A BETTER MEASURE OF ECONOMIC GROWTH: GROSS DOMESTIC OUTPUT (GDO)

The growth of total economic output affects our assessment of current well-being as well as decisions about the future. Measuring the strength of the economy, however, can be difficult as it depends on surveys and administrative source data that are necessarily imperfect and incomplete. The total output of the economy can be measured in two distinct ways—Gross Domestic Product (GDP), which adds consumption, investment, government spending, and net exports; and Gross Domestic Income (GDI), which adds labor compensation, business profits, and other sources of income. In theory these two measures of output should be identical; however, they differ in practice because of measurement error. With today's annual revision, the Bureau of Economic Analysis (BEA) began publishing a new measure of U.S. output—the "average of GDP and GDI"—which the Council of Economic Advisers (CEA) will refer to as Gross Domestic Output (GDO).[1] This issue brief describes GDO, reviews its recent trends, and explains why it can be a more accurate measure of current economic growth and a better predictor of future economic growth than either GDP or GDI alone.

What is Gross Domestic Output (GDO)?

What we are calling "GDO" is the average of two existing series, the headline Gross Domestic Product (GDP) and its lesser-known counterpart, Gross Domestic Income (GDI). Starting with today's annual revision, the Bureau of Economic Analysis (BEA) began publishing this new measure under the name of the "average of GDP and GDI."

Both GDP and GDI are designed to measure the same concept—the total value of the economy's output—but they rely on different methods and data. GDP tracks all *expenditures* on final goods and services produced in the United States, whereas GDI tracks all *income* received by those who produced that output. Conceptually the two should be equal because every dollar spent on a good or service (in GDP) must flow as income to a household, a firm, or the government (and therefore must show up in GDI). However, the two numbers differ in practice because of measurement error.

The first estimate of quarterly GDP is released nearly a month after each quarter's end. Owing to data lags, GDI is generally first released nearly two months after quarter's end, along with the second estimate of GDP.[2] As a result, with today's advance GDP release, GDI and thus GDO remain available only through 2015:Q1 but will become available for 2015:Q2 along with the second GDP estimate that next month's release reports. All of the GDP and GDO estimates published today are subject to future revision when the BEA incorporates new source data or improves its methodologies.

The BEA and other Federal statistical agencies make every effort to minimize inaccuracies and have greatly improved the scope and sophistication of their techniques since the Commerce Department and the National Bureau of Economic Research (NBER) published the first estimates of U.S. national income in 1934. But some measurement error is unavoidable when attempting to track an increasingly complex economy using limited data. Combining two independent measures of output, as opposed to focusing solely on

[1] McCulla and Smith (2015) discuss this new output series, which BEA refers to as the "average of GDP and GDI." See also Moulton (2015). Economists have long pointed to the potential gain from considering GDI along with GDP. For example, see then-BEA Director Steven Landefeld's comment in 2010 that "the conclusion that the gross domestic income measure of aggregate output is deserving of attention is noncontroversial."

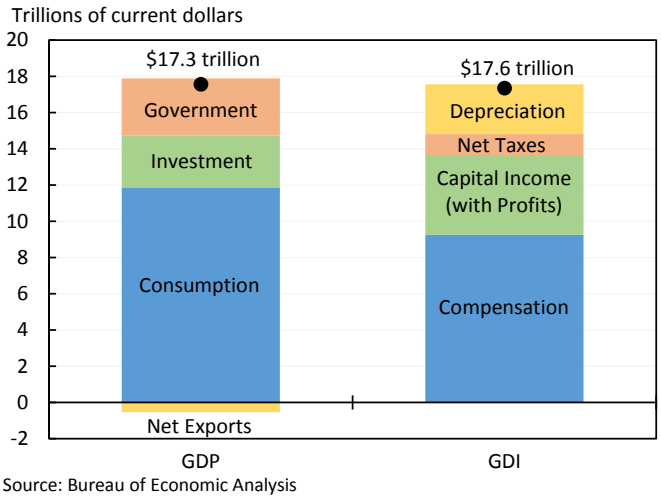
[2] For the fourth quarter of each year, GDI is first published three months after the quarter's end along with the third estimate of GDP. The estimates three months after the quarter's end complete BEA's initial round of GDP estimates; GDI in the initial round is revised again five months after the quarter's end. BEA updates estimates from the initial round subsequently on the basis of further information in its annual and comprehensive revision cycles. See Fixler et al (2014) and Holdren (2015) for more details on the process and statistical properties of the revisions.

