repeat of the concern the author expressed in her 1979 article over the same situation in 1978; “Slowdown in energy prices eases second-quarter inflation,” by William Thomas, Clem, and Eddie Lamb (September), an entry in the “Anatomy of price change” series discussing an all-too-temporary slackening in the pace of inflation during the quarter in question; “Record white-collar pay increase closes decade but trails inflation,” by Felice Porter (November), another lamentation about too much inflation in the midst of unusually high pay increases; and “Inflation slows in third quarter, although food prices soar,” by Howell, Thomas, and Lamb (December), a mixed account of the inflation situation. Although high inflation continued into 1980, the year 1981 saw a diminution in the number of articles devoted to the subject. Just four articles were written about the pace of inflation in 1980, and by 1981, inflation, though still high, began to slow noticeably, as recorded in the lone 1982 *Review* article on the subject, Craig Howell and Jesse Thomas’ “Price changes in 1981: widespread slowing of inflation” (April). By the end of 1982, inflation had returned to oft-seen, lesser levels, and while the *Review* continued, of course, to record the path of inflation up to the present, the era of double-digit inflation was over.

Interestingly, in the midst of the rampant inflation of 1979–81 came a debate about how accurately the CPI represented the phenomenon. The May 1980 issue of the *Review*—the same issue in which Early, Howell, and Clem compared the double-digit inflation occurring at the time with that of 1973–74—also was the first of several issues that featured a number of economists engaging in a spirited discussion over the merits of the CPI. The proceedings began in that issue with a pair of articles, one by Daniel J. B. Mitchell and the other by Jack E. Triplett, that addressed critics of the CPI. Mitchell opened the discussion by proposing that critics who maintain that the CPI exaggerates inflation because some of its components are upward biased ignore the very real possibility that other of its components have just the opposite effect. Also, maintained Mitchell, although there is no guarantee that the two sets of components offset each other, neither is there a guarantee that they don’t—and anyway, there is at least *some* effect in the opposite direction. In support of Mitchell’s argument, Triplett’s piece pointed to empirical studies showing that non-BLS indexes of owner-occupied housing, rental costs, and new-car prices—components ignored by critics—were, in general, higher than corresponding BLS indexes. Thus, it was by no means farfetched, and was even quite plausible, said Triplett, that these components could dampen whatever upward bias might exist in the other CPI components.

The March 1981 issue of the *Review* featured two articles on the accuracy of the CPI. In the first, BLS Commissioner Janet L. Norwood built on Mitchell’s and Triplett’s exposition, examining “Two Consumer Price Index issues: weighting and homeownership”—issues that those authors had cited as being ignored by critics. Bringing to bear past BLS experience showing that weighting changes necessitated by revisions to the CPI had little effect on the index and pointing out that estimates of inflation based on the U.S. Commerce Department’s Deflator for Personal Consumption Expenditures (PCE) with different weights were little different from those of the CPI, Norwood deflected the critics’ complaints as inadequate. Regarding homeownership, she offered an experimental, more accurate “rental equivalence” CPI as a possible way of addressing the critics’ arguments. As things turned out, BLS changed its treatment of homeownership and incorporated the change into the CPI in 1983. The second article, “Indexing federal programs: the CPI and other indexes,” excerpted from a publication jointly authored by the President’s Council of Economic Advisers and the Office of Management and Budget, complemented Norwood’s article in that it, too, addressed the complaints leveled at the CPI regarding the issues of

weighting and homeownership—and, in line with Norwood's conclusions, suggested the adoption of the new experimental CPI as the best way of overcoming the critics' objections.

Capping off the CPI controversy running through the high-inflation scenario of 1979–81 was a September 1981 trio of articles under the title "Measuring prices." Triplett led off the discussion with a highly technical piece titled "Reconciling the CPI and the PCE Deflator." Scrutinizing seven versions of the CPI published by BLS and three versions of the PCE deflator published by the Bureau of Economic Analysis (BEA),[2] he concluded that whatever differences there were among them could be reconciled if one distinguished between "longer-term inflation measurements and…period-to-period inflation rates." In the second article of the trio, "Defining the rate of underlying inflation," David W. Callahan observed that "Overall measures of price increase reflect both a core rate of inflation residing in the economy and the short-run effects of uncontrollable external shocks." Citing the kinds of shocks that need to be accounted for in the short term, he then reflected on how these prima facie very different measures might be reconciled, concluding that reconciling them is necessary only in the short run, because, in the long run, "All shocks are absorbed, all adjustments have been made, and the underlying rate of inflation coincides with the long-term trend in the measure of overall inflation." The final article, "Some proposals to improve the Consumer Price Index," by Phillip Cagan and former BLS Commissioner Geoffrey H. Moore, suggested fixing the CPI by changing the way homeownership was measured (the measurement of homeownership was universally acknowledged as problematic in the official BLS CPI) and experimenting with averaging current- and base-weighted indexes. Together, the articles in the three series from the *Review*s of May 1980, March 1981, and September 1981 on the ongoing controversy over the CPI heralded the change in the index described in Robert Gillingham and Walter Lane's June 1982 *Review* article "Changing the treatment of shelter costs for homeowners in the CPI"—a change subsequently begun in 1983 and completed in 1987, as related by John L. Marcoot in "Revision of Consumer Price Index is now under way" (April 1985).

After inflation eased in 1982, returning to "normal" levels toward the end of the year, not only was the era of double-digit inflation over, but low—sometimes even negative—inflation prevailed from then until the present.[3] Still, although inflation did not possess the urgency it had earlier, the *Review* reported on it regularly: articles on the year's inflation appeared annually well into the 1980s, and features on various aspects of inflation and the CPI arose from time to time, discussing theoretical and methodological issues (e.g., Kenneth J. Stewart and Stephen B. Reed, "Consumer Price Index research series using current methods, 1978–98," June 1999; Janice Lent, "Estimating an energy consumer price index from establishment survey data," December 2011), making comparisons across countries (Walter Lane and Mary Lynn Schmidt, "Comparing U.S. and European inflation: the CPI and the HICP," May 2006), and, in a grand tour de force, chronicling the entire history of inflation and the CPI—the latter's changing methodology, the political forces shaping the index, and the American experience with inflation for the past 100 years (Darren Rippy, "The first 100 years of the Consumer Price Index: a methodological and political history," April 2014; Stephen B. Reed, "One hundred years of price change: the Consumer Price Index and the American inflation experience," April 2014).

Employment

Employment is, by far, the bread and butter of the *Review*, with more than double the number of articles written on it than on any other topic from 1980 to the present. That should come as no surprise, because employment is, after all, the backbone of the U.S.—or, for that matter, any other developed country's—economy. The *Review*'s assessment of the employment situation in the 1980s is perhaps best captured by Lois Plunkert's September 1990

article, “The 1980’s: a decade of job growth and industry shifts.” Beginning with the interesting juxtaposition of two recessions in 3 years at the beginning of the decade with “the longest peacetime expansion on record” throughout the rest of the period, Plunkert went on to describe a scenario in which, indeed, the sheer magnitude of the growth in employment was impressive, but the reach of the growth was uneven. Led by the large number of new jobs posted month after month in the service sector, the economy nonetheless steadily lost jobs in the manufacturing and mining industries, which never recovered from the aforementioned recessions. Even the service sector record was spotty, with one-quarter of the new jobs created in business or health services and some industries, such as communications, railroads, and water transportation, losing jobs. On net, the 1980s saw a continuation of the shift from the goods-producing sector to the service-providing sector, with another 6 percent of employment shifting over.

In addition to Plunkert’s comprehensive article, a number of articles of lesser scope, but no less substantive, were written about various aspects of employment during the 1980s. Among the more salient ones were a special labor force report by Allyson Sherman Grossman on “Working mothers and their children” (May 1981) that cited changing marital patterns, high inflation, and smaller families as factors contributing to the labor force participation of more mothers with children under 18 years old; BLS Commissioner Norwood’s August 1983 piece, “Labor market contrasts: United States and Europe,” which was drawn from her commencement address at Tufts University’s Fletcher School of Law and Diplomacy and looked beyond the unemployment rates of eight countries in North America and Europe to find a more favorable employment outlook for the United States than for Europe—an insight that turned out to be correct as time went on; an article titled “The declining middle class: a further analysis” (September 1986), by Australian economist Patrick J. McMahon and BLS’s own John H. Tschetter, which found that, between 1973 and 1982, despite an increase in the proportion of workers in higher paying occupations, the earnings distribution in the top, middle, and bottom occupation groups had shifted such that each group included more lower paying positions; and Bruce W. Klein and Philip L. Rones’ “A profile of the working poor” (October 1989), in which the authors found that 6.4 million workers, or 5.6 percent of the labor force, were members of poor families. Among these “working poor,” unmarried women with children were at the greatest risk for living in poverty, with the chief reason being low wages likely due to low levels of education.

Employment in the 1990s is perhaps best summarized in Julie Hatch and Angela Clinton’s December 2000 article, “Job growth in the 1990s: a retrospect.” After a brief recession that lasted from July 1990 to March 1991, the U.S. economy “rebounded with the longest running expansion in the Nation’s history.” Employment grew by nearly 21 million over the decade, the most ever recorded between censuses. As in the 1980s, jobs continued to shift from the goods-producing sector to the service-providing sector of the economy, with mining and manufacturing again the biggest losers. Employment in business services grew the most, accounting for a third of all job growth in services over the decade. Computer and data-processing services added more than a million jobs, and colleges and universities could not produce graduates with computer degrees fast enough for the growing demand. Health services, though growing at a slower pace than in the 1980s, still contributed more than 2.5 million jobs to the economy. Government had mixed results: federal government employment fell to levels not seen since 1965 as the Department of Defense lost 333,000 jobs, but state government and local government added jobs, although state government did so at a level less than that of the 1980s. The stock market surged, and investors poured money into Internet-based companies, or “dot-coms.” Amongst all the good news, however, the stage was set for the bursting of the dot-com bubble in the opening years of the 21st century.

Foremost among articles addressing specific employment issues or subperiods of the 1990s was the “annual story” series of articles that tracked employment every year. The title of each article revealed the progression of the economy, from recession to record expansion, over the decade: “U.S. labor market weakened in 1990,” by Steven E. Haugen and Joseph R. Meisenheimer II (February 1991); “Job market slid in early 1991, then struggled to find footing,” by Meisenheimer, Earl F. Mellor, and Leo G. Rydzewski (February 1992); “1992: job market in the doldrums,” by Thomas Nardone, Diane E. Herz, Mellor, and Steven Hipple (February 1993); “The labor market improves in 1993,” by Jennifer Gardner, Hipple, and Nardone (February 1994); “Strong employment gains continue in 1994,” by Lois M. Plunkert and Howard V. Hayghe (February 1995); “Slower economic growth affects the 1995 labor market,” by Gardner and Hayghe (March 1996); “Employment in 1996: jobs up, unemployment down,” by William C. Goodman and Randy E. Ilg (February 1997); “Strong job growth continues, unemployment declines in 1997,” by Ilg and Clinton (February 1998); “Job growth slows during crises overseas,” by Goodman and Timothy D. Consedine (February 1999), referring to economic problems in Asia that reduced foreign demand for U.S. goods; and, despite the previous article, “The job market remains strong in 1999,” by Jennifer L. Martel and Laura A. Kelter (February 2000). Taken together, the articles in the series clearly proclaimed the overall strength of the economy from 1990 to 2000.

The “annual story” was not the only employment story that the *Review* covered in the 1990s. Another “story” was nonstandard employment, also known as contingent employment. The October 1996 issue was given over entirely to examining this topic. Anne E. Polivka began the discussion with two articles: “Contingent and alternative work arrangements, defined” and “A profile of contingent workers.” The first article identified a contingent worker as a worker without a contract, either explicit or implicit, for a long-term work arrangement and found that, under one set of criteria, there were 6 million contingent workers in the United States, making up about 5 percent of the workforce. The second article found that contingent workers were more likely than noncontingent workers to be female, Black, young, enrolled in school, and employed in either services or construction; more than 10 percent were teachers. Then came an article by Hipple and Jay Stewart on “Earnings and benefits of contingent and noncontingent workers” which found, perhaps to no one’s surprise, that contingent workers generally earned less, and were less likely to receive health insurance and pension benefits through their employers, than were noncontingent workers—although many had access to health insurance from other sources. Next, Sharon R. Cohany’s “Workers in alternative employment arrangements” reported that people working as independent contractors, temporary help agency workers, contract company workers, or on-call workers differed not only from workers in traditional arrangements, but also from one another in level of education and job security. Then, returning with another article, “Earnings and benefits of workers in alternative work arrangements,” Hipple and Stewart found that, although temporary help agency workers and on-call workers earned less than workers in traditional arrangements, contract company workers and independent contractors earned more.

Finally, Polivka and Donna S. Rothstein ended the conversation that took place in the October 1996 issue with a pair of articles that delved into the reasons for, and consequences emanating from, entering into an alternative work arrangement. In Polivka’s “Into contingent and alternative employment: by choice?,” the author sought to adjudicate between two opposing views: that being in a contingent arrangement consigns a worker to the bottom of the economic ladder, with frequent job changes, little economic security, and no prospect of advancement; and that contingent arrangements offer workers both pathways into the labor market and the flexibility to balance work with other obligations. What she found was that neither picture told the whole story: workers enter into nonstandard arrangements for many reasons, and although, indeed, some workers find themselves in such

arrangements involuntarily, they are relatively few in number; for many others, a contingent work arrangement presents an opportunity to work that might otherwise be unavailable. Rothstein's findings, set forth in her article "Entry into and consequences of nonstandard work arrangements," complement and add to Polivka's. Rothstein, too, found that workers enter into nonstandard arrangements for a host of reasons, two important ones for women being the birth of a child and a change in marital status. Rothstein also found that women are more likely than men to be in a contingent arrangement, especially if they had given birth during the previous 2 years—a finding implying that such arrangements "provide more flexibility than full-time regular work arrangements."

The employment situation of 2000–15 was in stark contrast to that of the 1990s. From the turn of the century to the present, events, many unprecedented, unfolded at a rapid pace, and their economic effects were profound. The bursting of the dot-com bubble in March 2000 and the subsequent stock market downturn; the terrorist attacks of September 11, 2001, and another stock market tumble; the Iraq War; Hurricane Katrina in August 2005; the subprime-mortgage crisis, the financial crisis, and yet a third stock market plunge, beginning in mid-2007; the Great Recession of 2007–09; and later events—all had an economic impact, and the *Review* covered those impacts in one or another article over the 15 years since 2000. Three articles by Michael Dolfman and colleagues were particularly noteworthy. In the June 2004 issue, Dolfman and Solidelle F. Wasser's article, "9/11 and the New York City economy: a borough-by-borough analysis," gave a detailed account of the economic aftermath of the attack on employment in each of the city's five boroughs. Focusing on Manhattan, they found that the export sector—the most internationally oriented part of the city's economy—was hardest hit, with the finance and insurance industry losing more than 35,000 jobs since 2000; professional, technical, and scientific occupations about 34,000; the information industry more than 23,000; and manufacturing more than 11,000. The other boroughs fared better than Manhattan, but still did not necessarily go unscathed: Queens lost more than 7,000 jobs in the scheduled air transportation industry and about 17,500 in export-related industries; Brooklyn about 4,500 in total; the Bronx 1,300 manufacturing jobs; and Staten Island less than 1,000 (with the caveat that not all of the jobs lost in Brooklyn, the Bronx, and Staten Island could be definitively attributed to the attack itself).

Two years later, following up on the earlier article, Dolfman, Wasser, and Kevin Skelly evaluated "Structural changes in Manhattan's post-9/11 economy" in the October 2006 issue of the *Review*. Concluding that employment bottomed out in Manhattan in 2005, they found that the borough nonetheless increased its role as a wage generator, with high wages in the global, or export, sector driving demand in the local sector—those industries supporting the global sector. In effect, although many jobs had been lost to the terrorist attack, wages in certain industries and occupations—primarily financial and insurance; information; professional, scientific, and technical services; management of companies; and real estate and leasing—had risen to such an extent that the former influence of employment as a driver of the local economy was eclipsed by the new role of wages. As a result, the global sector of Manhattan's economy has diminished in importance and the local sector has advanced. "In other words," said the authors, "the rising income in the global sector is what is spurring demand for more labor intensive local-sector jobs."

Less than 1 year later, in the June 2007 issue, Dolfman, Wasser, and Bruce Bergman assessed “The effects of Hurricane Katrina on the New Orleans economy.” What they found was far worse than what they had concluded about New York: the New Orleans economy was devastated, with 105,000 jobs, or roughly 42 percent of all jobs, lost a year after the hurricane. In industry after industry, occupation after occupation, the figures were eye opening: 10 months after the hurricane, tourism was down by almost 23,000 jobs; healthcare by about 13,500; port operations by 3,500; educational services by nearly 2,000; and professional, scientific, and technical services by just under 1,700. Construction alone registered large employment gains—almost 5,000 jobs—and that was due solely to recovery efforts that got under way after the industry lost jobs immediately after the hurricane. Using location quotients, the authors nevertheless judged New Orleans’ prospects for recovery as favorable: tourism, port operations, and educational services—despite suffering large employment losses—had survived as a foundation for the future, and that “triumvirate source of economic strength…bodes well for the future.”

Dolfman and colleagues were not alone in examining the employment effects of Hurricane Katrina: a year after the cataclysm, the *Review*’s entire August 2006 issue was devoted to the tragedy. An overview preceded six articles in which a number of authors assessed various aspects of the employment impact of the hurricane, not just on New Orleans, but also on other jurisdictions along the U.S. gulf coast. “The labor market impact of Hurricane Katrina: an overview” introduced the articles that followed, presenting essentially a visual essay of many salient facts surrounding the catastrophe. Then, Richard L. Clayton and James R. Spletzer discussed “Worker mobility before and after Katrina,” finding that a number of the many workers displaced from New Orleans by the storm quickly found jobs in Texas but still suffered a substantial decline in their short-term earnings. Next, Molly Garber, Linda Unger, James White, and Linda Wohlford analyzed “Hurricane Katrina’s effects on industry employment and wages” in 11 affected areas of Louisiana and Mississippi, and not only found that jobs were still down 1 year after

the hurricane, but also reported that BLS efforts to continue normal data collection and publication schedules and to adjust normal estimation and imputation procedures were relatively successful in getting accurate information on the employment effects of the storm. Following Garber and colleagues' article was "The Current Population Survey response to Hurricane Katrina," by Lawrence S. Cahoon, Diane E. Herz, Richard C. Ning, Anne E. Polivka, Maria E. Reed, Edwin L. Robison, and Gregory D. Weyland, which presented the results of a BLS–Census Bureau collaboration showing that "jobless rates were sharply lower for those evacuees who returned home than for those who did not." Then, Sharon P. Brown, Sandra L. Mason, and Richard B. Tiller found that "The effect of Hurricane Katrina on employment and unemployment" was severely depressed employment levels, and temporarily higher unemployment levels, in Louisiana and Mississippi. Next, in the fifth article of the set, "Conducting the Mass Layoff Statistics program: response and findings," Brown and Patrick Carey touted the "careful collaboration between BLS and State agencies" in overcoming data collection challenges and identifying the accommodation and food services sector in Louisiana and Mississippi as the sector with the most mass layoffs due to Katrina. Finally, rounding out the discussion of the hurricane, Charles S. Colgan and Jefferey Adkins examined the extent of "Hurricane damage to the ocean economy in the U.S. gulf region in 2005," finding that gulf coast counties and parishes affected by Hurricane Katrina—and, close to a month later, Hurricane Rita— sustained the largest insured dollar losses in a year from catastrophes of that nature. As a measure of the momentousness of the loss, the authors noted that the affected counties and parishes constituted 80 percent of employment in Louisiana, 33 percent in Texas, 14 percent in Alabama, and lesser, though by no means negligible, percentages in Florida and Mississippi.

The Great Recession, rivaling 9/11 as the most significant U.S. event of the 21st century to date, received an abundance of coverage that stretched over several years of issues of the *Review*. It all started with two March 2008 articles that, although published after the recession began, were actually harbingers of it, because, at the time, the recession had not yet been officially declared. First, reporting the CPS annual story in an article titled "Household survey indicators weaken in 2007," James Marschall Borbely informed readers that "unemployment rose, employment growth slowed, and the labor force participation rate and employment–population ratio trended down." Then, in "Payroll employment in 2007: job growth slows," Robyn J. Richards seconded Borbely's findings as she reported the CES annual story. Richards found that "employment grew by just 0.8 percent in 2007, the lowest rate in 4 years," with the 1-month diffusion index for total private employment falling below 50 for the first time since 2003—meaning that more industries lost than added jobs over the year. After that, the recession picked up full steam, officially beginning in December 2007 and ending in June 2009,[4] and the BLS annual stories recorded its progress during that time every spring from 2009 through 2011. Once again, the titles of the articles are by themselves descriptive: "U.S. labor market in 2008: economy in recession" (Borbely, March 2009); "Substantial job losses in 2008: weakness broadens and deepens across industries" (Laura A. Kelter, March 2009); "Job openings and hires decline in 2008" (Katherine Klemmer, May 2009); "Payroll employment in 2009: job losses continue" (Megan M. Barker and Adam A. Hadi, March 2010); "Job openings, hires, and separations fall during the recession" (Mark deWolf and Klemmer, May 2010); " Unemployment remains high in 2010" (Eleni Theodossiou and Steven F. Hipple, March 2011); and "Payroll employment turns the corner in 2010" (John P. Eddlemon, March 2011). Interspersed among the various annual stories were two broader, but still Great Recession–related articles. In the first, in April 2009, Harley J. Frazis and Randy E. Ilg, analyzing "Trends in labor force flows during recent recessions," found that the Great Recession (still in progress at the time of publication) was characterized by a decrease in flows into employment from March 2007 to December 2008 and a decrease in flows out of unemployment in mid-2007, consistent with "a prolonged slowdown in job creation occurring alongside

an increase in job destruction." Thus, maintained the authors, the Great Recession "differs from…most earlier recessions, which were marked more by increasing flows out of employment." In the second broad article, "The nation's underemployed in the 'Great Recession' of 2007–09," Andrew Sum and Ishwar Khatiwada used data from the CPS to show that "the less educated, those in low-skilled occupations, and those in low-paying occupations had a higher incidence of underemployment during the 2007–09 recession." The authors also found that underemployment was concentrated among workers from lower income households.

