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Compensation and Labor Market Slack

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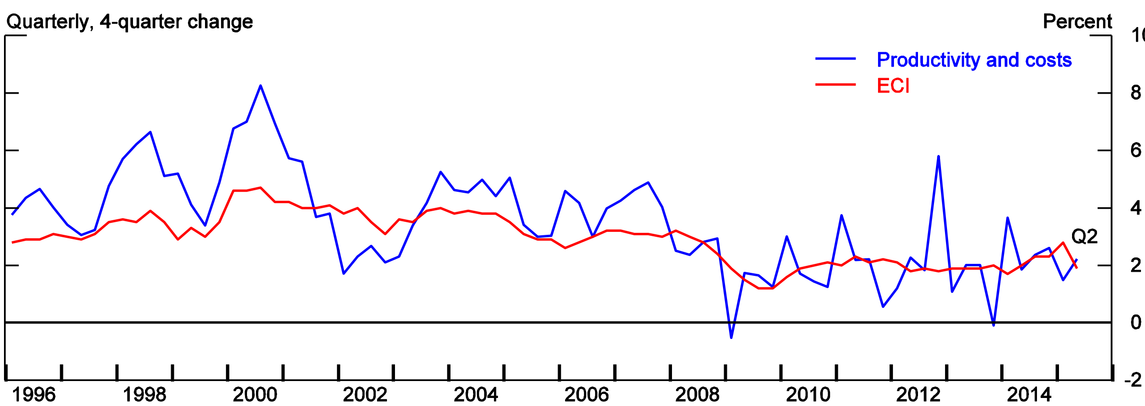
Introduction

The labor market has improved substantially over the past few years, with the unemployment rate now equal to the staff's estimate of its natural rate and other margins of labor market slack continuing to move toward levels that we see as consistent with the FOMC's full-employment mandate. Despite this progress, the aggregate measures of hourly compensation that we follow most closely have yet to show any noticeable signs of acceleration, but rather have continued to rise at an average pace of around 2 percent per year (figure 1). In this memo, we ask whether the absence of a pickup in compensation growth should be viewed as puzzling and, if so, what might explain it. More specifically, we assess the extent to which the behavior of compensation in recent years should be taken as evidence that more slack remains in the labor market than is assumed in the staff's Tealbook forecast.

Figure 1. Broad Measures of Compensation per Hour



We find that, under current staff assumptions about trend inflation, structural productivity growth, and the natural rate of unemployment, the behavior of compensation, on average, over the past few years has not been especially surprising. Instead, the steady modest pace of wage growth in recent years can be seen as reflecting the offsetting influences of the positive impetus from the narrowing of labor market slack and the negative impetus from the disappointing pace of structural productivity growth. However, we would caution that our assumptions about trend inflation and structural productivity are subject to considerable uncertainty, and we show that reasonable alternative assumptions can result in different estimates of the natural rate. Finally, we discuss several alternative models of wage dynamics and show how they can lead to different conclusions about the recent behavior of compensation growth. Thus, while we do not view the recent wage data as suggesting that the staff should alter its current estimate of the natural rate, we also conclude that the recent behavior of compensation provides only a little guidance about the current amount of slack in the labor market. For this reason, the staff tends to look at the results from a variety of techniques and uses a wide variety of data to form our judgmental point estimates of the degree of slack in labor markets and to assess the uncertainty that surrounds them.[1]

A framework for assessing wage growth and slack[2]

In the staff framework, nominal hourly compensation growth is assumed to be influenced by labor market slack, structural productivity growth, and expected inflation.

$$(1)\quad \pi_t^w = \pi_{t-1}^e + \Theta_t + \alpha\left(\pi_{t-1}^w - \pi_{t-1}^e - \Theta_t\right) + \beta X_t + \delta \Delta X_t + \zeta Z_t + \varepsilon_t \quad , \\ where\ \ 0 < \alpha < 1.$$

Here, π^w is the annual rate of change in quarterly measures of nominal hourly compensation—the Employment Cost Index (ECI) for private industry workers or the Productivity and Costs measure of hourly compensation in the business sector (CPH); π^e is the staff's judgmental estimate of trend inflation; Θ is trend real wage growth, which we proxy by a geometrically weighted moving average of structural productivity growth; X is a measure of labor market slack (for example, the staff's estimate of the unemployment gap or the employment-population ratio relative to its trend); ΔX is the change in slack and captures the effects of changes in growth on compensation, in part through bonuses and other forms of incentive pay; Z includes special variables that can affect compensation temporarily (such as changes in the rate of employer contributions for social insurance relative to other wages); and ε is a residual, which captures sources of variation in compensation growth that are unrelated to the model's other determinants.[3] Lags of compensation inflation are included to capture the sluggish adjustment of wage changes to changes in expected inflation, structural productivity growth, and slack; eventually, however, permanent changes in expected inflation and trend productivity growth are assumed to pass through one-for-one into nominal wage inflation.

[1] For more details on the methods used by the staff to assess labor market slack, see Bruce Fallick and Jeremy Rudd, "The Staff's Assessment of Economic Slack," memorandum to the FOMC, August 28, 2012.

[2] We use the terms "compensation" and "wages" interchangeably in this memo to refer to various measures of hourly compensation (i.e., wages plus employer-provided benefits).

[3] We would expect real product wages (real wages defined relative to the price of business output) to rise over time with business-sector productivity, rather than real consumption wages (real wages defined relative to consumer prices). However, the staff's judgmental estimate of underlying inflation—currently at 1.8 percent—is expressed in terms of core PCE inflation. As a result, the inflation trend in the staff's compensation equations equals the staff's judgmental estimate for core PCE inflation less the average differential between these two inflation series since 1988 (our estimation period). In addition, while CPH compensation and output per hour are both consistently measured series, the fixed-weighted ECI does not have a comparable productivity measure; accordingly, the productivity trend in the ECI equation is assumed to equal business-sector trend productivity adjusted for the average differential in ECI and CPH growth when the effects of slack and other special factors are set to zero.

