

## US Economic Research

# Target 4.0% unemployment to achieve 2.0% inflation

- In our view, achieving the FOMC's target of 2% PCE inflation may require a substantial undershoot on the unemployment rate (to 4.0% if not below). Should the unemployment rate remain near current levels or should inflation expectations drift lower, the FOMC would be unlikely to hit its inflation target over the foreseeable future.
- Our outlook for inflation reflects a tug of war between domestically generated price pressures and drags from a softer global outlook, a strong dollar, and falling energy and commodities prices. Despite its transitory nature, external disinflation is likely to last longer than first expected, and we believe it will now take much longer for PCE inflation to return to the Fed's 2.0% target.
- Supporting our outlook for faster wage growth and, in turn, stronger services inflation, is the output of our model that jointly estimates wage inflation, core PCE inflation, long-run inflation expectations, productivity growth, and the unemployment rate, among other variables.
- Given our macro forecast, which includes the unemployment rate falling below 4.0% in mid-2017, modest further appreciation in the dollar, inflation expectations anchored at 2.0%, and a modest pickup in productivity growth, we forecast the Employment Cost Index will reach 3.0% q/q saar in 2016 and 3.5% by Q4 17.
- Our forecast is predicated on a very rapid decline in the unemployment rate. While this pace is consistent with the historical record, it is considerably faster than that assumed by the FOMC. According to our estimates, if the unemployment rate does not fall much below current levels over the next two years, the inflation rate will not return to 2% even if inflation expectations remain well anchored.
- If inflation remains below target for an extended period, inflation expectations may well drift lower, which substantially reduces the likelihood that inflation returns to the FOMC's target. Therefore, while the FOMC may be uncomfortable with historically low levels of the unemployment rate, a significant undershooting of unemployment may be necessary to support wage growth, bring inflation back to target, and prevent inflation expectations from slipping lower.

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## Inflation: Lying low for longer

*The episode of external disinflation is likely to last longer than we previously thought...*

*...but our constructive outlook on labor markets is supportive of wage growth in 2016 and 2017*

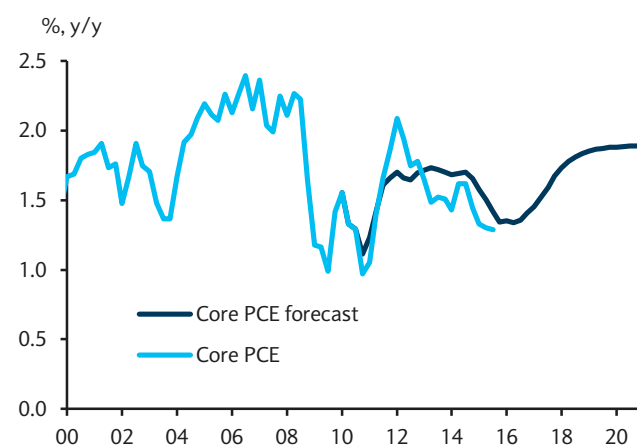
*The key assumption in our inflation outlook is a substantive further decline in the unemployment rate*

We recently lowered our forecast for inflation (*Inflation: Lying low for longer*). Our baseline scenario reflects a tug of war between domestically generated price pressures and drags from a softer global outlook, a strong dollar, and falling energy and commodities prices. Despite its transitory nature, the current episode of external disinflation is likely to last longer than first expected, and we believe it will now take about a year longer for PCE inflation to return to the Fed's 2.0% target. Nevertheless, we expect improving labor markets and a positive output gap to support domestic inflation, particularly in 2017, and look for faster wage growth to become more apparent in coming quarters.

Supporting our outlook for faster wage growth and, in turn, stronger services inflation, is the output of our model that jointly estimates wage inflation, core PCE inflation, long-run inflation expectations, productivity growth, and the unemployment rate, among other factors. We estimate the model using quarterly data from Q1 85 and run dynamic forecasts beginning in 2010.<sup>1</sup> Given our macro forecast, which includes the unemployment rate falling below 4.0% in mid-2017, modest further appreciation in the dollar, inflation expectations anchored at 2.0%, and a modest pickup in productivity growth, we forecast the Employment Cost Index will reach 3.0% q/q saar in 2016 and 3.5% by Q4 17.

