Buying Stocks
Household Participation Varies Widely by State

Worker Education
Is U.S. Falling Behind in Human Capital?

Quantitative Easing
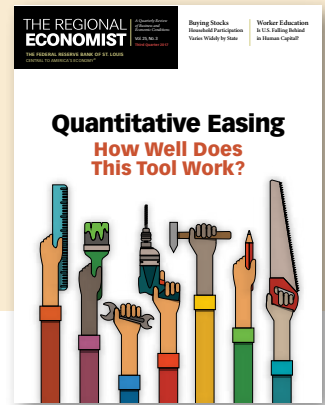## How Well Does This Tool Work?

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8 Quantitative Easing: How Well Does This Tool Work?

By Stephen Williamson

Central bankers around the world have embraced quantitative easing as an effective, though unconventional, monetary policy tool. Yet, has the promise matched the results? The empirical evidence is open to interpretation, while two "natural experiments" suggest that the policy isn't effective.

ONLINE EXTRA

Another Way to Compare Banking Conditions in U.S.

By Andrew Meyer

Many researchers have long categorized commercial banks by the Federal Reserve district in which the banks are physically located. But there may be times when it makes more sense to categorize the banks according to the Fed district that supervises the bank holding company that is the parent of the commercial bank.

COVER IMAGE © THINKSTOCK/ISTOCK/ALEX_DOUBOVITSKY

Does Low Unemployment Signal a Meaningful Rise in Inflation?

The unemployment rate in the U.S. is relatively low by recent historical standards. Some people argue that this means higher inflation is just around the corner, which they cite as a reason for the Fed to raise the U.S. policy rate (i.e., the federal funds rate target). In my view, however, low unemployment readings do not appear to be an indicator of substantially higher inflation to come.

Arguments that low unemployment will translate into high inflation are based on the so-called Phillips curve, which suggests that a negative relationship exists between the two variables. This relationship has been in the middle of central banking debates since the 1958 paper by the late economist A.W. Phillips. The Phillips curve dramatically fell out of fashion in the 1970s, when both high unemployment and high inflation gripped the U.S. economy and much of the rest of the world. In the inflation-targeting era that began in the 1990s, however, Phillips curve arguments have returned and have again been important in central banks' decision-making.

But how robust is the relationship between unemployment and inflation in the data?[1] In a recent analysis, economist Olivier Blanchard estimated a Phillips curve relationship for the U.S.[2] The general finding was that the statistical relationship between unemployment and inflation is much flatter today than it has been historically.

Using Blanchard's estimates for the U.S., we can see how much inflation would be generated if the unemployment rate continued to decline in the future. The table shows various predictions of what the inflation rate should be for a given unemployment rate, starting from the latest readings on unemployment

Estimated Influence of Unemployment on Inflation

If the unemployment rate was …	The predicted core PCE inflation rate would be …
4.3%*	1.50%*
4.0%	1.56%
3.5%	1.66%
3.0%	1.76%
2.5%	1.86%

SOURCES: Bureau of Labor Statistics, Bureau of Economic Analysis and author's calculations based on Blanchard. See the second endnote.

* The first row contains the latest values for unemployment (July 2017) and inflation (June 2017). The inflation rate is measured as the year-over-year percentage change in the core personal consumption expenditures price index (core PCE).

and inflation (for July 2017 and June 2017, respectively). The results suggest that even if the unemployment rate declined substantially from its current level, the inflation rate would increase only modestly. For example, if unemployment fell from 4.3 percent to 3.5 percent, inflation would increase by only 0.16 percentage points. Furthermore, inflation would remain below 2 percent.

There seems to be little risk—at least according to these estimates—that inflation would pick up appreciably from its current level *solely* because unemployment is low. The results shown here call into question the idea that unemployment outcomes are a major factor in driving inflation outcomes in the U.S. economy. Inflation expectations, for instance, are probably a more important determinant of inflation outcomes than unemployment.

Despite the empirical evidence suggesting that the Phillips curve relationship is relatively flat, some still argue in favor of raising the U.S. policy rate in an effort to get ahead of the anticipated surge in inflation. Implicit in that argument is the idea that the relationship

is nonlinear, meaning the impact on inflation would be much larger once unemployment reached extremely low levels. However, I am not aware of empirical estimates that have made a convincing case for the nonlinear Phillips curve using recent data.

For monetary policy purposes, we should not base our notions of what will happen with inflation solely on ideas related to low unemployment. While we certainly want to keep an eye on inflation readings, there seems to be no strong case for being pre-emptive with respect to inflation simply because the unemployment rate is low. Ω

James Bullard, President and CEO
Federal Reserve Bank of St. Louis

ENDNOTES

[1] For a FRED graph showing U.S. unemployment and core PCE inflation since 1995, see https://fred.stlouisfed.org/graph/?g=eBE3.

[2] Blanchard, Olivier. The US Phillips Curve: Back to the 60s? Peterson Institute for International Economics, Policy Brief No. PB16-1, January 2016. See https://piie.com/publications/pb/pb16-1.pdf.

Household Participation in Stock Market Varies Widely by State

By YiLi Chien and Paul Morris

From 1928 to 2016, the average annual stock return was about 8 percentage points higher than the return on three-month Treasury bills. This leads to sizable return gaps over time: $100 investments in stocks and in Treasury bills in 1928 would have yielded nearly $329,000 and $2,000, respectively, 88 years later.[1]

Given the high return of stocks, it is puzzling that many households do not participate in the stock market and, hence, forgo the high return. In addition, the nonparticipation behavior is at odds with modern portfolio theory. The theory implies that all households should invest at least a fraction of their wealth in stocks in order to take advantage of the equity premium. However, the data show that many households do not participate in financial markets.

The inability of modern portfolio theory to explain what is observed in the data leads to a "participation puzzle." A common explanation of this puzzle is the individual participation cost, which includes both monetary and nonmonetary costs. The monetary costs are relatively straightforward, including transaction or brokerage fees. The nonmonetary costs are broadly defined to be the cognitive and time costs of understanding the investment object or processing previous experiences with stock markets. The participation cost, especially the nonmonetary costs, could vary widely across the population.

While this participation puzzle has been well-documented at the national level, this article takes a first step in exploring whether the rates vary geographically. The aim is to see if the participation rate at the national level occurred homogeneously across states or if people in some states participated at a higher rate than others.

FIGURE 1

Stock Market Participation across Income Groups
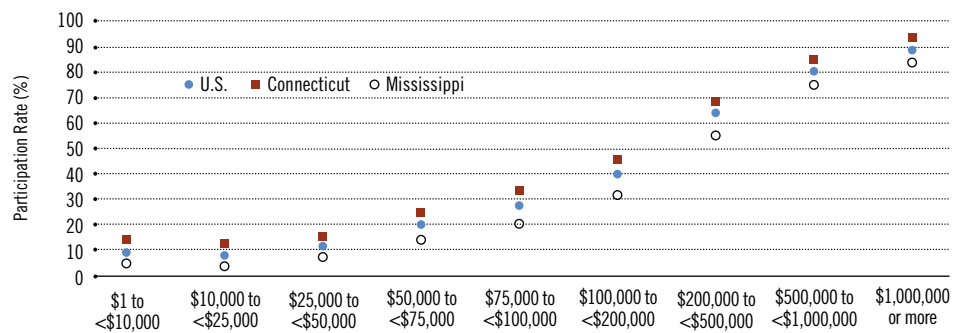
SOURCES: IRS' 2014 individual income and tax data and authors' calculations.

NOTE: Connecticut and Mississippi had the highest and lowest rates, respectively, for overall stock market participation among the states.

If the data indicate that there are regional differences in these rates, academic researchers could explore these disparities to better understand and resolve the puzzle. In addition, a better understanding of households' investment decisions across regions could improve the quality and effectiveness of conducting government policy.

To answer this question, we employed the IRS' individual income and tax data for 2014, the most recent year available. The data contain information on income from taxable dividends. We approximated the stock market participation rate as the ratio of the number of tax returns with dividend income to the number of total tax returns filed.

We used tax return data because of its availability at the state level. However, there is a shortcoming in doing so. Given that not all companies pay dividends out of their profits each year and that the dividend incomes of retirement accounts are not taxable, our figure underestimates the true participation rate and should therefore be considered a lower bound. Fortunately, this shortcoming might be less of a concern when comparing participation rates across states, as the downward bias is likely to affect states uniformly.

Wide Disparities among States

The data show a large variation in stock market participation rates across the United States. The disparities are sizable, with rates ranging from 10.5 percent in Mississippi to 26.6 percent in Connecticut. This seems reasonable, as the average household income is higher in Connecticut than in Mississippi and the existing literature shows that the participation rate increases with income.[2]

However, this is not the whole story. Even when controlling for household income level, the large variation in participation across states prevails. Figure 1 plots the participation rates for Connecticut, Mississippi and the United States across different income groups. The participation gap remains large for each group, indicating that

household income level does not entirely lead to differences in participation rates.

Note that this holds even for those groups with high income. In the income group ranging from $100,000 up to but not including $200,000, the participation gap stands at 14.2 percentage points (31.5 percent in Mississippi versus 45.7 percent in Connecticut).

This finding is even more puzzling when the cost of living is taken into consideration. The cost of living is lower in Mississippi, so given the same income level, those with high incomes in Mississippi should have more funds to invest in the stock market than comparable households in Connecticut.[3]

This pattern is not specific to these two states. Figure 2 maps the stock market participation rates across states for those with a relatively high household income: $100,000 up to but not including $200,000. Darker shades of blue indicate higher participation rates. Participation ranges from 30.7 percent in Utah to 47.5 percent in Vermont. This finding suggests that there might be some regional factors that are affecting the stock market participation rates.

What might these factors be? It is difficult to argue that individual participation costs are able to explain such large differences in participation rates from state to state. In today's information age, the monetary costs of participating should be uniform across the country. There are many online brokers offering low-cost and convenient services for stock market transactions. Moreover, the differences in nonmonetary costs should be similar across states after controlling for income. For example, given the same level of income, it is unlikely that the cognitive cost of processing investment knowledge could vary enough to explain the variation in participation across states.

Exploring the true regional factors is beyond the scope of this article. However, a potential explanation is the awareness of financial planning, which could be influenced heavily by the surrounding community. If households have less exposure to the importance of financial planning, then they are less likely to spend time and effort on improving investment decisions regardless of participation costs.

The investment decision matters for the welfare of households. Good financial decision-making could help households hedge against their income risks and achieve a better life. Although it is not necessarily the case that stock market participants are more financially sophisticated than nonparticipants, understanding the participation decisions made by households is important to both academic researchers and policymakers. An example is the shortage of retirement savings in the United States. If households cannot make the right investment decisions and, thereby, jeopardize their return on savings, then households are not only likely to save less but could fail to accumulate enough assets for retirement. Ω

YiLi Chien is an economist, and Paul Morris is a senior research associate, both at the Federal Reserve Bank at St. Louis. For more on Chien's research, see https://research.stlouisfed.org/econ/chien.

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FIGURE 2

Stock Market Participation Rate for Households with Incomes from $100,000 Up to but Not Including $200,000

Participation Rate (%)

- 30 to <32.5
- 32.5 to <35
- 35 to <37.5
- 37.5 to <40
- 40 to <42.5
- 42.5 to <45
- 45 to <47.5
- 47.5 to <50
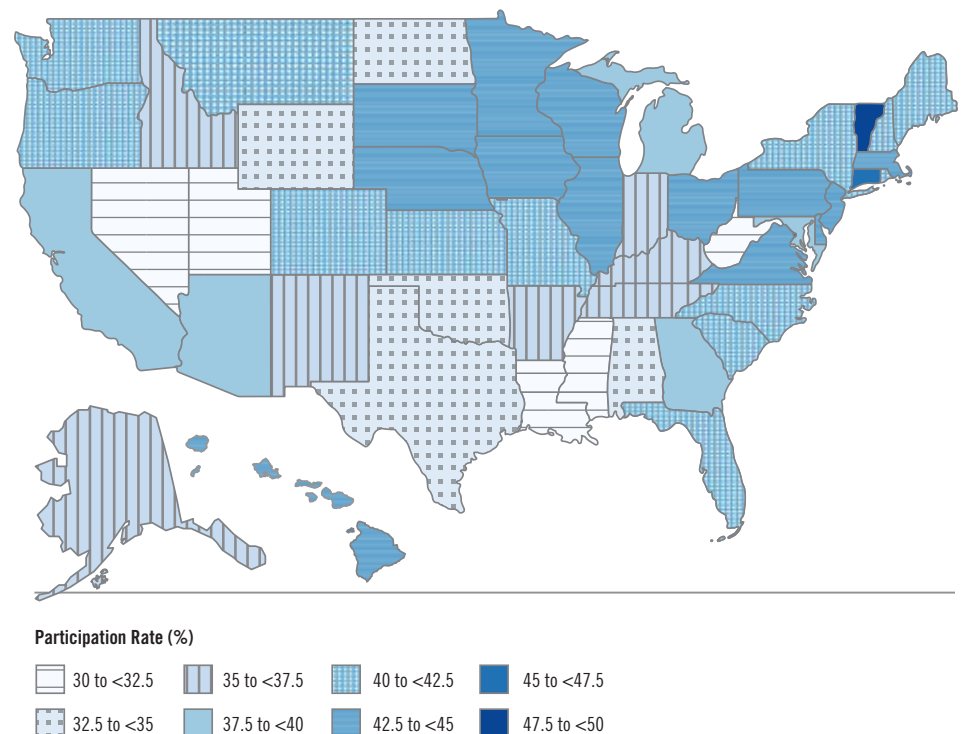
SOURCES: IRS' 2014 individual income and tax data and authors' calculations.