In equation 1, the degree of labor-market slack—the variable *X*—is the difference between an observable variable—typically the unemployment rate—and an estimate of its trend or equilibrium value. Thus,

$$X_t \equiv NRU_t - RU_t \ ,$$

where RU_t is the unemployment rate and NRU_t is the natural rate of unemployment. In this context, the natural rate of unemployment is the rate of unemployment consistent with wages rising at their trend rate, which is given by the sum of trend inflation and trend real wage gains. Note that for this relationship to hold, the other quantities on the right-hand-side of equation 1 must also be equal to zero. The term ΔX will be equal to zero when the economy is in equilibrium—that is, when labor-market slack is equal to its long-run value and isn't expected to change. The various components of *Z* are defined so that their long-run value is zero.

The staff takes a broad approach in formulating its estimate of the natural rate of unemployment, looking at a variety of factors largely related to demographics and the functioning of labor markets. To address the question of how informative the evolution of wages may be for our estimate of NRU_t, we replace the staff assumption about the natural rate in equation (1) with an assumption that *NRU* is an unobservable latent variable and then infer the best-fitting estimate of *NRU* using statistical methods. Specifically, we assume that the natural rate follows a simple random walk:

$$(2) \qquad NRU_t = NRU_{t-1} + \eta_t \ .$$

When combined with an assumption about the standard deviation of the change in the NRU, equations 1 and 2 can be used to infer changes in the natural rate of unemployment using standard statistical techniques—in particular, the Kalman filter. In such a model, errors in the model's forecast of wage inflation will lead to revisions to the model's estimate of the natural rate of unemployment. Thus, if wages come in lower than the model predicts, the model ascribes some portion of that error to the possibility that the natural rate may be lower, with the revision to the natural rate depending importantly on the variance of the error in the wage equation, ε_t, relative to the variance of the shock to the natural rate, η_t. When the variance of the wage-equation shock is larger, a smaller portion of any wage-equation error will be ascribed to the natural rate; when the variability of the natural rate is larger, any given wage-equation error will lead to a larger revision in the natural-rate estimate.

This model is just one of many that could be used to extract information about the natural rate of unemployment. Fleischman and Roberts (2011), for example, use information about price inflation along with other indicators of real activity to infer the cyclical state of the economy and the natural rate of unemployment, among other latent variables.[4] Consistent with the purpose of this memo, here we focus exclusively on the information content from the wage equation for movements in the natural rate of

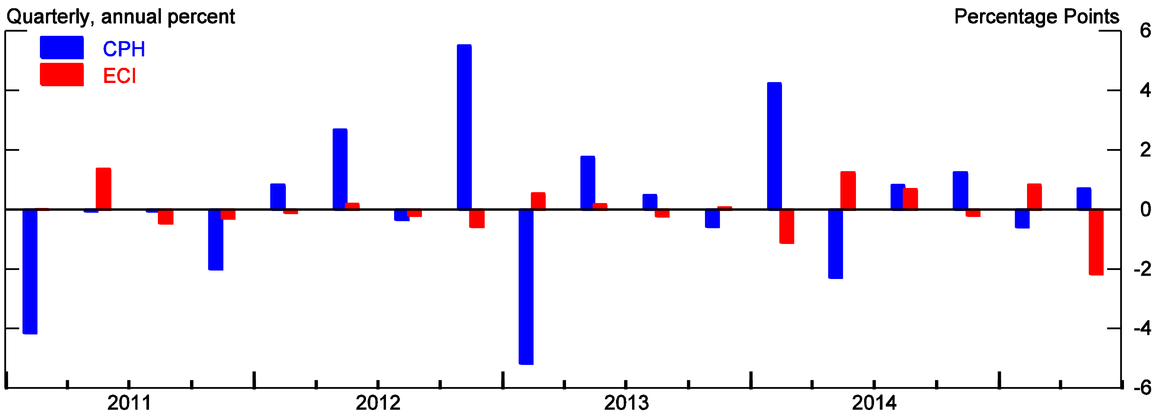
[4] Charles Fleischman and John Roberts, "From Many Variables, One Cycle," FEDS Working Paper no. 2011-12 (2011).

unemployment, bearing in mind that, by itself, such an approach is unlikely to provide a complete picture of forces affecting the natural rate.

The recent behavior of wages

Figure 2 shows recent errors from dynamic simulations of one of the staff's CPH inflation models (blue bars) and one of the staff's models for ECI inflation (red bars), where each simulation is run conditional on the staff's baseline estimates of the natural rate of unemployment, trend inflation, and structural productivity.[5] The errors can be quite large from quarter-to-quarter—especially for the CPH measure—reflecting the fact that a large amount of the variability in the compensation data is unrelated to the models' explanatory variables.[6] However, on average over the past four-and-a-half years, the forecast errors from these equations have been close to zero.[7]

Figure 2. Recent errors for staff models of CPH growth and ECI growth



To better understand the contributions of various factors to the model's view of the evolution of wages in recent years, figures 3 and 4 present a decomposition of the staff models' forecasts for compensation. As shown by the orange bars, narrowing slack, by itself, would have implied a pickup in wage growth since the recession; however, a decline in the model's estimate of trend real wage gains (yellow bars)—driven importantly by a weakening in the pace of structural productivity growth over the past decade—has offset about half of the estimated effect of narrowing slack in the CPH models, where the effect of slack is largest, and all of the effect of narrowing slack in the ECI equations.

[5] These models are estimated from 1988:Q1 to 2015:Q2 and then simulated starting in 2011:Q1. The trend productivity measure used in the equations is a geometric moving average of structural productivity that puts declining weight on more distant observations, with 75 percent of the weight put on the past seven years.
[6] As just one example, the large errors in the CPH equation in 2012:Q4 and 2013:Q1 are due to employers accelerating the payout of bonus payments in advance of tax changes that took effect at the beginning of 2013.
[7] Specifically, the mean error for the CPH equation from 2011:Q1 through 2015:Q2 is 17 basis points, while the average error for the ECI equation over the period is -1 basis point.