As a measure of the importance the *Review* attached to the Great Recession, the April 2011 issue was devoted entirely to that subject. A piece titled "Employment loss and the 2007–09 recession: an overview," by Christopher J. Goodman and Steven M. Mance, set the stage for nine articles that examined the effect of the recession on employment in various industries. Observing that "the downturn in employment accompanying the 2007–09 recession was notable for its prolonged length, for affecting an especially wide range of industries, and for being deeper than any other downturn since World War II," the overview pointed out that, as of December 2010, a year and a half after the trough of the recession, employment remained 7.7 million jobs below the prerecession peak. Next, surely by design, the article "Employment in health care: a crutch for the ailing economy during the 2007–09 recession," by Catherine A. Wood, set a positive tone, letting the reader know at the outset that there was at least one bright spot in the economy: through all the job losses, the healthcare industry grew by 428,000 jobs during the recession and continued to grow steadily thereafter. Wood concluded her exposition with a noteworthy observation: "that [the healthcare industry] boosted employment at all during such a severe and prolonged economic downturn is remarkable." Following Wood's article came Brian Davidson's piece "Mining employment trends of 2007–09: a question of prices," in which the author noted that the mining industry managed to sustain job growth through the first 10 months of the recession, buoyed by markedly higher oil prices; after that, when oil prices fell substantially, employment fell as well, reaching a trough 4 months after the recession had ended. In sum, the period of falling employment in mining was 6 months shorter than the duration of the recession.

Then came the parade of unpalatable news, leading off with the worst case of all: the construction industry. The title of Adam Hadi's article succinctly told it all: "Construction employment peaks before the recession and falls sharply throughout it." Job losses amounted to 1.5 million, a 20-percent decline in employment in the industry, the largest percent decline of all industries during the Great Recession. Not far behind, however, was manufacturing: fleshing out her article, "Manufacturing employment hard hit during the 2007–09 recession," Megan M. Barker cited the loss of 2 million employees, or 15 percent of the industry's workforce, as indicative of the ongoing dire straits of manufacturing, an industry on a downward trend since 1979, with job losses accelerating during every recession thereafter. Then, in "Professional and business services: employment trends in the 2007–09 recession," Frank Conlon related that industry's woes during the recession, including the loss of 1.6 million jobs, or nearly 9 percent of the industry's workforce. The loss was the largest ever recorded in the industry, in both percentage and absolute number. Most striking were the losses in the administrative and waste services component of the industry, a component that accounted for 3 of every 4 jobs lost in professional and business services. Next in the parade of industries pummeled by the recession was the finance industry,[5] whose troubles were aptly described in the title of George Prassas' article: "Employment in financial activities: double billed by housing and financial crises." Indeed, the industry had received a twofold hit: first, preceding the recession by more than a year and a half, the housing market bubble burst after a peak in employment in the real estate credit industry and among mortgage and nonmortgage brokers and real estate brokers in April 2006; then, in October 2008, after the start of the recession, the financial markets began to experience large losses that lasted until almost a year after the National Bureau of

Economic Research declared the recession over. All told, employment in the finance industry fell by 473,000, or 5.8 percent, during the recession.

Retail trade was next in the discussion of industries hit by the recession. Michael D. McCall described the "Deep drop in retail trade employment during the 2007–09 recession," a slide amounting to a loss of a little more than a million jobs, or 6.7 percent of the industry's employment. Motor vehicle and parts dealers lost the most jobs in the retail trade industry, 271,000, followed by clothing and clothing accessories stores, which shed 161,000 jobs. Then, in "Employment in leisure and hospitality departs from historical trends during 2007–09 recession," Eliot Davila told how the leisure and hospitality industry suffered the most severe and prolonged downturn in employment in a long history in which the industry had experienced almost uninterrupted job growth. Finally, Steven Kroll wound up the discussion with an article on "The decline in work hours during the 2007–09 recession," revealing the not-unexpected finding that average weekly hours for workers in private industry decreased across all industries during the recession. Hours were pulled down further, said Kroll, "as a result of heavy job losses in industries with above-average workweeks." Summing up the effect of the Great Recession and the economic situation as of December 2010, 4 months before publication of the series of articles in the *Review*, Goodman and Mance said, in their overview, "The U.S. economy is recovering from one of the longest and deepest recessions since the end of World War II…[in which] virtually no area of the economy remained unscathed,…particularly the labor market."

After the April 2011 issue, the *Review* continued to report on employment in a now recovering (though modestly) economy. Following a gloomy August 2011 assessment titled "Job openings and hires show little postrecession improvement," by Katherine Bauer Klemmer and Robert Lazaneo, the titles of the publication's "annual stories" reveal the slow upward progression of employment from March 2012 to the present: "Payroll employment growth accelerates in 2011" (Parth A. Tikiwala and Frank Conlon, March 2012—the CES annual story); "U.S. labor market shows gradual improvement in 2011" (Eleni Theodossiou, March 2012—the CPS annual story); "Job openings and hires continue to show modest changes in 2011" (Guy L. Podgornik, September 2012—the Job Openings and Labor Turnover Survey, or JOLTS, annual story); "Slow and steady: payroll employment grew moderately in 2012" (Sutton E. Puglia and Parth A. Tikiwala, March 2013); "U.S. labor market continued to improve in 2012" (Lisa Williamson, March 2013); "Job openings continue to grow in 2012, hires and separations less so" (Kendra C. Hathaway, May 2013); "Nonfarm employment continued its road to recovery in 2013" (Kara Sullivan, March 2014); "Unemployment continued its downward trend in 2013" (Catherine A. Wood, April 2014); "Continued improvement in U.S. labor market in 2014" (Eleni Theodossiou Sherman and Janie-Lynn Kang, April 2015); "CES employment recovers in 2014" (John P. Mullins and Brittney E. Forbes, April 2015); and "Job openings reach a new high, hires and quits also increase" (Kevin S. Dubina, June 2015). The *Review* will continue to report regularly on employment—the most basic aspect of the economy—for the foreseeable future.

Labor force

The labor force has been a key area of investigation for the *Review* since its inception. A sampling of articles from the 1980s, the 1990s, and the period from 2000 to 2015 reveals a variety of labor force–related topics examined from decade to decade: the demographic mix of the labor force, the labor force participation rate, the youth labor force, the employment-to-population ratio, the women's labor force, working mothers, the older labor force, baby boomers, the racial and ethnic composition of the labor force, and veterans in the labor force, to mention just a few. Articles from the 1980s include "The employment–population ratio: its value in labor force analysis" (February

1981), by Carol Boyd Leon, who touted the consistent cyclical properties of that statistic and the accuracy of its seasonal adjustment in measuring the ability of the economy to provide jobs; “The labor market problems of older workers” (May 1983), in which Philip L. Rones observed that “older workers do not have especially high unemployment rates, but when they become unemployed, they are less likely to find a job, and more likely to leave the labor force in discouragement”; Ellen Sehgal’s “Foreign born in the U.S. labor market: the results of a special survey” (July 1985), which found that, despite initial hardship, recent entrants to the U.S. labor force saw their employment and earnings approach those of native-born workers with the passage of time; “An international comparison of labor force participation, 1977–84” (May 1986), Patrick J. McMahon’s comprehensive look at labor force participation in six countries; and “Labor force status of Vietnam-era veterans” (February 1987), by Sharon R. Cohany, who presented the results of a special survey which found that men who served in Southeast Asia—especially those with service-connected disabilities—encountered labor market difficulties substantially greater than those of nonveterans of the same era.

Among labor force articles published in the 1990s were Paul O. Flaim’s “Population changes, the baby boom, and the unemployment rate” (August 1990), an article showing that, because of their large numbers, baby boomers (those born between 1946 and 1964) had a substantial effect on the unemployment rate. In the late 1960s and throughout most of the 1970s, they put upward pressure on the rate, with many of them having entered the job market as teenagers and twenty-somethings looking for employment. In the 1980s, they exerted downward pressure on the unemployment rate, when, in their thirties and forties, they found employment, and remained employed, more easily. Flaim projected that the baby boomers would continue to put downward pressure on the unemployment rate in the 1990s. Other articles of the same decade were “Working and poor in 1990” (December 1992), by Jennifer M. Gardner and Diane E. Herz, an article unequivocally linking poverty in working families chiefly to their low wages—an issue receiving much attention today—but also to a small number of workers in the

family and to families maintained by women; Herz's solo article examining "Work after early retirement: an increasing trend among men" (April 1995), in which the author found that early pensioners were returning to work at a faster pace than in the previous decade, a transition likely attributable to a number of factors, including changes in the types and provisions of pensions, increases in healthcare costs, and longer life expectancies spent more healthily; Alexander Kronemer's intriguing "Inventing a working class in Saudi Arabia" (May 1997), an international report on that country's unusual labor force, in which 9 of every 10 private sector workers were foreigners, and on the Kingdom's effort to replace as many of them as possible with qualified Saudis in the face of a culture that long has had a "strong distaste for the kinds of work found in most manufacturing and office-support jobs"; and "The long-term consequences of nontraditional employment" (May 1998), by Marianne A. Ferber and Jane Waldfogel, a followup to the *Review*'s October 1996 special issue on contingent and alternative work arrangements. Ferber and Waldfogel found strong evidence indicating that a history of part-time work is associated with lower pay for both men and women, except for men who were self-employed and women who were working part time voluntarily.

The years from 2000 to 2015 saw the *Review* continue its examination of the many aspects of the labor force. A sample of articles published during those years brings out the flavor of the issues discussed. Ten years after Flaim's piece on the initial negative and then positive unemployment effects of the baby boomers transitioning into older age groups, Arlene Dohm picked up the story in her article "Gauging the labor force effects of retiring baby-boomers" (July 2000). She began by observing that the boomers were approaching retirement age and their effect on both the overall economy and certain occupations and industries, as in all the previous decades, would be substantial. Then, she contemplated the prospect that many younger workers might not have the relatively high level of skills required to fill the jobs vacated by retiring baby boomers. Dohm went on to say that the industries most affected—those with the greatest percentage of workers 45 years and older who were likely to retire or otherwise permanently leave the occupation—would be educational services, public administration, transportation, and health services. She was encouraged, however—and in this, she was right, as was borne out in later *Review* articles—by indications that older workers were delaying their departure from the labor force or returning to it after retirement.

In another study of the labor force, Abraham Mosisa examined the "Labor force characteristics of second-generation Americans" (September 2006), focusing on the children of foreign-born workers. Comparing second-generation Americans—those with one or both parents foreign born—with their counterparts in third and higher generations, he found that "the second generation is more racially diverse than the third generation; and second-generation individuals tend to have higher levels of education than their third-generation counterparts." Thus, wrote Mosisa, "it appears that members of the second generation of American workers have achieved [labor market] parity with their third-generation counterparts; indeed, in some respects, they may have become more successful." He went on to point out that a key factor in the second generation's success in the workforce is its level of educational attainment: "The second generation has taken advantage of access to education," and "38.0 percent of those aged 25 to 54 years have at least a bachelor's degree, compared with 29.7 percent of the third generation." In this regard, continued Mosisa, "second-generation workers are somewhat more likely than third-generation workers to be employed in professional and related occupations, and in management, business, and financial operations. The median annual earnings of second-generation workers are somewhat higher than those of their third-generation counterparts."

By 2010, Asians in the nation numbered 11.2 million and accounted for 4.7 percent of the U.S. civilian noninstitutional population ages 16 and older. There were 7.2 million Asians in the labor force, and their participation rate was almost 66 percent. In the November 2011 issue of the *Review*, Mary Dorinda Allard captured the group's diversity—and similarities—in her article "Asians in the U.S. labor force: profile of a diverse population." Examining the labor force statistics of the six major Asian groups populating the nation, Allard arrived at the following results distinguishing the groups from one another: Chinese (22 percent of all Asians) workers were overrepresented in food preparation and serving-related occupations and in computer and mathematical occupations; Indians (18 percent) were most likely to be foreign born, be married, and have a bachelor's degree or higher; among Filipinos (17 percent), women outnumbered men and had a higher labor force participation rate than women in any other Asian group and about a third of workers were in the health care and social assistance industry; Vietnamese (11 percent) were the least likely of the groups to have a bachelor's degree or higher, and about one-fifth of Vietnamese workers were in personal care and service occupations; about one-quarter of Korean (10 percent) workers were self-employed, a much higher percentage than that for any other Asian group; and, unlike the other Asian groups, the Japanese (6 percent) were mostly native born, and they were more likely to be ages 55 and older. (Other Asians, including Thais, Pakistanis, Cambodians, Hmong, and Laotians, together made up the remaining 16 percent.) With regard to similarities, probably the most important economic one that Allard found was that all the Asian groups suffered increased unemployment rates during the Great Recession—though less so than non-Asians.

Rounding out the sample of *Review* articles on the labor force published in the period from 2000 to 2015 is an October 2012 entry by Alix Gould-Werth and H. Luke Shaefer examining "Unemployment Insurance participation by education and by race and ethnicity." In it, the authors analyzed results from the 2005 Unemployment Insurance (UI) Non-Filers Supplement to the CPS in order to learn "whether application for and receipt of benefits among applicants varies systematically with two key demographic characteristics" of the labor force: "educational attainment, and race and ethnicity." Regarding education, the highly educated were more likely than the less educated to apply for UI benefits and to receive benefits if they applied. If they perceived themselves as ineligible for benefits (and therefore didn't apply to the UI program), the highly educated were again more likely than the less educated to attribute their perceived ineligibility to voluntarily quitting their job. By contrast, the reason given by most of the less educated unemployed workers for perceiving themselves as ineligible for UI benefits (and hence not applying for them) was that they did not work enough or earn enough to qualify. The latter finding suggests that less educated workers may lack a sufficient understanding of UI eligibility criteria and is therefore an impetus for further research.

With regard to race and ethnicity, Hispanic respondents to the survey were far less likely than White non-Hispanic or African American respondents to apply for UI benefits and, when they did apply, to receive benefits. The authors ruled out noncitizenship as a reason for both disparities, because both persisted when the Hispanic sample was restricted to citizens. The authors found statistically significant differences between Hispanic respondents, on the one hand, and White non-Hispanic respondents and African American respondents, on the other, in a number of areas: (1) a greater proportion of Hispanic respondents than both White non-Hispanic respondents and African American respondents indicated that they did not know where or how to apply as a reason for failing to file; (2) a greater proportion of Hispanic respondents than both White non-Hispanic respondents and African American respondents also indicated that they did not know that benefits existed; and (3) more than 5 percent of Hispanic respondents (but no Hispanic citizens) listed inability to speak English as a reason for not filing, compared with

one-quarter of 1 percent of White non-Hispanic respondents and no African American respondents. All of these findings suggest that future studies of application for, and receipt of, UI benefits should examine Hispanic workers separately from African American workers and, indeed, from other minority workers in order to understand what factors are driving the differences between them.

Conclusion

Since 1980, the *Review*'s coverage of inflation, employment, and the labor force has been extensive. Although these topics were featured consistently in earlier periods, their treatment in the journal's more recent issues has added more to our understanding of, among other things, the causes and effects of inflation, the employment impacts of recessions and other economically disruptive events, and the imprint of demographic change on the labor force. The final installment in the series will focus on three additional topics discussed extensively in the *Review* since 1980: employee benefits, industries and occupations, and worker safety and health.

Note: Monthly Labor Review articles published since 1980 are available online at https://www.bls.gov/opub/mlr/2016/home.htm.

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NOTES

1 See "Table of historical inflation rates by month and year," *Historical inflation rates: 1914–2016* (San Antonio: Coinnews Media Group, January 20, 2016), http://www.usinflationcalculator.com/inflation/historical-inflation-rates.

2 Norwood referred to the PCE deflator as a product of the Commerce Department, Triplett as a product of the BEA. In actuality, it is both: the BEA is an agency of the Commerce Department.

3 "Table of historical inflation rates by month and year."

4 According to the National Bureau of Economic Research, the official arbiter of recession beginning and ending dates.

5 North American Industry Classification System sectors 52 (finance and insurance) and 53 (real estate and rental and leasing).

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Measuring quarterly labor productivity by industry

Timely statistics on output, employment, and productivity are essential to understanding the performance of the U.S. economy. This study examines newly available quarterly GDP-by-industry statistics to determine whether they can be used to produce reasonable quarterly labor productivity measures at the industry level. The results show that the quarterly labor-productivity data at the industry level can provide insights into which industries are driving current aggregate economic performance. However, the quarterly industry data are highly volatile and are most useful when evaluated in conjunction with long-run trends in order to more precisely assess the business cycle dynamics.

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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 needed to assess changes in technology, labor share, living standards, and competitiveness. The U.S. Bureau of Labor Statistics (BLS) produces both quarterly labor productivity measures for broad sectors of the U.S. economy and annual labor productivity measures for industries.[1] Quarterly labor productivity data are analyzed as indicators of cyclical changes in the economy and are closely watched by the financial community, nonfinancial businesses, government policymakers, and researchers. Industry-level productivity statistics provide a means for comparing trends in efficiency and in technological improvements across industries, and indicate which industries are contributing to growth in the overall economy. Although annual industry productivity data can be used to analyze past industry performance and long-term trends, they are not frequent enough to provide indicators of current industry performance or identify which industries are driving current aggregate economic performance. Industry-level labor input data are available on a quarterly basis, but corresponding quarterly industry-level output data for nonmanufacturing industries—data that are necessary for constructing labor productivity measures—have not been available until recently.

In April 2014, the U.S. Bureau of Economic Analysis (BEA) began releasing quarterly gross domestic product (GDP)-by-industry measures.[2] These new output measures were developed to be consistent with the annual industry accounts, and they 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 among industry inputs, outputs, and value added from the annual and benchmark statistics. This study examines the new quarterly GDP-by-industry statistics to determine whether they can be used to produce reasonable quarterly labor productivity measures at the industry level. This study develops quarterly labor hours and labor productivity measures for the 20 private industry groups for which BEA is releasing GDP-by-industry data.[3] In addition, the study evaluates the volatility in the quarterly productivity measures to determine the value of these industry data for better understanding the sources of economic growth—in order to provide recommendations.

BLS labor productivity measures

The preliminary and revised quarterly press release—"Productivity and Costs"—includes measures of labor productivity for six major U.S. sectors: business, nonfarm business, manufacturing, durable and nondurable goods manufacturing, and nonfinancial corporations.[4] Labor productivity measures are calculated as growth in real output relative to growth in 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, prepared by the BLS Productivity Program. 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). Because input-cost measures are used to measure the output for general government services, the household sector, and nonprofit institutions, the trends in these output measures will, by definition, move with measures of input data and will tend to imply little or no labor productivity growth. Therefore, the business sector is the most aggregate sector for which reliable measures of productivity can be produced.[5] Nonfarm business sector output further excludes the output of the farm sector, while the nonfinancial corporate sector even 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.[6]

For the U.S. manufacturing sector, as well as for individual manufacturing industries, 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 (intrasector or intra-industry transfers). This approach creates a measure of sectoral output that excludes those outputs produced and consumed within the sector or industry. To derive quarterly estimates from the annual manufacturing indexes, BLS adjusts the annual totals with the use of a quarterly reference series and a quadratic minimization formula.[7] The quarterly reference series is constructed from the Federal Reserve monthly indexes of Industrial Production.[8]

Studies of output per hour in individual industries have been produced by BLS since the late 1800s. The BLS industry productivity program has evolved from producing industry-specific studies to the regular publication of annual measures of labor productivity for 199 unique 3- and 4-digit NAICS industries.[9] BLS researchers construct industry output measures by using data primarily from the economic censuses and annual surveys of the U.S. Census Bureau, together with information on price changes primarily from BLS. Real output is most often derived

by deflating nominal sales or values of production with the use of BLS price indexes and removing intra-industry transactions; however, for a few industries, output is measured by physical quantities of output.[10]

Quarterly output by industry

BEA GDP-by-industry data are available from 2005 to the present, 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 8 years to reflect improved techniques.[11] The quarterly data were 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 (I–O) accounts. The 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; the sum of the entries across all industries is the total output of 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 the compensation of employees; taxes on production and imports, less subsidies; and gross operating surplus. Together, these three components compose total value added. The make and use tables are constructed from various data sources and are balanced to align the estimates of industry inputs, outputs, and value added across the economy.[12]

GDP by industry is a key component of the annual industry accounts, measuring each domestic industry's contribution to GDP.[13] BEA uses the annual I–O table and annual GDP-by-industry measures as the starting point for creating 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.[14] The five steps are described as follows:

1. Measures of 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. Data on value added by industry—representing the costs incurred and the incomes earned in production—are estimated with the use of compensation of employees by industry; taxes on production and imports, less subsidies; and gross operating surplus.
3. An initial use table—showing the consumption of intermediate inputs and final uses—is constructed for each quarter with the use of the available annual use table for the year and is revised during annual revisions.
4. A balancing procedure is applied 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 the industry's gross output.
5. Finally, the initial nominal industry and commodity gross output, intermediate inputs, and value-added results, and the corresponding quantity and price indexes are then interpolated (i.e., benchmarked) with respect to the most recently published annual data in accordance with 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.[15]

The new GDP-by-industry data provide more timely information on accelerations and decelerations in economic growth at the industry level. These data are a useful addition to the annual industry accounts that BEA publishes. This study makes use of the BEA 2005–14 quarterly output data published on January 22, 2015.

Output concepts

Labor productivity can be computed by using two different representations of output: sectoral or value added.[16] Sectoral output is a broader measure of output that removes intermediate inputs produced within an industry or sector from gross output—the total value of goods and services produced by an industry or sector. As previously mentioned, GDP is a value-added measure of output and is equal to gross output less all purchased intermediate inputs.

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.[17] As such, any changes in labor productivity may be due to technological progress, economies of scale, improved management techniques, and increased skills of the labor force, as well as changes to nonlabor inputs produced outside the industry or sector (i.e., capital services, energy, purchased intermediate materials, and purchased services).[18] Labor productivity based on a sectoral output concept will therefore increase with outsourcing and with 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.[19] Therefore, BLS labor productivity measures for the manufacturing sector, individual manufacturing industries, and NIPA-level nonmanufacturing industries are calculated under a sectoral output approach.