Workers Abroad Are Catching Up to U.S. Skill Levels

By Alexander Monge-Naranjo

At the turn of the 20th century, according to historical estimates, the United States took over from the United Kingdom as the world's leading economy, a rank it has sustained ever since. Before World War I, in 1913, income per capita in the U.S. was 8 percent higher than in the U.K., 52 percent higher than in all of Western Europe combined and almost 3.5 times the world average income per person.[1] By the end of World War II, those gaps were much higher: In 1950, the U.S. income per capita was 38 percent higher than that in the U.K., 112 percent higher than that in Western Europe and more than 4.5 times the world average income per person.[2]

This global dominance by the U.S. economy can be sustained only by a superior qualification of its workers. This article compares the education of U.S. workers with that of workers in other developed countries and in emerging economies. Although American workers have historically been much better trained than their counterparts abroad, that lead has been quickly disappearing in recent years as other countries have accelerated the skill formation of their workers. Formal skill through education has become increasingly important in a knowledge-based world economy.

Then: U.S. Workers Were No. 1

Figure 1 shows the level of education in 1950 for workers in the U.S. and several other countries that are identified today as developed.[3] The levels range from no formal schooling to college completed, which includes workers with education beyond an undergraduate degree. The data for this and the other figures cover males and females of all ages; in all cases, the education levels are the maximum achieved for that group.

Notice that even for developed countries, most of the workers in 1950 in France, West Germany, Japan and the U.S. ended their formal schooling somewhere between primary school and the completion of secondary education, levels that by today's standards would be deemed insufficient for turning out qualified workers. South Korean workers lagged further behind.[4]

The most remarkable finding in Figure 1 is the degree by which the U.S. workers were far better-educated. Although France had the lowest percentage of workers with no schooling, very few French workers had more than primary education. Albeit less dramatic, a similar pattern holds for West Germany and Japan. All of these countries had negligible fractions of workers who had completed a college education. Indeed, the U.S. is the only country with significant fractions of workers who had completed high school (21.6 percent), who had some college education (6.2 percent) and who had completed college (7.4 percent).

The lead is even wider when U.S. workers are compared with those in major developing countries, as seen in Figure 2. The other countries used in this comparison are Brazil, China, India, Mexico and the U.S.S.R.; nowadays, they are considered the key emerging economies. Most of the workers in Brazil, China, India and Mexico had either no schooling or just some primary schooling in 1950; all of these countries lagged the U.S.S.R., overall. None of these countries had more than a negligible fraction of college-educated workers.

The leadership of U.S. workers was due to more than higher incomes. The postwar period was a time of large-scale reconstruction and development programs around the world, e.g., the Marshall Plan in Europe, the reconstruction of Japan, the Alliance for Progress in Latin America and the many programs led by the World Bank in developing countries. These programs, which were led and financed by the U.S., were carried out by engineers, managers, doctors and many other professionals and technicians from the U.S.

Now: We're Not in Kansas Anymore

Much has changed since then. For 2010, Figures 3 and 4 show the distribution of workers across the same education levels for the same groups of countries as before. To better capture the trend for the coming years, the figures look only at younger workers, those who are 25-35, as their behavior could better represent the trend for the cohorts of workers in the years to come.

Figure 3 shows that developed countries have all but stopped producing workers with less than complete secondary schooling. The main differences can be seen in the distribution of workers across higher-education groups. First, notice that the main difference between the U.S. and the two European countries is that the latter have a higher fraction of workers who ended their schooling with secondary education and a lower fraction of college-educated workers. This difference is most pronounced with Germany, a country with a strong tradition of technical and vocational secondary education programs. Second, the main difference with the Asian countries is that they are now above the U.S. in the fraction of workers with a complete college education.

Figure 4 shows that there is a global trend to catch up to the U.S. in terms of highly educated workers. All the developing countries have moved toward much higher fractions

of workers with some college. And even if the fractions of Indian and Chinese college-educated workers remain far below those in the U.S., the population sizes of those countries, and the quality of some of their leading universities, make them relevant suppliers of highly skilled workers for the world economy.

Conclusion

Although U.S. workers still command a considerable lead with respect to most countries in the world, it is remarkable how strongly other countries have been able to catch up over the past 60 years. From essentially being the sole provider of high-skill workers for both the U.S. and the world economies, U.S. workers must compete, domestically and internationally, in knowledge and skills with workers from many other countries. No matter how tough the challenges brought on by more competition become, American workers—of all education levels—can obtain productive opportunities from knowledge emerging from the rest of the world. Ω

Alexander Monge-Naranjo is an economist at the Federal Reserve Bank of St. Louis. Research assistance was provided by Juan Vizcaino, a technical research associate at the Bank. For more on Monge-Naranjo's work, see https://research.stlouisfed.org/econ/monge-naranjo.

ENDNOTES

1 Data are taken from the Maddison Project. See www.ggdc.net/maddison/maddison-project/home.htm, 2013 version.
2 These ratios are computed using income levels that are adjusted for purchasing power differences. See Bolt and van Zanden.
3 The data are from Barro-Lee.
4 To be sure, in 1950, South Korea was far from being a developed country, with a per capita income of only 8.9 percent of that of the U.S. However, by 2010, South Korea clearly was a developed country, with per capita income equal to 72 percent of that for the U.S. and higher than the average per capita income in Western European countries.

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FIGURE 1

Education of Workers in the U.S. and Other Developed Countries, 1950
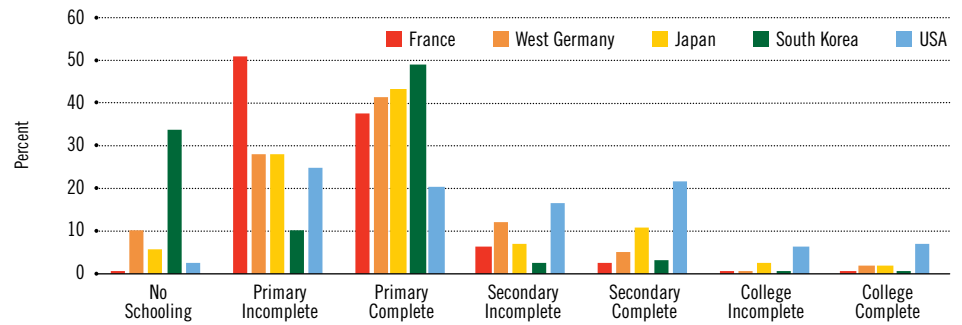
FIGURE 2

Education of Workers in the U.S. and Major Developing Countries, 1950
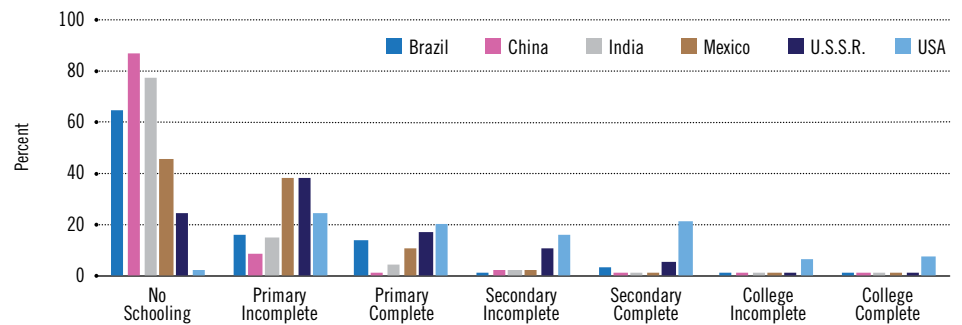
FIGURE 3

Education of Younger Workers in the U.S. and Other Developed Countries, 2010
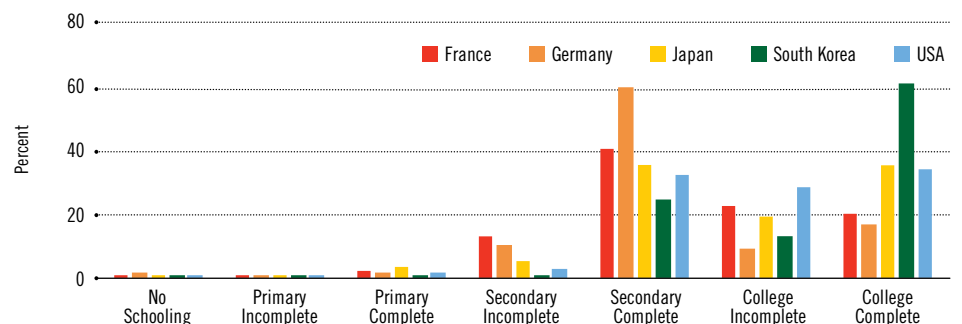
FIGURE 4

Education of Younger Workers in the U.S. and Major Developing Countries, 2010
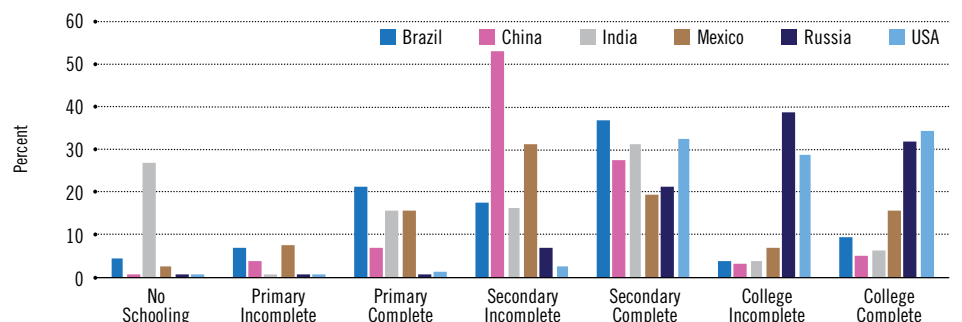
SOURCE: Barro-Lee.

NOTES: For each country, the figure shows the share of workers in each education group as defined by Barro-Lee. (See reference.) Younger workers are those 25-35. Regarding the data on Germans, the numbers in Figure 1 pertain just to the former West Germany, while the numbers in Figure 3 apply to reunited Germany. Similarly, the U.S.S.R. data in Figure 2 apply to all of the former Soviet Union, while the data in Figure 4 pertain just to modern-day Russia.

Quantitati

How Well
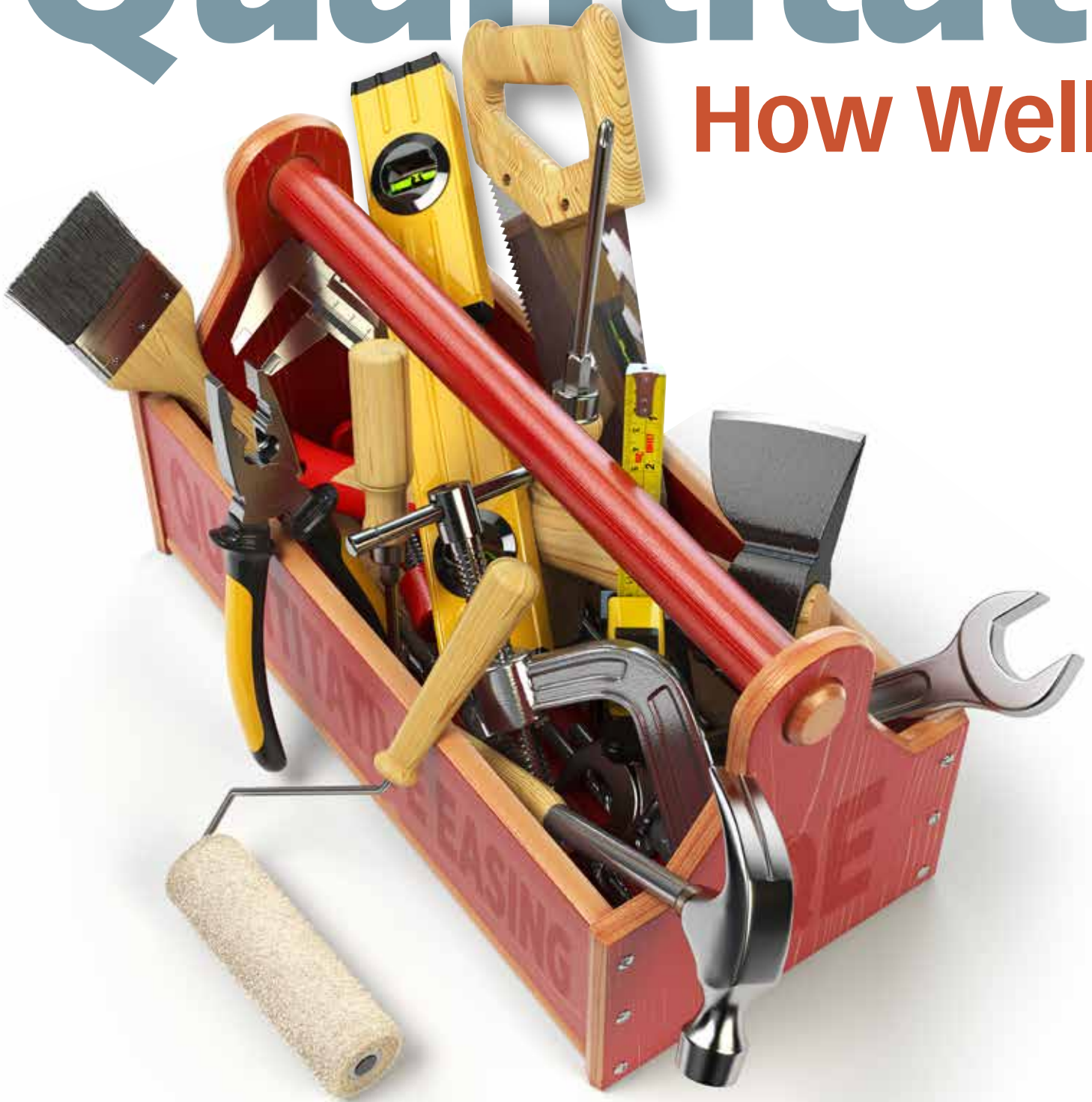
ive Easing

Does This Tool Work?