Figure 3. Average Annual Change in Compensation per Hour

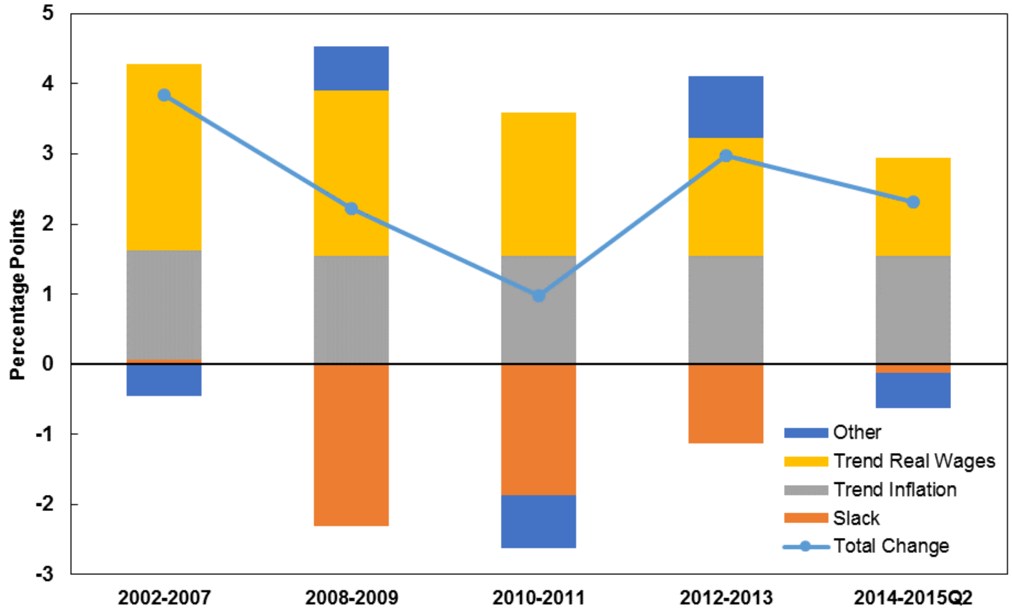
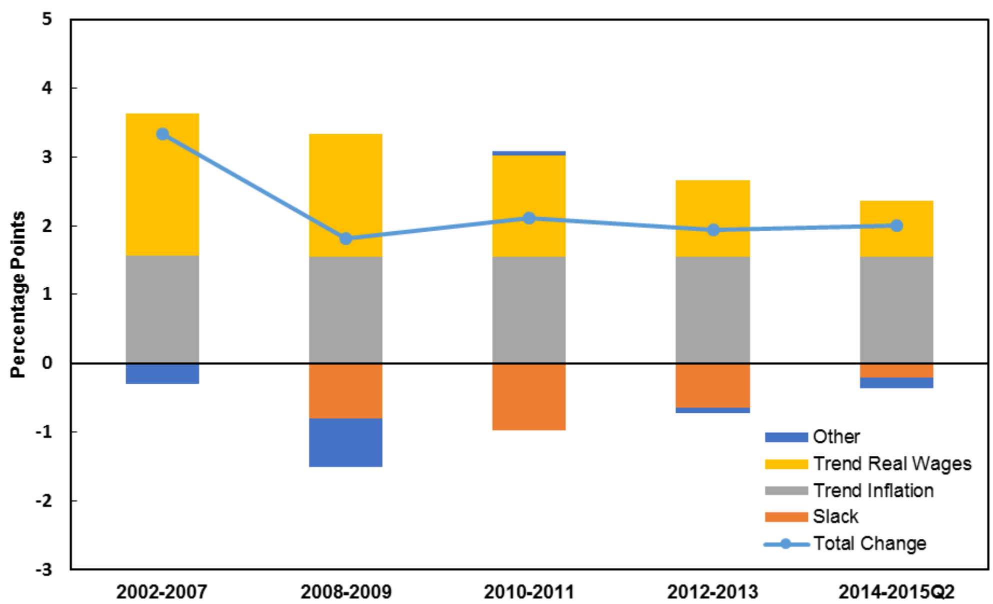


Figure 4. Average Annual Change in Employment Cost Index



As we have frequently noted, we think it likely that the unemployment rate gap is currently understating the amount of slack in labor markets, in large part because the labor force participation rate is below our estimate of its trend level. To assess the importance of this factor, we replaced the unemployment gap with a broader measure of labor market slack. Doing so has only minor effects on the results. In particular, the average errors from the compensation equation for CPH that uses the gap between the employment-population ratio and the staff's estimate of its trend are only a little smaller, on average, than those described above that are based on the unemployment gap. That is, even allowing for the possibility that the degree of slack has recently been a little larger than indicated by the unemployment rate alone, the conclusion that slow wage growth reflects the offsetting influences of declining labor market slack and slowing productivity growth is consistent with the predictions from the model.

While these models can explain recent movements in compensation growth reasonably well using our current judgmental assumptions for slack, trend productivity, and trend inflation, the Tealbook forecasts of compensation growth have tended to be too high in recent years. In particular, relative to the forecasts made in the December Tealbook for the following year, ECI growth has come in lower, on average, by nearly ½ percentage point over the 2011 to 2015:Q2 period; current estimates of CPH growth are also lower than originally predicted over this period, on balance, but the magnitude of this error is sensitive to the vintage of data used, given frequent revisions to the historical data. This overprediction occurred at the same time that the staff also underpredicted the extent to which labor market slack narrowed in each year, which would have tended to push wage gains higher, other things equal. In large part, this situation reflects the fact that productivity growth has been slower than projected in the Tealbook, which we have interpreted as suggesting that the structural rate of productivity growth is lower than we had previously assumed. That is, although we have been surprised by the rapidity with which labor market slack has narrowed in recent years, the effect on wage growth appears to have been more than offset by downward revisions to our estimate of structural productivity growth over the same time period.

Estimating the natural rate with a wage equation

Figure 5 shows the natural rate estimates from an empirical implementation of equations 1 and 2. In this model, we do not use the staff's estimate of the natural rate of unemployment but instead infer the natural rate of unemployment as a latent variable.