However, 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.[20] For example, to study the relationship between growth in wages and labor productivity, a preferred approach may be one that removes outsourcing and the quality of intermediate inputs from the model.[21] Unlike sectoral output measures, value-added output measures will decline with labor as a result of outsourcing; thus labor productivity will be less affected.[22] BLS measures for business, nonfarm business, and nonfinancial corporate sector labor productivity are constructed under a value-added approach. Because there few intermediate inputs are purchased from outside these aggregate sectors, labor productivity measures based on value-added output and those based on sectoral output will be similar—the largest difference is due to purchased imported materials.[23]

Data users may need 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 productivity measures more closely reflect the technical efficiency with which industries transform inputs into output. Because the choice of sectoral output or value-added output 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, labor productivity measures are presented under both the sectoral and the value-added output approach.

To construct sectoral output measures, intra-industry transactions were removed from the BEA quarterly real gross output-by-industry measures. These intermediate inputs were removed so that output is not overstated relative to the labor hours used to produce that output. Their removal was accomplished by estimating ratios of sectoral output to gross output with the use of industry current-dollar data from the BEA annual I–O use tables before

redefinition. Intra-industry transactions were calculated as the sum of all outputs that are produced and used within the same industry group. These transactions were subtracted from gross output, and then a sectoral-output-to-gross-output ratio was constructed. The annual adjustment ratios for each industry group were converted into a quarterly series by using a moving-average procedure to smooth the data. Estimates of real sectoral output by industry were calculated by multiplying the sectoral adjustment ratios by the BEA quarterly real gross output-by-industry data.[24]

Independence of output and hours data

Because complete data for constructing quarterly I–O tables are not available, BEA relies on assumptions about the relationships among industry inputs, outputs, and value added from the annual and benchmark I-O statistics to estimate quarterly output data. Input measures, such as wages from the BLS Quarterly Census of Employment and Wages (QCEW) or employment from the BLS Current Employment Statistics (CES) program, 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. Although such techniques are suitable for output measurement, they can be troubling for productivity measurement if input and output measures are not sufficiently independent. If similar source data are used in measuring inputs and outputs, then, by definition, labor productivity will be biased toward zero.

Most BEA output measures are constructed from U.S. Census Bureau data; value-of-shipments data 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 Service Annual Survey (SAS).[25] Industry coverage within the QSS and SAS has been significantly expanded over the past 10 years, resulting in decreased dependence on input-based data for BEA output measures. Since its initial publication of quarterly revenue and expenses for selected information industries in the fourth quarter of 2003, the QSS has added data for selected detailed industries within the following industries: health services (fourth quarter of 2004, first quarter of 2009), professional and business services (third quarter of 2006), administrative services (third quarter of 2006), transportation (first quarter of 2009, first quarter of 2010), leisure (first quarter of 2009), other services (first quarter of 2009), finance (third quarter of 2009), utilities (first quarter of 2010), real estate (first quarter of 2010), educational services (first quarter of 2010), and accommodations (third quarter of 2012).[26] The SAS underwent a similar expansion to annual statistics.[27] Many of these data have become available only since 2009.

The direct and indirect use of input-based output data is found, to some extent, in 11 service-providing industries. 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 incorporate QCEW data into quarterly output estimates.

It is difficult to quantify the impact of input-based data that are used indirectly, because such use often represents only a small portion of the industry measure. Input-based data are used to estimate some price indexes in both the professional and business services and the educational services industries. Indirect use of input-based data is also present when estimates are based on NIPA Personal Consumption Expenditures that have been constructed from

input-based data. Industries affected by the indirect use of input-based data include finance and insurance, real estate, professional and business services, educational services, health services, leisure, and accommodations.[28]

Gross output for most service-sector industries is derived from QSS data. However, labor productivity measures should be viewed with caution for those industries where input data are used to construct output measures.

BLS does not consider productivity for the total economy to be a reliable indicator, because of the correlation between measuring output and measuring labor input for several segments of the economy, especially nonprofit institutions serving households (NPISH). Because the output of NPISH cannot be measured independently of labor inputs, productivity measures that include NPISH will have a downward bias.

Information on the presence of NPISH within each industry group is available, allowing data users to estimate industry output and GDP share of nonprofits. Table 1 shows that NPISH are heavily concentrated in education (78 percent of educational services), health services (89 percent of hospitals and 63 percent of social assistance programs), leisure services (91 percent of museums, historical sites, and similar institutions), and other services (76 percent of religious, grantmaking, civic, professional, and similar organizations). From these data, it is estimated that input-based methods are affecting approximately 5 percent of measured GDP.

Table 1. Impact of nonprofits on gross domestic product (GDP)

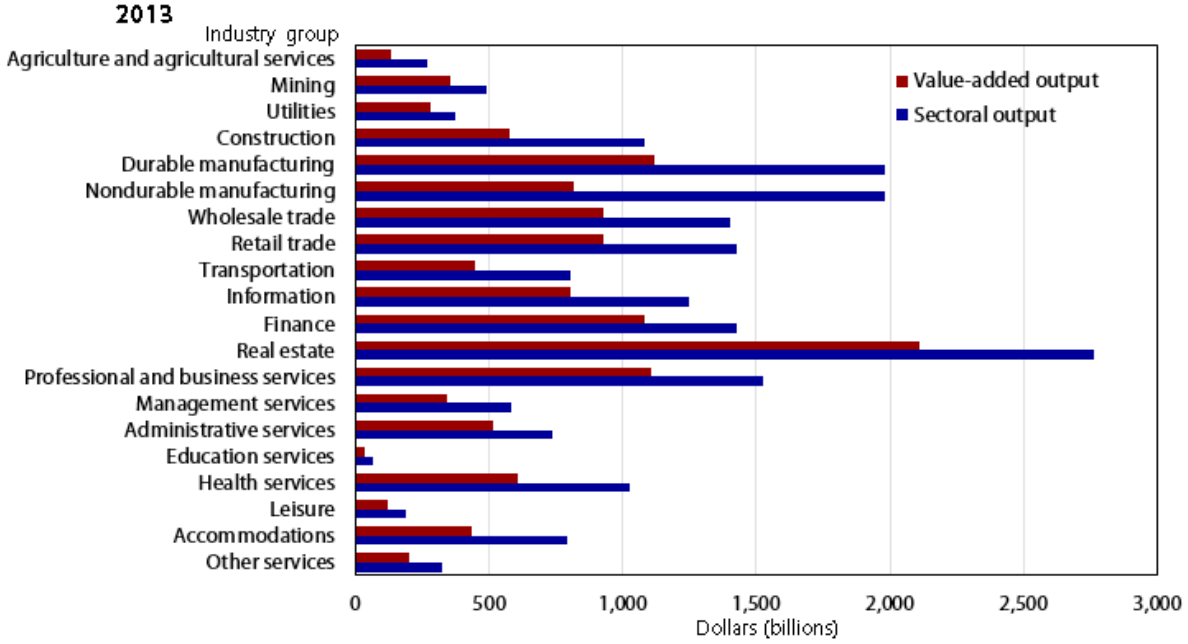
Industry group	Detailed industry affected	Nonprofit percentage of output	Industry share of GDP	Percent of GDP affected
Information	Broadcasting and telecommunications	1.70	2.76	0.01
Professional and business services	Professional, scientific, and technical services	2.40	6.39	.12
Educational services	Educational Services	78.00	1.14	.94
Health services	Ambulatory health care services	12.60	3.17	.35
	Hospitals	89.10	2.55	2.17
	Nursing and residential care facilities	40.70	.76	.29
	Social assistance	63.30	.59	.38
Leisure	Performing arts, spectator sports, and related industries	25.10	.48	.04
	Museums, historical sites, and similar institutions	91.10	.05	.04
	Amusement, gambling, and recreation industries	22.50	.45	.05
Accommodations	Accommodations	1.90	.72	.00
Other services	Religious, grantmaking, civic, professional, and similar organizations	76.10	.74	.67

Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

For the BLS quarterly business sector labor productivity measures, BEA provides aggregate business sector output and BLS uses data from the Economic Census and BEA to remove labor hours for nonprofits. Because the new, quarterly BEA industry output data do not exclude output for nonprofit institutions, this study adjusts both output and hours measures to remove NPISH at the industry level. The data presented show industry measures, less the nonprofit portion of the industry, corresponding to the private business sector portion of each industry.

Figure 1 presents the differences between GDP by industry measured as sectoral output and value-added output for 2014. The dollar level of sectoral output will always be larger than the dollar level of value-added output. The difference between the two series represents the value of the intermediate inputs that the industry is purchasing from outside its borders. The largest differences are found in the manufacturing and real estate industries; the smallest differences are found in education services, leisure services, and utilities.

Figure 1. Private business sector gross domestic product: value-added output and sectoral output, 2013



Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Quarterly hours worked, by industry

BLS does not currently publish quarterly hours worked for all people by industry.[29] Quarterly hours data have been constructed for this research study and, unless otherwise noted, closely follow the methods used to calculate quarterly estimates of hours worked that underlie the business sector productivity data.

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 CES program.[30] CES program surveys approximately 146,000 establishments, collecting employment and hours-paid data. Seasonally adjusted monthly data from the CES are used to construct quarterly averages of employment and quarterly employment-weighted averages of average weekly hours.[31] The CES average weekly hours for production and nonsupervisory employees[32] (AWH_P^{CES}) are adjusted to an hours-worked basis by using an hours-worked-to-hours-paid ratio ($hwhp_P^{NCS}$) estimated from data provided by the National Compensation Survey (NCS).[33] The hours-worked adjustment controls for changes in vacation, holiday, and sick pay. Total hours worked by production and nonsupervisory employees (H_P) are calculated as

$$H_P = \mathrm{AWH}_P^{\mathrm{CES}} \times \mathrm{hwhp}_P^{\mathrm{NCS}} \times N_P \times 52, \quad (1)$$

where N_P is the CES employment of production and nonsupervisory employees.[34]

Average weekly hours for nonproduction and supervisory workers are estimated by applying a ratio adjustment from the BLS Current Population Survey (CPS) to the hours data for production and non-supervisory employees. The CPS ratio is equal to the average weekly hours worked by nonproduction and supervisory employees divided by the average weekly hours worked by production and nonsupervisory employees.[35] This ratio is seasonally adjusted by means of an X-12-ARIMA program and is combined with the average-weekly-hours-worked series for production and nonsupervisory employees, as well as CES employment data.[36] Total hours worked by nonproduction and supervisory employees (H_{NP}) are estimated as

$$H_{NP} = \mathrm{AWH}_P^{CES} \times \mathrm{hwhp}_P^{NCS} \times \frac{\mathrm{AWH}_{NP}^{CPS}}{\mathrm{AWH}_P^{CPS}} \times N_{NP} \times 52, \quad (2)$$

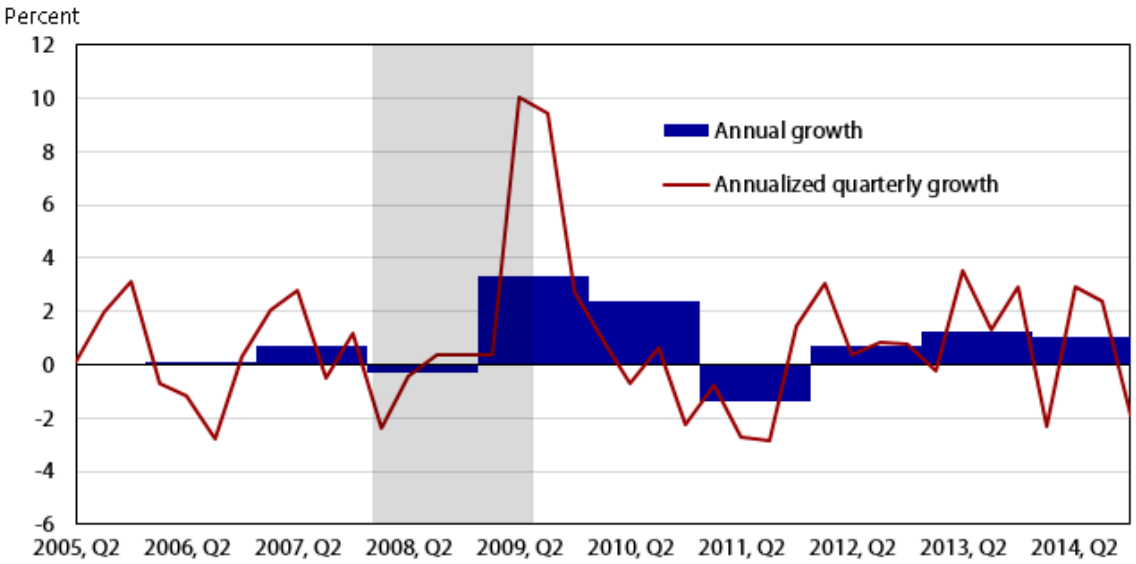
where AWH_{NP}^{CPS} and AWH_P^{CPS} represent CPS measures of average weekly hours for nonproduction and supervisory employees and production and nonsupervisory employees, respectively. N_{NP} is the CES employment notation for nonproduction and supervisory employees.[37]

Total hours is the sum of all employee hours and the hours worked by self-employed and unpaid family workers. Hours worked by self-employed and unpaid family workers are estimated by pooling 3 months of self-reported weekly hours from the CPS for the 20 major industry groups that match the GDP-by-industry series.[38] 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, data on the self-employed and unpaid family workers 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 category of hours worked on farms is constructed on the basis of CPS data.[39] Although the use of quarterly CPS data for the 20 industries of interest in this study is reasonable, further industry detail on a quarterly basis may be beyond the limits of the available CPS data.

Quarterly labor productivity by industry

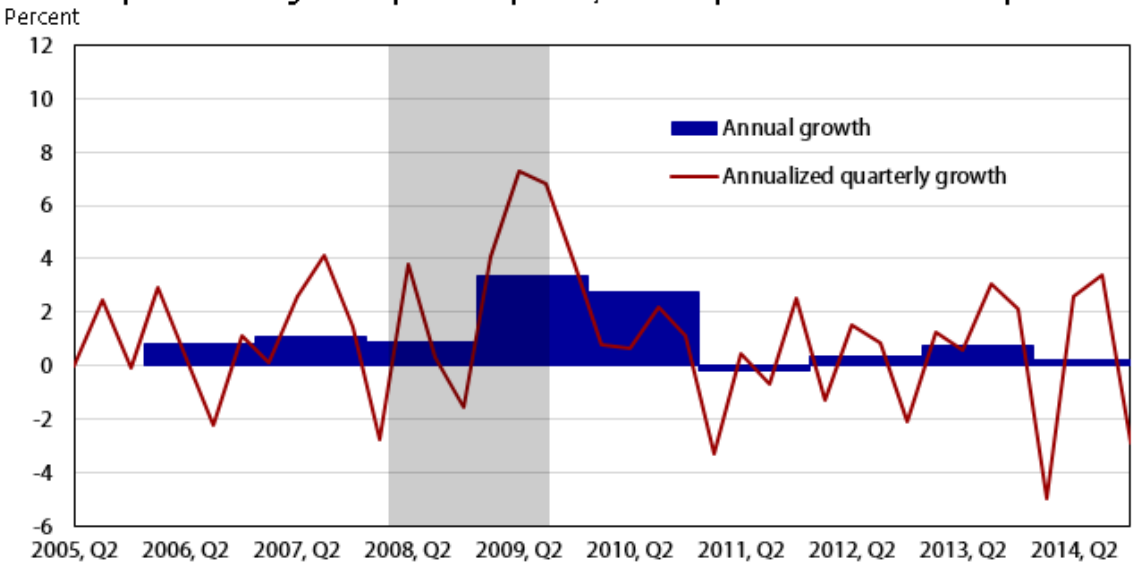
Quarter-to-quarter growth in labor productivity is calculated as quarter-to-quarter growth in output less quarter-to-quarter growth in labor hours and is expressed as an annual rate to facilitate comparisons with annual growth rates. Figures 2 and 3 use the sectoral output and value-added output approaches, respectively, to compare annual average growth rates of labor productivity with corresponding quarter-to-quarter growth rates in the private business sector.[40]

Figure 2. Labor productivity growth in the private business sector, sectoral output, percent change from previous period, second quarter 2005 to fourth quarter 2014



Note: Shaded area represents the 2007–2009 recessionary period.
Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Figure 3. Labor productivity growth in the private business sector, value-added output, percent change from previous period, second quarter 2005 to fourth quarter 2014



Note: Shaded area represents the 2007–2009 recessionary period.
Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Notice that, under both sectoral and value-added methodologies, the quarterly productivity growth rates provide additional information that is not readily apparent from the annual labor productivity growth rates: the quarter-to-quarter labor productivity growth rates show higher peaks and deeper troughs than the annual growth rates. (See table 2). During the recessionary period, the fourth quarter of 2007 through the second quarter of 2009, average annual growth was modest (1.2 percent under the sectoral output approach; 1.6 percent under the value-added

output approach), while quarterly data fluctuated considerably from period to period. (See tables 3 and 4.) Within time period, quarterly labor productivity growth rates ranged from −2.4 to 10.1 percent under the sectoral output approach and ranged from −2.8 to 7.3 percent under the value-added approach.

Table 2. Labor productivity growth for private business sector, annualized percent change from previous quarter, 2005–14

Year and quarter	Value-added output	Sectoral output
2005, Q2	−0.01	0.00
2005, Q3	2.48	1.98
2005, Q4	−.09	3.15
2006, Q1	2.90	−.73
2006, Q2	.22	−1.18
2006, Q3	−2.21	−2.76
2006, Q4	1.14	.32
2007, Q1	.11	2.08
2007, Q2	2.59	2.80
2007, Q3	4.11	−.53
2007, Q4	1.48	1.21
2008, Q1	−2.79	−2.35
2008, Q2	3.80	−.45
2008, Q3	.35	.39
2008, Q4	−1.56	.40
2009, Q1	4.06	.38
2009, Q2	7.27	1.06
2009, Q3	6.79	9.40
2009, Q4	3.78	2.75
2010, Q1	.77	.88
2010, Q2	.68	−.67
2010, Q3	2.20	.67
2010, Q4	1.11	−2.28
2011, Q1	−3.3	−.77
2011, Q2	.47	−2.75
2011, Q3	−.68	−2.86
2011, Q4	2.54	1.44
2012, Q1	−1.29	3.03
2012, Q2	1.54	.35
2012, Q3	.84	.81
2012, Q4	−2.12	.79
2013, Q1	1.24	−.21
2013, Q2	.59	3.54
2013, Q3	3.05	1.32
2013, Q4	2.11	2.91
2014, Q1	−4.95	−2.33
2014, Q2	2.58	2.92
2014, Q3	3.40	2.40
2014, Q4	−2.91	−1.91

Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Table 3. Labor productivity growth, sectoral output, annual average percent change, 2005−14

Industry	2005−14	2005, Q1− 2007, Q4	2007, Q4− 2009, Q2	2009, Q2− 2014, Q4
Private business	0.01	0.53	1.20	0.88
Agriculture services	−.58	−1.75	2.33	−.86
Mining	−.5	−6.36	7.30	.04
Utilities	−1.46	−.2	−8.79	.36
Construction	−1.49	−5.27	2.60	−.82
Manufacturing	1.65	2.02	−1.8	2.62
Durable manufacturing	1.90	2.33	−5.87	4.56
Nondurable manufacturing	1.05	.40	.73	1.47
Wholesale trade	1.20	.94	−9.68	5.25
Retail trade	1.02	1.15	−2.52	2.11
Transportation	.43	2.03	−3.36	.87
Information	4.80	4.91	2.69	5.21
Finance, insurance, and real estate	1.65	2.20	.97	1.51
Finance	1.18	3.05	−.35	.61
Real estate	1.55	1.51	1.81	1.41
Professional, management, and administrative services	.62	−.25	1.73	.69
Professional and business services	.15	−.99	.47	.66
Management services	1.31	−.92	−4.18	4.38
Administrative and waste management services	1.33	1.66	3.76	.21
Education and health services	1.25	.86	1.02	1.48
Education services	1.49	2.58	.92	1.08
Health services	1.20	.59	1.00	1.54
Leisure and hospitality	.42	1.02	−1.08	.58
Leisure	2.17	5.19	.90	.82
Accommodations	.01	.07	−1.74	.57
Other services	.07	−.06	−2.2	.90
Goods	.70	−.82	2.24	.96
Services	.97	1.10	−.01	1.18

Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Table 4. Labor productivity growth, value-added output, annual average percent change, 2005−14

Industry group	2005−14	2005, Q1− 2007, Q4	2007, Q4− 2009, Q2	2009, Q2− 2014, Q4
Private business	1.06	1.06	1.59	0.83
Agriculture services	.44	−4.32	11.41	−.35
Mining	.60	−4.95	16.75	−1.75
Utilities	1.19	1.60	−5.78	3.21
Construction	−1.58	−5.44	1.69	−.57
Manufacturing	2.26	4.43	1.82	1.12
Durable manufacturing	3.27	5.73	−.16	3.01
Nondurable manufacturing	1.08	3.01	3.23	−.74
Wholesale trade	.62	2.07	−5.22	1.85
Retail trade	.55	.22	−.06	.91
Transportation	.27	2.93	−1.17	−.69
Information	4.71	7.06	1.54	4.28
Finance, insurance, and real estate	2.14	1.80	3.99	1.62

See footnotes at end of table.