By Stephen Williamson

Quantitative easing (QE)—large-scale purchases of assets by central banks—led to a large increase in the Federal Reserve's balance sheet during the global financial crisis (2007-2008) and in the long recovery from the 2008-2009 recession. Over the same period, QE played a very important role at other central banks in the world. Indeed, in some of those countries, particularly Japan, QE remains a key instrument of monetary policy—an unconventional policy tool that central bankers can potentially use when all else fails. Public policy discussion suggests that QE is likely to be used again, by the Fed and other central banks, in a future recession or financial crisis. Thus, at this juncture it is useful to evaluate what we know about QE. How is it supposed to work, and does it work as advertised?

QE consists of large-scale asset purchases by central banks, usually of long-maturity government debt but also of private assets, such as corporate debt or asset-backed securities. Typically, QE occurs in unconventional circumstances, when short-term nominal interest rates are very low, zero or even negative.

The first high-profile use of QE seems to have been the Bank of Japan program that began in 2001. Then, during and after the international financial crisis, the use of QE became much more widespread, used by central banks in the U.S., the U.K., the euro area, Switzerland and Sweden, for example.

QE is controversial, the theory is muddy and the empirical evidence is open to interpretation, in part because there is little data to work with. The purpose of this article is to review the key features of QE and how it has been used, to explain and evaluate the available theory of QE, and to provide a critical review of the empirical work. Also discussed are two natural experiments that shed light on how QE works (or does not work).

What Is Quantitative Easing?

QE is an unconventional monetary policy action, in a class with forward guidance and negative nominal interest rates. To understand QE, we first need to review how conventional monetary policy works.

Conventional monetary policy is about the choice of the target for the short-term nominal interest rate and how that interest rate target should depend on observations concerning aggregate economic performance. Formally, some macroeconomists characterize central banks as adhering to a Taylor rule,[1] which specifies that the central bank's nominal interest rate target should go up if inflation exceeds the central bank's inflation target (2 percent for the Fed) and that the nominal interest rate target should go down if aggregate output (measured, say, by real gross domestic product [GDP]) falls below what is deemed to be the economy's potential.

But there is a limit to how low the short-term nominal interest rate can go—the so-called effective lower bound. In the U.S., this effective lower bound may be essentially zero, but in some other countries the effective lower bound is negative. For example, the central banks in Sweden, Denmark, Switzerland and the euro area have implemented negative short-term interest rates.

Traditionally, the interest rate that the Fed targets is the federal funds (fed funds) rate. Suppose, though, that the fed funds rate target is zero, but inflation is below the Fed's 2 percent target and aggregate output is lower than potential. If the effective lower bound were not a binding constraint, the Fed would choose to lower the fed funds rate target, but it cannot. What then? The Fed faced such a situation at the end of 2008, during the financial crisis, and resorted to unconventional monetary policy, including a series of QE experiments that continued into late 2014.

In essentially all of the QE programs conducted in the world during and after the financial crisis, central banks seemed primarily interested in how the type and quantity of asset purchases would affect financial market conditions and, ultimately, inflation and aggregate economic activity. For example, on Nov. 25, 2008, the Fed announced its first QE program, sometimes called QE1. The press release concerning the program provided detail on the types of assets that the Fed would purchase—agency debt and mortgage-backed securities issued by government-sponsored enterprises (GSEs)—along with the dollar amounts that would be purchased.[2] As well, the announcement made clear that the intent of the program was to affect general financial conditions and, more specifically, the housing and mortgage markets.

Further QE programs implemented by the Fed were, if anything, more specific about the nature of the purchases:

1. *QE1*, December 2008 to March 2010: Purchases of $175 billion in agency securities and $1.25 trillion in mortgage-backed securities.
2. *Reinvestment Policy*, August 2010 to present: Replacement of maturing securities to maintain the balance sheet at a constant nominal size if there is no QE program underway.
3. *QE2*, November 2010 to June 2011: Purchases of $600 billion in long-maturity Treasury securities.
4. *Operation Twist*, September 2011 to December 2012: Swap of more than $600 billion involving purchases of Treasury securities with maturities of six to 30 years and sales of Treasury securities with maturities of three years or less.

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Other central banks have been actively engaged in QE since the financial crisis—some in a bigger way than the Fed. For example, in December 2016 the Bank of Japan had a balance sheet that was 88 percent of GDP, Switzerland's was 115 percent of GDP, the Swedish Riksbank's was 19 percent of GDP, the Bank of England's was 24 percent of GDP and the European Central Bank's was 34 percent of GDP.

5. *QE3*, September 2012 to October 2014: Purchases of mortgage-backed securities and long-maturity Treasury securities, initially set at $40 billion per month for mortgage-backed securities and $45 billion per month for long-maturity Treasury securities.

The implications of all of these programs for the Fed's balance sheet can be observed in Figure 1. From December 2007 to May 2017, the Fed's total assets increased from $882 billion to $4.473 trillion—a fivefold increase. To give a measure of the magnitude of the program, total Fed assets increased from 6.0 percent of U.S. GDP in the fourth quarter of 2007 to 23.5 percent of GDP in the first quarter of 2017. Further, the average maturity of the assets in the Fed's portfolio in early 2017 was much higher than before the financial crisis. As of May 2017, the Fed held no Treasury bills, which mature in a year or less; the Fed's security holdings consisted almost entirely of long-maturity Treasury securities and mortgage-backed securities.

Other central banks have been actively engaged in QE since the financial crisis—some in a bigger way than the Fed. For example, in December 2016 the Bank of Japan had a balance sheet that was 88 percent of GDP, Switzerland's was 115 percent of

GDP, the Swedish Riksbank's was 19 percent of GDP, the Bank of England's was 24 percent of GDP and the European Central Bank's was 34 percent of GDP.[3]

What is a typical central bank justification for QE? How do central bankers think these policies work? At the 2010 Jackson Hole conference, then-Fed Chairman Ben Bernanke attempted to articulate the Fed's rationale for QE.[4] Bernanke's view was that, with short-term nominal interest rates at zero, purchases by the central bank of long-maturity assets would act to push up the prices of those securities because the Fed was reducing their net supply. Thus, long-maturity bond yields should go down, for example, if the Fed purchases long-maturity Treasury securities. Bernanke then argued that this was "accommodation," in the same sense as a reduction in the fed funds rate target is accommodation. Thus, QE should be expected to increase inflation and aggregate real economic activity.

Conventional Theory of QE

What macroeconomic theory has been brought to bear in evaluating the efficacy of QE? In conventional policy discourse, there are three basic theories: portfolio balance or segmented markets theory, preferred habitat theory, and signaling.

First, with respect to portfolio balance theory, when central bankers use QE, they appear to believe that purchases of long-maturity assets will make the yield curve flatter.[5] That is, with short-term interest rates at zero, or close to it, declines in long-term interest rates will narrow the margin between long-term and short-term rates. According to portfolio balance theory, assets of different maturities are imperfect substitutes because of frictions that inhibit arbitrage across maturities—assets are costly to buy and sell, for example. This, then, implies that the relative supplies of assets matter—a lower supply of long-term assets and a higher supply of short-term assets imply that long-term interest rates fall and short-term interest rates rise.

Second, preferred habitat theory posits that financial market participants have preferences over maturities of assets.[6] For example, life insurance companies have long-maturity liabilities; to hedge risk, these financial intermediaries have a preference

Fed Balance Sheet
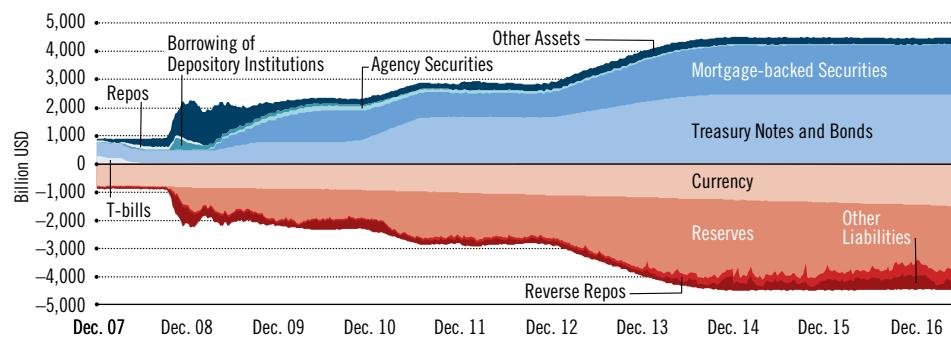
SOURCES: Federal Reserve Board/Federal Reserve Economic Data (FRED).

for long-maturity assets. This implies a type of asset market segmentation, making the mechanism by which QE might work similar to portfolio balance theory.

Third, in signaling theory, even if there are no direct effects of quantitative easing, commitment to future monetary policy can matter for economic outcomes in the present, and quantitative easing may be a means for the central bank to commit. That is, the structure of the central bank's current asset portfolio may bind future monetary policymakers to particular actions.[7]

An Alternative Approach to QE Theory

A central bank is a financial intermediary. It borrows from a large set of people—those who hold the central bank's primary liabilities, i.e., currency and reserves. And the central bank lends to the government, private financial institutions and sometimes to private consumers. (For example, the Fed indirectly holds private mortgages, which back the mortgage-backed securities in its portfolio.)

Like private financial intermediaries, central banks transform assets in terms of maturity, liquidity, risk and rate of return. Therefore, the ability of a central bank to affect economic outcomes in a good way depends on its having an advantage relative to the private sector in intermediating assets. Perhaps surprisingly, none of the theories typically used by central bankers to justify QE—portfolio balance (segmented markets), preferred habitat, signaling—integrates financial intermediation into the analysis in a serious way.

To see how financial intermediation theory is important for understanding

monetary policy, consider how conventional monetary policy works. The primary liabilities of a central bank are currency and reserves, which play important medium-of-exchange roles in retail transactions and in transactions among financial institutions. But we could imagine monetary systems in which the media of exchange used in transactions are the liabilities of private financial institutions, and those financial institutions create their own cooperative arrangements for executing transactions among themselves. Indeed, before the Fed opened its doors in 1914, much of the currency issued in the U.S. consisted of private bank notes. Those notes were issued by state-chartered banks during the free banking era (1837-1863) and by nationally chartered banks during the national banking era (1863-1913). From 1824 to 1858, one arrangement for interbank transactions was the Suffolk banking system, which operated in New England. Another example of a private monetary system was the pre-1935 note-issue system in Canada, under which chartered banks issued circulating notes and the Bank of Montreal (a private bank) acted as a quasi-central bank.

So, given historical precedent, the current functions of central banks could, in principle, be carried out by the private financial system. But there is a presumption that such an arrangement would be less efficient than having a central bank. Indeed, in the U.S., it was decided in the early 20th century that relying on private monetary arrangements is a bad idea. The argument, enshrined in the Federal Reserve Act of 1913, is that, in the absence of a central bank, the financial sector would be unstable and would be

insufficiently responsive to fluctuations in the need for financial intermediation. The Fed was designed to stabilize the financial sector through discount-window lending in crises and to accommodate fluctuating needs for currency.

The foundation for monetary policy rests on the central bank's uniqueness as a financial intermediary. In the case of the U.S., in pre-financial crisis times, the Fed's liabilities consisted mainly of currency and a relatively small quantity of reserves, and its assets were mainly Treasury securities. Thus, the Fed was primarily transforming the debt of the U.S. Treasury into currency. Given the Fed's monopoly on the supply

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of currency, and since private-sector bank deposits are imperfect substitutes for currency, if the Fed conducted an open market operation—say a swap of reserves for Treasury bills—then this would matter. That is, through movements in market interest rates and portfolio adjustments by financial institutions and consumers, the new reserves created by the open market purchase would end up as currency. Thus, the Fed would have increased the quantity of intermediation it was doing, in nominal terms. Because this central bank financial intermediation was not offset by less private-sector financial intermediation of the same type, there would be effects on asset prices, inflation and aggregate economic activity.

But QE is fundamentally different from conventional open market operations. QE is conducted in a financial environment in which there are excess reserves outstanding in the financial system. Given the interest rate on excess reserves (IOER), other interest rates and quantities adjust so that banks are willing to hold the reserves supplied by the central bank. It is generally recognized that a financial system flush with reserves, as has been the case in the U.S. since late 2008, is subject to a liquidity trap. That is, given IOER, which is set administratively, if the Fed simply swaps reserves for Treasury bills, then this may have no effect because reserves and Treasury bills might be viewed as roughly identical short-term assets.