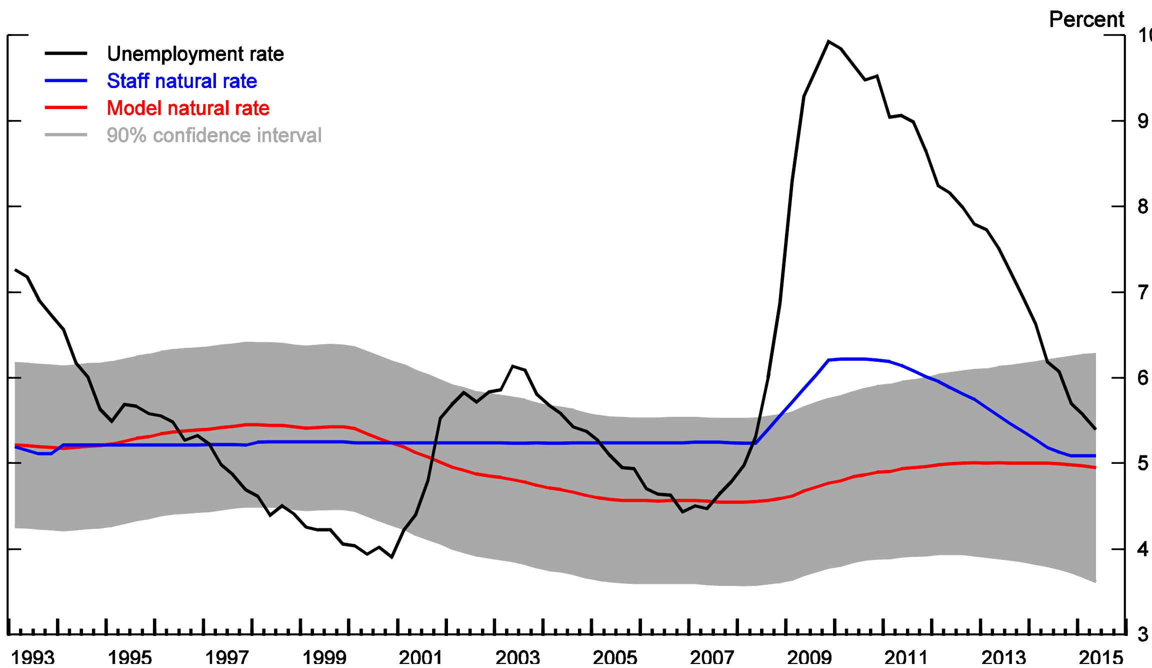
In our estimation, we use information on both the ECI and CPH measures of wages.[8] Each wage measure has strengths and weaknesses as an indicator of wage pressures: The CPH measure is more sensitive to the cyclical state of the economy than the ECI, but it also has much more unexplained quarter-to-quarter variability than the ECI. Including both measures in the model "lets the data speak" as to which is more informative about the natural rate. Our results suggest that both measures provide useful, and independent, information about the evolution of the natural rate; hence, using both measures together will, in principle, lead to more precise estimates of the natural rate.

[8] In particular, we include both measures of wages as observable variables, each with their own equation. Specifying a separate observation equation for each wage measure allows the coefficients on slack to vary across the two variables, and allows us to account separately for the different real-wage proxies, as discussed in footnote 3.

Because of concerns that the sensitivity of inflation to labor market slack may have fallen over time, we estimate our model over a relatively short sample, starting in 1985.[9]

As can be seen from the figure, the model's estimate of the natural rate has been fairly flat in the past few years. This reflects the fact that, as with the staff's econometric models, this model has made relatively small errors in recent years. Because this model infers changes in the natural rate from wage-equation errors, the lack of large errors, on average, has implied little need to revise the natural rate estimate.[10] That said, the confidence band around the model's natural rate estimate is quite wide, with the 90 percent confidence band around the estimate ranging from 3.6 percent to 6.3 percent at the end of the sample.[11]

Figure 5: Model estimate of the natural rate of unemployment



The figure also shows the staff's judgmental estimate of the natural rate. While the model's 2015:Q2 estimate of the natural rate is similar to the staff's estimate, the

[9] In our estimation, we impose the value of the standard deviation of the *NRU* innovation, η_t, but let the other parameters of the model be freely estimated. In particular, we set the *NRU* standard deviation to be 0.2 percentage point. This value is on the high side of some estimated values; Fleischman and Roberts (2011), for example, find a value of 0.11. We chose our calibration to ensure that we were not unduly minimizing the potential influence of wages on the natural rate.

[10] This result may be somewhat surprising given that the natural rate in the state-space model is substantially lower than in the staff view and so might have been expected to predict somewhat smaller wage increases. However, wages are estimated to be less sensitive to changes in economic activity in the state-space model, implying that the additional labor market slack in the state-space model puts less downward pressure on wages than in the staff model.

[11] The confidence intervals shown here do not take account of parameter uncertainty. Taking account of parameter uncertainty would imply even wider confidence intervals.

evolution of the natural rate in recent years has been different. In particular, the staff's estimate rose during the recession but has more recently reversed that run-up, while the model's estimate shows a decline in the natural rate over the 2000 to 2008 period and then an increase from 2008 to 2011. The evolution of the staff's estimate over this period is based importantly on information about the functioning of labor markets—chiefly, the collapse in the job-finding rate in the early stages of the recession, and subsequent partial rebound—rather than on wage or price developments.[12] By contrast, the model's estimate draws only on the variables entering the wage equation. Moreover, the model's estimate is likely affected by the decline in labor's share over much of the 2000-2011 period. Because we base our proxy for trend real wage growth on productivity gains, a period in which real wage growth fell short of productivity gains would lead the model to revise down its estimate of the natural rate.[13]

Despite the differences in the historical evolution of these competing estimates of the natural rate of unemployment, the new estimates presented here provide a useful additional perspective, focusing on the influence of compensation information on a model-based natural rate estimate. As noted above, these estimates reinforce the view that the slow pace of wage growth in recent years, by itself, does not imply a further reduction in our current estimate of the natural rate of unemployment.