GDP, should help mitigate the influence of measurement errors.

Although the information from GDP and GDI could be combined in a variety of ways, in practice the simple arithmetic average of the two—as BEA is now publishing—is a reasonable way to combine into a single measure that is more accurate than either component is individually. In fact, the NBER's Business Cycle Dating Committee includes the average of GDP and GDI in its official determination of peaks and troughs in economic activity.[3] CEA has also had a long-standing practice of monitoring and discussing GDO.[4] A number of other countries feature measures of economic output that are derived from both product-side and income-side estimates.[5] For example, Canada features both income and product estimates, referred to as "GDP by Income and Expenditure Accounts."

Figure 1 shows the current estimates of the nominal levels of GDP and GDI in 2014, along with their major subcomponents.[6] First, note that at $17.6 trillion, measured GDI was about $200 billion higher than measured GDP in 2014. The gap is referred to as the "statistical discrepancy" (because the two theoretically should be equal) and is roughly 1 percent of GDP. Second, the subcomponents of the two series differ—GDP totals up expenditures, such as consumption and investment, whereas GDI totals up income earned by workers and owners of capital, such as compensation, rent, and profits.[7] GDO, the average of GDP and GDI, combines these two perspectives on the economy in one blended measure of output.

Figure 1
GDP and GDI in 2014



Source: Bureau of Economic Analysis

In addition to measuring the size of the economy at a point in time, we generally focus on the change in the size of the economy, or economic growth. Figure 2 shows current estimates of the four-quarter change in real (that is, inflation-adjusted) GDO (dark green line) and real GDP (light green line).[8] Real GDO decelerated more than GDP prior to the last recession, an example of how income-side information can more accurately gauge business cycle fluctuations (more on this topic below).

[3] For example, see the NBER's announcement of the last business cycle trough at June 2009: http://www.nber.org/cycles/sept2010.html

[4] For a recent example see, Council of Economic Advisers (2015, pp 43-44), and for an earlier example, Council of Economic Advisers (1997, pp. 72-75).

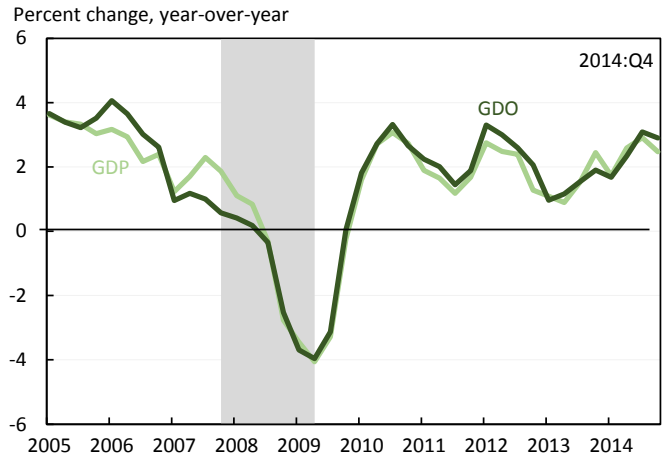
[5] See Moulton (2015) for more discussion of considering GDI and GDP together.

[6] The data used in this issue brief are from BEA: http://www.bea.gov/national/index.htm and the Real-Time Data Research Center at the Federal Reserve Bank of Philadelphia: https://www.philadelphiafed.org/research-and-data/real-time-center. We thank BEA's Dennis Fixler and Real-Time Data Center's Tom Stark for sharing vintage data on real GDI.