Table 4. Labor productivity growth, value-added output, annual average percent change, 2005−14

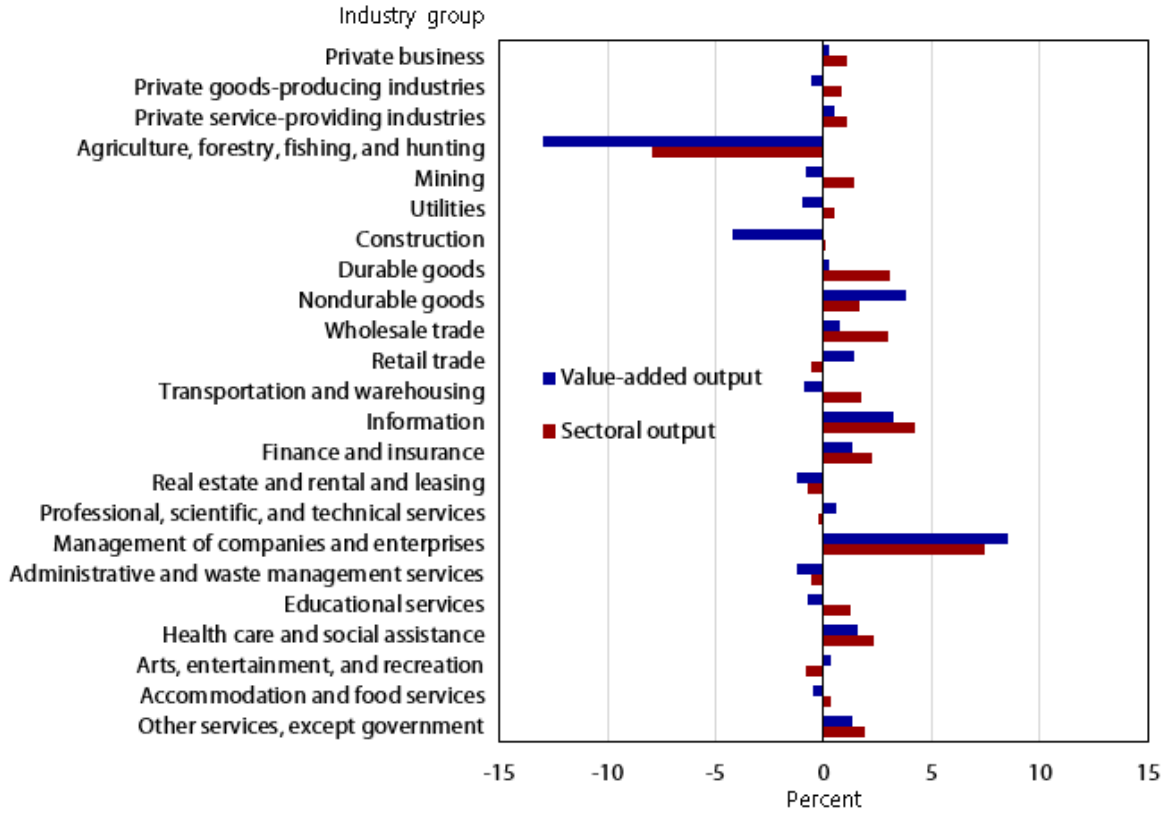
Industry group	2005−14	2005, Q1− 2007, Q4	2007, Q4− 2009, Q2	2009, Q2− 2014, Q4
Finance	2.08	−.89	7.94	1.77
Real estate	2.19	3.58	3.20	1.00
Professional, management, and administrative services	.62	−.34	2.20	.58
Professional and business services	.28	−.55	1.25	.39
Management services	−.18	−4.86	−4.96	4.14
Administrative and waste management services	1.27	1.70	3.61	.14
Education and health services	.50	.18	2.05	.17
Education services	−.3	.57	1.94	−1.41
Health services	.58	.27	2.04	.26
Leisure and hospitality	−.2	−.13	−2.59	.58
Leisure	1.78	2.84	.45	1.56
Accommodations	−.59	−.6	−3.35	.39
Other services	−.67	−1.07	−2.5	.19
Goods	1.38	.92	3.39	.85
Services	.94	1.09	.93	.82

Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Industry labor productivity growth

The heterogeneity among individual industries is lost when the data are presented at the aggregate level, as opposed to when data are shown in industry-level detail. Figure 4 presents the 2013–14 annual growth in labor productivity across all industries, under both the sectoral output and value-added output approach. For some industries, the story is the same for both output concepts, while in other industries the story is quite different. For example, in the retail trade sector, there is negative labor productivity growth from the sectoral output approach, but positive productivity growth with the value-added approach. Recall that the difference between sectoral and value-added output is that sectoral output excludes only those materials purchased from within the retail trade sector while value-added output excludes all intermediate purchases. Therefore, if sectoral labor productivity is declining, and value-added labor productivity is growing in retail trade, then the materials that are purchased from outside retail trade are declining.

Figure 4. Labor productivity growth, 2013–14



Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Under the sectoral output approach, labor productivity growth between 2013 and 2014 varied among individual industries, ranging from a decline of 8.0 percent (agriculture, forestry, fishing and hunting) to an increase of 7.4 percent (management of companies and enterprises). Labor productivity growth of 1.1 percent reflects a growth of 1.1 percent for service-providing industries and a growth of 0.8 percent for goods-producing industries. Labor productivity for service-providing industries was higher than that of goods-producing industries, a result of strong growth in the management and information industries. Concurrently, the slower growth of goods-producing industries was triggered by declines in agriculture. Under the value-added approach, labor productivity growth between 2013 and 2014 also varied among individual industries, ranging from a decline of 13.0 percent (agriculture, forestry, fishing, and hunting) to an increase of 8.5 percent (management of companies and enterprises). Labor productivity growth of 0.3 percent for total private business reflects a growth of 0.5 percent for service-providing industries and a decline of 0.5 percent for goods-producing industries.

The heterogeneity in labor productivity growth among industries is more pronounced in quarterly data than in annual data. In any given quarter, labor productivity growth will vary dramatically across industries. Over the most recent quarters, the smallest across-industry variation was 17.0 percent in the second quarter of 2013, with accommodations and food services declining 4.0 percent and administrative services growing 13.2 percent. In contrast, the largest variation across industries was 47.0 percent in the first quarter of 2013, with administrative and waste management services declining 15.6 percent and agriculture growing 31.7 percent. We do not see a similar range of variation in the annual data. Table 5 presents quarterly labor productivity growth rates for the last eight quarters of the reference period under the sectoral output approach; value-added data are presented in table

6. It is clear that the quarterly data present a more dynamic picture than the annual data. In the nondurable manufacturing industry (see figure 5), annual labor productivity grew 1.7 percent from 2013 to 2014, representing five quarters of moderate growth (from 1.7 percent to 4.3 percent) interspersed with three quarters of decline (from −0.1 percent to −1.7 percent). During this same period, the wholesale trade industry experienced six quarters of increases with only two periods of decline, an observation that is not evident from the 3.0 percent annual growth rate, visible in figure 6. Such volatility occurs within each of the 20 industries, but is not readily apparent in annual data.

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Table 5. Labor productivity growth, sectoral output, annualized percent change from previous period, first quarter 2013 to fourth quarter 2014

Industry group	2013				2014				2012–13	2013–14	Minimum growth rate	Maximum growth rate
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Agriculture, forestry, fishing, and hunting	31.72	11.32	−13.83	−4.65	−7.78	−1.66	−26.33	−1.96	9.07	−7.97	−26.33	31.72
Mining	−3.6	3.84	8.02	−14.17	−2.87	26.07	1.10	−17.34	4.09	1.42	−17.34	26.07
Utilities	−4.33	4.02	−3.55	22.86	−9.78	−8.15	2.57	6.87	−.16	.47	−9.78	22.86
Construction	−4.48	3.87	6.66	2.67	−3.91	.42	−2.63	−3.08	−.48	.10	−4.48	6.66
Durable goods	2.44	5.56	1.90	2.08	2.90	4.68	3.62	.11	3.08	3.04	.11	5.56
Nondurable goods	3.39	1.68	−1.67	−.12	2.28	4.05	4.33	−.94	1.05	1.70	−1.67	4.33
Wholesale trade	3.91	.75	4.76	9.05	−5.02	5.57	7.30	1.37	1.34	3.02	−5.02	9.05
Retail trade	1.04	.02	2.19	2.26	−8.35	7.04	.66	−7.81	3.24	−.61	−8.35	1.04
Transportation and warehousing	−5.8	4.35	.25	.59	.83	2.93	2.26	4.82	−1.66	1.75	−5.8	4.82
Information	.66	1.80	13.24	8.36	−2.56	5.92	.68	4.92	4.59	4.19	−2.56	13.24
Finance and insurance	12.57	−.04	.41	8.83	1.83	1.92	−1.34	−1.21	3.67	2.23	−1.34	12.57
Real estate and rental and leasing	−4.33	−.32	−1.25	.33	−3.73	.55	2.89	−2.34	−1.25	−.71	−4.33	2.89
Professional, scientific, and technical services	−8.11	5.82	2.54	−1.40	−7.9	5.18	3.37	−.08	−2.7	−.20	−8.11	5.82
Management of companies and enterprises	−1.63	1.72	7.63	3.54	7.02	13.39	8.69	−2.41	.87	7.43	−1.63	13.39
Administrative and waste management services	−15.63	13.20	−5.47	.08	−2.57	1.20	−4.11	3.72	−1.46	−.61	−15.63	13.20
Educational services	3.09	3.56	3.26	1.97	−1.16	2.30	−.24	1.76	2.52	1.22	−1.16	3.56
Health care and social assistance	−1.01	4.95	3.55	4.48	−5.42	6.55	6.08	3.56	1.81	2.34	−5.42	6.55
Arts, entertainment, and recreation	−14.49	8.57	−.50	3.31	−4.47	−8.16	5.49	2.40	−1.20	−.78	−14.49	8.57
Accommodation and food services	.53	−4.02	−2.52	3.88	−3.76	5.58	.64	.70	−.41	.35	−4.02	5.58
Other services, except government	−6.35	−.85	.58	2.77	.42	2.48	7.66	−3.00	−.57	1.89	−6.35	7.66
Private Business Sector	−.21	3.54	1.32	2.91	−2.33	2.92	2.40	−1.91	1.23	1.05	−2.33	3.54

See footnotes at end of table.

Table 5. Labor productivity growth, sectoral output, annualized percent change from previous period, first quarter 2013 to fourth quarter 2014

Industry group	2013				2014				2012–13	2013–14	Minimum growth rate	Maximum growth rate
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Private goods-producing industries	2.33	6.65	1.29	.56	.15	1.68	1.69	−6.78	2.91	.80	−6.78	6.65
Private service-providing industries	−1.14	2.46	1.28	3.75	−3.10	3.05	2.37	−.01	.67	1.09	−3.10	3.75

Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Table 6. Labor productivity growth, value-added output approach, annualized percent change from previous period, first quarter 2013 to fourth quarter 2014

Industry group	2013				2014				2012−13	2013−14	Minimum growth rate	Maximum growth rate
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Agriculture, forestry, fishing, and hunting	82.35	15.87	−2.17	−6.54	−32.17	6.41	−19.17	−3.34	16.68	−12.99	−32.17	82.35
Mining	−9.54	2.43	−0.19	.38	−24.34	12.09	19.64	8.64	3.43	−0.86	−24.34	19.64
Utilities	5.68	−2.38	.44	5.00	−22.87	16.49	16.67	−7.88	−0.39	−1.01	−22.87	16.67
Construction	−3.73	−3.77	4.41	−2.13	−10.19	−5.01	−1.36	−5.77	−1.69	−4.18	−10.19	4.41
Durable goods	−1.14	3.03	3.53	−1.19	−3.42	2.49	3.91	−3	.61	.25	−3.42	3.91
Nondurable goods	12.20	.11	5.66	9.56	3.36	5.41	−5.23	3.46	.85	3.78	−5.23	12.20
Wholesale trade	1.16	3.28	2.10	1.06	−6.48	3.77	7.82	1.23	.56	.73	−6.48	7.82
Retail trade	12.76	−5.26	1.66	3.82	1.65	3.72	.11	−4.43	2.69	1.42	−5.26	12.76
Transportation and warehousing	1.54	−3.57	2.82	3.66	−3.4	−2.83	2.46	−9.43	−2.33	−0.93	−9.43	3.66
Information	17.45	2.29	12.51	12.60	−9.73	7.10	2.76	1.02	4.82	3.22	−9.73	17.45
Finance and insurance	2.49	4.68	5.09	2.82	−10.22	5.22	19.98	−10.53	4.60	1.32	−10.53	19.98
Real estate and rental and leasing	.21	−3.1	1.26	1.94	−6.72	−0.57	3.51	−3.13	−1.8	−1.21	−6.72	3.51
Professional, scientific, and technical services	−14.17	2.06	7.17	−3.07	−4.79	5.38	2.14	1.54	−2.35	.63	−14.17	7.17
Management of companies and enterprises	−20.49	9.60	12.13	8.04	5.28	14.47	9.46	−4.31	1.24	8.49	−20.49	14.47
Administrative and waste management services	−7.21	2.56	−0.76	.65	−6.02	2.41	−1.73	−2.3	−1.17	−1.27	−7.21	2.56
Educational services	−4.42	−0.78	1.24	−0.15	−2.63	−2.57	3.10	−1.36	−1.27	−0.78	−4.42	3.10
Health care and social assistance	2.93	.54	1.71	−0.61	3.14	3.74	−0.12	−0.19	1.16	1.60	−0.61	3.74
Arts, entertainment, and recreation	−14.02	11.93	−2.7	2.08	−7.47	1.04	8.94	.43	−0.47	.31	−14.02	11.93
Accommodation and food services	−1.13	−5.9	−1.26	2.91	−2.61	1.47	.74	−2.83	−1.56	−0.46	−5.9	2.91

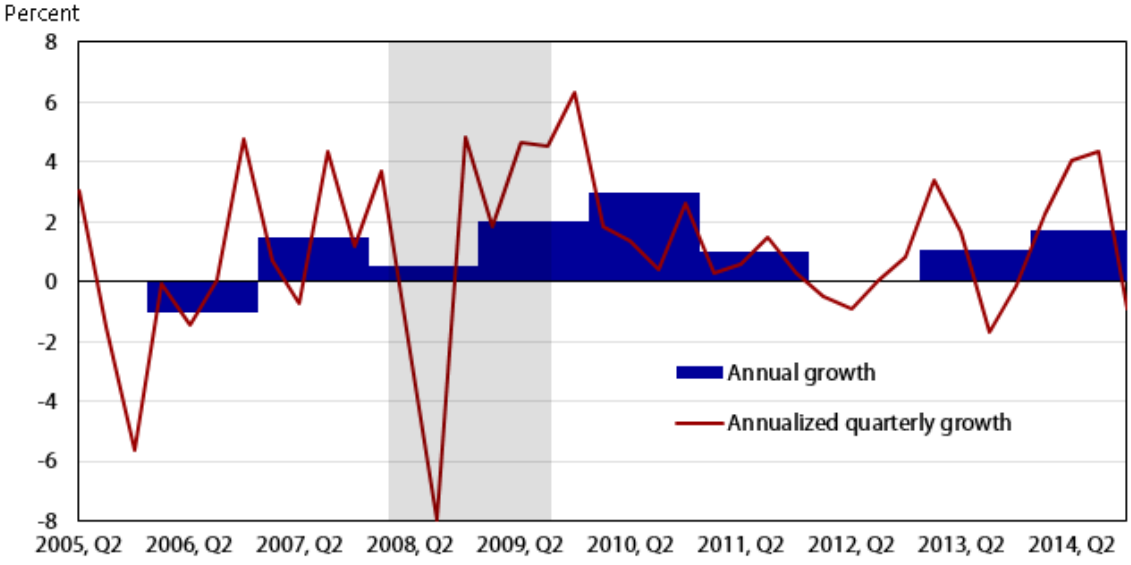
See footnotes at end of table.

Table 6. Labor productivity growth, value-added output approach, annualized percent change from previous period, first quarter 2013 to fourth quarter 2014

Industry group	2013				2014				2012–13	2013–14	Minimum growth rate	Maximum growth rate
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Other services, except government	−0.93	−0.98	3.10	4.97	−1.73	−2.5	10.10	−4.36	.33	1.35	−4.36	10.10
Private Business Sector	1.24	.59	3.05	2.11	−4.95	2.58	3.40	−2.91	.73	.25	−4.95	3.40
Private goods-producing industries	5.34	1.49	2.58	1.93	−5.36	1.78	−0.87	−1.48	1.42	−0.54	−5.36	5.34
Private service-providing industries	.01	.32	3.19	2.17	−4.82	2.82	4.69	−3.32	.52	.48	−4.82	4.69

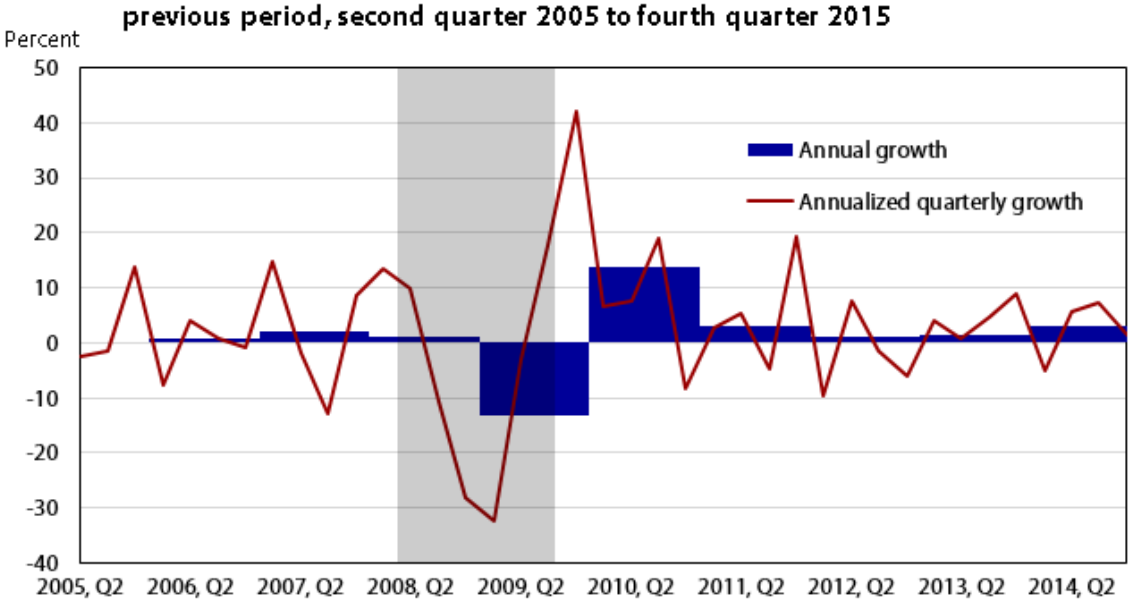
Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Figure 5. Labor productivity growth in the nondurable goods manufacturing industry, percent change from previous period, second quarter 2005 to fourth quarter 2014



Note: Shaded area represents the 2007–09 recessionary period.
Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Figure 6. Labor productivity growth in the wholesale trade industry, percent change from previous period, second quarter 2005 to fourth quarter 2015



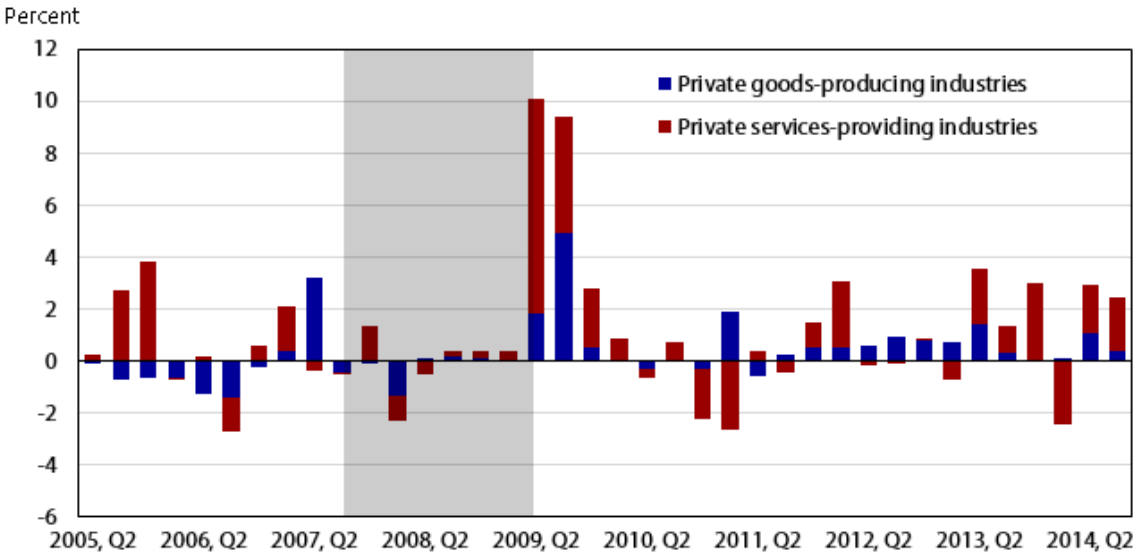
Note: Shaded area represents the 2007–2009 recessionary period.
Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Data users are often interested in short-term movements. However, such movements are subject to greater volatility than longer term movements. Macroeconomic series, such as GDP, frequently fluctuate around a trend that varies over time. Because of this tendency, the permanent trend should be separated from the transitory component. Most frequently, volatility is estimated on the basis of the standard deviation of the growth rate.[41] Referring back to tables 5 and 6, we see that quarterly growth rates are much more volatile than annual average growth rates. From 2013 to 2014, growth in labor productivity in the retail trade industry declined an average of 0.6 percent across eight quarters under the sectoral output approach. The quarterly data reveal that growth ranged from a minimum of −8.3 percent in the first quarter of 2014 to a maximum of 10.0 percent in the first quarter of 2013. The value-added approach yields similar results for this industry, with quarterly growth ranging from a minimum of −5.3 percent in the second quarter of 2013 to a maximum of 12.8 percent in the first quarter of 2013. By contrast, the average annual growth rate from 2013 to 2014 was a constant 1.4 percent.

Industry contributions to labor productivity growth

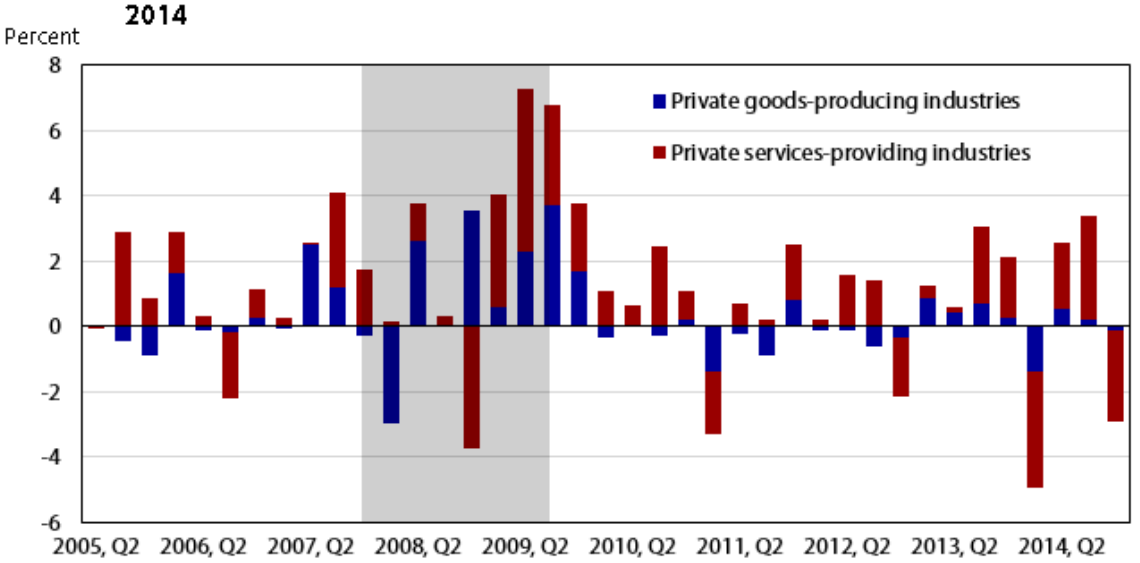
To examine how individual industries affect growth in the private business sector, industry contributions were calculated as the individual industry's growth in labor productivity weighted by its average share of output in the two periods of interest.[42] For ease of exposition, figures 7 and 8 show 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 both the majority of gains and the majority of declines in aggregate labor productivity.