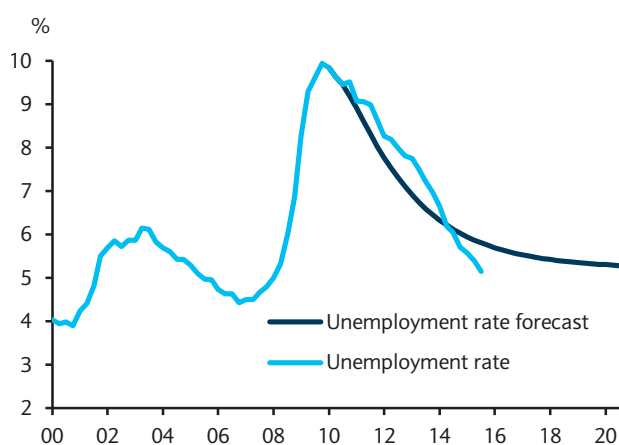
Our forecast is predicated on a further decline in the unemployment rate. While the forecasted pace of decline is consistent with the historical record, it is faster than anticipated by the model and considerably faster than assumed by the FOMC in its Summary of Economic Projections. If the unemployment rate does not fall well below 5% over the next two years, according to our estimates, the inflation rate will not return to 2%, even if inflation expectations remain well anchored at that level. If inflation remains below target for an extended period, inflation expectations may well slip, substantially reducing the likelihood that inflation returns to the FOMC's target. Therefore, while the FOMC may be uncomfortable with very low levels of the unemployment rate, a sub-4.0% unemployment rate may be necessary to bring inflation back to target and keep inflation expectations from slipping lower.

FIGURE 1  
Inflation moves back to 2%, but not before 2018



Source: BEA, Haver Analytics, Barclays Research

FIGURE 2  
The unemployment rate stabilizes above 5%



Source: BLS, Haver Analytics, Barclays Research

<sup>1</sup> We chose our sample period to avoid the nominal distortions associated with the 1970s and base the model during an environment of stable, albeit declining, inflation outcomes.

## A baseline view: Struggling to hit the 2.0% inflation target

*We calibrate a dynamic model of wages and inflation*

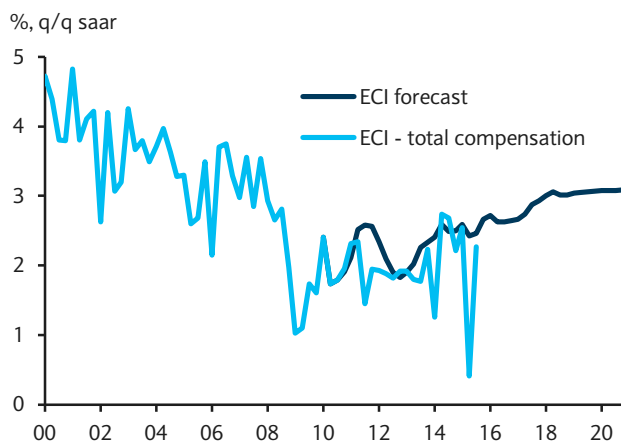
*If the unemployment rate remains near current levels, we find that it will be difficult for the Fed to achieve its 2.0% inflation target*

In our baseline estimation and forecast, we make exogenous assumptions for the path of the dollar, productivity, the share of imports in GDP, inflation expectations, and the natural rate of unemployment. In particular, we assume some modest further appreciation in the dollar in 2016, inflation expectations remain anchored at 2.0%, and productivity growth accelerates to 1.2% per year from its current sub-1.0% average during the recovery. The model then yields a forecast for core PCE inflation, nominal wage growth, import prices, and the unemployment rate from 2010 through 2020. The Appendix to this report contains details of the model construction.

