Forecasting inflation and the Great Recession

Marco Bassetto, Todd Messer, and Christine Ostrowski

Introduction and summary

In 2001, Atkeson and Ohanian (2001) presented a challenge for most statistical models of (U.S.) inflation, showing that for the period 1985–99, forecasting future inflation to remain at its most recently observed value (the "random-walk" hypothesis) would outperform more-sophisticated models that incorporated information from many other economic variables, such as unemployment. Brave and Fisher (2004) expanded and qualified this observation: They found that it did not necessarily hold true for periods other than 1985–99, but they also confirmed that it is difficult to find a model that would perform better than the simple random walk consistently across a variety of sample periods.

In more recent years, inflation has appeared to be more stable than in the past, and using a simple constant to forecast inflation has been an even more successful strategy than adopting the random-walk hypothesis, as shown by Stock and Watson (2007) and Diron and Mojon (2008). But, as noted by Stock and Watson, the quest for variables—other than inflation itself—that would consistently help predict inflation has yet to deliver satisfactory results.[1]

In this article, we reassess several of the models considered by Brave and Fisher (2004) in the wake of the Great Recession of 2008–09 and its aftermath. This period is particularly interesting because many economic variables saw more extreme movements than they had ever experienced in the stable-inflation era since 1985.

As an example, figure 1 shows the behavior of the Chicago Fed National Activity Index (CFNAI). If measures of economic or labor market activity are ever useful in forecasting inflation, then this should become particularly clear in times of large movements. In figure 2, we show the behavior of inflation over the same period. The black line shows total inflation as measured by the Personal Consumption Expenditure Price Index (PCE), while the red line shows core inflation, excluding the volatile energy and food sectors. Inflation did drop in 2008, at the same time as the economy was contracting, but this drop could not be forecasted based on the benign economic data of 2007. More importantly, inflation *recovered* between 2009 and 2010.

We are not the first to point out that inflation remained remarkably stable in the face of serious economic weakness over the last five years: This is discussed by Hall (2011), Ball and Mazumder (2011), and Simon,

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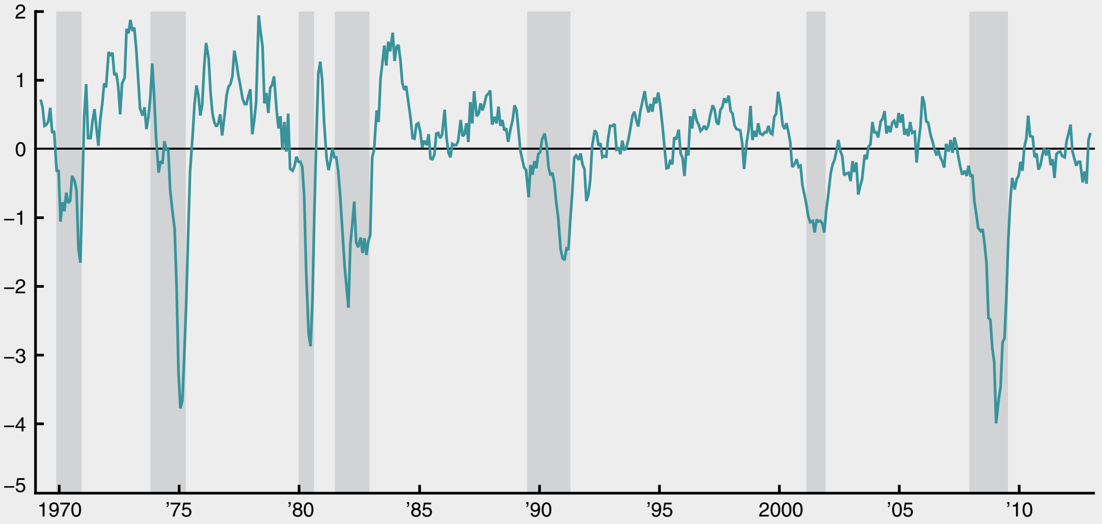
FIGURE 1