In the analysis above, we have taken as given the staff views of trend inflation and structural productivity growth (which underlies our proxy for trend real wage growth). We would emphasize, however, that estimates of the natural rate will be sensitive to alternative values of trend inflation or trend real wage growth. To illustrate the sensitivity of the estimates to assumptions about trend inflation, we re-estimated the Kalman filter model under two alternative assumptions about the value of trend inflation. Under the baseline assumption that trend PCE inflation has been 1.8 percent since the late 1990s, the model estimates that the natural rate of unemployment as of 2015:Q2 was 5.0 percent. If, instead, trend inflation has been at the Committee's target of 2 percent, the model would predict a natural rate of unemployment of 4.5 percent as of 2015:Q2; higher trend inflation would lead the model to expect higher compensation growth, so the model rationalizes the observed modest pace of compensation growth by inferring more slack and thus a lower natural rate of unemployment. Alternatively, if trend inflation were 1.5 percent, a value consistent with some time-series estimates of trend inflation, the model would predict an end-of-sample natural rate of 5.6 percent. Because trend real wage growth enters the model in a similar way to trend inflation, the sensitivity to

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[12] See, for example, Regis Barnichon and Andrew Figura, "What Drives Movements in the Unemployment Rate? A Decomposition of the Beveridge Curve," Finance and Economics Discussion Series 2010-48. Board of Governors of the Federal Reserve System. While labor-market functioning has not returned entirely to normal, demographic factors have been working to reduce the natural rate, leaving the staff's estimate of the natural rate, on net, slightly lower than before the crisis.

[13] We also considered a version of the model that allowed the real wage trend to be estimated as a latent variable, with identification achieved by including information on price inflation. In that model, wages were no longer informative about the natural rate of unemployment. Intuitively, that result is because, in the absence of an outside measure of trend real wage gains, the evolution of wages served mostly to inform the estimate of the real wage trend.

alternative estimates of trend productivity or trend real wage growth would be similar to the sensitivity to alternative estimates of trend inflation.

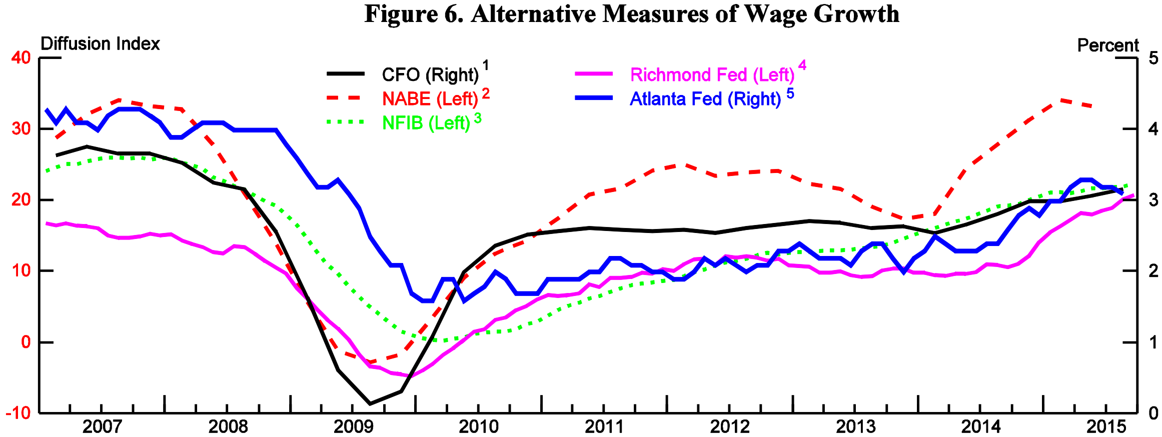
Alternative perspectives on the recent behavior of wages

The staff's framework for analyzing wages described by equation 1 assumes a linear relationship between wage inflation and a handful of key determinants—the unemployment gap, structural productivity growth, and trend inflation. Although this model appears to have performed relatively well in recent years, there are other plausible models of wage behavior that might lead to different interpretations about the reasons for the modest pace of wage growth in recent years, and thus lead to different views of the extent of slack remaining in the labor market. As well, there are other measures of wage growth that show somewhat more acceleration than the measures used in our analysis. In this section, we briefly discuss a few of these alternative perspectives, primarily as a means of highlighting the inherent uncertainty surrounding our efforts to use wage data to measure labor market slack.

Other measures of wages

Figure 6 presents a variety of other measures of wage growth that were originally shown in an alternative views box included in the March 2015 Tealbook. Several of these measures suggest that wage gains may already have moved back up to their pre-recession levels, a notably different picture than that suggested by the measures we have emphasized so far. While we lack formal models of these alternative wage measures, if the general impression they present is accurate, they could be read as implying less labor-market slack than the conventional models suggest. Thus, these measures would argue against revising down further our estimate of the natural rate of unemployment—and might argue for raising it, although in the absence of a formal model, it is difficult to say by how much.

Figure 6. Alternative Measures of Wage Growth



1. Duke's Fuqua School of Business/CFO Magazine Business Outlook Survey: average own-firm expected wage and salary increase over the next 12 months. 4-quarter moving averages.
2. National Association for Business Economics, Business Conditions Survey: net percent of firms reporting increased wages and salaries.
3. National Federation of Independent Business: net percent reporting increased compensation over last 3 months. 12-month moving averages.
4. Federal Reserve Bank of Richmond, Fifth District Survey of Service Sector Activity: net percent reporting increased average wage.
5. Federal Reserve Bank of Atlanta, Wage Growth Tracker, median percent change in hourly wages of individuals observed 12 months apart (based on the CPS).

