Twice a year, staff of the International Monetary Fund (IMF) rolls out forecasts for over 190 economies for the next five years.

Their flagship publication, the World Economic Outlook (WEO), is released around the spring and fall meetings of the IMF and World Bank, ensuring an audience of senior officialdom from around the world.

But it is not the quality or cleverness of what may appear in the WEO that makes it a must-read. Rather, the WEO’s conventionality makes it a window on official thinking through which outsiders can peer. After all, the IMF fishes for staff in the same gene pool as major central banks and finance ministries and often employs a “catch-and-release” policy in which more than a few hires go back to work for their governments. While at the IMF, some of the same staff involved with the WEO also participates in the annual reviews of member countries with local officials (the “Article IV” consultations) that further serve to align views. Moreover, the draft WEO is reviewed by the IMF executive directors, who are appointees of the capital-contributing countries comparing what they see in Washington, D.C. with what they hear from back home.

The undertaking is massive, in that the staff forecasts about 40 variables each across 192 economies. The sample ranges from populations of 11,000 to 1,382,710 (in 2016), with some of the places obscure enough to serve as hideouts for Carmen Sandiego. IMF staff resources are limited. As a result, there is no magical thinking, only a straightforward application of the models found, say, in intermediate-level textbooks.

So, the WEO is a good place to understand the conventional wisdom on the major forces shaping recent economic performance and their expected persistence. By way of example, we will tease out the basic economic relationships supporting the WEO outlook for the U.S. Using both historical data and forecasts, we estimate the building blocks of a standard macro model—aggregate demand, aggregate supply, and inflation determination. Do not think of these as independent estimates of these relationships, but rather what IMF researchers think those relationships are and how they think they have changed. Importantly, their views are probably similar to those of their Federal Reserve (“Fed”) counterparts.
AN OVERVIEW

The table below gives a snapshot of the U.S. economy as taken through the lens of the WEO. Briefly noted in columns 1 and 2, a wrenching recession began in 2008 that sent real GDP 4.6% below its potential and drove the unemployment rate to 9.25%, on average, in 2009. The destruction of housing wealth ripped through other asset markets and impaired financial intermediation. Inflation tumbled, tending to raise real interest rates and offsetting some of the stimulus of the Federal Reserve’s reduction in the nominal policy rate. Therein is the rationale for the Fed’s unconventional monetary policies, which augmented discretionary fiscal stimulus that amounted to a 1.75-percentage-point increase in the structural budget deficit relative to nominal GDP. The actual budget deficit worsened by more as automatic stabilizers kicked in and resolution costs mounted. Less was funded from abroad in that the current account deficit narrowed.

The subsequent recovery was sluggish, with a persistently wide output gap, high unemployment, and below-Fed-target inflation. Nine years on, the WEO puts resources as fully employed. Consumer price inflation overshoots the Fed’s goal of 2% for a time but settles at a level consistent with growth in the Fed’s preferred index at that goal. This new landscape, though, has a low nominal and real federal funds rate, a wide budget deficit, and growing gross government debt relative to income.

### United States

<table>
<thead>
<tr>
<th>annual average, percent</th>
<th>2008</th>
<th>2009</th>
<th>2010 to 2016</th>
<th>2017</th>
<th>2018 to 2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross domestic product, constant prices</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Output gap in percent of potential GDP</td>
<td>0.0</td>
<td>-4.6</td>
<td>-1.8</td>
<td>0.0</td>
<td>0.3</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>5.8</td>
<td>9.3</td>
<td>7.2</td>
<td>4.7</td>
<td>4.7</td>
</tr>
<tr>
<td>Inflation, average consumer prices</td>
<td>3.8</td>
<td>-0.3</td>
<td>1.6</td>
<td>2.7</td>
<td>2.4</td>
</tr>
<tr>
<td>Six-month LIBOR rate*</td>
<td>3.0</td>
<td>1.1</td>
<td>0.6</td>
<td>1.7</td>
<td>2.8</td>
</tr>
<tr>
<td>General government net lending/borrowing</td>
<td>-6.7</td>
<td>-13.2</td>
<td>-6.4</td>
<td>-4.0</td>
<td>-5.3</td>
</tr>
<tr>
<td>General government structural balance</td>
<td>-6.0</td>
<td>-7.7</td>
<td>-5.7</td>
<td>-4.0</td>
<td>-5.4</td>
</tr>
<tr>
<td>General government gross debt</td>
<td>73.6</td>
<td>86.9</td>
<td>103.2</td>
<td>108</td>
<td>112.9</td>
</tr>
<tr>
<td>Current account balance</td>
<td>-4.7</td>
<td>-2.7</td>
<td>-2.6</td>
<td>-2.7</td>
<td>-3.4</td>
</tr>
</tbody>
</table>