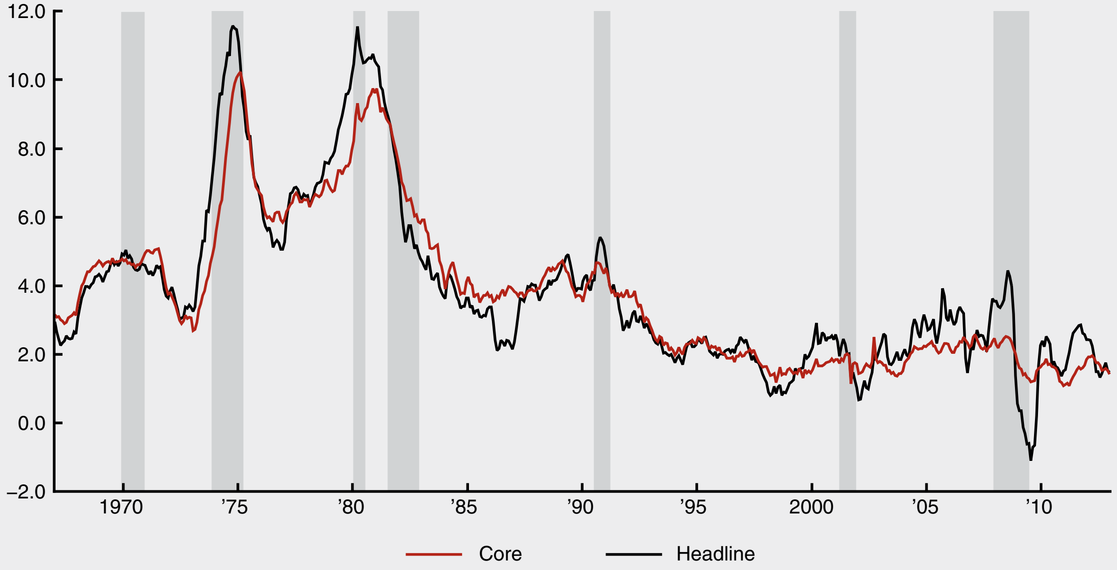
Chicago Fed National Activity Index, 1967–2012



Source: Federal Reserve Bank of Chicago, www.chicagofed.org.

FIGURE 2

Year-over-year headline and core PCE inflation (percent)



Note: PCE indicates Personal Consumption Expenditures Price Index.
Source: U.S. Bureau of Economic Analysis and Haver Analytics.

Matheson, and Sandri (2013), among others. This observation is commonly cited as evidence that the "Phillips curve," which illustrates the relationship between inflation and unemployment, has flattened in recent years. Our goal in this article goes beyond this observation in two ways:

1) We show how the recovery of inflation in 2009–10 occurred precisely at the only time (since 1985) in which the statistical models considered here would predict sharp disinflation, that is, inflation *went up* at the time at which the models would most strongly predict that it *should go down*.
2) We quantify the effect of the resulting large forecast errors on the coefficient estimates of the model, offering a metric by which we can assess how much weaker the relationship between inflation and economic activity appears when the data from 2008–12 are taken into account.

Our work is also related to Del Negro, Giannoni, and Schorfheide (2013). In their paper, they consider a fully fledged new Keynesian model, and they show that inflation during the Great Recession behaved in ways that are broadly consistent with the implications of the model; in particular, their model anticipated some disinflation, but not enough to get to deflation. The path of inflation forecasts displayed by Del Negro, Giannoni, and Schorfheide is not out of line with the results of the purely statistical forecasting models that we consider.[2] Indeed, if we only look at our figure 12 (p. 94), the performance of the statistical models does not appear as bad during the Great Recession. However, when we look at the forecasts of *changes* in inflation, the failure of the models to account for the behavior of inflation over the last five years becomes apparent: It is this failure that leads to the conclusion that estimates based on data up to 2007 were not robust to the inclusion of data observed since then. It would be interesting to perform experiments similar to ours in a wider class of both statistical and economic models.

In the next section, we describe the statistical models that form the basis of our analysis. Then, we present the results from our estimation. We first document the magnitude and timing of the forecast errors from the models and then discuss how the past five years affect the coefficient estimates.

Brief description of data and models

We use monthly data for both inflation and the variables to be used in forecasting it. We consider two forecasting horizons: 12 months and 24 months. This represents a fairly standard choice, and our results would not change substantially if we considered other, similar forecasting horizons. We perform our analysis on core inflation in order to strip out highly volatile food and energy prices. We consider two measures of inflation, based on the price index for Personal Consumption Expenditures (PCE) and the Consumer Price Index (CPI), respectively.[3] Most of our analysis is based on data from January 1985 to December 2012;[4] we exclude earlier years, in which monetary policy was conducted very differently and inflation was much less stable. As a robustness experiment, we also consider what happens if we include the high-inflation period of the 1970s and the disinflation period of the early 1980s.

Models in differences

It is common to assume that inflation itself is a unit-root process (or close to it), which suggests we should run forecasting regressions in differences. In this form, the forecasting regression is

$$1)\quad \pi_{t+h}^{12}-\pi_{t}^{12}=\alpha+\sum_{j=0}^{p*}\gamma_{j}\Delta\pi_{t-j}^{1}+\sum_{j=0}^{q*}\beta_{j}x_{t-j}+\varepsilon_{t+h}.$$

In equation 1, π_t^{12} is 12-month inflation in period t, that is, it is the logarithmic change in the price index between period t and $t-12$. Then h is the forecast horizon (12 or 24 months). $\Delta\pi_t^1$ is the one-month change in monthly inflation; x_t is the vector of variables used in the forecast (which varies by model); $p*$, $q*$, α, $(\beta_1,\ldots,\beta_{q*})$, $(\gamma_1,\ldots,\gamma_{p*})$ are parameters to be estimated; and ε_{t+h} is the forecast error, which (by construction) is uncorrelated with all the variables used in the regression up to period t. We study four models that share the common structure of equation 1, but differ in the variables used to predict changes in the inflation rate. These models follow research by Stock and Watson (1999, 2002, and 2003).