[7] See Landefeld et al. (2008) for a summary of the National Income and Product Accounts (NIPAs), including the measurement of GDP and GDI.

[8] GDI is measured in nominal dollars but there is no straightforward method for adjusting its subcomponents for inflation. Because GDP and GDI are conceptually the same, the implicit price deflator for GDP is used to calculate real GDI. BEA does not publish individual inflation-adjusted components of GDI as it does for GDP.

Figure 2
Real GDO and GDP



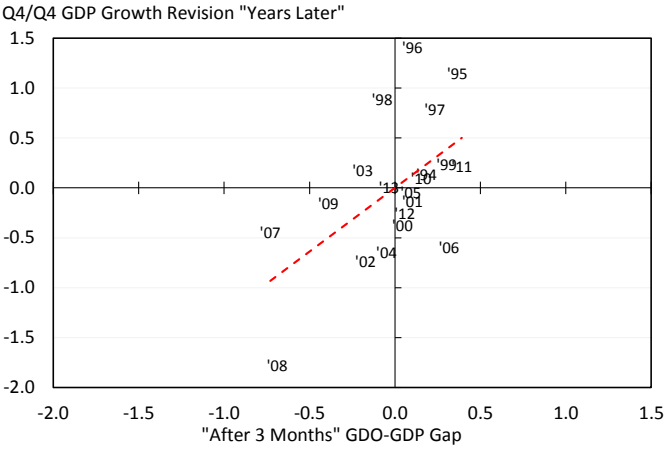
Source: Bureau of Economic Analysis

Is GDO a More Accurate Measure of Output in Real-time than GDP?

Households, businesses, and policymakers make their decisions in real time and rarely have the luxury of waiting years for all the data revisions. The income-side measure, and with it GDO, can be especially helpful in real time, that is, when BEA puts together its initial round of estimates for a quarter and has to rely on incomplete and preliminary source data. We will focus here on the estimates that BEA publishes about three months after the end of a quarter, and we will compare those initial estimates with the latest estimates that BEA publishes years later based on new and revised source data. Measuring an $18-trillion economy is a daunting and complex task—especially just months after the quarter's end—and so not surprisingly, the revision from the "after three months" estimate to the currently published "years later" estimate can be substantial.

The "after three months" estimates of output will be always be relatively noisy (measured with considerable error) because they are based on less complete data than later reads, but researchers have found that the early estimates of GDI often tell us something more about the later (and presumably more accurate) estimates of output than the early estimates of GDP alone.[9] As Figure 3 shows, when real GDO is increasing faster than real GDP in the "after three months" estimate, then GDP growth tends to revise up "years later,"–a sign that the initial estimates understated output growth. The specific relationship implies, for example, that real GDO growth that is 1/2 percentage point faster than GDP growth in the early estimates is associated with an eventual, upward revision to real GDP growth of roughly 1/2 percentage point.[10] And we can use this information in real time to tell us more about what is actually going on with economic activity. Of course, initial GDP estimates are also informative, but GDO, which combines information from the income and product sides, is a better predictor of future revisions to the data.

Figure 3
"After 3 Months" GDO Predicts "Years Later" GDP Revisions



Note: The line is the estimated relationship between the gap and the revisions. The data are deviations from their mean values in the 1994 to 2013 period.
Source: Bureau of Economic Analysis; CEA Calculations.

Of course, there are many ways that we could combine income and product side data.[11] GDO puts equal weight on GDP and GDI in its combination. This simple approach is broadly consistent with what a more formal analysis suggests about the optimal way to construct the

[9] See for example, Fixler et al (2014), Nalewaik (2010, 2011), and Aruoba et al (2013) for more analysis of the real-time properties of GDI and GDP. One to note, the revisions to real GDP and the revisions to real GDI in our sample have a positive correlation of 0.2 suggesting that the measurement error is not classical (that is, independent of the variable being measured).