Indeed, such a swap may even have negative effects, as reserves may be inferior assets to Treasury bills.[8] For example, on May 19, 2017, the one-month Treasury bill rate was 0.71 percent while IOER was 1.00 percent, so banks required a premium of 29 basis points to induce them to hold reserves rather than one-month T-bills. For what reasons are reserves inferior to T-bills? Basically, reserves can be held only by a restricted set

of financial institutions, while T-bills are more widely held and are useful as collateral in financial transactions (e.g., repurchase agreements) in ways that reserves are not.

When QE is conducted in a system flush with reserves, the central bank is typically transforming long-maturity assets into short-maturity reserves. The key question, if we compare this to how conventional monetary policy works, is what advantage the central bank might be exploiting in conducting such a transformation. That is not clear. Consider, for example, a shadow bank (an unregulated financial institution that conducts bank-like activities) that holds long-maturity assets—Treasury bonds, for example—and finances its portfolio by
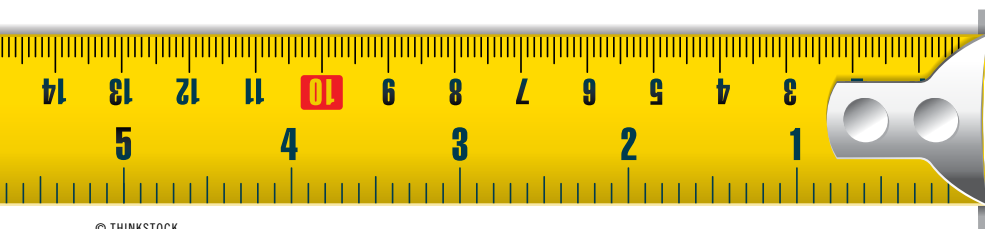
rolling over overnight repurchase agreements (repos), with the Treasury bonds serving as collateral. This looks much like the asset transformation in QE, except it might actually be more efficient because overnight repos may be superior assets to reserves for the same reason that T-bills may be superior to reserves.

Therefore, from financial intermediation theory, it is not clear that QE should have any effect and it might actually be detrimental to the efficiency of the financial system. Some economists have made the case that QE has negative effects, due to the fact that it withdraws safe collateral from financial markets, thus clogging up the "financial plumbing."[9] On the theoretical side, it has been shown that QE can have beneficial effects, provided that reserves and short-term government debt are identical, and long-maturity government debt is better collateral than short-term government debt.[10] However, it has also been shown that balance-sheet expansion by the central bank can be detrimental if reserves are inferior to short-term government debt.[11]

Empirical Evidence on QE

The empirical work evaluating the effects of QE was summarized nicely by two other economists last year.[12] For the most part, QE empirical studies fall into one of three categories: (1) event studies, (2) regression and VAR (vector autoregression) evidence, and (3) calibrated model simulations. The weight of the results was interpreted by those economists as favoring the standard central banking narrative concerning QE. That is, according to the narrative, QE works much as conventional accommodative policy does—it lowers bond yields and increases spending, inflation and aggregate output.

But we should be skeptical of this interpretation. First, event studies look at the reaction of asset prices in a short window around a policy announcement. But the fact that asset-market participants respond in the way that policymakers hope they respond to a policy announcement with little historical precedent may say very little. Second, the two economists of this study pointed out plenty of econometric problems in the studies they surveyed. Third, none of this empirical work actually measured the advantage that central banks

FIGURE 2
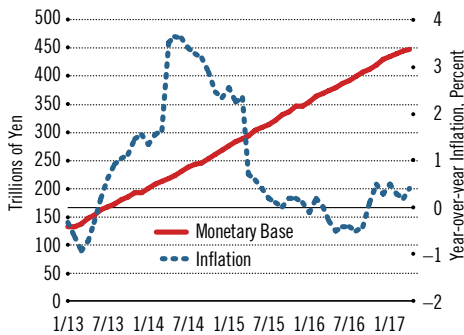
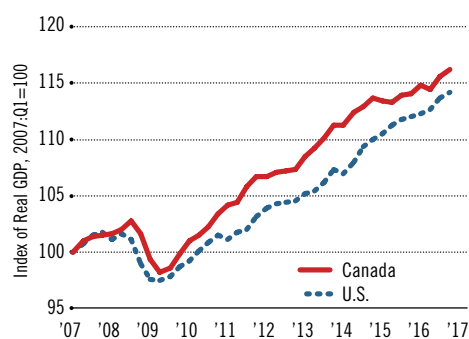**Japan Monetary Base and CPI Inflation**

SOURCES: Organization for Economic Cooperation and Development and Bank of Japan.

NOTE: The monetary base has grown by a large amount in Japan since January 2013, with little or no ultimate effect on inflation. The temporary increase in inflation in 2014 was primarily due to an increase in the consumption tax.

FIGURE 3

U.S. versus Canada Real GDP

SOURCES: Bureau of Economic Analysis/Federal Reserve Economic Data (FRED) and Organization for Economic Cooperation and Development.

NOTE: Canada and the U.S. are subject to the same basic macroeconomic forces, but over this period the Fed conducted QE and the Bank of Canada did not. Canada actually had slightly *better* real GDP performance.

ENDNOTES

[1] See Taylor.

[2] See Board of Governors.

[3] For the euro area, we counted GDP as a measure of total GDP for the countries that are members of Europe's Economic and Monetary Union.

[4] See Bernanke.

[5] For examples of this theory, see Tobin, as well as Vayanos and Vila.

[6] For examples, see Modigliani and Sutch.

[7] Such arguments have been made by Woodford and by Bhattarai et al. (2015).

[8] See Williamson (2017).

[9] See Singh and Stella.

[10] See Williamson (2016).

[11] See Williamson (2017).

[12] See Bhattarai and Neely (2016).

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might have in transforming assets when they conducted QE.

Natural Experiments

Primarily, we are interested in how QE matters for the ultimate goals of central banks—generally pertaining to inflation and real economic activity. One type of empirical evidence to which we can appeal is so-called natural experiments—instances in which the policy was tried and the effects are more-or-less obvious. We will look at two cases: (1) QE in Japan post-2013, and (2) Canada and the United States after the financial crisis.

In January 2013, the Bank of Japan (BOJ) announced that it would pursue a 2 percent inflation target, and in April 2013 it announced the Quantitative and Qualitative Monetary Easing Program, intended to achieve the 2 percent target within two years. From 2013 to early 2016, the overnight nominal interest rate was close to zero, and it has been negative since early 2016. In Figure 2, note that the monetary base in Japan (a measure of total liabilities of the Bank of Japan) increased by about threefold from the beginning of 2013 to May 2017.

If QE is indeed effective in increasing inflation—the BOJ's ultimate goal—then surely inflation should have increased in response to this massive QE program. But Figure 2 shows that this was not the case, if

we look at the consumer price index (CPI) for Japan. CPI indeed increased in 2014, but largely due to an increase of three percentage points in Japan's consumption tax in April 2014, which fed directly into the CPI measure. But, from mid-2015 to March 2017, average inflation in Japan was roughly zero, obviously far short of the 2 percent target.

Since the financial crisis, central bank interest rate policy has been little different in Canada and the U.S. But, the Bank of Canada did not engage in QE over this period, while the Fed did. As of December 2016, the Bank of Canada's balance sheet stood at 5.1 percent of GDP, as compared to 23.6 percent of GDP for the Fed. Canada and the United States are typically subject to similar economic shocks, given their close proximity and similar level of economic development; so, if QE were effective in stimulating aggregate economic activity, we should see a positive difference in economic performance in the U.S. relative to Canada since the financial crisis. In Figure 3, we show real GDP in Canada and the United States, scaled to 100 for each country in the first quarter of 2007. The figure shows that there is little difference from 2007 to the fourth quarter of 2016 in real GDP performance in the two countries. Indeed, relative to the first quarter of 2007, real GDP in Canada in the fourth quarter of 2016 was 2 percent higher than real GDP in the U.S.,

reflecting higher cumulative growth, in spite of supposedly less accommodative monetary policy.

Thus, in these two natural experiments, there appears to be no evidence that QE works either to increase inflation, if we look at the Japanese case, or to increase real GDP, if we compare Canada with the U.S.

Conclusion

Evaluating the effects of monetary policy is difficult, even in the case of conventional interest rate policy. With unconventional monetary policy, the difficulty is magnified, as the economic theory can be lacking, and there is a small amount of data available for empirical evaluation. With respect to QE, there are good reasons to be skeptical that it works as advertised, and some economists have made a good case that QE is actually detrimental.

One way of viewing QE is that it represents an asset transformation by the central bank; for example, the central bank turns long maturity government debt into short maturity reserves. Two questions then arise.

First, the fiscal authority could have done the same thing by issuing less long-maturity debt and more short-maturity government debt. So, is the case for QE that the central bank is somehow better at debt management than the fiscal authority? If so, there should be an explicit agreement between the government and the central bank concerning who possesses the power to manage the maturity structure of outstanding debt.

Second, perhaps the private sector can do a better job than the central bank in turning long-maturity debt into short-maturity debt. If that is the case, then perhaps the central bank should be permitted to issue a richer set of liabilities—circulating debt similar to Treasury bills for example, which would be superior as an asset to bank reserves. Indeed, the central banks in Switzerland and China already have the power to issue such central bank bills. Ω

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REAL GDP GROWTH

NOTE: Each bar is a one-quarter growth rate (annualized); the red line is the 10-year growth rate.

INFLATION-INDEXED TREASURY YIELD SPREADS

NOTE: Weekly data.

CIVILIAN UNEMPLOYMENT RATE

U.S. AGRICULTURAL TRADE

NOTE: Data are aggregated over the past 12 months.

CONSUMER PRICE INDEX (CPI)

RATES ON FEDERAL FUNDS FUTURES ON SELECTED DATES

INTEREST RATES

NOTE: On Dec. 16, 2015, the FOMC set a target range for the federal funds rate of 0.25 to 0.5 percent. The observations plotted since then are the midpoint of the range.

AVERAGE LAND VALUES ACROSS THE EIGHTH DISTRICT

SOURCE: Agricultural Finance Monitor.

On the web version of this issue, 11 more charts are available, with much of those charts' data specific to the Eighth District. Among the areas they cover are agriculture, commercial banking, housing permits, income and jobs. To see those charts, go to www.stlouisfed.org/economyataglance

Momentum Appears to Have Swung Upward for Economy

By Kevin L. Kliesen

Headline PCE Inflation: Actual and Forecast

SOURCES: Bureau of Economic Analysis, along with Laura Jackson, Kevin Kliesen and Michael Owyang, the authors of the article in the note below.

NOTE: The above forecast is produced from the St. Louis Fed's FAVAR model. For more details on the model, see "A Measure of Price Pressures," Federal Reserve Bank of St. Louis Review, First Quarter 2015, Vol. 97, No. 1, pp. 25-52.

Following a rather tepid showing in the first quarter of 2017, the U.S. economy expanded at a modestly faster rate of growth in the second quarter. Although data indicated a springtime lull in housing construction and slower truck and auto sales, these slowdowns are likely temporary in view of other developments:

First, the manufacturing sector is strengthening—new and unfilled orders for new manufactured capital goods are increasing from year-earlier levels.

Second, job growth and real income growth remain robust, and the unemployment rate fell to its lowest level in a little more than a decade in the second quarter.
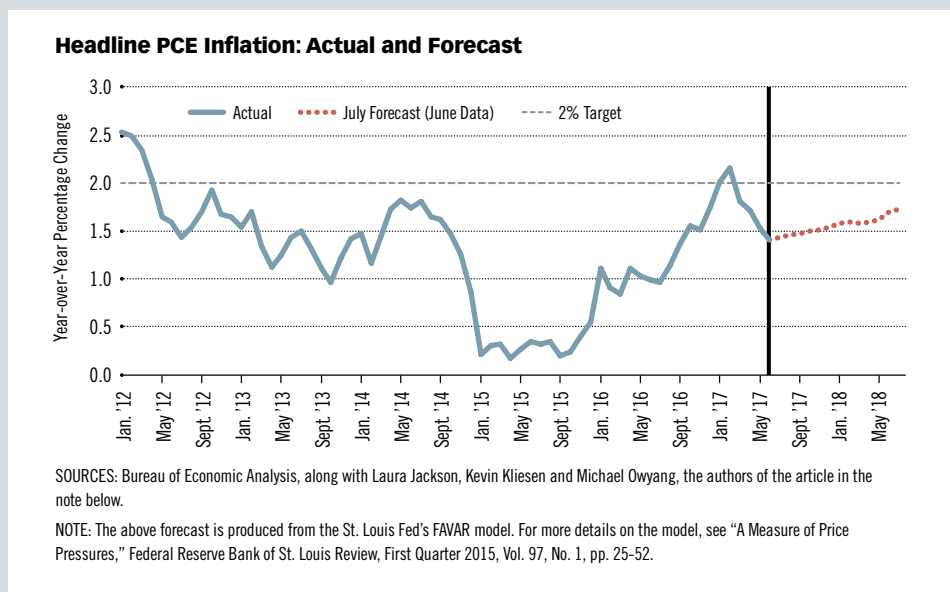
Third, household net worth rose sharply over the first half of the year, powered by rising house prices and sharp increases in stock prices.