Other staff models

Two other leading staff models, FRB/US and EDO, have perspectives on wage determination that are notably different from the staff models we have been discussing so far. FRB/US and EDO take a more structural approach to modeling wages, assuming explicit costs of adjusting wages and forward-looking behavior. The FRB/US wage model shares with the judgmental framework important influences of trend inflation, trend productivity growth, and labor market slack. In addition, the FRB/US wage model includes a term that works to enforce a long-run relationship among the *levels*—as opposed to the growth rates—of wages, prices, and productivity. In EDO, as in other DSGE models, real wages are determined by the interplay between labor supply and labor demand, with labor supply derived from an explicit maximization problem. While wages in EDO will be correlated with the deviation of the unemployment rate from its long-run value and fluctuations in productivity, these relationships are a reflection of the general-equilibrium outcomes of the model and are not explicit parts of the main equations determining wages in EDO.

Figure 7 shows recent errors from the FRB/US wage equation. In FRB/US, wages are measured using the ECI for total hourly compensation; the errors from the staff's ECI model—shown in figure 2 above—are also included here for comparison purposes. The FRB/US residuals are very similar to the staff's—the correlation over this period is 0.97—with the FRB/US residuals on average slightly more negative over this period, about -¼ percentage point versus zero in the staff equation. An important factor behind the larger wage gains predicted by FRB/US is a higher value for the trend wage component: FRB/US bases its trend inflation estimate on the 10-year PCE inflation projection from the Survey of Professional Forecasters, and that trend estimate has averaged about ¼ percentage point higher than the staff's judgmental inflation trend of 1.8 percent. In addition, the trend real wage proxy used in the FRB/US model is currently running somewhat higher than the staff's estimate. The FRB/US natural rate estimate, at 4.9 percent, is a little lower than the staff's estimate.

Figure 7. Recent errors for the FRB/US model's ECI equation

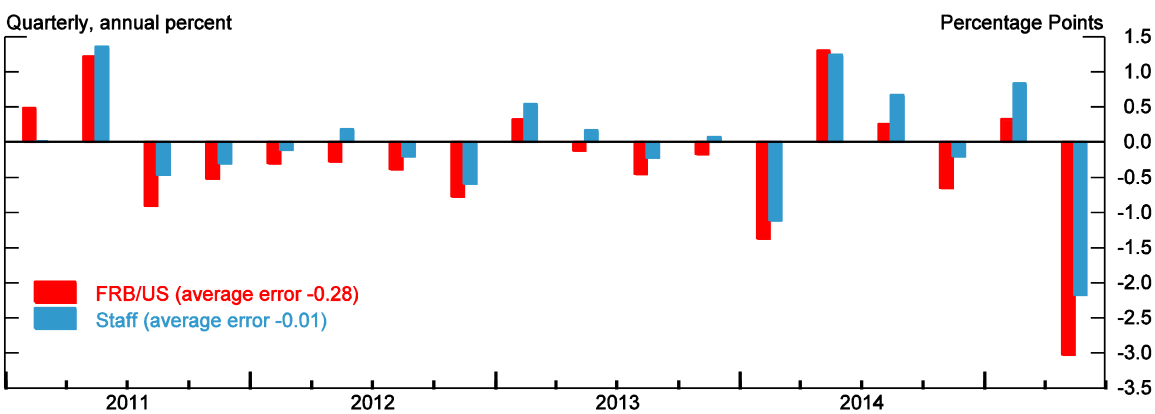
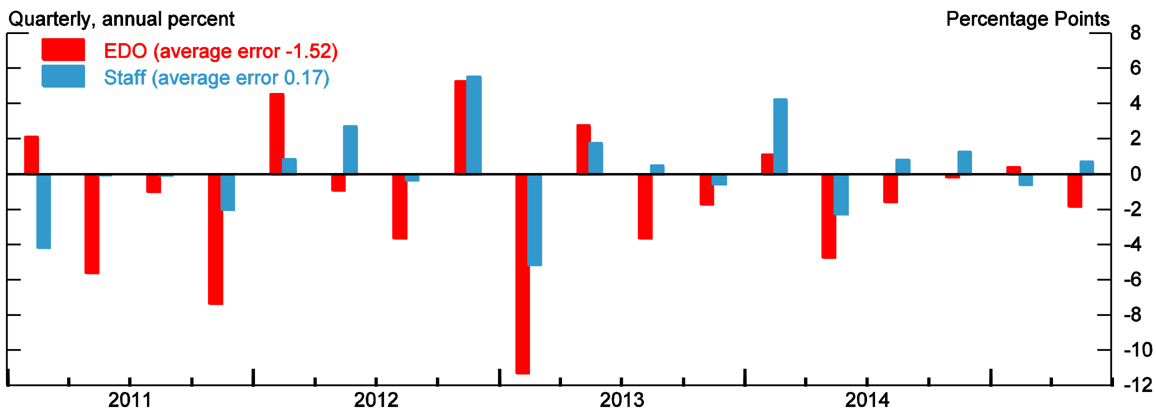


Figure 8 presents recent wage errors from the EDO model.[14] EDO's measure of wages is CPH compensation per hour, and the errors from the staff's CPH model are also shown. While both models generate large residuals over this period, the overall variability of the EDO errors has been greater. As well, the average error of the EDO model over the past several years is considerably larger, with EDO expecting higher wage increases than actually occurred. Relatedly, EDO's estimate of the natural rate is 6.0 percent, noticeably higher than the staff's.

Figure 8. Recent errors for the EDO model's CPH equations



While the overprediction of wages in EDO is a notably different outcome than in the staff framework, the structure of the EDO model is sufficiently different from the staff's that the implications are not immediately clear. In EDO, labor supply is affected by all of the factors influencing the household decision problem. In particular, for reasons unrelated to the gap between unemployment and EDO's estimate of the long-run natural rate, the saving propensity in EDO has been particularly weak in recent years. Household labor supply is thus also weaker than average and so EDO anticipates large wage increases. But these errors reflect a link between household spending decisions and labor supply that is not at work in the staff's framework and on which there is not complete consensus in the DSGE literature.[15]

Alternative measures of labor market slack

Although the unemployment rate gap is the most commonly used measure of labor market slack in wage equations, it is sometimes argued that the unemployment rate gap does not fully capture the effects of labor market tightness on wage behavior. We highlighted above the effects on our results from replacing the unemployment rate with

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[14] Because EDO is a general-equilibrium model, all shocks affect all variables and there is, technically speaking, no single wage residual. We judged that the residuals in EDO that are most likely to have similar effects to the staff and FRB/US wage residuals were the wage markup and labor supply shocks. Accordingly, we present the combined effects of those two structural shocks on nominal wages in EDO. EDO also takes account of measurement error, and the reported EDO residuals include the model's estimate of the measurement error in wages.