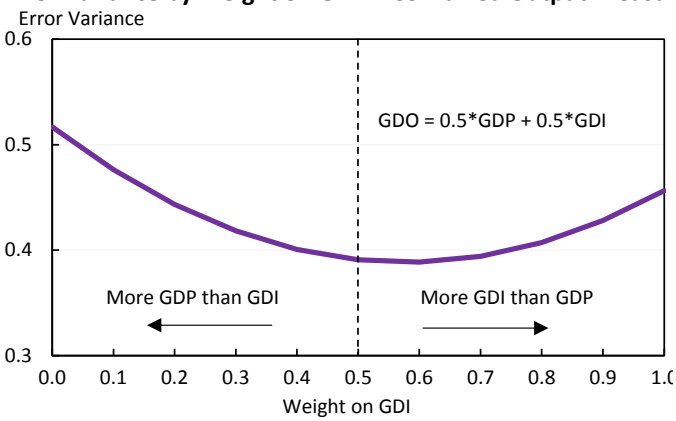
[10] Regression of GDP revisions on the GDO – GDP gap yields an estimated coefficient of 1.3 on the gap (t-statistic of 2.7) for the 1994 to 2013 period. The adjusted R-squared (a metric of how well the regression line fits the data) is 25 percent.

[11] This issue brief highlights the usefulness of GDO, the simple average of GDP and GDI. Alternate procedures for extracting information from GDP and GDI, such as those that underlie the so-called GDPplus estimates, allow for different weights on the two series (Aruoba et al. 2013). Those procedures also rely on both GDP and GDI.

weighted average of the data.[12] For example, Figure 4 shows that the "error variance" is, in fact, minimized when roughly equal weights are placed on GDP and GDI, as GDO does.[13] Here, the error we want to minimize is the difference between GDP growth ("years later") and the growth of the combined measure ("after three months"). GDO performs well on this metric and noticeably better than using GDP alone (zero weight on GDI) which is, in fact slightly worse than GDI alone (zero weight on GDP). Appendix Figure A-1 provides further summary statistics on the revisions.

Figure 4

Error Variance by Weight on GDI in Combined Output Measu



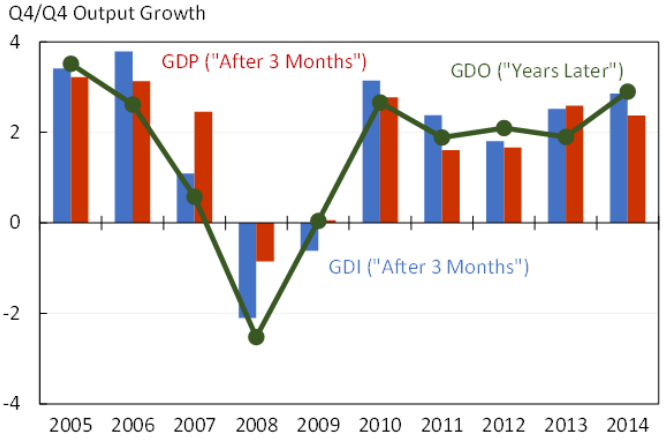
Note: The error is the difference between Q4/Q4 real GDP growth "years later" and the Q4/Q4 real growth "after three months" of the combined output measure. Data from 1994 to 2013.
Source: Bureau of Economic Analysis. CEA Calculations.

What Measures of Output Best Predict Future Growth?

A more accurate measure of recent output growth is useful; however, we are also interested in where the economy is headed. This information can be particularly important when the changes ahead are unusually large, such as at the start of a recession. Some researchers have found that GDI improves our ability to recognize the start of recessions.[14] Figure 5 provides a recent example. GDI growth (blue bars) decelerated much more in 2007—the year before the Great Recession began—than did GDP growth (orange bars). And these estimates are the data that were available in relative real time, specifically, "after three months" from a quarter's end. Thus, the sharp slowing of GDI growth provided a better signal than GDP growth for the severe recession, shown by the latest estimates of GDO growth (green line), which reflect years of data revisions.