Figure 7. Industry contributions to labor productivity, sectoral output approach, annualized percent change from previous quarter, second quarter 2005 to fourth quarter 2014



Note: Shaded area represents the 2007–2009 recessionary period.
Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

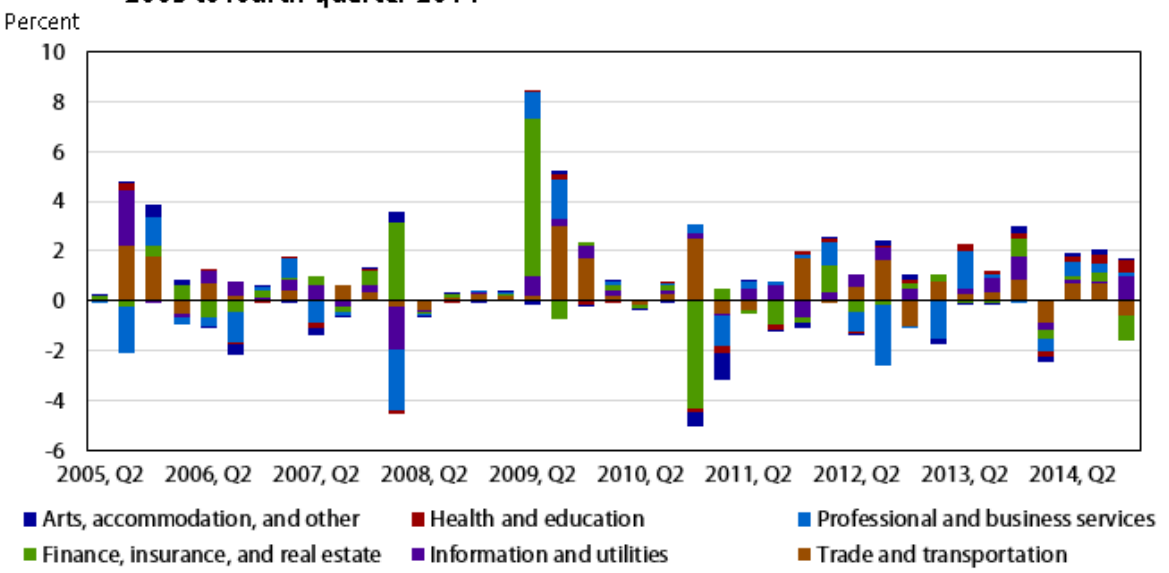
Figure 8. Industry contributions to labor productivity, value-added output, annualized percent change from previous quarter, second quarter 2005 to fourth quarter 2014



Note: Shaded area represents the 2007–2009 recessionary period.
Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

A closer look at individual service-providing industries reveals that, under the sectoral output approach, the finance, insurance, and real estate industry contributed to strong gains in the second quarter of 2009. (See figure 9.) In the fourth quarter of 2014, the losses in labor productivity are also primarily from this industry while the gains can be attributed primarily to the information and utilities industries.

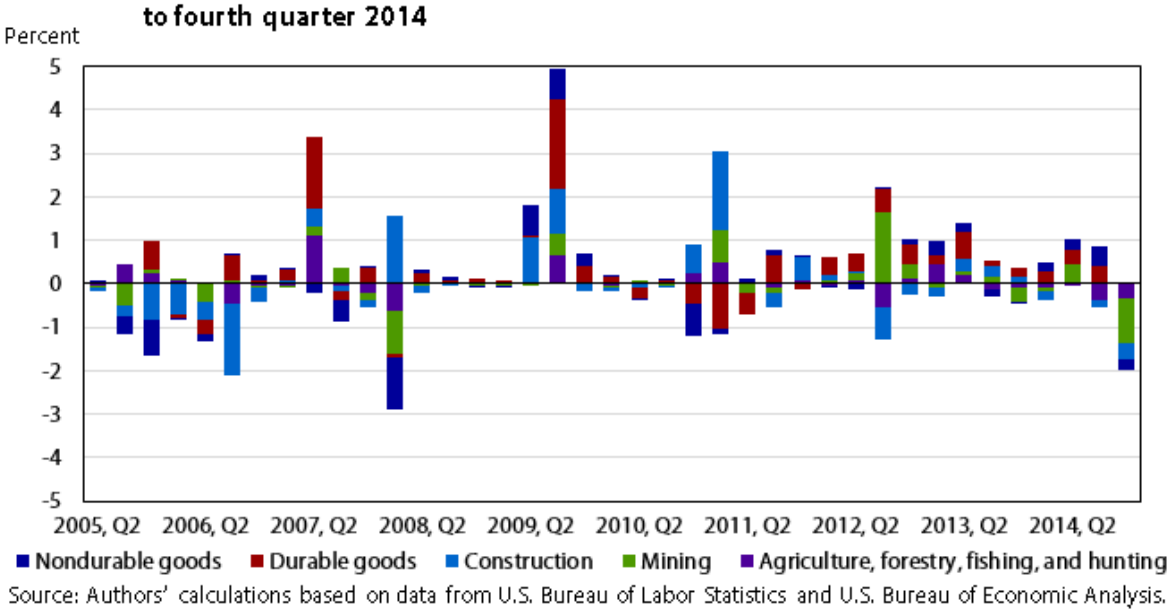
Figure 9. Industry contributions to labor productivity, service-providing industries, sectoral output, annualized percent change from the previous quarter, second quarter 2005 to fourth quarter 2014



Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Among the goods-producing industries, there were early gains in construction and nondurable goods in the second quarter of 2009 followed by gains in all goods-producing industries in the third quarter of that year. (See figure 10.) However, in the fourth quarter of 2014, productivity declines were due largely to negative productivity growth in mining. These quarterly data on labor productivity by industry provide new insights into economic activity and highlight the heterogeneity among industries, complementing the existing aggregate labor productivity measures.

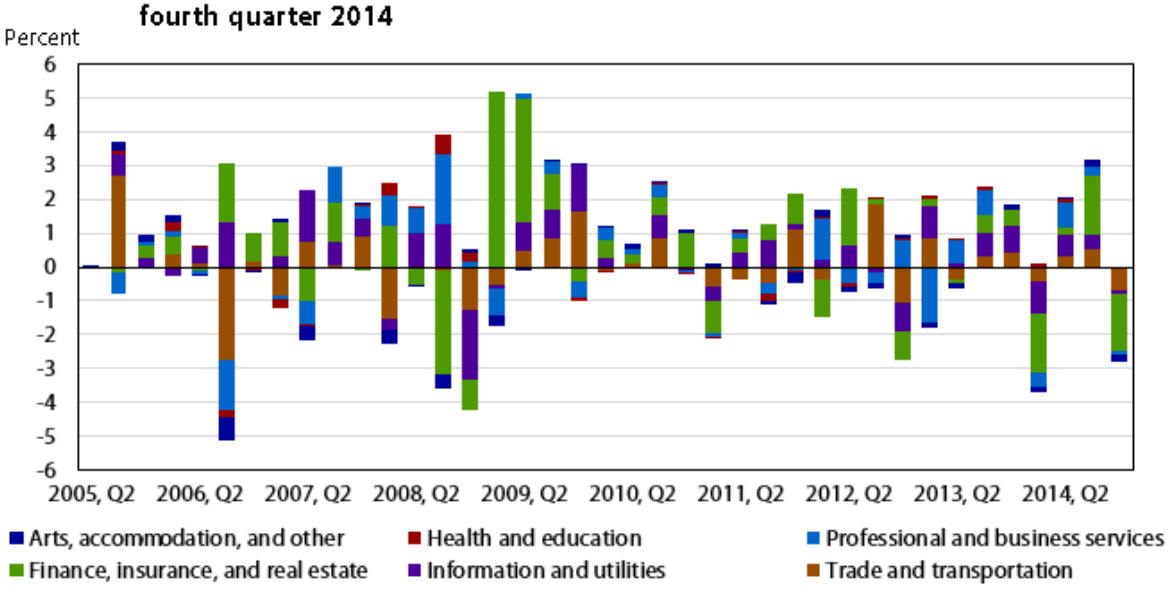
Figure 10. Industry contributions to labor productivity, goods-producing industries, sectoral output, percent change from the previous quarter, second quarter 2005 to fourth quarter 2014



Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

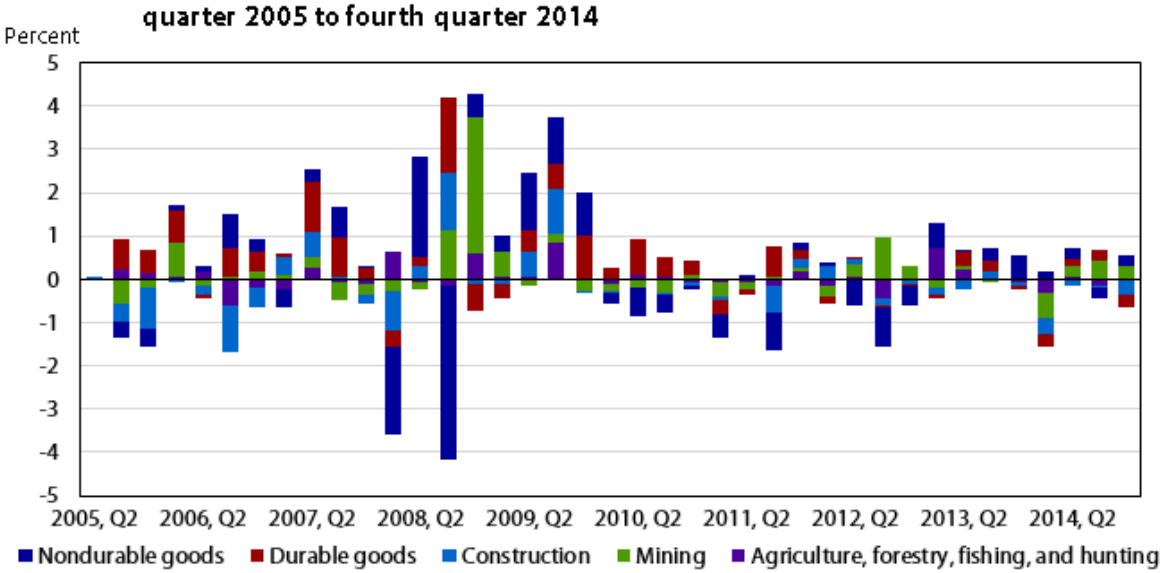
Under the value-added methodology, the finance, insurance, and real estate industry is the greatest contributor to aggregate gains in service-providing industries coming out of the recessionary period. (See figure 11.) However, in the fourth quarter of 2014 (the most recent quarter included in the figures), this industry contributed heavily to the decline in aggregate productivity. Among goods-producing industries, durable goods manufacturing exhibited strong growth, contributing significantly to aggregate labor productivity coming out of the recession. In this most recent quarter, productivity growth in durable manufacturing and construction were offset by productivity declines in mining and nondurable manufacturing, resulting in little growth in the goods-producing sector. (See figure 12.)

Figure 11. Industry contributions to labor productivity, service-providing industries, value-added output, percent change from the previous quarter, second quarter 2005 to fourth quarter 2014



Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and Bureau of U.S. Economic Analysis.

Figure 12. Industry contributions to labor productivity, goods-producing industries, value-added output, annualized percent change from the previous quarter, second quarter 2005 to fourth quarter 2014



Source: Authors' calculations based on data from U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis.

Conclusion

Sustained growth in labor productivity enables an economy to produce additional goods and services without an increase in labor resources, resulting in higher standards of living. Given the newly available quarterly GDP-by-industry data, this study showed that it is feasible to create reasonable quarterly hours-worked measures for 20 industry groups of interest; however, further industry detail on a quarterly basis may be beyond the limits of the available CPS hours data. Although quarterly labor productivity data at the industry level offer users insights into which industries are contributing the most to aggregate productivity growth, the high volatility in the data limit their usefulness.

This quarterly labor productivity measures developed in this study at the industry level are presented as growth in output relative to growth in hours worked. Labor productivity series were constructed out of both GDP-by-industry data and a broader measure of sectoral output.

It is apparent from the data that the choice of output approach affects labor productivity growth rates as well as individual industry contributions to aggregate economic growth. It is therefore important for data users to be aware of whether intermediate purchases from outside the industry are included or excluded from measures of output. In addition, adjustments were made to both output and labor data to eliminate known sources of productivity bias resulting from the use of input data in the construction of measured output. That is, the output and hours worked by NPISH were removed from the industry data. Although their removal improved the data, in some industries input and output data remain correlated, and users should be cautious when interpreting these data, particularly in the information, real estate, management services, administrative services, finance and insurance, professional and business services, leisure, accommodations, and other services industries.

Under both the sectoral and value-added methodologies, quarterly productivity growth rates provide additional information that cannot be gleaned from existing aggregate quarterly or annual industry measures. Heterogeneity among individual industries is lost when the data are presented at the aggregate level, and quarter-to-quarter labor productivity growth rates show higher peaks and deeper troughs than the annual growth rates exhibit for specific industries. In addition, the heterogeneity in labor productivity growth among industries is more pronounced in the quarterly data. However, because quarterly labor productivity data at the industry level are highly volatile, data users should use the information to supplement long-run analysis and should be cautious when drawing conclusions about the state of the economy on the basis of a single quarterly data point.

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NOTES

1 Major sectors include business, nonfarm business, manufacturing, and nonfinancial corporations. Annual industry measures are calculated for two-, three-, four-, five-, and six-digit industries as defined by the North American Industry Classification System (NAICS). For more information, see *Labor Productivity and Costs*, (U.S. Bureau of Labor Statistics), https://www.bls.gov/lpc/home.htm.

2 “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 (U.S. Bureau of Economic Analysis, April 25, 2014), https://apps.bea.gov/newsreleases/industry/gdpindustry/2014/gdpind413.htm.

3 The government sector is not included in the study.

4 The press release includes quarterly and annual indexes, and percentage changes, for output per hour and related measures, such as unit labor costs, real and current dollar compensation per hour, and unit nonlabor payments. (See *Labor Productivity and Costs*.)

5 Although quarterly labor productivity measures are produced for the total economy, the methods for 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 business sector measures and are not included in the press release.

6 Although the farm sector in the United States is small, it is highly volatile. For more information on BLS methods, see “Technical information about the BLS major sector productivity and cost measures” (U.S. Bureau of Labor Statistics, March 11, 2008), https://www.bls.gov/lpc/lpcmethods.pdf.

7 Frank T. Denton, “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), pp. 99–102, http://www.oecd.org/std/21779760.pdf. 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.

8 Because of a lag in the availability of the annual benchmark data, more recent quarterly and annual manufacturing output measures are also extrapolated on the basis of changes to the indexes of Industrial Production.

9 Industry measures produced include output per hour, output per employee, output, implicit price deflators, employment, hours of employees, labor compensation, and unit labor costs. Separate news releases are issues for selected services, manufacturing, and trade.

10 *BLS Handbook of Methods* (U.S. Bureau of Labor Statistics), chapter 11, p. 2, https://www.bls.gov/opub/hom/pdf/homch11.pdf.

11 For more information on the evolution and early phases of the 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* (U.S. Bureau of Economic Analysis, February 2010), pp. 24–31, https://www.bea.gov/scb/pdf/2010/02%20February/0210_gdp_indy.pdf.

12 Annual I–O accounts are available for 1997–2012 and include data on 69 industries. Benchmark I–O accounts include more detailed information for about 400 industries. Benchmark I–O accounts are prepared roughly 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 Donald D. Kim, Erich H. Strassner, and David B. Wasshausen, “Industry economic accounts: results of the comprehensive revision, revised statistics for 1997–2012,” *Survey of Current Business* (U.S. Bureau of Economic Analysis, February 2014), pp.1–18, https://www.bea.gov/scb/pdf/2014/02%20February/0214_industry%20economic%20accounts.pdf.

13 See “Measuring the nation’s economy: an industry perspective, a primer on BEA industry accounts” (U.S. Bureau of Economic Analysis, May 2011), https://www.bea.gov/resources/methodologies/industry-primer.

14 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* (U.S. Bureau of Economic Analysis, May 2014), https://www.bea.gov/scb/pdf/2014/05%20May/0514_gdp-by-industry.pdf.

15 The domestic and foreign portions of intermediate inputs are deflated separately to account for commodities purchased as inputs from both domestic and foreign sources.

16 Labor productivity is not measured under a gross output concept because, under that concept, intermediate inputs made within an industry or sector would be double counted—counted by both the establishment producing the product and the establishment consuming the product.

17 Edwin R. Dean, Michael J. Harper, and Mark S. Sherwood, “Productivity measurement with changing weight indices of outputs and inputs,” *Industry Productivity: International Comparison and Measurement Issues* (Paris: Organisation for Economic Co-operation and Development, Washington, DC, 1996), chap. 7, pp. 183–215, http://www.oecd.org/sti/ind/1825894.pdf.

18 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, because of the complexities associated with constructing MFP measures, these data are not available on a quarterly basis. BLS publishes MFP on major sectors and selected detailed industries on an annual basis. For more information, see https://www.bls.gov/mfp/.

19 See William Gullickson, “Measurement of productivity growth in U.S. manufacturing,” *Monthly Labor Review*, July 1995, pp.13–37, https://www.bls.gov/mfp/mprgul95.pdf.

20 For a complete discussion of the advantages and disadvantages of the two output concepts, see “Measuring productivity: measurement of aggregate and industry-level productivity growth,” *OECD Manual* (Paris: Organisation for Economic Co-operation and Development, 2001), chapter 3, pp. 23–38 https://www.oecd.org/std/productivity-stats/2352458.pdf.

21 Ibid., p. 28. If technical change within an industry does not affect all factors of production but operates primarily on the primary inputs, then the value-added approach is preferable.

22 Value-added labor productivity measures are generally less sensitive to outsourcing than are sectoral measures. But for multifactor productivity, sectoral measures are less sensitive to outsourcing than value-added measures are.

23 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, pp. 3–15, https://www.bls.gov/opub/mlr/2010/06/art1full.pdf.

24 Sectoral output measures for manufacturing industries are derived from BLS quarterly labor productivity data. Measures for nonmanufacturing industries were calculated for this study and may differ from annual BLS multifactor productivity because of data vintages.

25 See “NIPA Handbook: Concepts and methods of the U.S. national income and product accounts” (Bureau of Economic Analysis, February 2014), chapter 3, https://apps.bea.gov/national/pdf/NIPAhandbookch1-4.pdf.

26 “Annual benchmark report for services: fourth quarter 2003 to fourth quarter 2013” (U.S. Census Bureau, June 2014), https://www2.census.gov/services/qss/2013/benchmark_text-2013.pdf.

27 Annual SAS reports are available at the Census Bureau's "Annual and quarterly services," https://www.census.gov/services/sas/historic_data.html.

28 For more information on BEA data sources, see Strassner and Wasshausen, “New quarterly gross domestic product by industry statistics,” (*BEA Briefing*, May 2014), pp. 10–11, https://www.bea.gov/scb/pdf/2014/05%20May/0514_gdp-by-industry.pdf.

29 BLS does produce quarterly hours for wage and salary workers on nonfarm payrolls for 14 major industry groups, available in tables at https://www.bls.gov/lpc/special_requests/tableb10.txt.

30 For more information on the CES, see Current Employment Statistics–CES (National)" (U.S. Bureau of Labor Statistics), https://www.bls.gov/ces/.

31 Seasonally adjusted three-digit CES data are used for nonmanufacturing industries, and two-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 for the 20 industries of interest.

32 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 workers. 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. The BLS Productivity Program is currently evaluating whether to start using this new series.

33 Estimates of quarterly hours-worked-to-hours-paid ratios are derived from annual data at the three-digit industry level via a smoothing procedure. The BLS major sector productivity program makes use of ratios at a more aggregate level. For more information on the NCS, see "National Compensation Survey" (U.S. Bureau of Labor Statistics), https://www.bls.gov/ncs/.

34 To facilitate comparisons across various periods, quarterly estimates are expressed as annualized levels and quarterly growth rates are expressed as annual growth rates via the following formula: $g_t = \left(\frac{x_t}{x_{t-1}}\right)^4 - 1$.

35 See Lucy P. Eldridge, Marilyn E. Manser, and Phyllis Flohr Otto, “Alternative measures of supervisory employee hours and productivity growth,” *Monthly Labor Review*, vol. 127, no. 4, April 2004, pp. 9–28, https://www.bls.gov/opub/mlr/2004/04/art2full.pdf.

36 The X12-ARIMA program was developed by the U.S. Census Bureau. It is the same adjustment technique that CES employs to adjust employment and average weekly hours, 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 "X-13-ARIMA-SEATS Seasonal Adjustment Program" (U.S. Census Bureau), https://www.census.gov/srd/www/x13as/.) Given the limited observations for some industry groups, the CPS data are seasonally adjusted quarterly rather than monthly.

37 For this study, CPS ratios were constructed for 20 selected industry groups; BLS quarterly major-sector productivity measures use 14 industry categories, while annual labor productivity measures use ratios constructed at the three- and four-digit industry level. For more information on the CPS, see "Labor force statistics from the Current Population Survey" (U.S. Bureau of Labor Statistics), https://www.bls.gov/cps/.