[15] A prominent example of a DSGE model that eschews wealth effects on labor supply is Nir Jaimovich and Sergio Rebelo, "Can News about the Future Drive the Business Cycle?" *American Economic Review* 99, 1097-1118.

the employment-population ratio, although there are even broader measures that could be used as well.[16] However, other researchers have argued that narrower measures of slack (such as the short-term unemployment rate) are more useful for predicting compensation, or that wage growth is better predicted by the pace of quits or job-to-job flows.[17] Historically, most of these measures have moved closely with the unemployment rate. More recently, however, they have deviated in important ways: The broader measures of labor market slack and the quit rate have improved less than the staff's unemployment gap, while the short-term unemployment rate was back to its pre-recession levels by early 2014. Thus, specifications using quits or broader measures of labor market slack might predict lower wage growth than does a model that uses the staff's unemployment gap, while specifications using narrower measures would presumably be surprised by the apparent absence of an acceleration in wages thus far.

Changes in labor's share

For much of the post-World War II period, real product wages tended to rise roughly in line with average labor productivity, keeping labor's share of income (or equivalently, the mark-up of output prices over unit labor costs) relatively stationary (figure 9). However, over a ten-year period from the early 2000s to the early part of the current decade, labor's share of income fell to historically low levels.[18] One factor that likely contributed to the decline in labor's share over the past decade is the Great Recession, as compensation growth is considerably more cyclical than price inflation. However, the decline began prior to the recession, and a number of structural explanations, including greater import competition and offshoring of jobs, technological change, weaker worker bargaining power associated with lower rates of unionization, and decreasing dynamism in labor markets, have been put forth to explain this decline.[19] Depending on the underlying reasons, structural changes in the relationship between real wage growth and productivity growth could reduce the information content of changes in nominal wage growth as in indicator of labor market slack.[20] That said, labor's share

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[16] See David Blanchflower and Andrew Levin, "Labor Market Slack and Monetary Policy," Dartmouth College (2015) for arguments along these lines.

[17] For example, the Council of Economic Advisers, *Economic Report of the President* (2014) uses short-term unemployment (spells less than 14 weeks) as the indicator of labor market slack in its preferred wage equation, while Jason Faberman and Alejandro Justiniano, "Job Switching and Wage Growth," *Chicago Fed Letter*, No. 337 (2015) find a strong relationship between the quit rate and nominal wage growth.

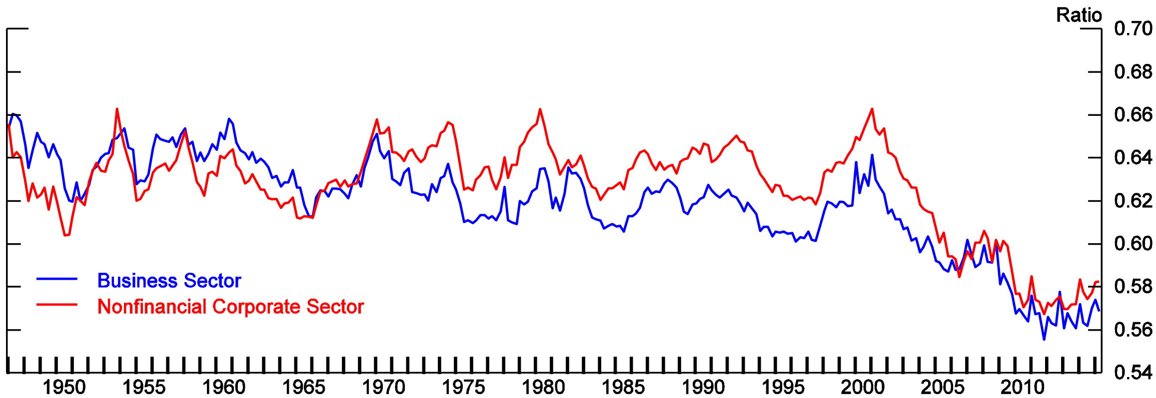
[18] For the business sector as a whole, the decline in labor's share appears to have begun earlier than in the nonfinancial corporate (NFC) sector. However, because of the difficulty in measuring compensation and output for sole proprietorships and partnerships and for the financial sector, the NFC sector, which excludes these sectors, is likely measured better than the business sector. Elsby, *et al*. estimate that a third of the measured decline since 1948 in the nonfarm business sector's labor share reflects mismeasurement of self-employment income. (Michael Elsby, Bart Hobijn and Ayşegül Şahin, "The Decline of Labor's Share," *Brookings Papers on Economic Activity*, Fall 2013, 1-51.)

[19] Elsby, at al. (2013), "The Decline of Labor's Share."

[20] For example, Figura and Ratner (2015) note that, in the context of a standard model of unemployment, a decrease in worker bargaining power would cause a lower labor share to be associated with a lower natural rate, while an increased risk of job destruction or a higher discount rate applied to future profits would cause a lower labor share to be associated with a higher natural rate. In their empirical analysis, they find that the vacancy/unemployment ratio has increased more in states and industries where the labor's share has fallen more, which they interpret as consistent with a decline in worker bargaining power. (Andrew

appears to have leveled off since 2011 (albeit at a level well below that in the late 1990s), perhaps suggesting that there have not been changes in the labor share that would complicate our analysis of compensation growth in recent years.