Finally, inflation pressures eased in the second quarter, which financial markets assume will slow the pace of future Fed rate hikes. Despite the Fed's three tightening moves since late 2016, long-term nominal interest rates fell slightly in the second quarter and measures of financial market stress remain low.

Looking Past the Headlines

Swings in private inventory investment are volatile and can sometimes mask the underlying pace of growth in sales of goods and services. For example, the change in private inventories (goods produced but not sold) added 1 percentage point to real gross domestic product (GDP) growth in the fourth quarter of 2016, but then subtracted 1.5 percentage points from real GDP growth in the first quarter of 2017.

Accordingly, to gauge the underlying strength of the economy, economists sometimes pay more attention to real final sales (GDP less inventory investment). When viewed from this standpoint, the economy exhibited an upswing in growth over the first half of 2017, as real final sales advanced at a 2.6 percent annual rate in the first and second quarters. By contrast, growth of real final sales increased at only a 0.7 percent rate in the fourth quarter of 2016.

Professional forecasters expect both real GDP and real final sales to increase at about a 2.25 percent annual rate over the second half of 2017, similar to their averages seen during this expansion. For comparison purposes, real GDP increased at a 1.9 percent rate over the first half of the year, while real final sales increased at a 2.7 percent rate.

One of the keys to faster real GDP growth is a sustained rebound in nonresidential fixed investment (business capital expenditures, or capex), which grew very slowly in 2015 and then declined slightly in 2016. In the first quarter of 2017, capex rose at a brisk 7.1 percent annual rate.

Although capex growth slowed moderately in the second quarter to 5.2 percent, several developments suggest that business investment is on the upswing. These include a strengthening manufacturing sector, an improving global economic outlook, a rebound in corporate earnings and profits, and a modest retreat in economic uncertainty. If these trends continue, firms may soon scramble to keep up with rising demand; that's because many have delayed capital expenditure projects in the previous two years, when U.S. and global economic conditions were weaker and uncertainty was higher.

Inflation's Disappearing Act

Inflation slowed sharply in the second quarter. After increasing at a 2.2 percent rate in the first quarter, the personal consumption expenditures price index (PCEPI) rose at a tepid 0.3 percent rate in the second quarter; the index was up 1.6 percent from a year earlier.

Double-digit declines in prices of energy goods and wireless telephone services accounted for the bulk of the slowing in inflation during the second quarter. In July, though, crude oil prices began to tack higher in response to a rebound in the demand for energy, driven by faster global growth.

Although rising oil prices will help push inflation higher, there is little evidence to suggest that inflation is poised to breach the Federal Open Market Committee's 2 percent inflation target over the short term. Indeed, the St. Louis Fed's FAVAR (factor-augmented vector autoregression) model predicts that the 12-month percent change in the PCEPI will slowly rise from 1.4 percent in June 2017 to 1.7 percent in July 2018, as can be seen in the figure.

Inflation expectations from financial markets and professional forecasters portray a similar inflation outlook. As always, though, this outlook is conditioned upon Fed policymakers' remaining committed to defending their inflation target, should upside risks to the inflation outlook arise.

Overall, real GDP growth over the second half of the year will probably be stronger than in the first half, but inflation should remain modestly below 2 percent. Thus, healthy labor market conditions should remain. Ω

Kevin L. Kliesen is an economist at the Federal Reserve Bank of St. Louis. Brian Levine, a research associate at the Bank, provided research assistance. See http://research.stlouisfed.org/ econ/kliesen for more on Kliesen's work.

Making Ends Meet on the Federal Budget: Outlook and Challenges

By Fernando M. Martin

With the advent of every new administration come numerous proposals to fix the federal budget, mostly involving tax code overhaul, entitlement reform and curbs on government debt. Invariably, these proposals get toned down during congressional review and often die before becoming a reality. With the various plans currently floating around, it seems like a good time to review the state and future of the federal government's accounts.

Current Situation

During the fiscal year 2016, the federal government spent almost $3.9 trillion, or 20.9 percent of gross domestic product (GDP).[1] Revenues amounted to about $3.3 trillion, or 17.8 percent of GDP. The deficit was nearly $600 billion, or 3.2 percent of GDP, of which the interest on the debt accounts for about 41 percent. Current estimates by the Congressional Budget Office (CBO) project a similar outcome for 2017.

If we take the period from 1955 until the Great Recession (2007) as a reference, revenues are at normal levels, while expenditures are a bit high. On the upside, the government has benefited from prevailing low interest rates, which imply low interest payments on the debt.

At the end of 2016, government debt held by the public was at 77.0 percent of GDP.[2] If we exclude the holdings by Federal Reserve banks, this figure drops to 63.6 percent of GDP. However we measure it, debt is high: roughly twice the average percentage of GDP over 1955-2007.

The recent increase in the debt is the product of the government's response to the financial crisis and subsequent recession; that response consisted of a combination of tax cuts and spending hikes. But, as mentioned above, while revenues returned to normal levels, spending remained elevated due to the permanent expansion of transfers to individuals, particularly major health care programs like Medicare and Medicaid. As the late American economist and Nobel laureate Milton Friedman once said, "Nothing is so permanent as a temporary government program."[3]

A Closer Look at Spending and Revenues

Let us dig deeper into the federal government's accounts. Roughly two-thirds of total expenditures correspond to mandatory outlays, i.e., spending required by existing law, other than appropriation acts. By far, the largest components in this category are Social Security and health care expenditures. Unemployment compensation, food stamps and student loans are examples of programs that also contribute to mandatory spending.

The role of mandatory spending became more prominent between the mid-1960s and mid-1970s, and then again starting with the most recent recession. In 2016, Social Security outlays were 4.9 percent of GDP, while major health care programs (net of offsetting receipts) totaled 5.5 percent of GDP.[4] The combined impact of these two items has been increasing steadily over time.

In contrast, discretionary spending as a fraction of GDP has been declining steadily over time, mainly driven by a relative reduction in defense expenditures. Although U.S. defense expenditures remain by far the largest in the world, amounting to $585 billion in 2016, their burden in terms of output is actually small: about 3.2 percent of GDP.

Interestingly, some developed countries (e.g., Italy and Portugal) spend more, as a fraction of GDP, on their debt interest than the U.S. pays on national defense.

On the revenue side, the biggest contributors are individual income and payroll taxes. Together, both of these sources amounted to 14.5 percent of GDP, accounting for a bit over 80 percent of total revenue in 2016. Perhaps surprisingly, corporate income taxes are a minor component in the government's budget: 1.6 percent of GDP, or 9.2 percent of total revenue. This item used to be significantly more prominent before the 1980s. The causes of this decline are various and difficult to decompose precisely.[5] It is important to note the relatively small contribution of corporate income taxes to government coffers given the various reform proposals floating around that often involve further contractions. On the other hand, a flat-out repeal of the corporate income tax would simplify the tax code enormously and, if properly implemented, would not have a measurable impact on total revenues. (Corporate income taxes would, in this case, be collected as individual income taxes, as dividends are disbursed to shareholders.)

The Fiscal Picture in 10 Years

The June 2017 projections by the CBO estimate the evolution of the federal budget until 2027 under current law. In broad terms, expenditures are projected to rise significantly over the next decade, to 23.6 percent of GDP, while revenues will increase modestly to 18.4 percent of GDP. The CBO projects rising deficits and further accumulation of government debt. By 2027, government debt held by the public is expected to surpass 90 percent of GDP.

Although discretionary spending as a share of GDP is expected to continue on its declining path, contracting by about 1 percentage point of GDP over the next decade, mandatory spending is expected to increase significantly. In particular, the combined expenditures on Social Security and health care programs are projected to go from 10.4 percent of GDP in 2016 to 12.9 percent in 2027. Other mandatory spending items are not expected to change significantly as a proportion of GDP.

A nontrivial part of the projected increase in spending over the next decade is attributed to larger interest payments on the debt, as both the interest rate on bonds closes on precrisis levels and outstanding debt rises. It is debatable whether interest rates will return to their precrisis levels, and there are reasons to believe that they will remain low (in part due to innovations in the financial system). If this turns out to be the case, the projected deficits are overstated by perhaps as much as 1 percentage point of GDP.

On the other hand, the modest projected increase in revenues may be overstated as well. As the CBO recognizes, part of the increase in individual income taxes is due to real "bracket creep," that is, as income increases faster than consumer prices, larger proportions of income are subject to higher tax rates. It is conceivable that, due to equity considerations, Congress would prevent significant proportions of middle-class taxpayers from being subjected to higher tax rates. In such a case, revenues would not increase as expected, so the deficit might be higher than projected.

Narrowing Options

The federal budget is currently burdened by high obligations on Social Security payments and health care expenditures. In contrast, discretionary items are in decline. The prominence of mandatory spending programs implies less room for fiscal maneuvers in the future and will make reform more difficult to implement. Financing of these expenditures relies heavily on taxing individual income (including payroll taxes). Closing the deficit without reforming entitlements will invariably lead to tax hikes.
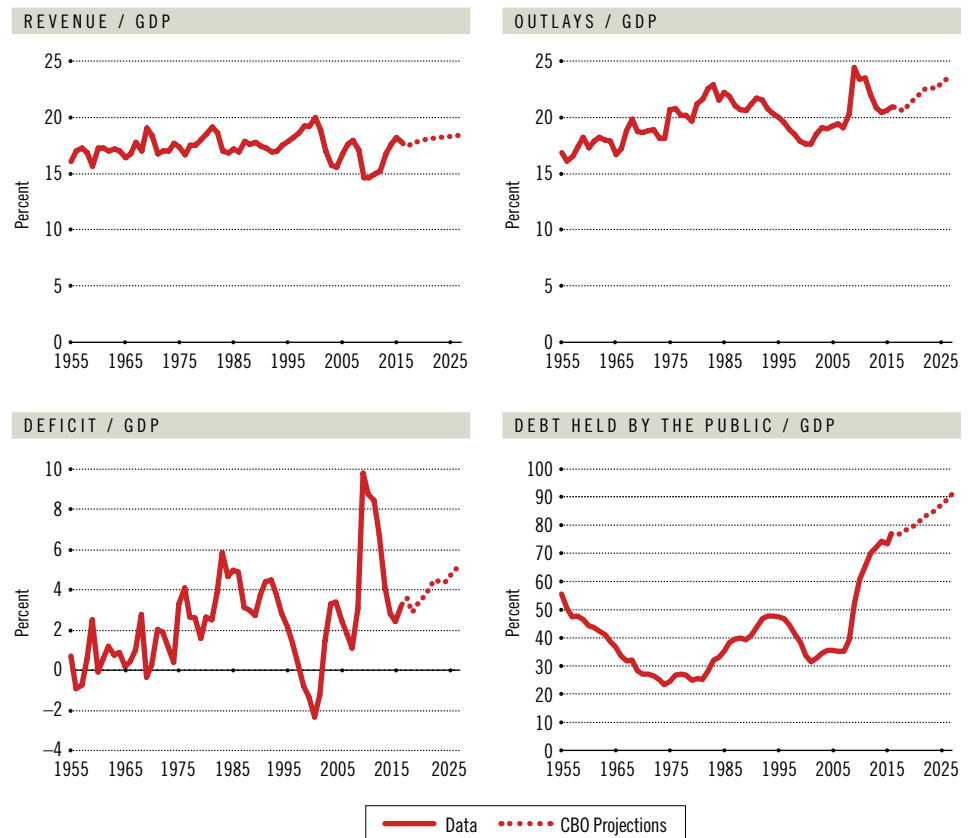
As I argued before, the federal government cannot rely on tax hikes on the rich, as these would have to be massive and may not even be enough.[6] Most likely, taxes on the middle class would have to be raised. If anything, the political climate for a while has been pointing in the opposite direction (i.e., tax relief for the middle class).

Government debt levels are not yet a cause for concern in the U.S., although they might make fiscal responses to future recessions harder to implement. If current trends persist, debt held by the public will remain at manageable levels for the next decade. Another big adverse shock to the economy might change this outlook for the worse. Even in this case, the U.S. has the advantage of issuing debt in its own currency, so outright default (as in Greece) is not a likely outcome, though inflation might be (as was the case during and immediately after World War II). Ω

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ENDNOTES

[1] The U.S. government's fiscal year begins Oct. 1 and ends Sept. 30 of the subsequent year and is designated by the year in which it ends. Unless otherwise stated, all years refer to fiscal years.

[2] Government debt held by the public excludes holdings by federal agencies (mainly, the Social Security trust funds), but includes holdings by the Federal Reserve System.

[3] See Becker Friedman Institute.

[4] Offsetting receipts are certain fees and other charges that are recorded as negative outlays.

[5] See Auerbach (2007) and Auerbach and Poterba (1987).

[6] See Martin.

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FIGURE 1
U.S. Fiscal Outlook

SOURCES: Congressional Budget Office and author's calculations.

Coal's Future Looks Uncertain as Rival Fuels Grow

By Jonas Crews and Charles Gascon

The coal industry has experienced a significant decline over the past decade. This descent has been driven predominantly by the advent of cheap natural gas, along with policies to promote cleaner, more sustainable sources of energy.

While the industry's overall decline has been a more recent phenomenon, labor productivity in U.S. coal production has increased steadily for over three decades as firms move toward complete automation of the mining process. From January 1985 to May 2017, the amount of coal produced by the average mine worker increased 224 percent.