Under these assumptions, our dynamic model of wages and inflation indicates core PCE inflation will remain at its current low levels through the first half of 2016 before gradually rising to 1.9% by the end of 2017 (Figure 1). Inflation does not quite fully return to 2% over the remainder of the decade, despite the assumption that inflation expectations are anchored at that level, because the unemployment rate does not fall sufficiently far to put substantial upward pressure on inflation. Although the size of the miss is small and could be considered trivial, this profile for inflation is likely troublesome to some on the FOMC who, among other factors, believe inflation outcomes should be symmetric around the 2.0% target. We also believe our model output is likely consistent with the long-term inflation forecast by Federal Reserve Board staff as expressed in the minutes of the October FOMC meeting. This is not surprising to us since our inflation equation and dynamics are similar to those used by staff as reported in publicly available documents, models, and speeches. In the minutes to the September meeting, Board staff reported that inflation is unlikely to return to the 2.0% target by the end of 2018.

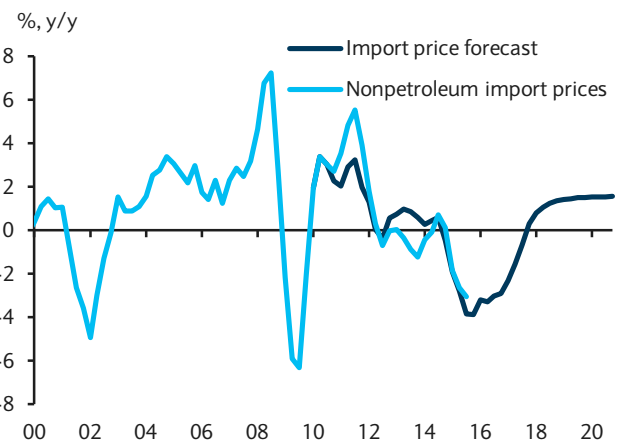
Inflation in the baseline model is held down for two reasons. First, core PCE inflation has not been consistently at or above the FOMC's 2% target since the late 1990s. Second, the unemployment rate stabilizes at a relatively high number close to 5.2%, driven in part by our estimate of the long-run rate of unemployment. Figure 2 shows the dynamic forecast of the unemployment rate. Because the unemployment rate is currently below this level, the dynamic forecast yields a path that moves up to 5.2% in the near term and then remains at

**FIGURE 3**  
Wage inflation gradually rises to 3% as low productivity growth slows the forecasted rise



Source: BLS, Haver Analytics, Barclays Research

**FIGURE 4**  
Import prices continue to decline through the end of 2017 before steadily rising in 2018 and beyond



Source: BLS, Haver Analytics, Barclays Research

*Without a further decline in the unemployment rate, wage growth remains muted,...*

*...leaving inflation at the mercy of weak import prices*

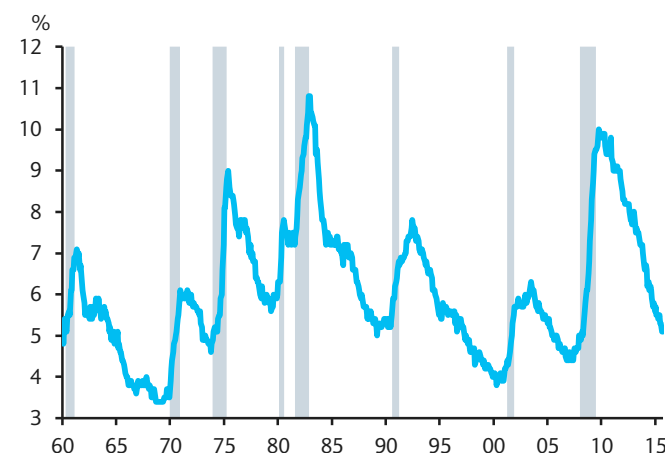
that level through the end of 2020. Although we do not know the Board staff forecast for the longer-run unemployment rate, a stable forecast near this level has long been a feature of the FOMC's Summary of Economic Projections.<sup>2</sup>

The inability of unemployment to decline from current levels is problematic to the outlook for inflation, since our estimates of the relationship between labor market slack and inflation suggests the Phillips Curve is extremely flat.<sup>3</sup> In our inflation specification, we find that for every 1pp decline in the unemployment rate below NAIRU, the year-on-year rate of inflation rises only 0.1pp. This estimate is the same as reported by Chair Yellen in her recent [speech](#) on inflation dynamics. Therefore, with the unemployment rate only modestly below the estimate of NAIRU, labor market slack is not playing a substantive role in supporting services inflation and, in turn, core inflation.