Figure 5

Changes in Real Output Growth, 2005-2014



Source: Bureau of Economic Analysis; CEA calculations.

Headline measures like overall GDO and GDP will get the most attention, but the *source* of the change in output can be helpful for interpreting the data and predicting future changes. For example, an increase in wages may, if persistent, boost current and future consumer spending. In contrast, an increase in the volatile category of inventory investment may boost to GDP growth at the time but may or may not tell us much about the underlying trend in output. And while the growth of GDO is a more accurate predictor of future GDP growth than is GDP itself, there are less volatile subcomponents of GDP and GDI which better forecast output growth: private domestic final purchases (the sum of consumption and fixed investment, also published by the BEA starting with today's revision), and wages and salaries plus business profits.

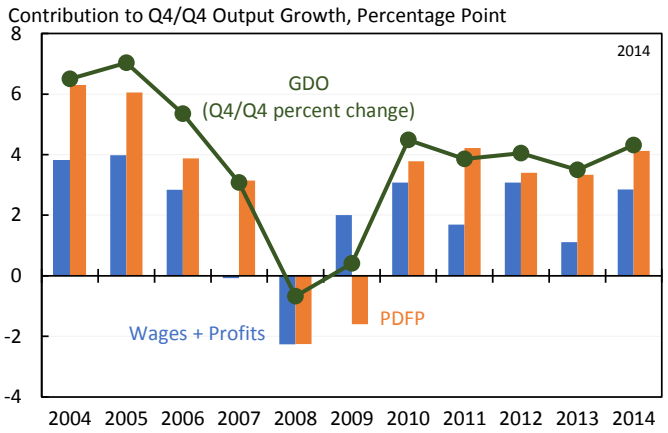
[12] As discussed in McCulla and Smith (2015), various research has suggested weights on GDI between 0.3 and 0.7 in an average of GDP and GDI.

[13] In this sample the optimal weighted average for output would be a weight of 0.6 on GDI and weight of 0.4 on GDP. But the exact weights would depend on the sample period and regardless this optimal measure is a barely better predictor than GDO (which puts a 0.5 weight on both).

[14] Nalewaik (2010, 2012) makes the argument about the better cyclical properties of GDI. Though Landefeld (2010) argues that GDI, while useful, does not always outperform GDP. A long literature, for example, Dynan and Elmendorf (2001), underscores how difficult it is to forecast business cycle turning points. Using income-side data, such as GDI or GDO, appears to be an improvement but the forecasts remain very imprecise.

Figure 6 shows nominal GDO growth, along with contributions from two key subcomponents, using the currently published data. On the product-side, private domestic final purchases—the sum of consumption and fixed investment—is a better predictor of future GDP or GDO growth than GDP itself (as noted in previous CEA analysis).[15] Appendix Table A-1 provides the R-squared from regressions of future output growth on recent growth in GDP, GDO, and select components. On the income-side, the sum of wages and salaries plus corporate profits serves as a good predictor of future GDI growth. These subcomponents often reveal more about future trends than the headline number alone. The pattern in Figure 6 is even more pronounced, the contributions of wages and profits to GDI growth turned negative in 2007, ahead of the recession, and turned strongly positive during 2009—in both cases, sending an even stronger signal about the cyclical turning points than overall measures.