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

39 Because the CES collects employment and average weekly hours only for the logging industry, nonfarm agricultural services employment data from the QCEW are combined with CES logging data to construct nonfarm employee hours. The data for constructing these estimates were released by the CES program in February 2015.

40 All series presented in this article were constructed by the authors. Differences between these data and the published BLS productivity statistics are a result of the difference in data vintage, as well as the adjustments made at different levels of industry aggregation.

41 See Joël Cariolle and Michaël Goujon, “Measuring macroeconomic instability: a critical survey illustrated with exports series,” *Journal of Economic Surveys*, vol. 29, no. 1, February 2015, pp. 1–26.

42 The authors explored different approaches for estimating the contributions to labor productivity growth, including those discussed in Evsey D. Domar, “On the measurement of technological change,” *Economic Journal*, December 1961, pp. 709–729, http://www.jstor.org/stable/2228246?seq=1#page_scan_tab_contents; and Marshal Reinsdorf and Robert Yuskavage, “Exact industry contributions to labor productivity change,” in *Price and productivity measurement*, vol. 6, chapter 5, (2010), http://www.indexmeasures.com/Vol6_10,09,26.pdf. Both approaches produce similar results. The authors used the Domar approach but scaled the contributions to the aggregate level in order to capture interactions between industries.

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June 2016

The effect of the Affordable Care Act's Medicaid expansion on health insurance coverage in 2014

Richard Works

The major components of the Affordable Care Act (ACA) went into effect in 2014 with Medicaid expansion being optional. How was health insurance coverage affected in states that expanded versus those that did not? According to "Impacts of the Affordable Care Act on Health Insurance Coverage in Medicaid Expansion and Non-Expansion States" (National Bureau of Economic Research working paper no. 22182, April 2016) by Charles Courtemanche, James Marton, Benjamin Ukert, Aaron Yelowitz, Daniela Zapata, gains in insurance coverage were largest for nonwhites, young adults, unmarried individuals, and those with incomes below the threshold for Medicaid eligibility.

Data were collected through the American Community Survey administered by the Census Bureau. This survey samples approximately 1 percent of the U.S. population: over 3-million people per year. The sample for this study consisted of 18–64 year olds from calendar years 2011 to 2014. The researchers incorporated multiple control variables for demographic characteristics, family structure, and economic/labor force characteristics. Researchers also controlled for the seasonally adjusted monthly state unemployment rate published by the Bureau of Labor Statistics. These controls addressed concerns that Medicaid expansion may be correlated with other factors.

The preferred specification for the regression analysis was a difference-in-difference-in-differences design that disentangles year-to-year changes from causal effects of non-Medicaid portions of the ACA. The full-sample regressions estimate the ACA, including the Medicaid expansion, increased insurance coverage by 5.9 percentage points at the sample mean pretreatment uninsured rate; this compares with 3.0 percentage points without the expansion. The effect reached as high as 15.4 percentage points (compared with 7.8 without the expansion) in the area with the largest uninsured rate. Results passed falsification tests and remained similar across checks for robustness.

Results indicate the ACA increased private insurance coverage by 2.4 percent. The authors indicate this is due to the increased take-up rates for employer-sponsored plans that resulted from the individual mandate. No consequential difference was found between coverage gains among low-income and middle-income earners in non-Medicaid-expansion states. Private insurance was the source of coverage gains in non-Medicaid-expansion states. Gains in Medicaid-expansion states were exclusively attributable to increased Medicaid coverage. However, some evidence suggest that reduced private coverage crowded out a portion of gains in Medicaid coverage from the expansion.

This study extends literature through methodological approaches. The authors state, "Our identification strategy for the non-Medicaid expansion portion of the ACA can potentially be used in future research to identify the impacts of

the ACA on other outcomes such as health care utilization, health, and personal finances.” However, data availability is indicated to be a limitation. Additional research is recommended as more data become available.

Monthly Labor Review
BLS
June 2016

Long may they live: cities and neighborhoods over the centuries

Edith S. Baker

Regions come, and regions go. Cities arise, flourish for a time, and then fall into decline. Neighborhoods change. But not always. In some—even many—cases, cities and towns persist over centuries and even millennia. Neighborhoods get new residents, but the character of the neighborhood remains. Why is all this so? Why is it that some places last for a long time and others don't? In "The puzzling persistence of place" (Federal Reserve Bank of Philadelphia *Business Review*, Second Quarter 2015), Jeffrey Lin asks three questions about neighborhoods, cities, and regions that have endured despite changes in their circumstances that would have caused other neighborhoods, cities, and regions to fall by the wayside in one way or another: "Why haven't these urban patterns changed over decades, centuries, or even millennia? Is such persistence desirable? And what does persistence imply about the prospects for 'place-making' policies aimed at generating development or attracting [development] to particular locations?" The rest of his article seeks to answer these questions and to shed light not only on the reasons that certain places remain practically perpetually livable, but also on what we can do to encourage policies which feed into the natural attributes that make them so livable.

Lin cites three factors that economists have identified to "account for the remarkable long-run persistence of place": natural geographic advantages; human geography, or agglomeration economies; and the human geography of the past, or sunk factors.

Natural geographic advantages are features of the territory, such as natural harbors, navigable rivers, and defensible hills, that attract households and businesses to the area. Their value may change over time—for example, natural harbors once were a magnet for trade and development, but now are more likely to attract residents and tourists because of the beauty of the landscape—but they still retain value.

Human geography is represented by those features of the environment which are valuable because they offer proximity to households and businesses whereby people can work, shop, be entertained, and give and receive all sorts of services. In other words, people benefit from the very fact that they agglomerate and form a thriving economic unit. Places that have done so tend to persist over time, despite both internal and external changes that might otherwise be disruptive.

Finally, the human geography of the past gives locations "durable capital left over from decades or centuries ago." These sunk factors are a firewall against degradation and decay, providing a legacy of infrastructure and institutions that keeps a city or neighborhood vibrant while other areas fall into decline. Often, they serve purposes different from those they originally served—as, for example, a dilapidated bridge that once was a busy thoroughfare connecting heavy traffic between two "Rust Belt" towns. The bridge was never torn down and

replaced because it would have been too costly to do so. Now it is of use only to local residents and businesses—a purpose different from the original one, but a purpose nonetheless.

As evidence of the role of natural geographic advantages in persistence, Lin points to the strong correlation between the distribution of population among Japanese cities today and the population distribution of those same areas 8,000 years ago, as discovered by archaeologists. Moreover, despite heavy, random bombing of those cities during World War II, population returned to its prewar distribution shortly after the war. Regarding the role of human geography in persistence, Lin recalls the many U.S. cities that owe their establishment and early existence to some natural geographic advantage they had over other cities—for example, being near a waterfall that provided waterpower or being a port city when river traffic was the only way commerce could be conducted with other parts of the nation. Later, when that advantage was lost because of technological advancements (electrification and new land transportation technology, respectively), those cities still thrived because of the strong agglomeration economies that remained.

In a different, but related, vein, some among the first Europeans to America settled in certain New York City marshlands whose poor drainage resulted in flooding and disease. These areas became low-income areas of cities, with poor amenities and meager public services. Later, despite improvements in drainage and sewerage which made that natural disadvantage disappear, those areas remained impoverished, likely because of their by-now long established human geography—and they remain so today. Thus, there can be “bad” agglomeration economies that lead to the persistence of cities with undesirable characteristics.

Finally, confirming the role of sunk factors (the human geography of the past) in persistence, Lin calls the reader’s attention to Sweden, where towns that grew up along that country’s budding railroad system grew faster than other towns and remain larger today; to sub-Saharan Africa, where cities and agricultural development continue to follow long-abandoned rail lines; and to Los Angeles, California, where “population density today is strongly correlated with the location[s] of streetcar stops in the 1910s, and this correlation has been increasing over time.” All of these situations provide evidence that historical investments in infrastructure (i.e., sunk factors) may keep a location viable beyond what would otherwise be expected.

So, what can we learn from the factors underlying persistence about policies aimed at creating or attracting economic activities to particular locations? What kinds of policies can we adopt that offer a reasonable probability of success? One thing we can learn, says Lin, is that “policies that work against these three factors are unlikely to succeed.” For example, consider the prospect of building a new airline hub from scratch. Given that existing hubs are characterized by large sunk costs and economies of scale, building a new hub would require overcoming those advantages. Similarly, policies that seek to improve the condition of Los Angeles neighborhoods with poor natural amenities would be almost doomed to failure from the start because it would be difficult to overcome that large “sunk” disadvantage. To bring the point home via a concrete example, it would take “an implausibly large investment…to improve South Los Angeles to the level of Beverly Hills.” But policies that recognize the factors underlying persistence and that take full advantage of them “may be most effective in creating long-lasting change in neighborhoods and cities.” For example, if it is known that certain neighborhoods have businesses that engage in economic activities which strongly benefit other businesses and households, then policies that encourage those activities might have permanent beneficial effects.

Monthly Labor Review

BLS

June 2016

Labor productivity growth in elementary and secondary school services: 1989–2012

New measures of labor productivity in elementary and secondary schools show that labor productivity declined from the mid-1990s through the first decade after 2000. However, it increased from 2010 forward because of labor input declines combined with modestly increasing enrollments and test scores.

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Education is a primary driver of economic growth and stability for nations and for individuals.[1] Investments in education affect the ability of a country to compete in international markets and to ensure increases in living standards for its residents. On an individual level, returns to investments in education are well documented. For example, high school dropouts earn less over their lifetimes than high school graduates. In addition, the penalty associated with lower educational attainment has become more pronounced over time: after the earnings are adjusted for inflation, economists project that expected lifetime earnings of high school dropouts today are less than the expected lifetime earnings of high school dropouts in 1970.[2]

In 2014, nearly 9 percent of all U.S. workers, almost 13 million individuals, were employed in the educational services sector.[3] In fact, the education sector now employs more workers than the entire manufacturing sector. Within the educational services sector, the elementary and secondary schools industry employed just over 8 million individuals, or 65 percent of employees in the broader education sector.[4] For the 2013–14 school year, expenditures for educational services in the United States are estimated at $1,194 billion, or 7.1 percent of the United States Gross Domestic Product (GDP). Of this total, $682 billion, or 4.1 percent of GDP, were expenditures for educational services at public and private elementary and

secondary schools and $512 billion, or 3.1 percent of GDP, were expenditures for education at postsecondary degree-granting institutions.[5]

Labor productivity is a statistical measure that relates an industry's output of services to the quantity of labor required to produce those services. Productivity data are essential for one to understand the education industry because they provide information on the efficiency of the production of services.

The U.S. Bureau of Labor Statistics (BLS) has developed measures of labor productivity and related series, including unit labor costs, for North American Industry Classification System (NAICS) 6111, elementary and secondary schools, the second largest component industry in the education sector by employment and receipts, after NAICS 6113, colleges, universities, and professional schools.[6] This is the first detailed industry in the education sector for which BLS has developed labor productivity series. The new measures reflect BLS commitment to expand its coverage of service industries, including those industries for which developing reliable series presents a significant challenge. This article introduces the new measures and examines productivity trends in this industry from 1989 to 2012.

The elementary and secondary schools industry includes both public and private schools providing educational and related services that constitute a basic preparatory education, typically from kindergarten through the 12th grade.[7] BLS measures for this industry include data for all schools, as well as separate data on public and private schools. During the 2012–13 school year, 98,454 public schools and 30,651 private elementary and secondary schools, serving over 55 million students, were operating in the United States.[8] Over 90 percent of these students attended public schools, while less than 10 percent attended private schools.[9] Although public school students overwhelmingly attended traditional public schools, the number of public school students attending charter schools increased from 0.7 percent in the 1999–2000 school year to 4.6 percent in 2012–13.[10] Charter schools are independent public schools operating under a contract or "charter," with a state agency or local school board. In exchange for greater flexibility and independence, the charter school agrees to be accountable for goals outlined in the charter, such as improving student performance. Failure to achieve these goals may cause the school's charter to be revoked.[11] Finally, 3.4 percent of school-age children were homeschooled during the 2012–13 school year.[12]

U.S. education system

Educational services in the United States have their roots in early colonial days. The first law establishing universal public education was the Massachusetts General School Law of 1647, which ordered, ". . . that where any town shall increase to the number of one hundred families or householders, they shall set up a grammar school . . . ."[13] From these rudimentary beginnings, the elementary and secondary education system in the United States has evolved and striven, guided by landmark legislation such as the 1965 Elementary and Secondary Education Act and the 1975 Education for All Handicapped Children Act, to educate children with varied economic circumstances, language skills, and mental and physical capabilities appropriately.[14]

The U.S. public school system historically has been the responsibility of local school districts and states. State education departments set general education requirements, whereas local school boards manage school district level decisions.[15] To receive federal funds for education, states must comply with various guidelines and standards that the federal government has established, through legislation.[16] Public school systems, which are required to provide free educational services to all, provide the majority of educational services to elementary and secondary school-age individuals with disabilities. In addition, public school systems serve the majority of economically

disadvantaged students.[17] States generally assign responsibility for providing adult education services, such as General Educational Development (GED) programs, literacy programs, and English as a Second Language (ESOL) programs, to local public school systems.

Educational standards for grades K–12 in public schools are established at the state level and are overseen by the individual state's education department. These standards typically include requirements for proficiency in basic subjects such as reading, writing, mathematics, and science; minimal achievement gaps by race, gender, ethnicity, and socioeconomic status; college readiness preparation, including availability and participation in college credit programs such as Advanced Placement (AP) and International Baccalaureate (IB) programs; and minimum academic credits for graduation. Requirements for a high school diploma vary by state and include achieving a minimum number of credits in English, mathematics, science, social studies, arts or vocational education, physical education and, in some states and school districts, a foreign language.[18]

Private schools must observe federal, state, and local laws, such as maintenance of state-required attendance, curriculum, and safety records and reports; compliance with local building, fire, and sanitation codes; and annual reports to the Internal Revenue Service.[19] Private schools may receive services under the federal Elementary and Secondary Education Act (ESEA), including participating in programs such as the National School Lunch Program, receiving funds from Individuals with Disabilities Education Act grants, and receiving funds from the Title I, Improving the Academic Achievement of the Disadvantaged, program for supplemental education.[20] Note, however, that private schools serve a small percentage of individuals with disabilities. Often, regional or national accrediting agencies, such as the Association of Independent Schools of New England, or the National Christian School Association, accredit private schools.

Although private schools are generally required to provide a curriculum of study meeting the state minimum requirements, they often offer broader curriculums, lower pupil–teacher ratios, additional extracurricular activities, more qualified teachers, and even longer school years.[21] Graduation requirements of private high schools typically are more demanding than the requirements of public high schools.[22] From 1999 to 2000, private high schools required more coursework in social studies, mathematics, science, foreign language, and computer science than did public high schools.[23] For example, private schools required, on average, 3.1 years of mathematics and 1.5 years of foreign language, whereas public schools required 2.7 years and only 0.5 years, respectively.[24] Most private elementary and secondary schools are nonprofit; a very few are for profit, particularly schools run by Education Management Organizations, private organizations that manage charter schools.[25]

Today, public and private schools in the United States provide students with not only instructional services but also supplementary student support services, such as guidance counseling, healthcare services (including school nurses; school psychologists; vision, dental, audiology and speech screenings; and speech therapy services), food services, and transportation services (primarily offered by public schools). Additional support services for learning, emotionally, or physically disabled students are also provided, when appropriate.

Major challenges that the elementary and secondary schools industry has experienced include large increases in the number of non-English-speaking students, an increase in the number of students from impoverished circumstances, the integration of mentally and physically challenged students into general classrooms, and a cultural shift toward more working mothers, particularly mothers with preschool children. Demand for early

education programs has increased markedly because a growing number of women continue to work while raising young children.[26] Other additional challenges include the following:

- English language learners increased in all but 11 states and grew from 5.0 percent of students in 1993 to 9.2 percent in 2012.[27]
- Students living in poverty increased from 17 percent in 1990 to 21 percent in 2012.[28]
- Students participating in the free or reduced price lunch program increased from 32 percent in 1990 to 51 percent in 2012.[29]
- Students receiving special education services under the Individuals with Disabilities Education Act increased from 11 percent in 1990 to 13 percent in 2012.[30] The percentage of disabled students spending 80 percent or more of their time in a regular classroom environment increased from 33 percent in 1990 to 61 percent in 2012.[31]
- Enrollment of 3- and 4-year-olds in academic preschool programs increased from 32 percent in 1975 to 44 percent in 1990 and 55 percent in 2013.[32]
- Women in the labor force with children under age 6 increased from 39 percent in 1975 to 58 percent in 1990 and 65 percent in 2013.[33]

Education output

Constructing a labor productivity measure for elementary and secondary schools (NAICS 6111) first requires developing industry output and labor input measures. The output produced by establishments in NAICS 6111 includes educational and related services that develop the knowledge, skills, and competencies of students, culminating in completion of a basic preparatory education. However, educational services are difficult to measure directly.[34] In the United States, educational services are provided by a mixture of public and private organizations that include both nonprofit and for-profit entities. Measuring education output involves all the difficulties associated with measuring service outputs, further complicated by production in a nonmarket setting, such as production of educational services by public schools.[35] Services produced in a nonmarket setting are sometimes measured in terms of employee hours; that is, the service is defined as the employees' time. However, this definition of output is not appropriate for use in measuring productivity. If output growth is based on the related change in labor, then measured labor productivity is by definition constant and no information regarding industry efficiency can be determined.

Various countries use different methods of measuring education output. These output measures range from the very simple (such as a count of students enrolled) to more complex measures, which include a quality adjustment reflecting some aspect of educational outcome.[36] For primary and secondary education, several countries, including Australia, Finland, Germany, Greece, the Netherlands, and New Zealand, use a volume measure such as the number of pupils or number of teaching hours with no further adjustment.[37] Other countries, such as Hungary, Italy, Poland, and Spain, use the number of pupils as a volume measure and adjust for differences in class size.[38] The United Kingdom constructs an education output measure that uses the number of students as a volume

measure and the average point score per student in the 11th-year General Certificate of Secondary Education test as a quality adjuster.[39]

Although the number of students enrolled is a useful starting point for measuring elementary and secondary education output, it does not reflect changes in the educational attainment level of students. Educational attainment has been shown to vary over time, depending on teacher quality, class size, curriculum quality, and other factors. However, the extent to which the various characteristics of the educational environment and activities influence education output is not always clear. Fraumeni, Reinsdorf, Robinson, and Williams evaluated various combinations of characteristics, such as improved student–teacher ratios, changes in teaching staff composition, and high school dropout rates, and found that, although the direction in which a particular characteristic of the educational environment affects education output may be known, quantifying the impact on education output is difficult.[40]

A wealth of information is available on school performance. The federal government, through Title I of the federal ESEA and reauthorized by the federal Every Student Succeeds Act of 2015, requires states to create annual assessments of schools and school districts.[41] In addition, the Every Student Succeeds Act requires states to hold schools, districts, and states to yearly standards of achievement of students on standardized tests in reading and mathematics.[42] These standards are used to determine if schools, districts, and states are making adequate yearly progress (AYP) as a whole and for specific subgroups of students (including racial and ethnic groups, special education students, and English language learners). Schools, districts, and states failing to meet the AYP levels of achievement for 2 consecutive years in the same subject are considered to need improvement and must take specific steps to improve performance of their students.[43]

States also generally maintain testing programs and meet federal requirements for testing. Individual states perform testing in public and charter schools using standardized tests as required by their state department of education.[44] The charter agreement typically requires charter schools to participate in state and national testing programs.[45] Private schools may or may not be required by a state to participate in state-level academic testing.[46]

BLS education output measure

The BLS output measure for elementary and secondary schools introduced in this article adopts an approach that relies on student performance on standardized tests for capturing the effects of quality change. Separate attendance-adjusted series on numbers of students in public and private schools are used as proxies for the volume of output. To account for the effects of quality change, BLS analysts then applied adjustments based on national mathematics and reading test score data. Finally, BLS staff aggregated the public and private school quality-adjusted output measures using expenditure share weights to obtain a measure of overall output for the elementary and secondary schools industry.

BLS obtained public school enrollment data for students in prekindergarten to grade 12 (pre-K–12) from the National Center for Education Statistics (NCES), State Nonfiscal Survey of Public Elementary/Secondary Education.[47] Private school enrollment data for students in pre-K–12 are obtained from the NCES Private School Universe Survey.[48] Public and private school enrollments in kindergarten through 12th grade are adjusted for variations in daily attendance with the use of NCES data on the average daily attendance of public school students.[49]

Separate public and private school quality-adjustment series are developed on the basis of students' mathematics and reading test scores from the National Assessment of Educational Progress (NAEP) long-term trend (LTT) testing program for public and private schools.[50] These LTT test scores are available (in certain years only) in various subjects for students ages 9, 13, and 17. BLS interpolates the test score data between testing years in order to estimate test scores for nontesting years. As shown in this article, for each of the three categories of schools (all schools, public schools only, and private schools only), a ratio of the reading or mathematics test score to the perfect score was computed for each year and the mathematics and reading test scores were averaged together. When the attendance-adjusted student enrollment series for public and private schools were multiplied by the appropriate test score ratio series, quality-adjusted student output was obtained.

Although quality-adjusted output measures similar to the measure introduced in this article are used in other countries, such as the United Kingdom, research efforts to account for other dimensions of quality are ongoing. Research continues toward establishing empirical relationships between other educational characteristics of U.S. schools and the resulting education outputs. Industry providers themselves in all three types of schools (traditional public, charter, and private) track numerous metrics, in addition to the number of students enrolled, to measure their own output. These metrics include

- performance measures such as student–teacher ratios;
- parental involvement proxies;
- high school course difficulty rankings;
- lesson quality rankings;
- teacher experience and qualification;
- student composition;
- number of AP, IB, or dual credit courses completed;
- standardized testing of student achievement in selected subjects;
- percentage of pupils moving up each year;
- average daily attendance;
- high school dropout rates;
- graduation rates;
- percentage of graduating students enrolling in college; and
- percentage of transfer requests out of a specific school.

These are only some of the numerous measures often cited in assessing educational programs, and in the future, they may be used to develop more sophisticated methods of adjusting for quality change in the provision of educational services. Advances in the economics of education are discussed further in the Appendix.