The flat path for unemployment means our dynamic model forecasts only a gradual rise in wages. From its current prediction of 2.5%, nominal wages stabilize at 3.1% in late 2018 (Figure 3).<sup>4</sup> In addition to the stability of unemployment near current levels, the low level of productivity growth we assume in constructing the model is another factor preventing faster growth in wages. Our assumed rate of productivity growth at 1.2% may be above that achieved so far during the recovery, but is well below its longer-run average of about 1.8% or the 2% pre-recession average. We find that every percentage point of improvement in productivity yields an increase in annual wage growth of about 0.2pp. In sum, a lack of labor scarcity and tepid productivity do little to boost average wage gains.

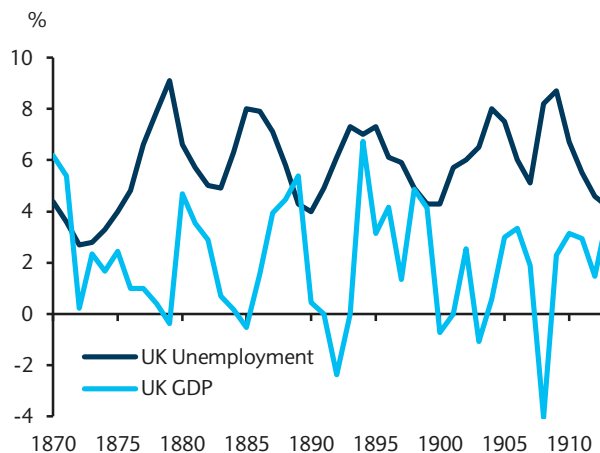
The lack of any substantive sources of domestic price pressures leaves inflation dynamics at the mercy of import prices. The dip in PCE inflation through 2017 is caused by the low level of import prices (Figure 4). In our official Barclays forecast of inflation, we expect past appreciation of the dollar and excess capacity in China to weigh on import prices, which

**FIGURE 5**  
In the US, the unemployment rate has not stabilized during expansions; the rate falls until it rises



Source: BLS, NBER, Haver Analytics

**FIGURE 6**  
Even in the 19<sup>th</sup> century, unemployment fell until it rose



Source: Boyer, George R. and Timothy J. Hatton. 2002. "New Estimates of British Unemployment, 1870–1913," *The Journal of Economic History* 62.3: 643–667.

<sup>2</sup> In the *Summary of Economic Projections of the meeting of September 16-17, 2015*, the median unemployment rate was projected at 5.0% in 2015 and is projected to remain stable at 4.8% in 2016-18. Some participants forecast a further modest decline, but none forecasts an unemployment rate below 4.4% over the forecast horizon.

<sup>3</sup> We discuss this feature of the Phillips curve in our piece *Some unpleasant dual mandate arithmetic*. Also see *Low inflation in the United States: A summary of recent research* by Michael Kiley of the Federal Reserve Board for further discussion on Phillips curve dynamics.

<sup>4</sup> The recent variability in the ECI was due to *quarterly variation in sales and office jobs categories*.

pulls down the level of inflation. As shown in Figure 4, the model sees large declines in nonpetroleum import prices on a y/y basis through late 2017, and import prices do not begin to rise on a sustained basis until 2018. Our official forecast, based on the models we used in *Just passing through: the effect of USD appreciation on inflation, growth, and Fed policy*, reveals a similar path, albeit not quite as pessimistic.