Figure 6
Contributions to Nominal Output Growth

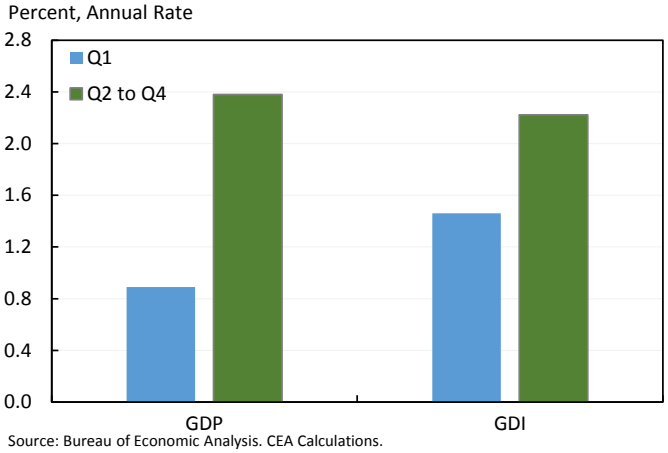


Note: "Output" refers to GDI for "Wages + Profits" and to GDP for "PDFP".
Source: Bureau of Economic Analysis; CEA calculations.

Can GDO Help Address Recent Economic Anomalies?

To provide some examples of the usefulness of GDO, consider the recent debate about the BEA's estimates of real activity in the first quarter of this year. To eliminate predictable fluctuations in activity due to calendar-specific factors (like holidays or cold winter months), BEA reports quarterly GDP on a seasonally adjusted basis. On that basis, real GDP decreased 0.2 percent at an annual rate in the first quarter, according to the BEA's "after three months" estimate. Several analysts have expressed concerns with the quality of this estimate—specifically, that even after undergoing seasonal adjustment procedures, real GDP in the first quarter has been systematically understated for several years (referred to as "residual seasonality").[16] Conversely, analysts have argued that the "after three months" estimates of other quarter—particularly third quarter—have been systematically too high. As Figure 7 shows, first quarter GDP growth "after three months" was, on average, 1.5 percentage point lower than the average growth in the second, third and fourth quarters in 2005 to 2014. In contrast, first-quarter real GDI growth was only 0.8 percentage point lower, on average than the second, third, and fourth quarter growth.

Figure 7
Average Output Growth by Calendar Quarter, 2005-2014, "After 3 Months" Estimates



Source: Bureau of Economic Analysis. CEA Calculations.

This year the "after three months" seasonally-adjusted real GDI rose 1.9 percent at an annual rate in the first quarter (since revised down to 0.3 percent)—a considerably stronger initial view of economic activity than GDP. It is worth noting that seasonally-adjusted GDI does tend to have weaker-than-average growth in first quarters, but markedly less so than GDP. This may suggest that the "after three months" seasonal

[15] This updates and extends the analysis in Council of Economic Advisers (2015, pp. 45-47).

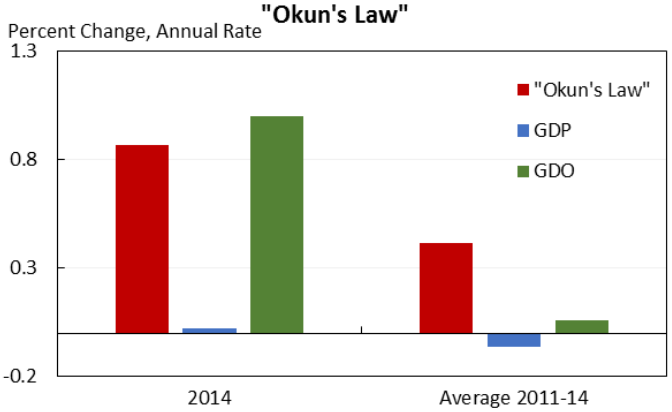
[16] Wolfers' *New York Times* articles "Why You Can't Put Faith in Reports of First-Quarter Economic Slumps" and "Dueling Views on the First-Quarter Slump" summarize the debate about the first-quarter GDP estimates. BEA in its "Preview of the 2015 Annual Revision of the National Income and Product Accounts" noted that today's annual revision would introduce "improvements to the seasonal adjustment of GDP."

adjustment of GDI is more complete than of GDP.[17] Today with its annual revision, BEA revised up real GDP growth for 2015:Q1 to 0.6 percent. The GDO's increase of 1 percent at an annual rate in the first quarter provided a more balanced "after three months" view of economic growth in the first quarter of this year than did GDP alone.