Figure 9. Labor Share of Income in the Business Sector and Nonfinancial Corporate Sector



Downward nominal wage rigidity

Another hypothesis that is sometimes put forth to explain the pattern of wage growth in recent years relates to the idea that there is downward nominal wage rigidity in the wage-setting process. In particular, employers may have been reluctant to cut nominal wages during the recession, thus preventing nominal wage growth from slowing as much as would have been expected at that time. In this view, the recent period of slow wage growth reflects the unwinding of this rigidity, as employers hold down nominal wage increases in order to return real wages to their notional levels even as the unemployment rate is falling, with the implication that the natural rate may be higher than in the staff's linear specification.[21]

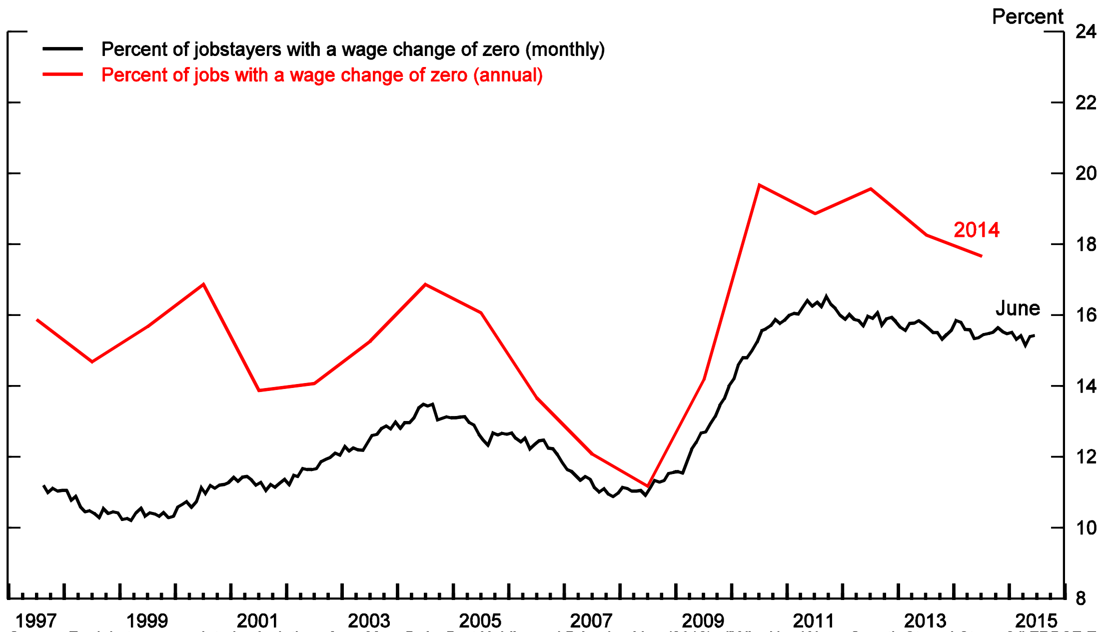
Figure 10 provides some evidence related to this hypothesis. In particular, both the percentage of job stayers who did not receive a wage increase over the previous 12 months and the percentage of jobs in which the wage was held constant moved up noticeably in 2009 and 2010, consistent with the hypothesis that some employers may have elected to keep the nominal wages of their employees unchanged despite the negative demand shock affecting the economy at that time. Moreover, the number of workers and jobs with zero wage change has remained elevated in recent years, which may suggest that some employers are withholding wage increases until inflation and productivity growth bring real wages closer to their desired level. As Daly and Hobijn (2015) show, such behavior on the part of employers would cause the Phillips curve to be flatter when the degree of downward nominal wage rigidity is high.[22]

Figura and David Ratner, "The Labor Share of Income and Equilibrium Unemployment," FEDS Note, June 8, 2015.)

[21] Mary Daly and Bart Hobijn, "Why Is Wage Growth So Slow?" *FRSB Economic Letter*, 2015-01.

[22] Mary Daly and Bart Hobijn, "Downward Nominal Wages Bend the Phillips Curve," *Journal of Money, Credit, and Banking*, 46(S2), 2014, pp. 51-93.

Figure 10: Nominal Wage Rigidity



Source: For jobstayers, updated calculations from Mary Daly, Bart Hobijn, and Brian Lucking (2012). "Why Has Wage Growth Stayed Strong?," FRBSF Economic Letter 2012-11 (April 2). For jobs, updated calculations from Bruce Fallick and William Wascher, "Downward Nominal Wage Rigidity in the United States During the Great Recession" (November 2011).

Other nonlinearities

Although not explicitly modeled in a theoretical sense, other researchers have argued that the wage Phillips curve is nonlinear, rather than linear as assumed in the staff's framework—indeed, Phillips himself posited a nonlinear specification in his original paper. For example, economists at the Dallas Fed estimate a nonlinear relationship between compensation growth and labor market slack, while an alternative views box in the January 2015 Tealbook shows a scatter plot suggestive of a steepening in the relationship at lower levels of unemployment.[23] Note, however, that with the unemployment rate now at 5.1 percent, these analyses arguably would have expected to see a pickup in compensation growth by now.

Conclusion

In this memo, we describe how the staff's models of wage inflation interpret the recent slow pace of wage growth and offer some alternative interpretations from other models of wage behavior. We find that the staff's basic model described in equation 1 has not been especially surprised by the recent behavior of hourly compensation growth and thus would not suggest reducing our estimate of the natural rate of unemployment. That said, we also show that the conclusions from that model are sensitive to the staff's assumptions about trend inflation and structural productivity growth, as well as to the

[23] See, for example, Richard Fisher and Evan Koenig, "Are We There Yet? Assessing Progress Toward Full Employment and Price Stability," *Dallas Fed Economic Letter* (2014); Anil Kumar and Pia Orrenius, "A Closer Look at the Phillips Curve Using State Level Data," Dallas Fed Working Paper 1409 (2014).

assumption that there is a linear relationship between compensation growth and the unemployment rate gap. For these reasons, we also conclude that the behavior of wages, taken alone, provides little guidance about the level of the natural rate, but rather should be viewed as one element of a range of information that can be used to assess the degree of tightness or slack in the labor market.