The outlook for coal, which once was the dominant fuel for electricity generation, is waning. This article analyzes the coal industry both nationally and within our region (the states that make up the Eighth Federal Reserve District[1]) and ponders its future as a source of both electricity and jobs.

Coal serves two main purposes in the global economy: It can be burned to create electricity, or it can be used to produce steel. In 2016, the U.S. electricity sector's coal consumption was equal to 93 percent of domestic coal production.

The National Scene

After a modest, consistent rise in coal production over the past few decades, U.S. coal production started to decline in 2009. (See Figure 1.) By the end of 2016, annual production had fallen 38 percent from its 2008 peak. Figure 1 also shows the steady decline in mining employment, going as far back as at least 1985, when data became available.

The drop in production is a response to plummeting coal prices, driven largely by rising international supply and declining domestic demand. The increased global supply has come from multiple countries, particularly Australia, China and India; they have boosted their mining of coal over the past decade. The U.S. share of world coal production has dropped from 18 percent in 2004 to 11 percent in 2014. Meanwhile, the decline in U.S. coal demand is a product of reduced electricity demand and increased competition from other energy sources.

Coal's largest competitor in energy production is natural gas, which saw its supply skyrocket and price plummet with the now-ubiquitous use of hydraulic fracturing to extract natural gas in the U.S. The price of natural gas fell from an average of $7 per million British thermal units in 2007 to an average of $3 in the first five months of 2017.[2]

According to a cost-benefit analysis by the U.S. Energy Information Administration (EIA), upcoming advanced natural gas power plants—called advanced combined cycle plants—will reduce electricity production costs in supplied regions by 8 percent compared with a scenario in which the plants are not built. Meanwhile, the EIA estimates a negative return on investment for a "clean coal" plant built anywhere in the U.S.[3] On average, the EIA estimates a new "clean coal" plant would more than double electricity production costs over the alternative of not building.[4]

Natural gas's price advantage has resulted in coal-fired electricity plants across the country being shut down or retooled for natural gas-fired energy production. In 2016, for the first time in U.S. history, natural gas surpassed coal as the top electricity creator. For comparison, in 2000, natural gas produced only a third of the electricity that coal produced in the U.S.

While natural gas's supplanting of coal has been primarily market-driven, government-sponsored research, tax

FIGURE 1

U.S. Coal Production and Coal Mining Employment
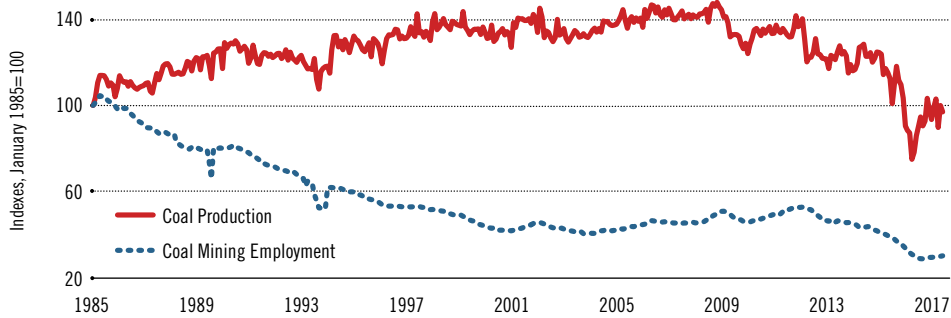
SOURCES: Energy Information Administration/Haver Analytics and Bureau of Labor Statistics/Haver Analytics.

FIGURE 2

Ranges of Electricity Generation Cost by Type of Power Plant
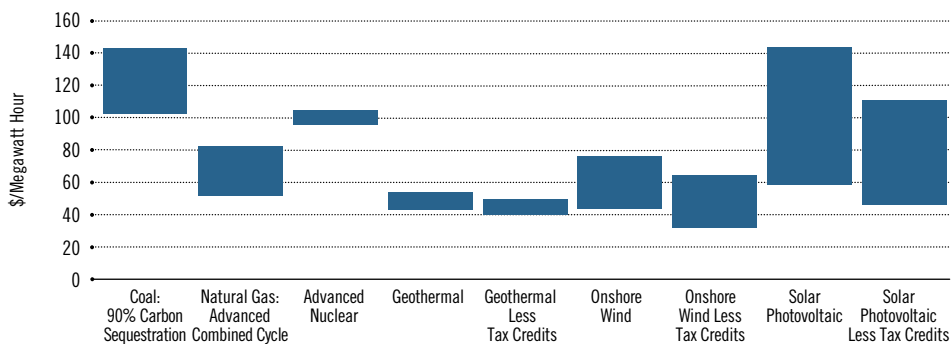
SOURCE: Energy Information Administration.

NOTES: A megawatt hour is a unit of electricity. Ranges are based on the forecasted fixed and variable costs of building a power plant, beginning electricity production by 2022, and operating the plant for 30 years in one of 22 U.S. regions; there can be significant regional variation due to local labor markets and the cost and availability of fuel or energy resources, such as windy sites. Because all 22 U.S. regions have existing power plants that have already covered initial fixed costs, values in the figure imply what types of plants will be built once old ones are retired. Values do not imply that certain types of plants will be closed early in favor of new plants. Carbon sequestration refers to the capturing of carbon released upon the burning of coal to prevent it from being released into the atmosphere. Advanced combined cycle is the most cost-effective large-scale method of producing electricity from natural gas. Solar photovoltaic refers to the most cost-effective method of generating electricity from solar energy.

E N D N O T E S

[1] Headquartered in St. Louis, the Eighth District includes all of Arkansas and parts of Illinois, Indiana, Kentucky, Mississippi, Missouri and Tennessee.

[2] A British thermal unit is a measure of energy.

[3] "Clean coal" plants, for our purposes, refer to coal plants that capture CO_2 produced during coal burning and, generally, deposit it underground instead of allowing it to be released into the atmosphere.

[4] See U.S. EIA's Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2017.

[5] See U.S. EIA's 2017 Annual Energy Outlook.

[6] The rare-earth elements are 17 metallic elements often found together in the Earth's crust.

[7] See Kliesen.

R E F E R E N C E S

Kliesen, Kevin. "Electricity: The Next Energy Jolt?" The Regional Economist, October 2006, Vol. 14, No. 4, pp. 4-9.

U.S. Energy Information Administration. Annual Energy Outlook 2017. January 2017. See www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf.

U.S. Energy Information Administration. Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2017. April 2017. See www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf.

credits and environmental protections have resulted in two more coal competitors. Wind and solar technologies, while not necessarily cost-effective for the U.S. as a whole, are more cost-effective than coal in some areas of the country even without any government support.

Figure 2 shows the per-unit-of-electricity cost associated with building various types of U.S. power plants and operating them for 30 years.

Long-term Outlook for Coal

Coal's electricity-related problems do not seem to be short-term. In its 2017 Annual Energy Outlook, the EIA explained that the move away from coal-fired electricity production will likely continue.[5] According to EIA's base scenario, electricity production from renewable resources will surpass that from coal by 2030. We expect to see continued labor productivity gains in coal production, which will further reduce employment in the industry.

Although coal companies have needed to file for bankruptcy and to restructure in the past few years, there are two areas worthy of optimism: demand for coal used in steel production and demand for rare-earth elements that can be extracted from coal.[6] Coal needs to have certain characteristics to be used in steel production, and such coal is bought at a premium over coal used for electricity. High demand for steel in China and other developing countries has resulted

© THINKSTOCK/ISTOCK/NITO100

shows that production has rebounded over the past few months. The District's major coal producing areas have all climbed modestly from their early-2016 troughs. Data on District mining employment are sparse, but trends in available data have generally followed the national trend of reduced labor intensity.

Looking Forward

The U.S. energy sector has been turned on its head over the past two decades. Developments in fracking have led to natural gas's unseating coal in electricity production. U.S. oil production has almost doubled, wind and solar are now the cheapest producers of electricity in some areas of the U.S. even before tax credits, and ethanol refinement has changed both energy and corn markets. At the same time, significant moves in energy efficiency have mitigated the growth in U.S. electricity demand. This scenario was anticipated by very few.[7]

If new trends in electricity production continue, coal power plants may eventually become obsolete. But if the energy sector has taught us anything, it's that we can't rely on trends. New technologies are constantly reshaping our existing industries, and the coal industry could be no different. Ω

FIGURE 3

U.S. and District Coal Production

SOURCE: Energy Information Administration/Haver Analytics.

NOTES: The 2017 data end in May. The short ton, commonly known as a ton in the U.S., is equal to 2,000 pounds. Coal production includes state-level date from the District states except for Kentucky, which includes data only from the western portion of that state.

Charles Gascon is a regional economist, and Jonas Crews is a senior research associate, both at the Federal Reserve Bank of St. Louis. For more on Gascon's work, see https://research.stlouisfed.org/econ/gascon.

in a large premium over the past several years.

Mining coal for rare earth elements is a more recent phenomenon. Both policymakers and private corporations have shown interest in such mining as a future for the coal industry, and the U.S. Department of Energy has allocated $7 million toward research on the economic viability. The process is expected to involve extracting coal from existing mines and removing the carbon from the coal in order to obtain any rare metals within. Such metals are expected to be in high demand for the foreseeable future, due to their use in cell phones, laptops and many other electronics.

The District's Coal Industry

Coal has a very significant presence in the Eighth District. St. Louis is home to two of the largest coal producers in the world: Peabody Energy Inc. and Arch Coal Inc. The District also consumes a lot of coal: Illinois, Indiana, Kentucky and Missouri were among the top six consuming states in 2015.

District coal production is dominated by mines in the Illinois Basin, which covers most of Illinois, the southwestern portion of Indiana, the western portion of Kentucky, and small sections of Missouri and Tennessee. Illinois Basin coal is moderately efficient in regard to electricity production, but it also produces the most sulfur dioxide—one of the major pollutants released when coal is burned—of any coal from major U.S. mining areas.

Because there are higher-quality substitutes elsewhere in the U.S., some coal-fired power plants, including those in the District, look elsewhere for coal. This has resulted in the basin's coal selling at a lower price than other coals with similar energy efficiency. Thus, in an industry already struggling with low prices, coal mines found in this basin face even tighter margins.

Although there is pessimism about the future of the District's coal industry, Figure 3

Startups Create Many Jobs, but They Often Don't Last

By Maximiliano Dvorkin and Charles Gascon

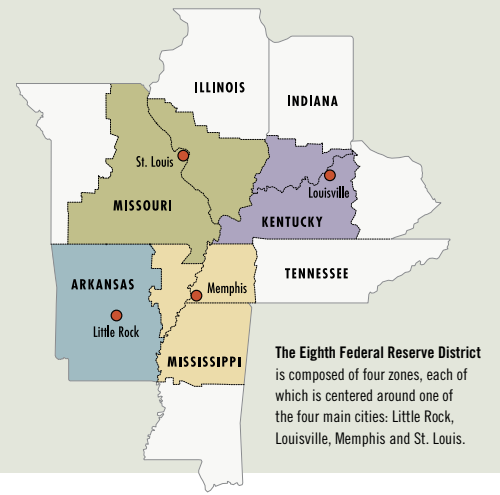**The Eighth Federal Reserve District** is composed of four zones, each of which is centered around one of the four main cities: Little Rock, Louisville, Memphis and St. Louis.

Millions of jobs have been created since the last recession ended. From 2011 to 2014 alone, the U.S. economy added approximately 2.5 million jobs per year. Much of this job growth has come from the formation of new businesses (i.e., startups) and their initial growth.[1]

When many people hear about startups, they may think just about the tech startups in places like Silicon Valley. However, startups occur in all industries and in many places around the country. Granted, the startup rate may be higher in industries with low barriers to entry (e.g., retail), and the rate may be lower in industries with high barriers to entry (e.g., capital-intensive industries such as manufacturing).

In this article, we look closely at how firms of different ages contributed to the net growth in jobs between 2011 and 2014. We started in 2011 since this is the year with solid aggregate employment growth after the recession ended, and we ended in 2014 since it is the latest year available in the data we used.

We show what happened on the national level and within the four largest metropolitan statistical areas (MSAs) in the Eighth District: St. Louis; Little Rock, Ark.; Louisville, Ky.; and Memphis, Tenn.

For this analysis, we used data from the Business Dynamics Statistics collected by the U.S. Census Bureau. This data set contains annual aggregate statistics describing establishment openings and closings, firm startups, and job creation and destruction by firm age and metropolitan area, among other characteristics.[2] The data include establishments with paid employees and cover most of the nonfarm private sector. The data provide a snapshot of firms and their employees on March 12 of each year.

Net Job Creation in the United States by the Age of Firms
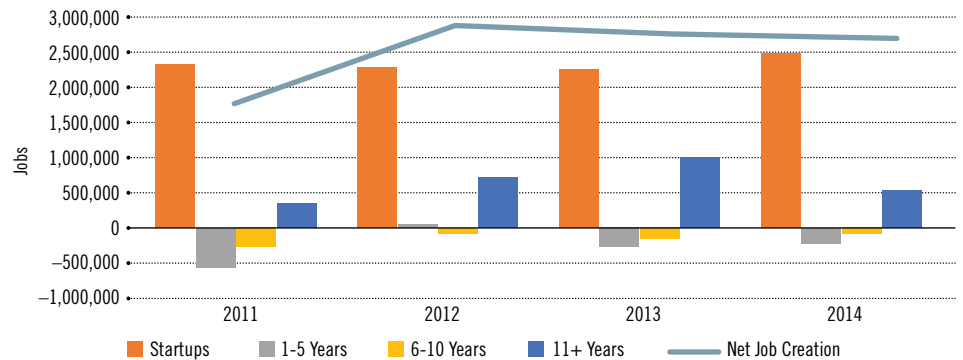
SOURCES: Business Dynamics Statistics and authors' calculations.