Another recent economic anomaly has been the strengthening seen in labor market data without commensurate strengthening in GDP data. Specifically, the unemployment rate declined 0.8 percentage point in 2013 (Q4 to Q4) and then declined an even faster 1.3 percentage point in 2014. At the same time, real GDP growth was steady at 2.5 percent in both 2013 and 2014. No increase in GDP growth with faster declines in the unemployment rate violates the long-standing empirical relationship, known as Okun's Law, which, in its simplest form, says that a 1 percentage point decline in the unemployment rate is associated with real output growth 2 percentage points above trend growth. One possible explanation for this anomaly could be measurement error in the GDP data; in reality output growth may have increased in 2014. This is precisely what was seen in the estimates of real GDO growth which picked up from 1.9 percent during 2013 to 2.9 percent during 2014. The increase in real GDO growth (green bar) in Figure 8 is much closer to (and even somewhat above) the predicted increase in growth from a simple "Okun's Law" (red bar) than the increase in real GDP growth (blue bar). However, if we average over the period from 2011 to 2014, the advantage of GDO over GDP is more modest.

Figure 8

Increase in Q4/Q4 Output Growth, GDP and GDO versus "Okun's Law"



Note: The "Okun's Law's" prediction for the increase in output growth is -2 times the change in the unemployment rate change . This simple form abstracts from changes in trend growth.
Source: Bureau of Economic Analysis; CEA Calculations.

Over a longer time horizon, such as from 1983 to 2014 and using the currently published data, it is also the case that GDO fits the Okun's Law relationship better than GDP or GDI. The estimated coefficient relating GDO growth with changes in the unemployment rate is slightly higher than for GDP growth or GDI growth, and the adjusted R-squared in the GDO regression is higher than for GDP or GDI.[18] This is another indication that GDO has less measurement error and more economic content than GDP, particularly since the unemployment rate is an independent measure of economic activity that the BEA does not directly use in its estimates of GDP or GDI.

Conclusion

It has long been the practice of many economic analysts, including CEA, to combine product- and income-side measure of output as a way to reduce measurement error and gain a more accurate understanding of the economy. Because there are partially uncorrelated measurement errors in both GDP and GDI, combining them can increase overall accuracy. In fact, the simple average—what we have called GDO—of the initial estimates historically have been a better gauge of the latest and presumably most accurate estimates of GDP growth than either GDP or GDI individually as well as a more stable predictor of future economic growth. Moreover, using GDO helps at least partially to resolve some recent economic anomalies. As a result, GDO offers

[17] Most components of GDP and GDI are seasonally adjusted though the seasonal adjustment tends to be done by the source data agencies, not BEA. Some components are not seasonally adjusted if there is no statistically significant seasonal pattern or if the time series is too short to estimate seasonal factors.

[18] See also Braun (2011) for a similar exercise.

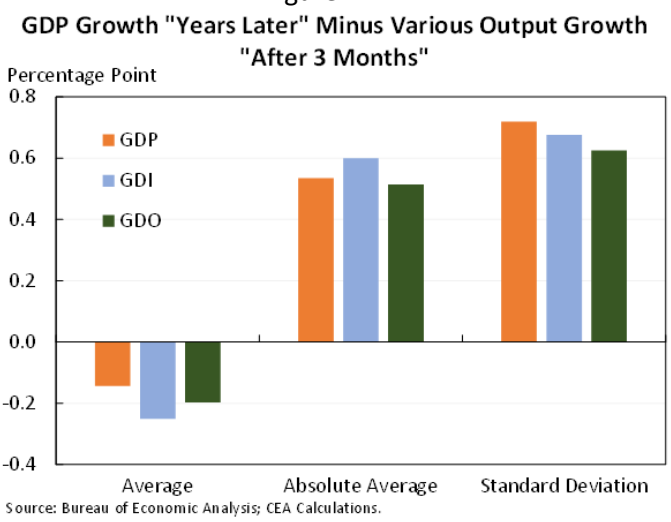
a valuable new source of information for households, businesses, researchers, and policymakers seeking to understand economic issues in real time.