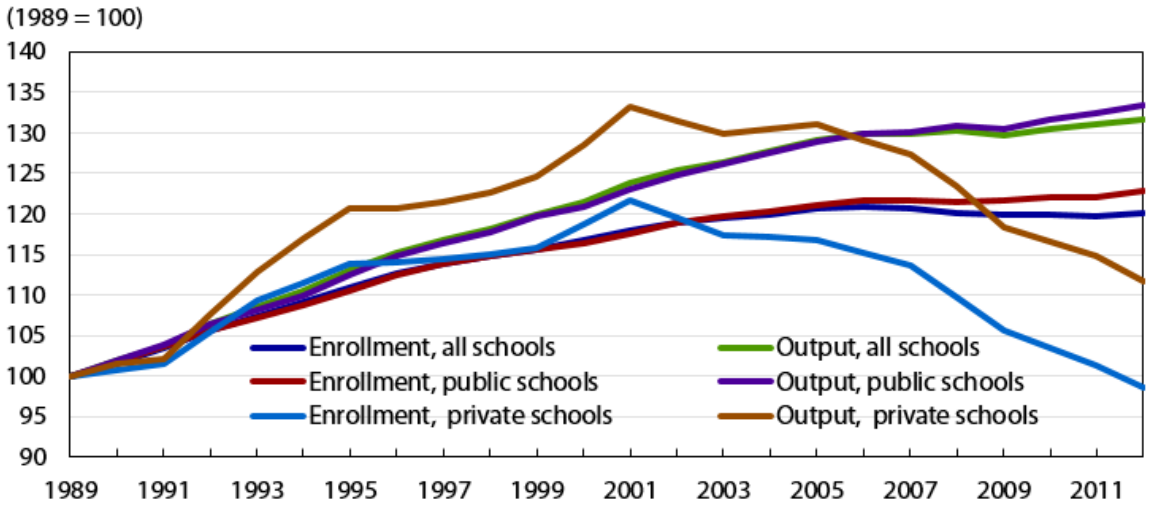
Labor input and expenditures

BLS traditionally measures the labor input component of productivity as the total number of hours worked in an industry. However, not many data of these types are available for primary and secondary education. Instead, BLS measures labor inputs for NAICS 6111, elementary and Secondary Schools, using data on the number of full-time equivalent (FTE) employees in detailed employment categories.[51] Public school labor input is measured with the use of NCES data on the number of FTE employees in 16 detailed employment categories.[52] These categories include not only teachers but also other school employees, such as librarians, guidance counselors, administrators, and student support staff. Private school labor input is drawn from the NCES Schools and Staffing Survey, Private School Questionnaire.[53] BLS combines counts of FTE employees in the detailed employment categories into broad employment categories. Then to develop labor input measures for public and private schools, BLS further combines the counts using expenditure share weights.[54] BLS constructs these weights for public school labor inputs using NCES National Public Education Financial Survey data on salaries and benefits.[55] Total labor input for the industry is measured as an aggregate of the public and private school labor inputs, aggregated with the use of the public and private school expenditure share weights.

Trends in elementary and secondary schools

Output. Output in all elementary and secondary schools increased at a 1.2-percent average annual rate from 1989 to 2012, with the greatest rate of growth occurring in the 1990s, as shown in figure 1. Output grew 1.8 percent per year between 1990 and 2000, slowed to 0.5 percent per year between 2000 and 2007, and then slowed even further to a 0.1-percent average annual rate from 2007 to 2012. Because public schools constituted just over 90 percent of all elementary and secondary schools, output trends in public schools were similar to those for all elementary and secondary schools. For private elementary and secondary schools, output increased at only a 0.5-percent average annual rate from 1989 to 2012, with the highest period of growth from 1990 to 2000.

Figure 1. Enrollment and quality-adjusted output for all schools, public schools, and private schools, 1989–2012

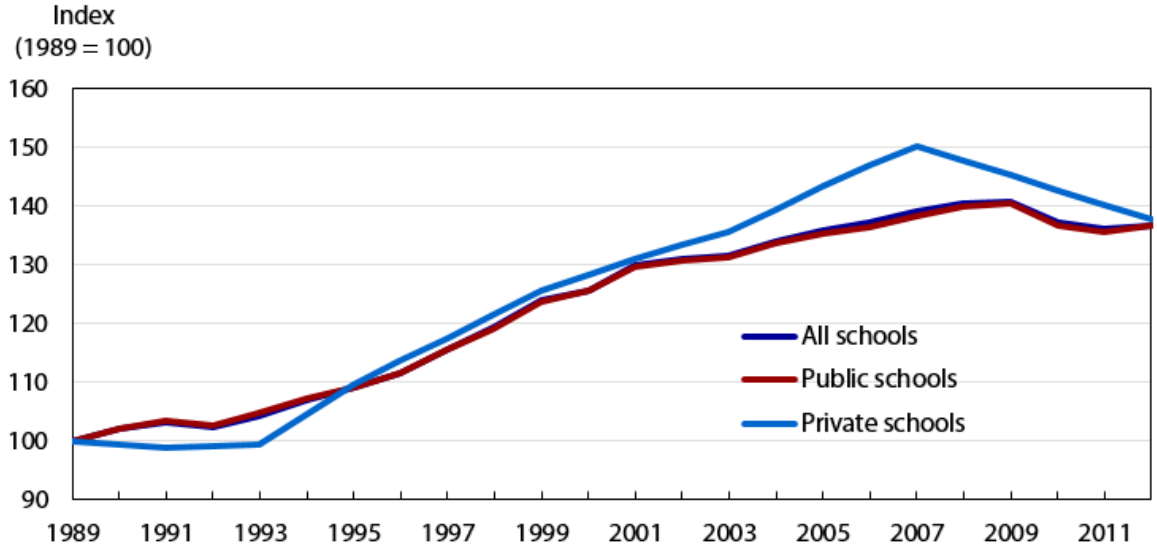


Sources: U.S. Department of Education, National Center for Education Statistics, State Nonfiscal Survey of Public Elementary/Secondary Education and Private School Universe Survey; U.S. Bureau of Labor Statistics.

One factor that strongly affects the output measure is school enrollment, which changed along with the population of school-age children.[56] Public school enrollment grew 1.2 percent per year from 1990 to 2007 but only increased 0.2 percent per year from 2007 through 2012.[57] Private school enrollment increased steadily from 1990 to 2000 at an average annual rate of 1.8 percent, then declined 0.5 percent per year from 2000 to 2007, and fell 2.8 percent per year from 2007 to 2012.[58] Increased tuition and fees, a decline in the economic well-being of families, and increased competition from public schools, particularly charter schools, have been cited as possible explanations for the decline in private school enrollment.[59] Public charter schools have served an increasing number of students, with enrollment rising from 0.3 million students in 1999 to 2.3 million students in 2012.[60]

The output measures also reflect variation in the NAEP LTT mathematics and reading student test scores of public and private schools, which were used as output quality adjusters. Private school student test scores ranged from 8.6 to 22.0 points higher than public school student test scores during the 1989–2012 period (on a 500-point scale) and were, on average, 14.89 points higher than public school student scores, with the largest differences found in reading scores.[61] Both public and private school student test scores have increased gradually since the long-term trend assessments of private schools began in 1978.[62] For public schools, incorporating the quality adjustment increased output growth by 0.25 percentage points from 1989 to 2012, while private school output increased by 0.44 percentage points because of the test-score-based quality adjustment.

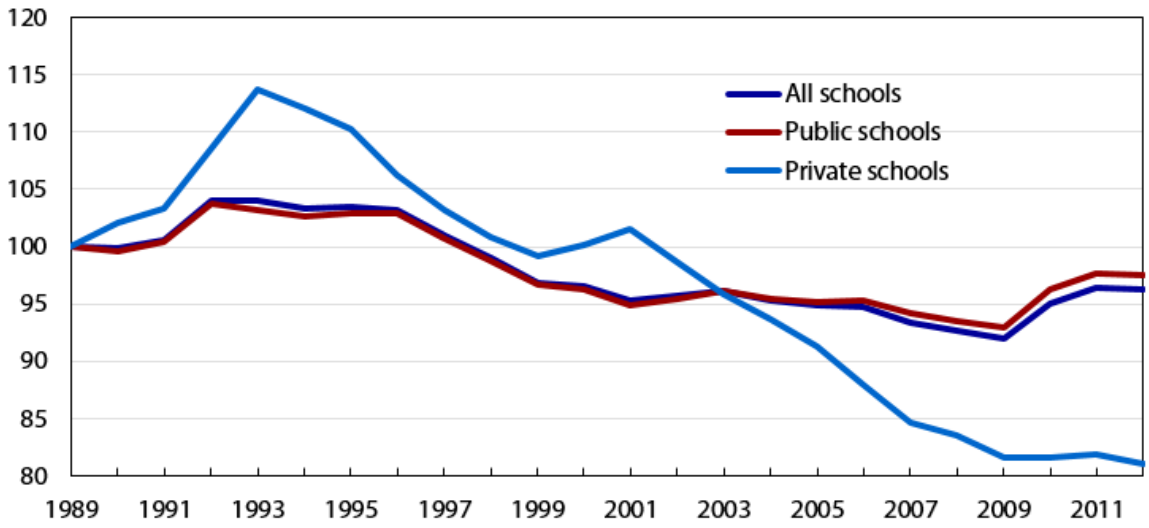
Figure 2. Labor input for all schools, public schools, and private schools, 1989–2012



Sources: U.S. Bureau of Labor Statistics; U.S. Department of Education, National Center for Education Statistics, State Nonfiscal Survey of Public Elementary/Secondary Education and Schools and Staffing Survey, Private School Questionnaire.

Labor input. Labor input grew 1.3 percent annually from 1989 to 2012 in elementary and secondary schools, as shown in figure 2. Average annual growth rates for labor input dropped in each successive subperiod examined, a pattern also seen for output. Labor input grew 2.1 percent per year from 1990 to 2000, increased more slowly at 1.5 percent per year in 2000–07, and then declined at a 0.5-percent rate from 2007 to 2012. Labor input at private schools increased 2.3 percent per year from 2000 to 2007, much faster than that for public schools. From 2007 through 2012, labor input declined more rapidly in private schools (1.7 percent per year) than in public schools (0.4 percent per year).

Figure 3. Labor productivity for all schools, public schools, and private schools, 1989–2012



Source: U.S. Bureau of Labor Statistics.

Labor productivity. Labor productivity in elementary and secondary schools, calculated as output per FTE of labor input, rose from 1990 to 1995 and then declined steadily until 2009. Although productivity rose from 2010 forward, it did not regain the level that it had reached in 1989. The average change in labor productivity for all elementary and secondary schools over the period, as a whole, was a slight decline of 0.2 percent per year. Figure 3 displays labor productivity trends for the industry and for public and private schools, from 1989 to 2012. Because public schools educate over 90 percent of the students, the industry and the public school trends are nearly identical. Public school labor productivity peaked in 1992 and 1995 and then declined steadily until 2009, reflecting declining growth in output and a somewhat slower decline in labor input growth. The decline in the public school output growth rate primarily reflects the slowing growth rate of the school-age population. From 1990 to 2012, the school-age population grew at an average annual rate of 0.79 percent, with a growth rate of 2.02 percent from 1990 to 2000 and 0.26 percent from 2000 to 2012.[63] As shown in table 1, beginning in 2009, public school output growth continued to slow while labor input fell off significantly, with a –0.91-percent growth rate of labor input for 2009 to 2012, resulting in an upturn in public school labor productivity. Labor productivity in private schools declined sharply after 1993 and even more severely after 2001 than in public schools. This decline appears to be the result of a more cautious reduction in labor inputs by private schools than by public schools. In addition, private schools did not experience the same uptick in productivity after 2010 as their public counterparts. Private school output growth remained positive from 1993 to 2001, while labor input growth increased markedly. From 2001 to 2012, private school output growth retreated to negative values and while labor input growth fell dramatically, labor productivity growth for private schools remained negative. Figure 4 displays output, labor input, and labor productivity annual growth rates for the industry overall, public schools only, and private schools only, from 1990 to 2012.

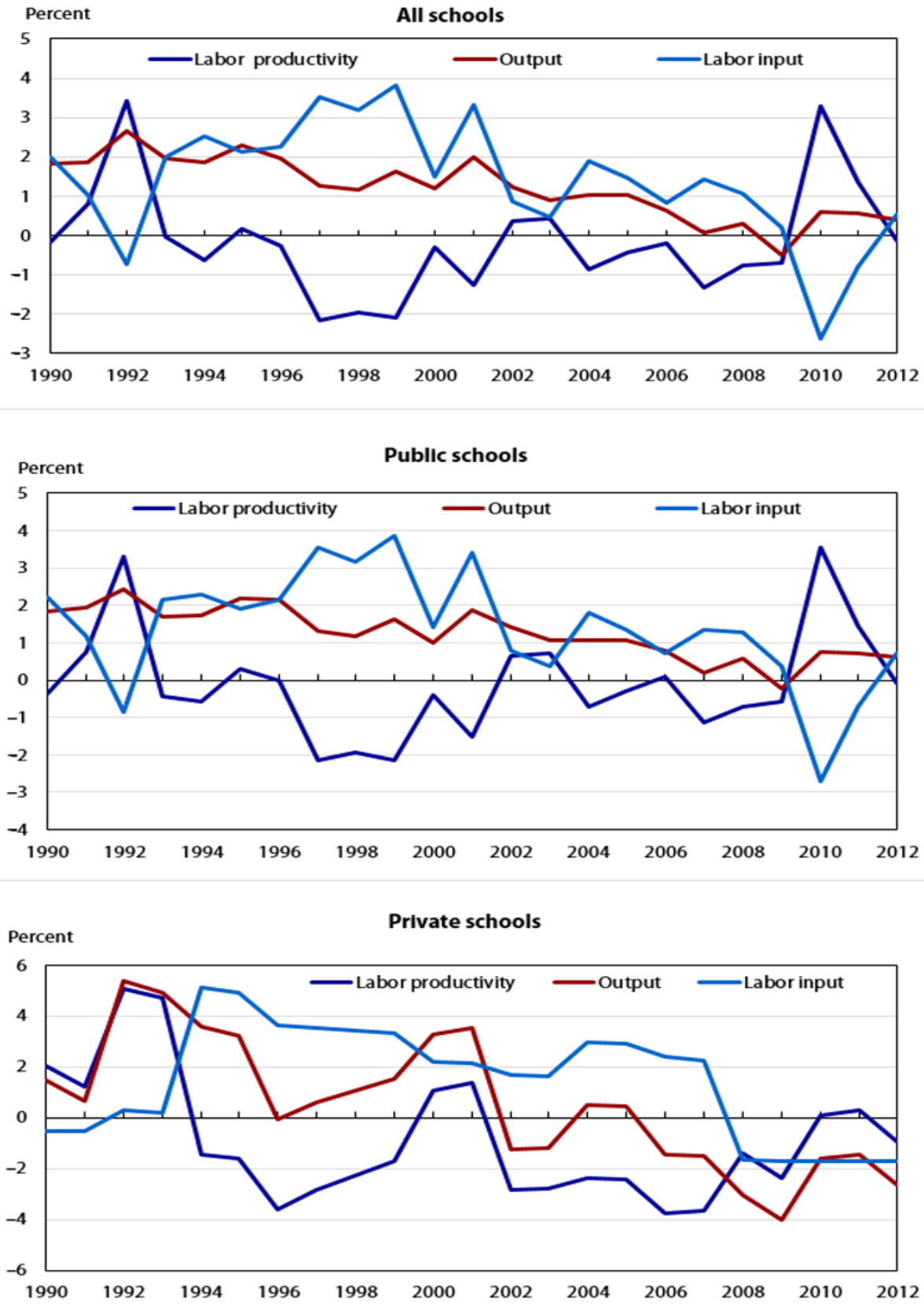
Table 1. Average annual percentage-growth rates of labor productivity, output, and labor input for all schools, public schools, and private schools, 1989–2012

Time span	All schools			Public schools			Private schools		
	Labor productivity	Output	Labor input	Labor productivity	Output	Labor input	Labor productivity	Output	Labor input
1989–2012	–0.17	1.20	1.37	–0.11	1.26	1.37	–0.91	0.49	1.41
1989–93	.99	2.06	1.06	.80	1.98	1.17	3.25	3.09	–.15
1993–2001	–1.08	1.66	2.77	–1.05	1.63	2.71	–1.40	2.07	3.53
2001–12	.08	.56	.47	.25	.73	.47	–2.02	–1.58	.46
1989–95	.58	2.07	1.48	.49	1.97	1.48	1.63	3.20	1.54
1995–2009	–.84	.98	1.83	–.73	1.07	1.82	–2.13	–.14	2.03
2009–12	1.49	.51	–.97	1.62	.70	–.91	–.20	–1.90	–1.71

Source: U.S. Bureau of Labor Statistics.

Unit labor costs and compensation. The concept of “unit labor costs” compares labor compensation with output and is a useful gauge of how much output is received over time relative to labor costs, or the “cost competitiveness” of labor input in the production of output. One may also calculate unit labor costs by dividing hourly compensation (labor cost per hour) by labor productivity (output per hour). Therefore, an increase in labor productivity growth offsets the growth of hourly compensation in calculating unit labor costs. A greater rate of labor productivity growth relative to growth in hourly compensation will result in lower unit labor costs.

Figure 4. Annual growth rates of labor productivity, output, and labor input for all schools, public schools, and private schools, 1990–2012



Source: U.S. Bureau of Labor Statistics.

BLS calculated unit labor costs for public elementary and secondary schools using data on public school salaries and benefits from the NPEFS. Unit labor costs increased at an average annual rate of 3.4 percent from 1989 to 2012.[64] Public school unit labor costs varied over this period, increasing at a rate of 3.6 percent from 1990 to 2000, 4.3 percent from 2000 to 2007, and declining to 1.2 percent from 2007 to 2012. Regarding data from the National Association of Independent Schools, private school unit labor costs increased at a rate of 5.4 percent for the 1998–2012 period.[65] From 1990 to 2000, private school unit labor costs rose at a rate of 4.2 percent, increasing to 7.7 percent from 2000 to 2007 and falling to 5.0 percent for 2007–12. For the industry overall, unit labor costs rose at an average annual rate of 3.6 percent from 1989 through 2012, with a variation of 3.7 percent from 1990 to 2000, and at a rate of 4.6 percent from 2000 to 2007 and declined to 1.5 percent from 2007 to 2012.[66]

Labor compensation, the sum of salaries and benefits paid to employees, increased at a rate of 4.8 percent for the elementary and secondary schools industry from 1989 to 2012. Labor compensation increased steadily in the industry overall, growing at a rate of 5.5 percent from 1990 to 2000 and 5.6 percent from 2000 to 2007 before declining to 1.7 percent for 2007–12. This 4.8-percent annual growth in labor compensation from 1989 to 2012 for the elementary and secondary schools industry is similar to the 4.4-percent annual growth in labor compensation found in the nonfarm business sector as a whole, one of the broadest aggregates for which productivity measures are published. However, when combined with flat or declining labor productivity in the industry, this increase in hourly compensation resulted in relatively rapid increases in unit labor costs.

Public school labor compensation increased at a rate of 4.7 percent during this period (1989–2012), whereas private school labor compensation increased at a rate of 5.9 percent. Public school labor compensation grew at a steady 5.4-percent growth rate from 1990 to 2007 before declining to 1.6 percent growth for 2007–12. Labor compensation of private schools grew at a rate of 6.7 percent from 1990 to 2000 and 7.6 percent from 2000 to 2007 before declining to 2.3 percent from 2007 to 2012. Looking at the components of labor compensation, we find that benefits grew at a faster rate than salaries in the elementary and secondary schools industry. The gap between growth in benefits and growth in salaries was particularly wide between 2000 and 2007, with benefits rising 4.1 percent faster than the rate salaries rose.

Conclusion

The elementary and secondary schools industry must be responsive to changes in the population requiring educational services. Increased enrollments of students with specific needs, such as English-language learners, disabled students, and impoverished students, challenge the industry. The industry is also subject to variation in economic conditions, with public schools facing tighter budget constraints during periods of economic downturn and private schools facing families with more limited budgets. Variations in factors influencing student educational outcomes, such as teacher quality, student–teacher ratios, and curriculum quality, also play a role in determining the output of educational services. In the future, we hope to provide additional information on changes in these underlying factors and their quantitative impact on educational services. This new measure is a first step toward understanding the relationship between production of educational services and the labor inputs used in this production.

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Appendix: advances in education economics

Over the last few years, economists have progressed tremendously in understanding some of the central issues in education. Many research studies have used large datasets to understand school performance and to unravel connections between school performance and students' economic success later in life. This appendix summarizes much of the recent economic research and guides interested readers toward other research topics in which they may be interested.

We begin with three studies conducted shortly after 2000 that influenced the economics of education considerably. In the first study, Hanushek and Kimko come to two central conclusions.[67] First, countries that have students who score high on international tests in science and mathematics also have higher rates of economic growth. Second, immigrants to the United States who come from countries with higher scores also earn more in the United States. These results suggest that these countries produce high-quality human capital and are thus able to grow more quickly. Such evidence is also consistent with an emphasis on science and technology education.

In a second study, Hanushek shows that, in most contexts, more resources devoted to education do not lead to better results.[68] A few exceptions to this general rule exist, mostly among young children and disadvantaged groups. For example, Hanushek remarks that if disadvantaged students were fortunate enough to have strong teachers, at the 85th percentile, for 5 consecutive years, such a boost in itself would be sufficient to eliminate the entire gap between mainstream and disadvantaged students.[69] What stands out most strongly from this study is how additional resources generally do not lead to improved results. Findings such as these have led scholars to conclude that, since added resources do not work, educators will have to fundamentally change the structure of schools and their incentives to produce better outcomes.

In the final study, Rivkin, Hanushek, and Kain studied the value added of learning of students in Texas schools.[70] "Value added" is a measure of a student's learning in a given year, and it is measured by the increase from the previous year's test scores. The value-added measure reflects the "gain" in a student's test scores compared with previous years' scores and controls for family, neighborhood, and school influences on a student. This value-added approach makes adjusting for individual student differences in learning capability possible. Teacher evaluation by year-to-year gains in student achievement then become a useful additional measure of teacher effectiveness.

Teacher effects are generally found to be consistent over time: Teachers with high value-added scores within a given year tend to have similar scores in other years; teachers with low value-added scores tend to have similar scores in other years. This result has been the basis for a renewed emphasis on measuring and rewarding good teachers.