The National Scene

The figure shows total net job creation in the U.S. from 2011 to 2014. The line shows the total net job creation across all firms, while the bars disaggregate job creation based on the age of the firm.

A very important pattern emerges from the figure. Business startups, that is, firms that are less than a year old, account for most of the net job creation. Apart from startups, the only other firms with a positive contribution to job creation are very mature firms, those with 11 or more years in operation.

Although startups make a very large contribution to net job creation, they account for only 2 percent of total employment in the U.S. economy. Moreover, a business startup in any given year will join the 1 to 5 year cohort the following year if it remains in business. The figure shows that net job creation for that group is very small and in many cases negative. This small contribution is due to the high

probability of exit that young firms face. Successful young firms will continue to add more jobs on net, but about half of these firms will fail and close, resulting in considerable net job losses.

On balance, this up-or-out process leads to low levels of net job creation after the initial year for the firm. Finally, by the time firms are 11 years old, they have sorted into two groups: subsistence entrepreneurs (that is, "mom and pop" shops) that are unlikely to hire additional workers and high-growth firms that continue to grow and hire. Regardless of the type, the firms with 11 or more years in operation are, on average, composed of more successful firms, and since fewer of them exit, their contribution to net job creation tends to be positive.[3]

Net Job Creation in the Eighth District

Looking at the Eighth District, the table summarizes net job creation dynamics by firm age for the four largest metropolitan areas (and, for comparison purposes, the

Net Job Creation in the Largest Metro Areas of the Eighth District

	Startup Employment Share	Net Job Growth 2011-14	Contribution to Net Job Growth			
			Startups	1 to 5 Years	6 to 10 Years	11+ Years
U.S.	2.0%	10,173,430	9,271,799	−1,058,923	−519,623	2,480,177
St. Louis	1.6%	92,533	76,846	−10,762	−4,800	31,249
Louisville	1.7%	52,092	37,465	−4,796	−4,193	23,616
Little Rock	2.0%	5,459	22,261	−5,317	−2,175	−9,310
Memphis	1.4%	26,634	30,633	−770	−3,590	361

SOURCES: Business Dynamics Statistics and authors' calculations.

U.S. as a whole). In general, startups account for a slightly smaller share of total employment in the District than they do for the nation overall.

There are some important differences in the contribution to net job creation by startups during the recovery in the four MSAs.

The case of St. Louis is similar to the national average, with startups accounting for about 1.6 percent of total employment but 83 percent of net job creation.

Thus, while startups are very dynamic and have an important role in net job creation, in terms of total employment and earnings they tend to have a modest impact. Only the few firms that survive to the 11+ year age group have a lasting impact on employment.

In Louisville, startups comprise a slightly greater share of total employment than they do in St. Louis, but older firms account for 45 percent of net job creation compared with the U.S. average of 24 percent. Similar to the situation in St. Louis, firms in Louisville aged 1 to 10 years reported net job losses over the economic recovery.

In Little Rock, 2 percent of employment is accounted for by startups, which is the highest among the four major MSAs in the District. Startups accounted for 22,261 new jobs, on net, which is about four times the net job growth in the region. The

contribution to net job creation of firms in other age groups was negative, on net.

Memphis shows a pattern of net job creation that is similar to that in Little Rock. Startups added 30,633 jobs, essentially all the net job growth during this period.

Summary

Despite the important role startups play in job growth, the importance of mature firms should not be understated. An important difference between young and old firms is the wage they pay. Older firms pay, on average, a much higher wage than younger firms. This is because a firm's success is a function of productivity: Output per worker at surviving older firms is higher and, therefore, workers are paid a higher wage.

Thus, while startups are very dynamic and have an important role in net job creation, in terms of total employment and earnings they tend to have a modest impact. Only the few firms that survive to the 11+ year age group have a lasting impact on employment. Ω

Maximiliano Dvorkin is an economist and Charles Gascon is a regional economist, both at the Federal Reserve Bank of St. Louis. For more on Dvorkin's work, see https://research. stlouisfed.org/econ/dvorkin. For more on Gascon's work, see https://research.stlouisfed. org/econ/gascon. Research assistance was provided by Evan Karson and Hannah Shell, both senior research associates at the Bank.

ENDNOTES

[1] See, for example, Haltiwanger, Jarmin and Miranda.

[2] The data can be accessed at https://www.census. gov/ces/dataproducts/bds/.

[3] A nice summary of this process is described in Decker et. al.

REFERENCES

Decker, Ryan A.; Haltiwanger, John C.; Jarmin, Ron S.; and Miranda, Javier. The Role of Entrepreneurship in U.S. Job Creation and Economic Dynamism. Journal of Economic Perspectives, Summer 2014, Vol. 28, No. 3, pp. 3-24.

Haltiwanger, John C.; Jarmin, Ron S.; and Miranda, Javier. Who Creates Jobs? Small versus Large versus Young. The Review of Economics and Statistics, May 2013, Vol. 95, No. 2, pp. 347-61.

READER EXCHANGE

ASK AN ECONOMIST

Bill Dupor has been an economist at the Federal Reserve Bank of St. Louis since 2013. His research primarily focuses on how the government's purchases of goods and services affect the economy and monetary policy. When he isn't working, he enjoys spending time with his wife and three kids. For more of his research, see https://research.stlouisfed.org/econ/dupor.

Bill Dupor and his family.

Q: Does government spending stimulate the economy?

A: Economists hold two different views on whether government spending is an effective way to stimulate the economy. According to one view, purchases by the government cause a chain reaction of spending. That is, when the government buys $1 worth of goods and services, people who receive that $1 will save some of the money and spend the rest, and so on. This theory suggests that the "government spending multiplier" is greater than 1, meaning that the government's spending of $1 leads to an increase in gross domestic product (GDP) of more than $1.

The other view suggests that government spending may "crowd out" economic activity in the private sector. For example, government spending might be used to hire workers who would otherwise be employed in the private sector. As another example, if the government pays for its purchases by issuing debt, that debt could lead to a reduction in private investment (due to an increase in interest rates). In this case, the $1 increase in government spending leads to an increase in GDP of less than $1 because of the decline in private investment. Therefore, the government spending multiplier is less than 1.

My research focuses on disentangling these two conflicting views. One way to do this is by looking at changes in defense spending, which are caused by international geopolitical factors rather than short-term economic concerns. In a recent paper, my research analyst Rodrigo Guerrero and I examined the impact of defense spending on the U.S. economy in the post-World War II period.[1] Our results suggest that the multiplier is less than 1, meaning that the government spending causes some crowding out of private economic activity. In particular, we found that an additional $1 in defense spending leads to a reduction of about 50 cents from some other part of the economy.

Of course, economists also want to know if government spending is effective at stimulating the economy during a recession. To that end, I have studied the effects of the American Recovery and Reinvestment Act of 2009, with a primary focus on employment. My general finding is that the government was able to create jobs but at a fairly expensive cost. For example, in one study I worked on, I found that creating a job lasting one year cost the government about $100,000, whereas the median compensation for a U.S. worker was roughly $40,000.[2]

The overall takeaway from my research is that government spending does not seem to be a very cost-effective way to stimulate the economy and create jobs. However, economists have a lot more to learn on this topic.

1 Dupor, Bill; and Guerrero, Rodrigo. Local and Aggregate Fiscal Policy Multipliers. Federal Reserve Bank of St. Louis Working Paper 2016-004C, June 2017.

2 Dupor, Bill; and Mehkari, M. Saif. The 2009 Recovery Act: Stimulus at the Extensive and Intensive Labor Margins. European Economic Review, June 2016, Vol. 85, pp. 208-28.

INVESTING IN LOCAL FOOD TO BOOST ECONOMIES

The St. Louis Fed has helped produce a new book that explores how the local food movement can be leveraged to improve the economies of low- and moderate-income communities, as well as their residents' health.

The book, Harvesting Opportunity: The Power of Regional Food System Investments to Transform Communities, includes 17 essays written by community development experts from around the country. Among the many topics covered: demand for local food, investing in regional food systems, sustainable food enterprises as a matter of national security, and bringing businesses to life through competitions, incubators and accelerators.

The St. Louis Fed has released the book in partnership with the Federal Reserve Board of Governors and the U.S. Department of Agriculture's agencies of Rural Development and the Agricultural Marketing Service. Read it at **www.stlouisfed.org/harvesting-opportunity.**

NEW PODCAST FEATURES HEAD OF ST. LOUIS FED BRANCH

The question "What does a Fed branch do?" is answered in the newest podcast in our Timely Topics series. Nikki Jackson, the head of the St. Louis Fed's Louisville, Ky., Branch, talks about her role, that of her staff and that of her board of directors. Listen to her describe the "aha moment" when people realize the variety of work that the Branch does, from gathering information on Main Street for monetary policymakers to supervising banks to encouraging community development in underserved areas.

Jackson, the child of civil-rights activists, also talks about diversity at the St. Louis Fed, where she is a member of the senior leadership team. This 18-minute podcast also touches on the Branch's upcoming centennial.

Listen to the podcast on iTunes, Stitcher or at www.stlouisfed.org/timely-topics.

We welcome letters to the editor, as well as questions for "Ask an Economist." You can submit them online at www.stlouisfed.org/re/letter or mail them to Subhayu Bandyopadhyay, editor, *The Regional Economist,* Federal Reserve Bank of St. Louis, P.O. Box 442, St. Louis, MO 63166-0442.

NEXT ISSUE

The Evolving U.S. Labor Force
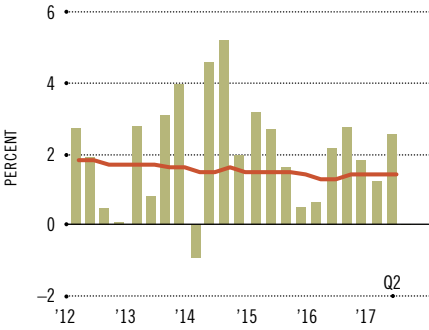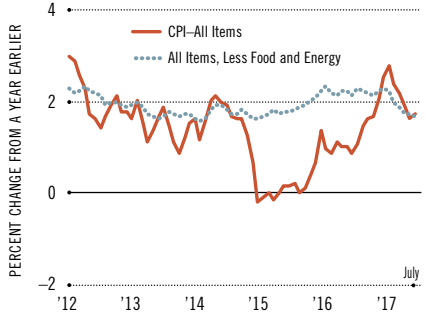
The workforce in America is undergoing important changes—for example in schooling and in the share of work handled by different age groups and by different genders. Of particular concern is the decline over the past 40 years in the opportunity for those with a relatively low level of education to obtain high-paying jobs. Get the details in the Fourth Quarter issue of The Regional Economist.

REAL GDP GROWTH

NOTE: Each bar is a one-quarter growth rate (annualized); the red line is the 10-year growth rate.

CONSUMER PRICE INDEX

- CPI–All Items
- All Items, Less Food and Energy

INFLATION-INDEXED TREASURY YIELD SPREADS

- 5-Year
- 10-Year
- 20-Year

NOTE: Weekly data.

RATES ON FEDERAL FUNDS FUTURES ON SELECTED DATES

- 02/01/17
- 03/15/17
- 05/03/17
- 06/14/17
- 07/26/17
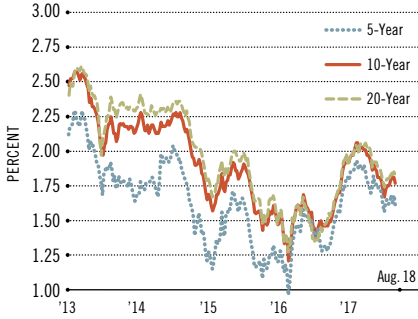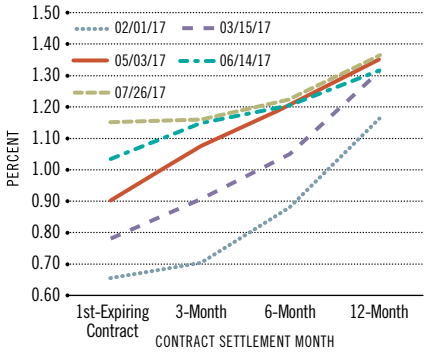
CIVILIAN UNEMPLOYMENT RATE

INTEREST RATES

- 10-Year Treasury
- Fed Funds Target
- 1-Year Treasury

NOTE: On Dec. 16, 2015, the FOMC set a target range for the federal funds rate of 0.25 to 0.5 percent. The observations plotted since then are the midpoint of the range.

U.S. AGRICULTURAL TRADE

- Exports
- Imports
- Trade Balance

NOTE: Data are aggregated over the past 12 months.