Nevertheless, GDO also suffers from a number of limitations. Many of these it shares with GDP: Both face substantial measurement challenges. It takes several years for the source data for GDP and GDI to be collected, which can lead to large revisions, especially around business cycle turning points. Both GDP and GDO face a challenge in representing real economic growth because the available price indexes may not fully reflect improvements in quality, especially those due to rapid technological developments. In addition, economic output measured at market prices does not adequately capture societal well-being. GDO has further timing limitations in that it is not available until one or two months after the initial estimates of GDP growth are available.

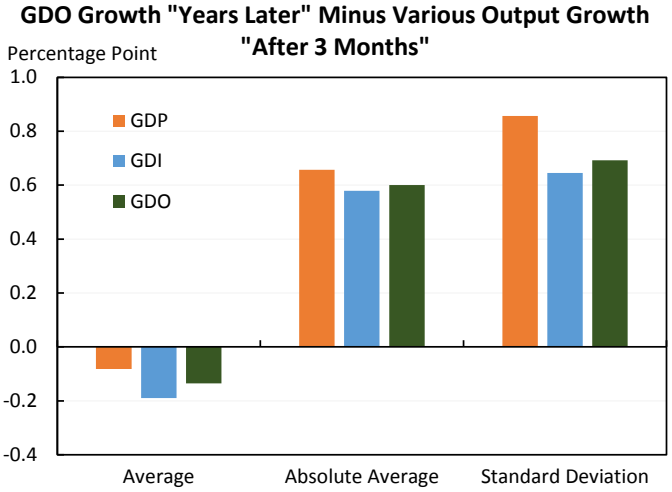
No single measure of the economy is perfect because of measurement error, transitory real fluctuations, conceptual challenges, and the fact that any measure provides only one perspective on the economy. As a result, it is important to look at multiple measures of the same variable, look over longer periods of time so as to discern trends, and look from a variety of viewpoints. Widening the focus from GDP to other measures of output that reflect signals from the income side can provide a more accurate and forward-looking picture of the state of the economy and is a good next step in better understanding how to measure economic growth and well-being.

Appendix

Figure A-1



Source: Bureau of Economic Analysis; CEA Calculations.



Source: Bureau of Economic Analysis; CEA Calculations.

Table A-1

R-Squared for 1-Quarter-Ahead Forecast of Real Output Growth

Using 1-Qtr	Predict GDP	Predict GDI	Predict GDO
GDP	0.24	0.25	0.27
GDI	0.31	0.23	0.32
GDO	0.31	0.26	0.33
PDFP	0.36	0.29	0.38
Wages + Profits*	0.28	0.25	0.32

*Wages + Profits are deflated using the Implicit Price Deflator for GDP.
Note: "Years later" data from 1984:Q1to 2014:Q4 are used. The one-quarter-ahead, annualized growth in real output (GDP, GDI, and GDO) is regressed individually on the one-quarter annualized growth in GDP, GDI, GDO, PDFP, and Wages + Profits. Source: Bureau of Economic Analysis, National Income and Product Accounts; CEA Calculations.

R-Squared for 4-Quarter-Ahead Forecast of Real Output Growth

Using 4-Qtr	Predict GDP	Predict GDI	Predict GDO
GDP	0.15	0.13	0.14
GDI	0.25	0.19	0.23
GDO	0.20	0.17	0.19
PDFP	0.20	0.19	0.21
Wages + Profits*	0.27	0.23	0.26

*Wages + Profits are deflated using the Implicit Price Deflator for GDP.
Note: "Years later" data from 1984:Q1to 2014:Q4 are used. The four-quarter-ahead, annualized growth in real output (GDP, GDI, and GDO) is regressed individually on the four-quarter annualized growth in GDP, GDI, GDO, PDFP, and Wages + Profits. Source: Bureau of Economic Analysis, National Income and Product Accounts; CEA Calculations.

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