* Ends in 2018.

Charts are provided for illustrative purposes only and are not indicative of the past or future performance.

Sources: International Monetary Fund, World Economic Outlook (4/2017) and Standish calculations.
The movements among these magnitudes in history and the forecast reveal important features of conventional thinking about the economy. For example, IMF staff must believe that potential output growth is around 2% because that keeps the output gap narrow and holds the unemployment rate at 4.75% in the out-years. This latter value must be the natural rate of unemployment because output is at its potential and inflation moves sideways.

In what follows, we will be more precise by estimating a few basic relationships in the data. To be specific about these, we ask three questions about demand, supply, and their interaction reflected in prices.

- How significant were the headwinds on aggregate demand?
- How much has the growth of aggregate supply slowed?
- Why is inflation so low?

Along the way, we draw eight lessons about the U.S. economy, or at least how officials think about the U.S. economy.

1. How significant were the headwinds on aggregate demand?

Central to the new Keynesian models used at the IMF and central banks is an explanation of aggregate demand. It may be dressed up as an intertemporal relationship, but basically the level of spending is negatively related to the expected real interest rate, or the nominal interest rate less expected inflation. Essentially, a high real rate encourages people to defer consumption—to save—which is the fulcrum for the monetary policy lever of changing the short-term interest rate. We can subtract the level of potential output and expect the gap to vary inversely with the real-term interest rate. But what real interest rate? Within the WEO database, the best approximation is the nominal six-month LIBOR rate less contemporaneous consumer price inflation. Even with this crude proxy, the negative relationship shows through in the chart, which pairs observations on the IMF estimate of the output gap (along the horizontal axis) with the real short-term rate (along the vertical axis). Blue diamonds mark the sample up to the crisis (1981 to 2007), red dots show the post-crisis historical data (2009 to 2016), green triangles give the IMF forecast (2017 to 2022), and the dashed line plots the least-squares fit between the two. Four points stand out to varying degrees of obviousness.

The Output Gap and the Real Short-Term Interest Rate

estimated from 1981 to 2007

Sources: International Monetary Fund, World Economic Outlook April 2017 and Standish calculations.

First, for a macroeconomist, the financial crisis represents an enormous adverse shock to aggregate demand. The line connecting the post-crisis sample moves chronologically from left to right. That is, the first three points (2009 to 2011) appear to be along the historical relationship shifted left by 6 percentage points of potential GDP. Those outliers, the largest in the sample, calibrate the cumulative effects of the hit to wealth, loss of confidence, and impairment produced by the crisis.
Second, there was no apparent way for conventional monetary policy to offset this shock. The real short rate necessary to keep demand at supply (to put the output gap at zero) is where aggregate demand crosses the vertical axis, or about 3% on average from 1981 to 2007. That is the equilibrium real interest rate in the pre-crisis sample. If the demand relationship shifted 6 percentage points leftward, as the 2009 to 2011 points suggest, the new line crosses the vertical axis at around -5%. With inflation falling to near zero in that period and policymakers seemingly constrained that the lowest they could pull the nominal policy rate is to zero, there was no way for the Federal Reserve to get from where they were to where they wanted to be. Fed officials resorted to unconventional policies to fill the space between the actual and temporarily lower equilibrium real interest rate.