AVERAGE LAND VALUES ACROSS THE EIGHTH DISTRICT

- Quality Farmland
- Ranchland or Pastureland

SOURCE: Agricultural Finance Monitor.
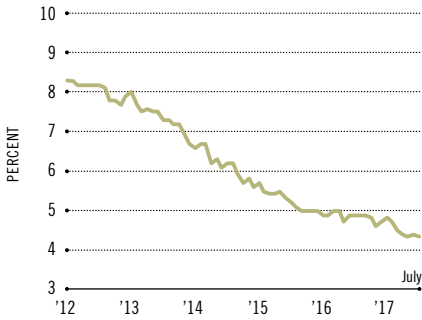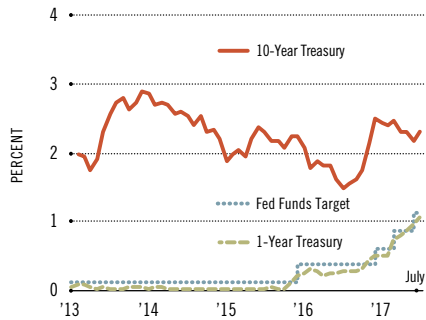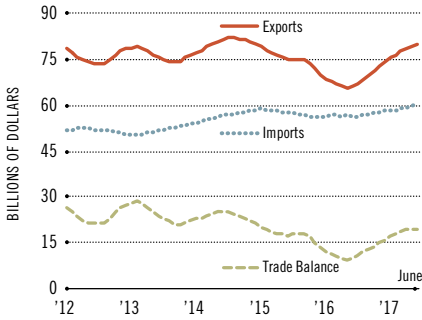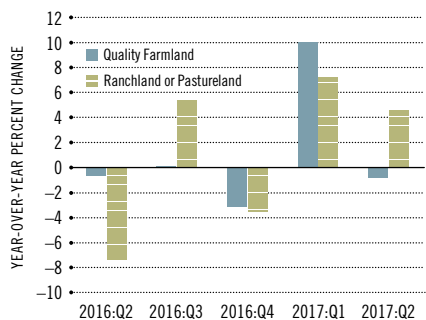
U.S. CROP AND LIVESTOCK PRICES

INDEX 1990-92=100

Crops
Livestock

June

'02 '03 '04 '05 '06 '07 '08 '09 '10 '11 '12 '13 '14 '15 '16 '17
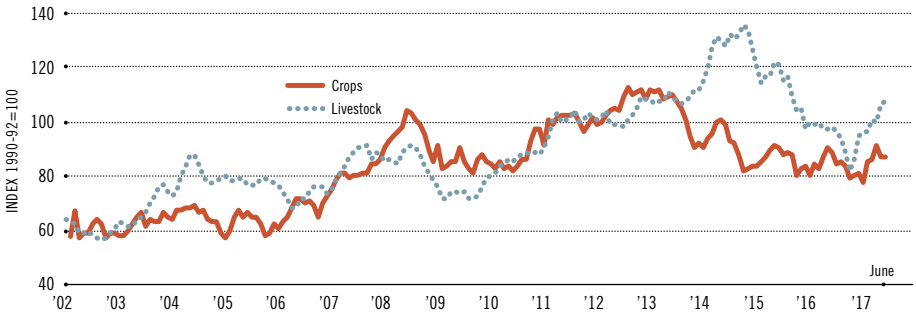
COMMERCIAL BANK PERFORMANCE RATIOS

U.S. BANKS BY ASSET SIZE / SECOND QUARTER 2017

	All	$100 million–$300 million	Less than $300 million	$300 million–$1 billion	Less than $1 billion	$1 billion–$15 billion	Less than $15 billion	More than $15 billion
Return on Average Assets*	1.07	1.07	1.04	1.10	1.08	1.19	1.15	1.06
Net Interest Margin*	3.13	3.83	3.82	3.81	3.81	3.77	3.78	2.99
Nonperforming Loan Ratio	1.21	1.03	1.06	0.92	0.97	0.87	0.91	1.29
Loan Loss Reserve Ratio	1.26	1.37	1.39	1.32	1.34	1.11	1.20	1.28

RETURN ON AVERAGE ASSETS*

	Second Quarter 2017	Second Quarter 2016
Eighth District	1.17	1.09
Arkansas	1.36	1.28
Illinois	0.96	1.02
Indiana	1.09	0.98
Kentucky	1.14	1.13
Mississippi	1.09	0.96
Missouri	1.10	1.04
Tennessee	1.16	1.04

.00 .20 .40 .60 .80 1.00 1.20 1.40 PERCENT

■ Second Quarter 2017 ■ Second Quarter 2016

NET INTEREST MARGIN*

	Second Quarter 2017	Second Quarter 2016
Eighth District	3.70	3.69
Arkansas	4.11	4.08
Illinois	3.49	3.53
Indiana	3.58	3.70
Kentucky	3.91	3.78
Mississippi	3.77	3.85
Missouri	3.44	3.45
Tennessee	3.32	3.29

0.0 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 PERCENT

■ Second Quarter 2017 ■ Second Quarter 2016
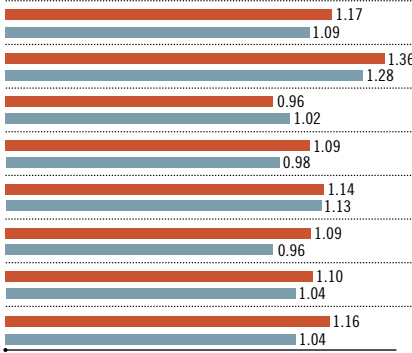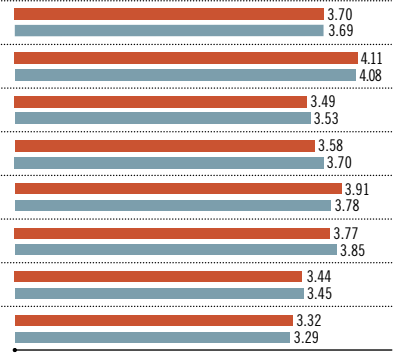
NONPERFORMING LOAN RATIO

	Second Quarter 2017	Second Quarter 2016
Eighth District	0.85	0.97
Arkansas	0.88	1.06
Illinois	1.12	1.04
Indiana	1.06	1.34
Kentucky	0.80	0.82
Mississippi	0.65	0.84
Missouri	0.77	0.82
Tennessee	0.85	1.10

.00 .25 .50 .75 1.00 1.25 1.50 PERCENT
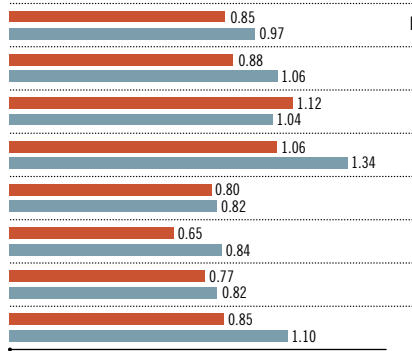
■ Second Quarter 2017 ■ Second Quarter 2016

LOAN LOSS RESERVE RATIO

	Second Quarter 2017	Second Quarter 2016
Eighth District	1.11	1.18
Arkansas	1.08	1.20
Illinois	1.16	1.21
Indiana	0.73	0.74
Kentucky	1.19	1.18
Mississippi	1.00	1.07
Missouri	1.27	1.35
Tennessee	1.02	1.13

.00 .25 .50 .75 1.00 1.25 1.50 PERCENT
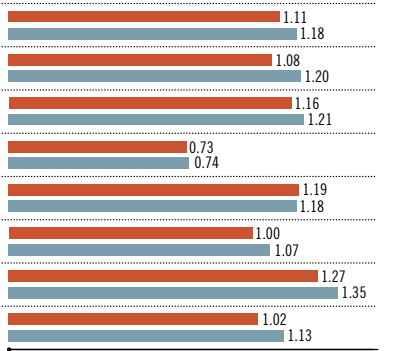
■ Second Quarter 2017 ■ Second Quarter 2016

NOTE: Data include only that portion of the state within Eighth District boundaries.

SOURCE: Federal Financial Institutions Examination Council Reports of Condition and Income for all Insured U.S. Commercial Banks.

* Annualized data.

For additional banking and regional data, visit our website at: https://fred.stlouisfed.org.

REGIONAL ECONOMIC INDICATORS

YEAR-OVER-YEAR PERCENT CHANGE

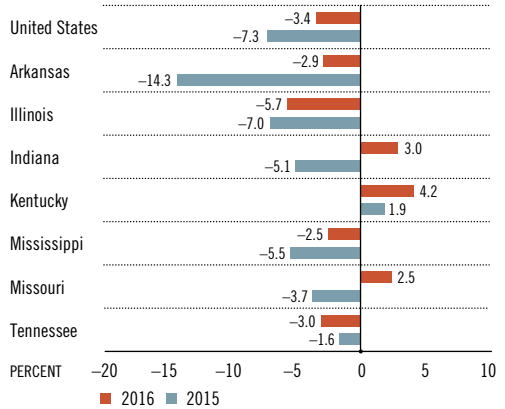|	United States	Eighth District †	Arkansas	Illinois	Indiana	Kentucky	Mississippi	Missouri	Tennessee
Total Nonagricultural	1.5%	1.2%	1.8%	0.5%	1.4%	1.7%	0.3%	1.4%	2.0%
Natural Resources/Mining	5.2	−0.5	−3.2	1.7	3.7	−6.4	1.0	5.7	8.3
Construction	2.7	−0.3	0.1	−1.7	4.0	3.8	−6.2	−3.0	NA
Manufacturing	0.4	0.8	2.1	−0.4	1.0	1.6	−0.3	1.2	1.3
Trade/Transportation/Utilities	0.6	0.8	1.0	−0.4	0.6	1.8	1.2	1.6	1.7
Information	−1.7	−1.1	−3.2	1.6	−5.8	6.6	−6.3	−6.0	0.2
Financial Activities	2.0	2.4	1.4	2.5	3.3	2.7	0.6	2.3	2.3
Professional & Business Services	3.1	2.5	5.0	1.9	1.9	4.0	−0.8	3.7	2.7
Educational & Health Services	2.2	2.1	3.7	1.6	3.0	1.7	2.0	2.2	1.7
Leisure & Hospitality	2.0	1.4	2.2	0.6	0.9	1.0	1.2	2.5	2.3
Other Services	1.3	1.0	3.9	−0.4	2.3	2.4	2.1	−0.5	1.6
Government	0.6	0.1	−0.8	−0.4	0.4	−0.3	0.1	0.0	1.8

† Eighth District growth rates are calculated from the sums of the seven states. For the Construction category, data on Tennessee are no longer available. Each state's data are for the entire state even though parts of six of the states are not within the District's borders.

UNEMPLOYMENT RATES

	II/2017	I/2017	II/2016
United States	4.4%	4.7%	4.9%
Arkansas	3.4	3.7	4.1
Illinois	4.7	5.3	5.9
Indiana	3.3	4.0	4.6
Kentucky	5.1	5.0	5.0
Mississippi	5.0	5.3	5.9
Missouri	3.9	4.1	4.6
Tennessee	4.1	5.3	4.6

EXPORTS

YEAR-OVER-YEAR PERCENT CHANGE

	2016	2015
United States	−3.4	−7.3
Arkansas	−2.9	−14.3
Illinois	−5.7	−7.0
Indiana	3.0	−5.1
Kentucky	4.2	1.9
Mississippi	−2.5	−5.5
Missouri	2.5	−3.7
Tennessee	−3.0	−1.6

HOUSING PERMITS / SECOND QUARTER

YEAR-OVER-YEAR PERCENT CHANGE IN YEAR-TO-DATE LEVELS

	2017	2016
United States	7.9	−0.9
Arkansas	4.3	25.0
Illinois	22.2	7.4
Indiana	24.0	7.8
Kentucky	13.6	39.1
Mississippi	25.8	8.9
Missouri	−15.6	30.0
Tennessee	2.3	18.4
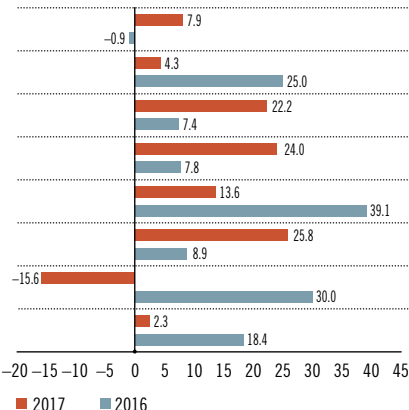
All data are seasonally adjusted unless otherwise noted.

REAL PERSONAL INCOME / FIRST QUARTER

YEAR-OVER-YEAR PERCENT CHANGE

	2017	2016
United States	1.7	2.7
Arkansas	1.1	2.4
Illinois	0.3	2.8
Indiana	2.0	3.1
Kentucky	1.8	2.0
Mississippi	0.4	3.1
Missouri	1.5	2.8
Tennessee	2.4	3.6
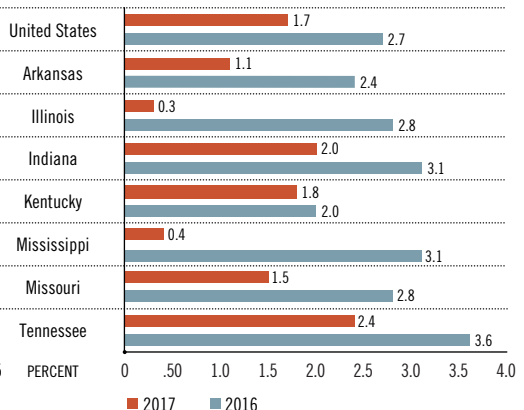
NOTE: Real personal income is personal income divided by the PCE chained price index.