## A more realistic view: Unemployment will decline further

*We see the unemployment rate falling throughout the cycle*

We view the stability of unemployment as a stylized outcome of standard macroeconomic modelling techniques. In contrast, history provides ample evidence in favor of an alternative outcome in which the unemployment rate can be expected to keep falling throughout the cycle. In previous US business cycles, the unemployment rate continued to decline amid steady employment gains until the very end of the cycle (Figure 5). Although there are some periods of relative stability in the unemployment rate at low levels – the late 1960s and late 1980s provide examples – the bulk of the post-WWII US experience suggests a steady drop in the unemployment rate until the cycle turns. This pattern was also evident between 1870 and 1920 in the United Kingdom (Figure 6), suggesting similar business cycle patterns across countries and time.

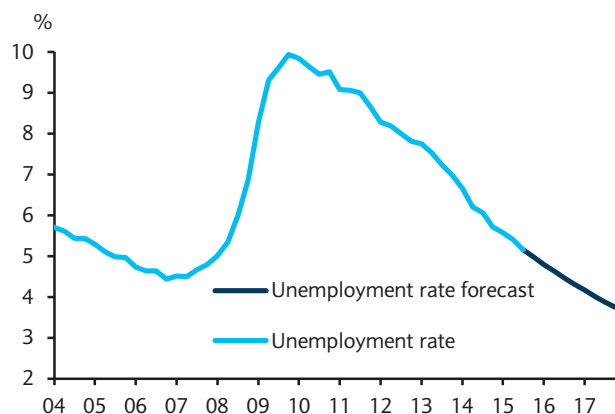
*Imposing our path for the unemployment rate leads to faster wage growth*

To incorporate the likelihood that the unemployment rate will decline further, as opposed to remaining stable at current levels, we estimate an alternative to the baseline specification above that imposes our official Barclays unemployment rate forecast on the model. We do this through a restriction on the model that forces the evolution of the unemployment rate to pass through our forecast (Figure 7). The path for the unemployment rate becomes another exogenous variable in addition to the path of the dollar, productivity, the share of imports in GDP, inflation expectations, and the natural rate of unemployment. The model under this alternative specification then yields a forecast for core PCE inflation, nominal wage growth, and import prices from 2010 through 2020.

The faster decline in the unemployment rate leads to a much more aggressive forecast for wage inflation (Figure 8). Even assuming that productivity growth remains relatively muted at 1.2% per year, wage inflation accelerates from its current forecast of 2.5% to 3.5% by the end of 2017 and rises above 4% by the end of 2020. The rapid decline in unemployment and associated acceleration in wage growth also boosts the profile for core PCE inflation.

FIGURE 7

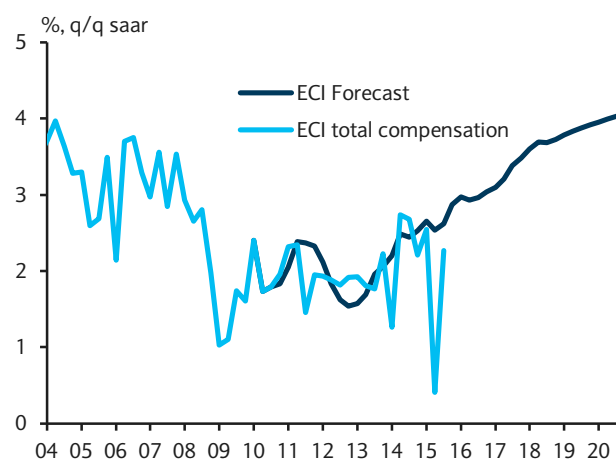
**A path consistent with our official forecast for the unemployment rate**



Source: BLS, Haver Analytics, Barclays Research

FIGURE 8

**With the lower unemployment rate, wages return to their historical levels, even with low productivity growth**



Source: BLS, Haver Analytics, Barclays Research

*Stronger domestic price pressures create a firmer path for import prices*

Under this alternative scenario, core PCE inflation is above 2% by the end of 2017 and reaches 2.25% by the end of 2020 (Figure 9). Finally, the combination of higher domestic prices and lower unemployment also increases the level of imported inflation; import prices rebound and rise at an annual rate of about 2% by 2020 (Figure 10).