Third, the shock, at least as teased from the pages of the WEO, was temporary. The red circles and the green triangles move back toward the historical relationship (recognizing that all of these data points are approximations of two economic abstractions, the expected real interest rate and the output gap, and one half of those observations are projections). Slow healing after a severe financial crisis is a pattern repeated through history, as documented, say, in “After the Fall.” Over time, fiscal and monetary policies get traction and wealth is rebuilt.

Fourth, however, the return to the historical relationship is incomplete. The final green triangles, representing the longer-term forecast of the IMF, cluster along a relationship inward of the 1981-to-2007 one, more consistent with an equilibrium real short-term interest rate of 1%. A lower equilibrium real rate may be partly a legacy of the crisis, including adverse effects of greater government debt and permanently more costly intermediation as the result of tighter regulation. But this probably also reflects coincidental changes in important trends, including the aging of a population that is growing more slowly, participating less in the organized labor market, and adding less extra output per additional hours worked. There is something happening here, and it is not exactly clear. Among the implications is that the Fed’s 2% inflation goal pegs the equilibrium nominal rate at 3%, which does not offer much space between it and the zero lower bound to nominal interest rates.

2. How much has the growth of aggregate supply slowed?

The growth of potential output is among the more important abstractions of economists, as it sets the slope of households’ expected path of income and firms’ expected path of earnings. If potential output growth slows, those paths rotate down, implying households should save more and firms should invest less. The market resolution is a lower equilibrium real interest rate—precisely what we saw with the aggregate demand relationship.

There are alternative routes to estimating potential output growth, but one of the straightest ones is via Okun’s law. When written in terms of levels, it relates the percentage output gap (GDP, \( y \), relative to potential GDP, \( y^* \)) to the unemployment rate (\( u \)) relative to its natural rate (\( u^* \)), or

\[
\ln\left(\frac{y}{y^*}\right) = a + b(u - u^*).
\]

Since it holds in every period (with error), it also can describe the changes in these variables over time. This is especially useful if we assume that the natural rate of unemployment and the rate of growth of potential output are both fixed. Let that latter growth rate be denoted \( g \). Okun’s law in changes is written:

\[
\Delta \ln(y) = g + b\Delta u.
\]

That is, the constant term in the regression of real GDP growth on the change in the unemployment rate represents the average growth of potential output over the sample. That relationship in the WEO sample is shown in the chart of annual pairs of GDP growth (measured along the vertical axis) and the change in the unemployment rate (measured along the horizontal axis). Retaining the prior convention, the pre-crisis period

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1 This paper by Carmen and Vincent Reinhart was prepared for the Federal Reserve Bank of Kansas City Jackson Hole Symposium, Macroeconomic Challenges: The Decade Ahead, August 26-28, 2010.
is represented by blue diamonds, the experience since by red dots, and the IMF forecast by green triangles. The two dashed lines plot the pre- and post-crisis data, and where they cross the vertical axis identifies the “g” parameter, the rate of growth of potential output. As is evident, from 1981 to 2007, the data accord with potential output growing at 3%. After that, what was observed and what IMF staff expects (from 2008 to 2022) is growth at half that pace, 1.6%.

### Okun’s Law in Changes: Real GDP Growth and the Change in the Unemployment Rate

The diagram visualizes the relationship between real GDP growth and the change in the unemployment rate as estimated using actual and forecast data, 1981 to 2022.

- **Implied growth of potential output**
  - 1981 to 2007: 3.0%
  - 2008 to 2022: 1.6%

Sources: International Monetary Fund, World Economic Outlook April 2017 and Standish calculations.

This leads to our fifth takeaway: the apparent shift inward of aggregate demand is consistent with a re-anchoring of expectations regarding slower long-run growth.