After the Rivkin et al. study and other similar work showed that teacher value added could be estimated, further work analyzing education in terms of teacher value-added data then exploded. New teachers were found to have below-average teacher scores in their earlier years, particularly in their first year.[71] Many teachers with especially low scores in their early years soon left the profession. Having shown that low income and minority students are taught more frequently by beginner teachers and experience higher teacher turnover rates, Rivkin et al. and others argued for implementing policy incentives such as higher pay to retain more experienced, qualified teachers for

disadvantaged students.[72] Teacher scores were uncorrelated with many factors often used in teacher pay, such as the presence of a graduate degree.[73]

A recent study has also illustrated the very strong returns associated with early childhood education. James Heckman demonstrated that attempts to improve learning are much more effective in children's early years, when the brain is more malleable.[74] Heckman explained many of the basic ideas in clear, nontechnical language. Heckman's work often distinguishes between cognitive (learning) skills and noncognitive skills, such as perseverance and reliability, which have proven to influence children's future economic success extensively.

In the last few years, economists have published several articles showing the important and enduring affect teachers have over a student's lifetime. For example, Chetty et al. showed that unusually effective kindergarten teachers could create $8,500 to $10,700 greater lifetime earnings per student, in present value, or $170,000 to $214,000 greater earnings for a class of 20 students.[75] Interestingly, the effects of class quality on test scores faded over time, but the effect on eventual adult income remained operating through noncognitive effects. Similarly, Chetty, Friedman, and Rockoff found that, as long as they controlled for previous test scores, value-added measures are an unbiased measure of teachers' effect on student achievement.[76] In further work, Chetty, Friedman, and Rockoff showed that [measures of teacher value added] are not just measures of effectiveness in teaching for the test but are useful predictors of future adult income.[77] Finally, Chetty and Hendren showed that students benefit from moving from poor to higher income areas as long as they move before age 13.[78]

The evidence just summarized illustrates the importance of teacher value-added effects. Nevertheless, value-added methods have become a controversial topic, especially because, depending on the construction of the particular measure and the accuracy of student testing, they may mischaracterize the contribution of individual teachers. The American Statistical Association has cautioned about the use of value-added methods in evaluating individual teachers.[79] Rothstein tested three different value-added measures and found that the measures fail to uphold some underlying assumptions, including that fifth-grade teacher assignments should not be correlated with fourth-grade student gains.[80] Rothstein finds that students who do exceptionally well in fourth grade trend downward in gains in fifth grade as their achievements fall back toward the mean gain, and students who do poorly in fourth grade trend upward in gains in fifth grade as they advance toward the mean. According to Rothstein, the value-added measures he tested credited teachers for the students assigned, rather than accurately capturing the value added by the individual teacher.[81] Despite such concerns, measures of the value added by teachers are important. The Gates Foundation (Measures of Effective Teaching [MET] Project) found that constructing a composite measure of teacher effectiveness that combines information from test score growth, classroom observations, and student-perception surveys of the classroom environment results in a fair and reliable measure.[82] In addition, using classroom observations of teacher performance and student-perception surveys to evaluate teachers generates valuable measures in their own right.[83] In a pioneering effort, the Gates Foundation is underwriting a project that will videotape teachers with high value added, analyze the characteristics that high value-added teachers have in common, and explore how the secrets of their effectiveness can be taught to other teachers.[84]

Susan G. Powers and Steven Flint, "Labor productivity growth in elementary and secondary school services: 1989–2012," *Monthly Labor Review,* U.S. Bureau of Labor Statistics, June 2016, https://doi.org/10.21916/mlr.2016.29.

NOTES

[1] Michael Greenstone, Max Harris, Karen Li, Adam Looney, and Jeremy Patashnik, “A dozen economic facts about K–12 education,” Policy Memo, The Hamilton Project (Washington, DC: The Brookings Institution, September 2012), p. 1.

[2] Ibid. See figure 1, pp. 1–2.

[3] According to the U.S. Bureau of Labor Statistics, employment in all occupations in North American Industry Classification System (NAICS) code 61, educational services, was 12,758,610 in May 2014.

[4] Ibid. Elementary and secondary schools, NAICS code 61111, employed 8,308,980 individuals in all occupations in the industry as of May 2014.

[5] *Digest of education statistics*, table 106.10, “Expenditures of educational institutions related to the gross domestic product, by level of institution: selected years, 1929–30 through 2013–14” (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2014), https://nces.ed.gov/programs/digest/d14/tables/dt14_106.10.asp.

[6] See 2007 County Business Patterns and 2007 Economic Census. Also, see 2013 County Business Patterns, Statistics of U.S. Businesses Main (U.S. Bureau of the Census), https://www.census.gov/econ/susb/.

[7] Prekindergarten students attending academic prekindergarten programs affiliated with elementary and secondary schools in this industry are typically included in data for this industry.

[8] *Digest of education statistics*, table 203.10, “Enrollment in public elementary and secondary schools, by level and grade;” table 214.10, “Number of public school districts and public and private elementary and secondary schools”; and table 205.10, “Private elementary and secondary school enrollment and private enrollment as a percentage of total enrollment in public and private schools, by region and grade level (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2014), https://nces.ed.gov/programs/digest/d14/.

[9] Ibid.

[10] For more information, see Susan Aud, William Hussar, Frank Johnson, Grace Kena, Erin Roth, Eileen Manning, Xiaolei Wang, and Jijun Zhang, *The condition of education 2012*, NCES 2012-045, appendix A, table A-4–2, “Number, percentage, and percentage distribution of public charter schools and students, by region and state or jurisdiction” (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, May 2012), p. 134, http://nces.ed.gov/pubs2012/2012045.pdf; and *Digest of education statistics*, table 216.30, “Number and percentage distribution of public elementary and secondary students and schools, by traditional or charter school status and selected characteristics: selected years, 1999–2000 through 2012” (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2014), https://nces.ed.gov/programs/digest/d14/tables/dt14_216.30.asp.

[11] For additional information, see Center for Research on Education Outcomes, Stanford University, National Charter School Study, 2013; and *The nation’s report card: national assessment of educational progress*, “America’s charter schools: results from the NAEP 2003 pilot study,” NCES 2005-456 (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, December 2004), http://nces.ed.gov/nationsreportcard/pdf/studies/2005456.pdf.

[12] *Digest of education statistics*, table 206.10, “Number and percentage of homeschooled students ages 5 through 17 with a grade equivalent of kindergarten through 12th grade, by selected child, parent, and household characteristics” (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2014), https://nces.ed.gov / programs/digest/d14/tables/dt14_206.10.asp.

[13] Frederick Huntley Magison and Thomas Tracy Bouvé, *The statute law of municipal corporations in Massachusetts* (Albany, NY: Mathew Bender and Company, 1917), p. 208; and American history online, Facts on File, Inc., http://online.infobase.com/HRC/Search/Details/201886?q=laws%20of%201642.

[14] For a chronology of federal education legislation, see *Digest of education statistics 2012*, chapter 4, "Federal programs for education and related activities," NCES 2014-015 (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, December 2013), pp. 589–597, http://nces.ed.gov/pubs2014/2014015.pdf.

[15] School boards develop policies and regulations to control the operation of the schools in a school district, including system organization, school site location, school finance, equipment purchase, staffing, attendance, curriculum, extracurricular activities, and other functions, and may also be authorized to levy taxes, initiate eminent domain proceedings, acquire land, and assume bonded indebtedness. See Joseph Beckham and Barbara Klaymeier Wills, *Education encyclopedia*, "Duties, responsibilities, decision-making and legal basis for local school board powers," http://education.stateuniversity.com/pages/2391/School-Boards.html.

[16] *Digest of education statistics 2012*, chapter 4, "Federal programs for education and related activities."

[17] These students often require additional support through the public school system, such as breakfast and lunch programs, safe after-school programs, and tutoring, to compensate for their reduced access to in-home and in-community resources.

[18] The National Council of State Supervisors for Languages (NCSSFL) provides documentation on foreign language high school graduation requirements by state at http://ncssfl.org/.

[19] *State regulation of private schools* (Washington, DC: U.S. Department of Education, Office of Innovation and Improvement, July 2009), https://www2.ed.gov/admins/comm/choice/regprivschl/regprivschl.pdf.

[20] *Council on American private education*, "Private schools and the Every Student Succeeds Act" (Germantown, MD: Council for American Private Education, January 2016), http://www.capenet.org/pdf/ESSACAPE.pdf.

[21] *State regulation of private schools*, 2009.

[22] Martha Naomi Alt and Katharin Peter, *Findings from the condition of education 2002*, "Private schools: a brief portrait," NCES 2002–013 (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2002), pp. 21–23, http://nces.ed.gov/pubs2002/2002013.pdf.

[23] Ibid.

[24] Ibid.

[25] See William C. Symonds, "For-profit schools: They're spreading fast. Can private companies do a better job of educating America's kids?" *BusinessWeek*, February 7, 2000. In 2000, the United States had about 200 for-profit elementary and secondary schools serving roughly 100,000 of 53 million students in grades K–12. Although nominally for-profit organizations, few of these schools are in fact profitable, http://www.bloomberg.com/news/articles/2000-02-06/for-profit-schools.

[26] For more information on mothers who continue to work while raising their young children, see Robert Kaestner, Darren Lubotsky, and Javaeria Qureshi, "Mother's employment by child age and its implications for theory and policy," paper submitted to National Bureau of Economic Research, April 12, 2016, pp. 2–31; *Digest of education statistics,* table 202.20, "Percentage of 3-, 4-, and 5-year-old children enrolled in preprimary programs, by level of program, attendance status, and selected child and family characteristics: 2014" (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2014), http://nces.ed.gov/programs/digest/d15/tables/dt15_202.20.asp; and *Digest of education statistics*, table 42, "Number of preschool children under 6 years old, percentage in center-based programs, average hours in nonparental care, and percentage in various types of primary care arrangements, by selected child and family characteristics: 2005" (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2006), http://nces.ed.gov/programs/digest/d06/tables/dt06_042.asp.

[27] *Issue brief*, "English language learner students in U.S. public schools: 1994 and 2000," NCES 2004–035 (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, August 2004), p. 1, http://nces.ed.gov/pubs2004/2004035.pdf; *Digest of education statistics,* table 204.20, "Number and percentage of public school students participating in programs for English language learners, by state: selected years, 2002–03 through 2011–12" (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2014), https://nces.ed.gov /programs/digest/d13/tables/dt13_204.20.asp; and Jennifer Robinson, Xiaolei Wang, Amy Rathbun, Jijun, Zhang, Sidney Wilkson-Flicker, Amy Barmer, and Erin Dunlop Velez, *The condition of education 2015,* NCES 2015-144 (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, May 2015), p. 85, http://nces.ed.gov/pubs2015/2015144.pdf.

[28] Ibid, p. 50.

[29] *Digest of education statistics*, table 362, "Public school students receiving publicly funded free or reduced price lunch, by selected school characteristics: school year 1990–91" (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 1993), https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=93292 ; and *Digest of education statistics*, table 204.10, "Number and percentage of public school students eligible for free or reduced-price lunch, by state: selected years, 2000–01 through 2011–12" (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2014), https://nces.ed.gov/programs/digest/d13/tables/dt13_204.10.asp.

[30] *Digest of education statistics*, table 204.30, "Children 3 to 21 years old served under Individuals with Disabilities Education Act, Part B, by type of disability: selected years, 1976–77 through 2012–13" (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2014), https://nces.ed.gov/programs/digest/d14/tables/dt14_204.30.asp.

[31] *Digest of education statistics*, table 204.60, "Percentage distribution of students 6 to 21 years old served under Individuals with Disabilities Education Act, Part B, by educational environment and type of disability: selected years, fall 1989 through fall 2012" (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2014), https://nces.ed.gov /programs/digest/d14/tables/dt14_204.60.asp.

[32] *Digest of education statistics*, table 103.20, "Percentage of the population 3 to 34 years old enrolled in school, by age group: selected years, 1940 through 2013" (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2014), https://nces.ed.gov /programs/digest/d14/tables/dt14_103.20.asp.

[33] See table 7, "Employment status of women by presence and age of youngest child," March 1975–March 2013, in BLS reports, "Women in the labor force: a databook," Report 1052 (U.S. Bureau of Labor Statistics, December 2014), p. 25, https://www.bls.gov/opub/reports/womens-databook/archive/women-in-the-labor-force-a-databook-2014.pdf.

[34] For further discussion, see Barbara M. Fraumeni, Marshall B. Reinsdorf, Brooks B. Robinson, and Matthew P. Williams, "Price and real output measures for the education function of government: exploratory estimates for primary and secondary education," NBER Working Paper no. 14099 (Cambridge, MA: National Bureau of Economic Research, June 2008), http://www.nber.org/papers/w14099.

[35] Mark K. Sherwood, "Difficulties in the measurement of service outputs," *Monthly Labor Review*, March 1994, pp. 11–19, https://www.bls.gov/mlr/1994/03/art2full.pdf.

[36] Paul Schreyer, *Towards measuring the volume output of education and health services: a handbook*, Working Paper no. 31 (Paris, France: Organisation for Economic Co-operation and Development, April 28, 2010), pp. 49–52, http://www.oecd-ilibrary.org/economics/towards-measuring-the-volume-output-of-education-and-health-services_5kmd34g1zk9x-en.

[37] Ibid.

[38] Ibid.

[39] *Sources & methods*, "Public service productivity estimates: education" (Newport, South Wales: Office for National Statistics, July 2012), p. 5.

[40] Fraumeni et al., "Price and real output measures for the education function of government," p. 20.

[41] Every Student Succeeds Act, Pub. L. No. 114–95, December 10, 2015, https://www.congress.gov/114/plaws/publ95/PLAW-114publ95.pdf.

[42] Ibid.

[43] Ibid.

[44] Commonly used standardized tests include the Iowa Tests of Basic Skills for K–8 and the Iowa Tests of Educational Development, used for grades 9–12, published by Riverside Publishing/Houghton Mifflin; the Stanford Achievement Test, Ninth Edition, published by Harcourt Educational Measurement; and the Michigan Educational Assessment Program (MEAP), devised to assess educational achievements of students in the Michigan school systems.

[45] Lee Anderson, Nancy Adelman, Kyo Yamashiro, Mary Beth Donnelly, Kara Finnigan, Jose Blackorby, and Lynyonne Cotton, "Evaluation of the public charter schools program: year one evaluation report" (Washington, DC: U.S. Department of Education, Office of the Under Secretary, Planning and Evaluation Service, Elementary and Secondary Education Division, 2000), pp. 43–58, https://www2.ed.gov/rschstat/eval/choice/pcsp-year1/year1report.pdf.

[46] Josh Cunningham, *Improving school choice in the states,* "Accountability in private school choice programs" (Washington, DC: National Conference of State Legislatures, December 2014), p. 4, http://www.ncsl.org/documents/educ/AccountabilityInPrivateSchoolChoice.pdf.

[47] The State Nonfiscal Survey of Public Elementary/Secondary Education is one of five annual surveys comprising the U.S. Department of Education, National Center for Education Statistics Common Core of Data (CCD). The CCD is a national statistical program that collects and compiles administrative data from state education agencies covering the universe of all public elementary and secondary schools and school districts in the United States. Only prekindergarten students enrolled in a group or class that is part of a public school program taught during the year or years preceding kindergarten, excluding Head Start students unless part of an authorized public education program of a local education agency, are included in the survey. For more information, see http://nces.ed.gov/ccd/stnfis.asp.

[48] The National Center for Education Statistics (NCES) Private School Universe Survey of the U.S. Department of Education produces data similar to that of the NCES Common Core of Data for the public schools. Private schools are included in the survey when they teach at least one of grades 1–12, ungraded students between 5 and 18 years old, kindergarten (traditional year of school primarily for 5-year-olds before first grade), transitional kindergarten (extra year of school for kindergarten-age children who are judged not ready for kindergarten), or transitional first grade (extra year of school for children who have attended kindergarten but have been judged not ready for first grade). Early childhood programs and daycare centers that teach kindergarten, transitional kindergarten, or transitional first grade are also included in the survey. For more information, see http://nces.ed.gov/surveys/pss/index.asp.

[49] Average daily attendance data are obtained from the U.S. Department of Education, National Center for Education Statistics, National Public Education Financial Survey, http://nces.ed.gov/ccd/stfis.asp. Because average daily attendance data are not available for private schools, the public school data on average daily attendance are used for adjusting both public and private school enrollment for variations in daily attendance. The attendance of prekindergarten student enrollment is not adjusted because attendance is not compulsory for this group of students.

[50] The National Assessment of Educational Progress (NAEP) is the largest nationally representative and continuing assessment of elementary and secondary school students in the United States. Assessments are conducted periodically in mathematics, reading, science, writing, the arts, civics, economics, geography, and U.S. history. The NAEP (also known as "The Nation's Report Card"; see endnote 11) is a congressionally mandated assessment in various subject areas administered by the National Center for Education Statistics, a branch of the U.S. Department of Education. Results are summarized only at the national, state, and trial urban district (Trial Urban District Assessment [TUDA]) levels. The NAEP created the TUDA in 2002, beginning with six urban districts participating in reading and writing assessments, to support the improvement of student achievement in the nation's large urban districts. In 2009, 18 districts participated in mathematics, reading, and science. In 2011, 2013, and 2015, 21 districts participated. NAEP assessments are administered uniformly with use of the same sets of test booklets across the nation and, as a result, serve as a common metric for

all states and selected urban districts. The assessment stays essentially the same from year to year, with only carefully documented changes. This process permits NAEP to provide a clear picture of student academic progress over time. Long-term trend assessment in mathematics and reading is conducted differently from the NAEP's main assessments, and the two types of assessments are not comparable. For additional information, see http://nces.ed.gov/nationsreportcard/about/.

[51] These categories include elementary and secondary school teachers, instructional aides, guidance counselors, librarians and library support staff, school administrators (principals, assistant principals, head masters, assistant heads), school administrative support staff, psychologists, speech therapists, audiologists, school nurses, attendance officers, cafeteria staff, bus drivers, custodial and building maintenance staff, and security staff. Public school systems also employ local education agency administrators such as school district superintendents, assistant superintendents and deputy superintendents, administrative assistants, business managers, administrative support staff, and instructional coordinators. Although private schools do not require local education agency staff, they may employ business officers, admissions officers, development officers, and directors of studies.

[52] These data are obtained from the National Center for Education Statistics, State Nonfiscal Survey of Public Elementary/Secondary Education. The 16 public school detailed employment categories include prekindergarten teachers, kindergarten teachers, elementary school teachers (excluding prekindergarten and kindergarten teachers), secondary school teachers, ungraded teachers, instructional aides, instructional coordinators, guidance counselors, librarians, library support staff, local education agency administrators, local education agency administrative support staff, school administrators, school administrative support staff, student support services staff, and all other support staff.

[53] Private school detailed employment categories include principals, assistant principals, other managers, instruction coordinators, teachers (grades K–12), teacher aides, other aides, guidance counselors, librarians and media specialists, librarians and media center aides, nurses, student support staff (includes student support services professional staff, such as school psychologists, social workers, and speech therapists), secretaries and clerical staff, food service personnel, custodial and maintenance staff, and other employees (includes health and other noninstructional aides and other employees not identified by function). These data are available every 4 to 6 years. Data points between available years are interpolated with use of average annual growth rates. Because the Schools and Staffing Survey, Private School Questionnaire, gathers data on number of teachers for grades K–12 only, we estimate the number of private school prekindergarten teachers for each year by dividing annual private school prekindergarten student enrollment by the private school student–teacher ratio for that year.

[54] We defined the six broad employment categories to closely match the six public school expenditure categories available in the National Center for Education Statistics (NCES), National Public Education Financial Survey. Expenditure share weights for each of the six broad employee categories are calculated with the use of NCES National Public Education Financial Survey data on salaries and benefits (http://nces.ed.gov/ccd/stfis.asp). The use of expenditure share weights in constructing nonmarket output and input index measures is discussed by W. Erwin Diewert in "The measurement of nonmarket outputs and inputs using cost weights," Discussion Paper no. 08-03 (Vancouver, BC, Canada: University of British Columbia, April 2008); and in chapter 16, System of National Accounts 1993, Eurostat, IMF, OECD, UN, and the World Bank (New York: United Nations, 1993).

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[60] *Digest of education statistics*, table 216.30.

[61] Because private school participation rates in the NAEP long-term testing program fell overall below the required standard for reporting results in 2012, private school test scores for 2012 are estimated with the use of the 2008 values.

[62] Differences between long-term trend reading and mathematics test scores administered by Catholic schools and public schools are presented in *The nation's report card: trends in academic progress, 2012*, NCES 2013-456 (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2012), pp. 42–43, http://nces.ed.gov/nationsreportcard/subject/publications/main2012/pdf/2013456.pdf.

[63] *Digest of education statistics*, table 101.40, "Estimated total and school-age resident populations, by state: selected years, 1970 through 2013" (Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2014), https://nces.ed.gov/programs/digest/d14/tables/dt14_101.40.asp.

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[65] The National Association of Independent Schools (NAIS) generously provided mean and median salary data by employee category for private schools. Total annual private school salary expenditures were estimated with use of data on the number of private school employees by employee category from the U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, Private School Questionnaire, and NAIS salary data by type of employee. Because private school benefits data were unavailable, private school benefits were estimated with the use of private school salary data and the ratio of public school benefits to salaries. This estimation approach constrains estimated private school benefits to the public school benefits growth rate, and as a result, the private school benefit data are not published separately. The U.S. Bureau of Labor Statistics, Occupational Employment Statistics program (OES), began publishing wage data by occupation for private schools in this industry in 2009. The OES data may eventually be used to replace the NAIS data, which are not from a representative sample of private schools.

[66] Labor compensation is defined to include salaries and benefits. Labor compensation for public schools is measured with use of data on salary and benefit expenditures from the National Center for Education Statistics (NCES), National Public Education Financial Survey. While extensive and detailed expenditure data are available for public schools, little expenditure data are available for private schools. Using NCES data on number of employees and historical salary data from the National Association of Independent Schools (NAIS), we construct estimates of salary expenditures for each of 10 detailed private school employee categories. Benefits expenditures for private schools are not available from the NAIS. To estimate private school benefits, we computed the ratio of public school benefits expenditures to public school salaries expenditures and applied this ratio to total salaries expenditures obtained from the NAIS. We obtained aggregate elementary and secondary industry compensation by summing total public and private labor compensation.

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