Most members of the FOMC view import prices as a purely exogenous force on the path of US inflation. In our (admittedly simple) model framework, import prices also respond to domestic pressures. From a theoretical standpoint, this relationship makes sense; as US prices rise, importers have the ability to increase mark-ups on their products, while still keeping their price increases below that of domestic producers. Altogether, allowing the unemployment rate to drop a full percentage point or more below NAIRU over the forecast horizon results in inflation outcomes that, on balance, prove superior to the baseline scenario.

*The Chair's preferred model of inflation is very sensitive to changes in inflation expectations*

## What happens if inflation expectations slip?

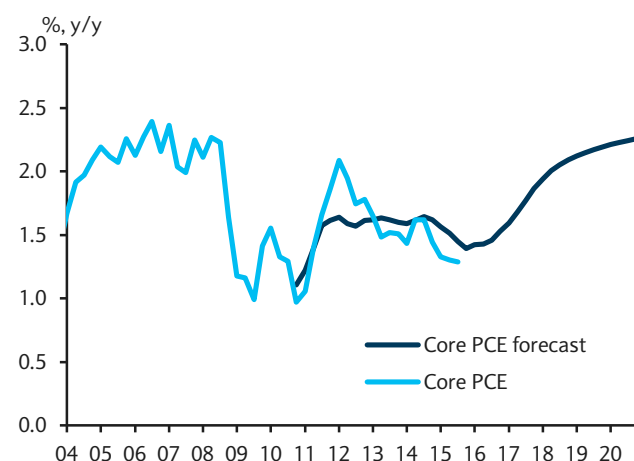
The FOMC has missed its inflation target for the past three years, and if the staff forecast is correct, it will have achieved its target in only one year between 2008 and 2018. Even if the misses are all attributable to transitory factors, as stated by the Chair in her speech *Inflation Dynamics and Monetary Policy*, inflation consistently away from the target can cause inflation expectations to drift. Therefore, we run one final simulation of the model in which we modify the baseline framework to allow inflation expectations to drift lower to 1.8%, a seemingly innocuous change in expectations and one that in practice the FOMC is likely to look through. All other assumptions of the baseline model remain (ie, we do not impose our Barclays forecast for unemployment and let inflation expectations drift only modestly lower).

*Gradual rate hikes that let the unemployment rate drift lower are one way to keep inflation expectations from becoming unanchored*

Unfortunately from the perspective of the FOMC, the expectations-augmented Phillips curve favored by the Chair is sensitive to even minor changes in expectations. With inflation expectations at 1.8%, core PCE inflation remains below 1.5% through the end of 2017 and rises to only 1.6% by the end of 2020 (Figure 11). The low level of inflation and inflation expectations, when combined with a stable unemployment rate, keeps wages from increasing substantively. At the end of 2017, wage inflation remains close to 2.5% and rises to only 2.9% by the end of 2020. The same forces weigh on import price inflation, which stabilizes near 1% y/y growth by the end of 2020 (Figure 13).

FIGURE 9

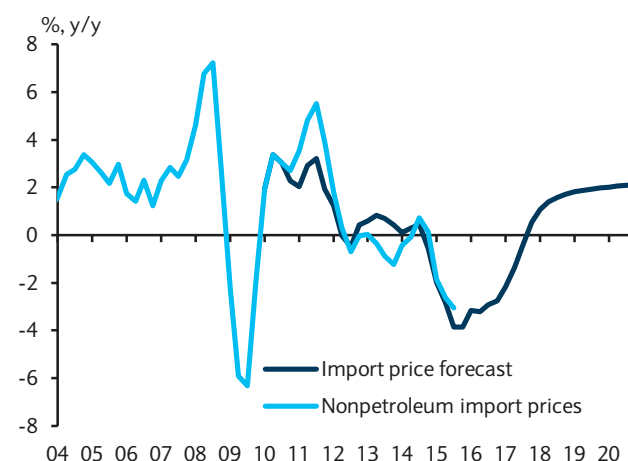
**With lower unemployment, PCE rises faster...**