### 3. Why is inflation so low?

As noted at the outset, inflation has mostly run below the Fed’s goal of 2% since the crisis. To put this into perspective, consider a variant of the price-level chart often shown by James Bullard, the president of the Federal Reserve Bank of St. Louis. The solid line is the consumer price level, reported annually in the WEO dataset, both actual and outlook. The dashed line shows a counterfactual path consistent with 2.5% CPI inflation beginning in 1995, when the Fed started its discussion of a numerical inflation goal in earnest. This both fits the pre-crisis data and is consistent with a 0.5-percentage-point growth wedge between the CPI and the Fed’s preferred index, personal consumption expenditure prices. Up to the crisis, the Federal Reserve basically met its numerical interpretation of the mandate inserted in the Federal Reserve Act in 1977 to promote maximum employment and stable prices. Since then, outcomes have fallen short of that instruction. In the forecast period, the IMF sees a return of inflation to form (in that the price level runs parallel to the counterfactual path), but no significant make-up of the shortfall in the price level.

### Consumer Prices, Actual and a 2.5% Inflation Counterfactual

The chart compares actual consumer prices to a 2.5% inflation counterfactual from 1995 to 2022.

Sources: International Monetary Fund, World Economic Outlook April 2017 and Standish calculations.
We have already seen some of the sources of this epic fail. Considerable headwinds to aggregate demand made it impossible for the Fed to lower the real interest rate enough to preserve economic expansion. As the shadow of the crisis receded, a lower growth of potential output reduced the equilibrium real interest rate. This lessened monetary policy stimulus by narrowing the gap between the actual and equilibrium real interest rate.

But inflation dynamics also seem to have changed in two material ways.

First, we go back to Okun's law in its original levels specification. The chart below shows the annual pairings of the WEO estimate of the output gap (varying along the vertical axis) and the unemployment rate (varying along the horizontal axis). Logically, a zero output gap should be accompanied with the unemployment rate equaling its natural rate, or where the average association crosses the horizontal axis. The dashed lines give the best fit pre- and post-crisis and cross the horizontal axis at 6% and 4.9%, respectively. The sixth headline from the WEO is that the natural rate of unemployment has dropped. Note that the observations in the forecast part of the sample, the green triangles, hug the green predicted line fairly closely, suggesting that IMF staff are on board with the notion.

Okun’s Law in Levels: The Output Gap and the Unemployment Rate

This revised interpretation of full employment in the WEO matches the intellectual journey of Fed officials, who now pin the natural rate of unemployment between 4.7% and 5% in their most recent Summary of Economic Projections. That is the math, but the reasons are less obvious. One possibility is that as more people refrain from working (the employment population moved lower), those who stay find employment more readily. Another, more negative take, is that downward wage pressure on low-skilled occupations has required more in that cohort to stay employed.

In addition, the U.S. economy also appears to be less inflation-prone, even taking into account a lower natural unemployment rate. The postcard version of economists' understanding of price determination is the accelerationist Phillips curve, or the tendency of inflation to rise (fall) when the output gap is positive (negative). The most basic form of this relationship shows through in the WEO data, with the annual change in inflation along the vertical axis paired with the unemployment rate along the horizontal axis. The two estimated lines (pre- and post-crisis) are forced to go through the origin on the notion that inflation holds steady when the output gap is closed. Our seventh bullet point builds on the observation that the relationship has pivoted lower with the more recent data. Inflation now appears less responsive to resource slack or excess, probably because inflation expectations are better anchored. The good news for the Fed is that inflation did fall by as much when the output gap began to widen after 2008 as would have been predicted from the earlier relationship. The bad news is that the change implies that increasing inflation requires a longer run of a hot labor market. And if there is an overshoot and inflation expectations re-anchor above the Fed’s goal, returning to that goal will require a long spell of excess unemployment.
SOME FINAL THOUGHTS

Aggregate demand, aggregate supply, and price determination have changed materially since 2008. The U.S. economy is growing more slowly over time, offers a lower real return to savers, needs more of those willing to work to work, and seems more sluggish in its inflation response to slack. Of course, this is all model-dependent, and the model throughout was a conventional new Keynesian one, familiar from textbooks.

But the eighth bullet point explains why we have done all this: even those who do not share this framework should understand these perceived shifts because Fed officials are believers and this has shaped and will continue to shape monetary policy. Accept that they believe:

• The headwinds to demand that started blowing in 2008 have mostly abated, so policy has to be renormalized.
• This process has to continue even as GDP growth disappoints by historical standards because the trend growth rate is lower.
• Another consequence of slow potential GDP growth, however, is a lower equilibrium real interest rate, implying that the real rate does not have to return to its pre-crisis norm.
• And because the economy seems less inflation-prone, the process can be gradual.

The key driver to this dour outlook is that there were permanent declines in the level and growth of potential real GDP, and this message can be taken from the pages of the WEO. The final chart plots actual and forecasted real GDP as the solid line and potential real GDP as the blue dashed one. That these two lines now coincide suggests that whatever happened to us was permanent. To see how consequential this is, consider the red dashed line, which plots a counterfactual extrapolation of real GDP from its 2008 level (when real GDP previously equaled its potential) assuming the continuation of the trend rate was that observed on average from 1998 to 2007, 2.9%. In 2016, real GDP was 11% below that trend, and by 2022 the IMF pegs the shortfall at 15%.

This is an unfair calculation, to be sure, in that some of the slowing owes to demographics, which has an air of inevitability to it. The harder part is to identify the remaining loss. The cratering of wealth in the crisis and shallowing of the physical and human capital stock in the recession and slow recovery may have permanently changed attitudes of savers and impaired the job prospects of a generation. But the policy response of making financial intermediation more expensive, tightening regulation, and changing expectations of the Federal Reserve’s role may have had a part, too. The former cannot be easily made up but the latter is open for reconsideration.
Italo Calvino wrote a novel in which the first word of each chapter created a coherent sentence. The eight talking points describe a short but complete description of why Federal Reserve officials have been doing what they have been doing and are therefore predictive of what they will do. Indeed, it only takes five sentences to tell the story.

1. The financial crisis represents an enormous adverse shock to aggregate demand, and
2. There was no apparent way for conventional monetary policy to offset this shock,
3. The shock was temporary, but
4. The return to the historical relationship is incomplete.
5. This apparent shift inward of aggregate demand is consistent with a re-anchoring of expectations regarding slower long-run growth. In addition,
6. The natural rate of unemployment has dropped, and
7. Inflation now appears less responsive to resource slack or excess.
8. Even those who do not share this framework should understand these perceived shifts because Fed officials are believers, and this has shaped and will continue to shape monetary policy.

This paper used data from the International Monetary Fund’s World Economic Outlook database, vintage April 2017, for the United States. This is available at: https://www.imf.org/external/pt/weo/2017/01/weodata/index.aspx These data were accessed 4/28/2017. All the data run through 2022 except the six-month London interbank rate, which evens in 2018. The chart of aggregate demand used the Federal Reserve Summary of Economic Projections (March vintage) to forecast the nominal interest rate over the outlook period. This is available here: https://www.federalreserve.gov/monetarypolicy/files/fomcpjtabl20170315.pdf The row numbers refer to the order in the WEO database.

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The Consumer Price Index (CPI) is a measure that examines the weighted average prices of a basket of consumer goods and services, such as transportation, food and medical care. It is calculated by taking price changes for each item in the predetermined basket of goods and averaging them. Intercontinental Exchange London Interbank Offered Rate (LIBOR) or ICE LIBOR is a benchmark rate that some of the world’s leading banks charge each other for short-term loans and serves as the first step to calculating interest rates on various loans throughout the world.

Okun’s law pertains to the relationship between the U.S. economy’s unemployment rate and its gross national product (GNP). It states that when unemployment falls by 1%, GNP rises by 3%. However, the law only holds true for the U.S. economy and only applies when the unemployment rate falls between 3% and 7.5%.

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