Source: BEA, Haver Analytics, Barclays Research

FIGURE 10

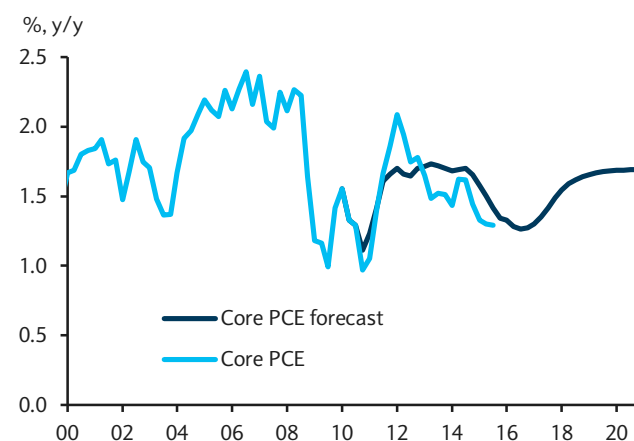
**...and even import prices rise more quickly**



Source: BLS, Haver Analytics, Barclays Research

FIGURE 11

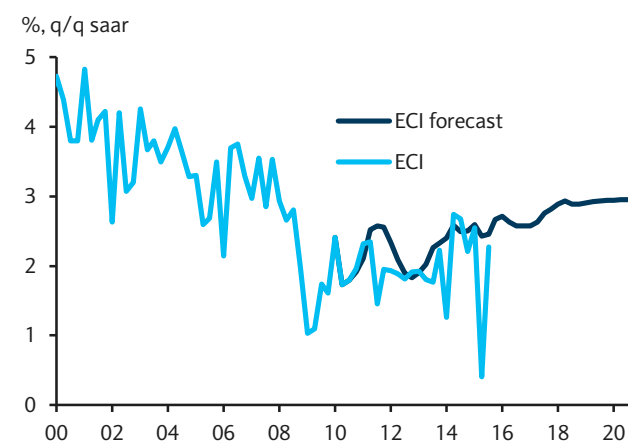
**Lower inflation expectations lead to lower inflation...**



Source: BLS, Haver Analytics, Barclays Research

FIGURE 12

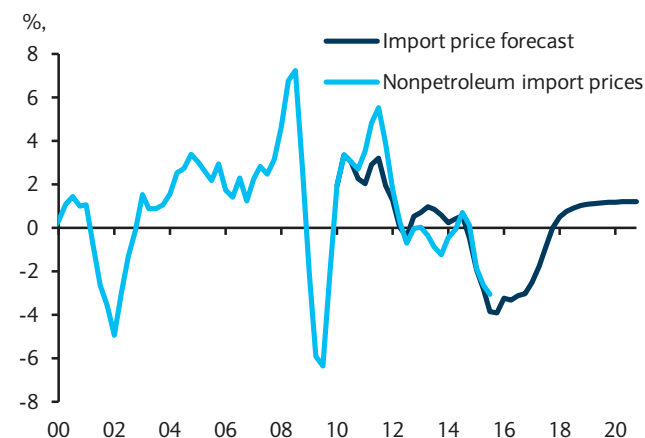
**...and much softer wage growth**



Source: BLS, Haver Analytics, Barclays Research

FIGURE 13

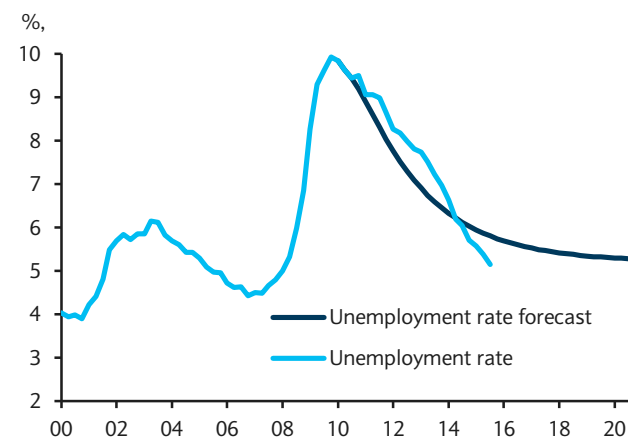
**Import price inflation is only modestly lower**



Source: BLS, Haver Analytics, Barclays Research

FIGURE 14

**The path of the unemployment rate is not influenced by inflation expectations**



Source: BLS, Haver Analytics, Barclays Research



## Appendix: A dynamic wage model

We begin with the model of inflation used by Chair Yellen in her recent speech on inflation and monetary policy (*Inflation dynamics and monetary policy*). Her framework falls under the class of models known as expectations-augmented Phillips curve models and assumes that core inflation is influenced mainly by inflation expectations, past inflation, resource utilization (as proxied by the unemployment rate relative to its long-run value), and the relative price of imports. She uses the framework to argue that inflation will return to the FOMC's 2% inflation target once transitory shocks to energy and the dollar subside.

We construct our model of wages and inflation around her equation. However, we want to understand the broader dynamics of inflation and, hence, estimate her equation jointly with equations that estimate the dynamic evolution of unemployment, import prices, and wages. This structure allows us a more fully specified dynamic forecast of the economy.

We have four equations in our model:

- The first is the Chair's inflation equation. Following her specification, we write core PCE inflation as a function of its first two lags, the difference between the unemployment rate and the natural rate of unemployment, and a term that captures the relative price of imports. In past work (see *Some unpleasant dual mandate arithmetic*), we took great pains to replicate her coefficients and carefully constructed a relative import price term. Even with this construction, we could not replicate the Chair's coefficients without placing additional restrictions on the regression. We find that using the much simpler construction of nonpetroleum import prices times the share of goods imports in GDP works very well and gets us close to our results published in *Some unpleasant dual mandate arithmetic*. We experimented with a wage term in this first equation, but econometrically, wages seem to have little to no predictive power for inflation. However, we do find that past inflation influences the evolution of wages.
- Our second equation is the evolution of wages. We model total ECI compensation as a function of lagged productivity growth, lagged PCE inflation, the difference between the unemployment rate and an estimate of the natural rate of unemployment, and lagged ECI compensation.
- The third is an import price equation, in which we model import prices as a function of lagged import prices, the broad trade-weighted nominal dollar, and lagged PCE inflation.
- Our fourth equation models the evolution of the unemployment rate. We find that the change in this is reasonably well explained by lags in the change in the unemployment rate and lags in its level. We also include the identity that the unemployment rate gap is equal to the unemployment rate minus the natural rate of unemployment.

We do not use dynamic equations for several elements of the model. The natural rate of unemployment and its evolution are exogenous. The model is only slightly influenced by different estimates of the natural rate. We use our in-house estimate but find similar results using the CBO's estimate of the longer-run natural rate. We assume a slight downward drift of the natural rate between 2016 and 2020. We do not estimate the exchange rate. We assume the broad nominal dollar appreciates 5% in 2016 and is unchanged in 2017 and beyond. Inflation expectations are held constant over the forecast period. Following the standard established by Chair Yellen, we use the survey of professional forecasters' long-run expectations in sample (see *Some unpleasant dual mandate arithmetic* for details on how forecasts for CPI and PCE are combined to create the series). The share of goods imports in GDP is assumed constant in the forecast period.



Finally, we are unable to find a satisfactory specification for productivity growth in our sample period and, hence, treat productivity as an exogenous variable. Not surprisingly, wages are sensitive to the assumption of productivity growth. For our baseline case, we assume productivity growth holds at a 1.2% annual pace from Q4 15 onward. This rate is slightly above the 0.8% average the US economy has had over the past four years but is well below its longer-run average of about 1.8% or the 2% pre-recession average. Some improvement in productivity seems likely, in our view, as headwinds from the recession fade over time.

We solve the system in *EViews* using quarterly data from 1985 to the present. We choose a dynamic-deterministic simulation method using the Broyden solver. A detailed description of the solution method is available in the guide, [Nonlinear equation solution methods](#).

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