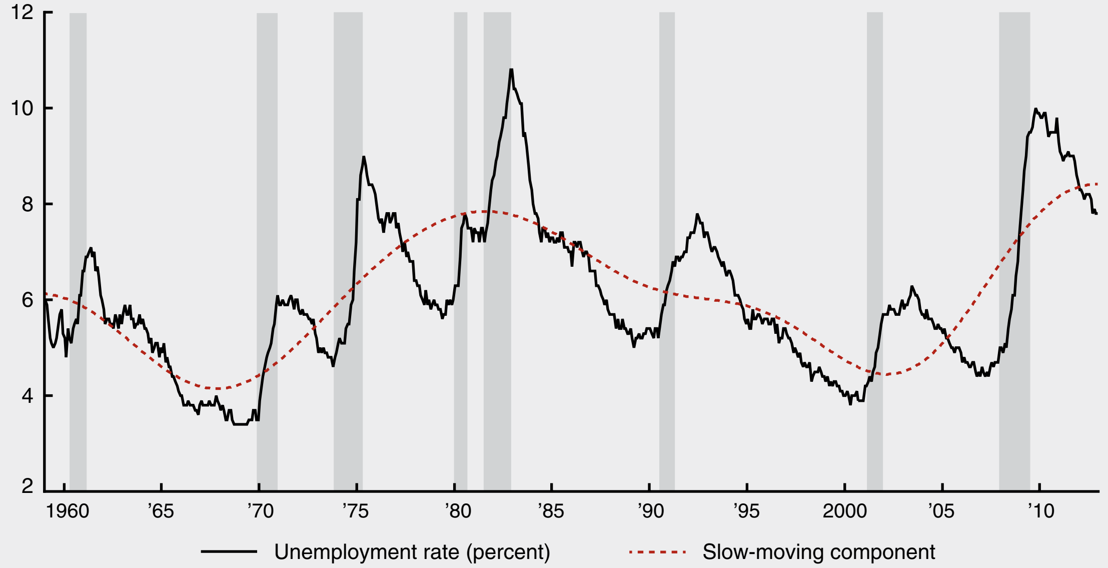
Specifically, all four models include a constant[5] and lags of one-month changes in inflation, but they then differ as follows:

Activity index model

This model is based on the premise that inflation may increase in periods of brisk economic activity and decrease when the economy exhibits slack. Activity is measured by the three-month moving average of the Chicago Fed National Activity Index (CFNAI).[6] The CFNAI aggregates information[7] from 85 series capturing various aspects of economic activity and is calibrated so as to have a mean of zero and a variance of one, with positive or negative values, respectively, indicating periods of above-average or below-average economic activity. As shown in figure 1, the Great Recession of 2008 brought the CFNAI to values that were matched only by the most severe recession of the 1970s.

FIGURE 3

Civilian unemployment and slow-moving component, 1959–2012



Source: U.S. Bureau of Labor Statistics and Haver Analytics.

Natural rate model

This model looks more specifically at labor market conditions. To construct x_t, we start with the civilian unemployment rate, and we split it into two components.[8] The first component is a slow-moving trend, which captures demographic changes and other institutional factors that may affect unemployment without being associated with the business cycle. The second component (the "cyclical component"), which is the residual after the trend has been removed, is meant to be associated with business cycle movements in unemployment that may be predictive of inflationary pressures.

Figure 3 plots the civilian unemployment rate and its slow-moving trend *as estimated at the end of 2012*. Because the most recent recession was so unusually protracted, a significant part of the increase in unemployment of the past five years is attributed to the trend (dotted red line). This formulation has the counterintuitive implication that during the recession of 2008, unemployment was actually *lower* than its long-run trend. For this reason, we choose to construct the residual in a period t that is used for estimation from the trend as it would be estimated on data only up to that period.[9] Using this one-sided estimate, the spike in unemployment in 2008 and 2009 is entirely perceived as a cyclical downturn, which should affect inflation. For the sake of robustness, we also repeated the experiment using the trend as currently estimated; our conclusions would be similar and, if anything, stronger in this case.

Diffusion model

This model closely resembles Stock and Watson (2002). As for the activity index model, we rely on a large number of series whose common information is summarized by means of principal components. The difference between the activity index model and the diffusion model is that we include here a much larger number of series (148), which capture not only economic activity, but also information on prices and financial market conditions. Here, x_t represents the first four principal components of the 148 series.

Indicator model

While for the diffusion model we first summarize the information from many series into a few principal components and then use those to forecast inflation, here we proceed in reverse. First, we use 22 economic series[10] and run 22 separate regressions, each one containing a single series as a regressor x_t. Then we summarize this information by taking the median forecast among the 22.

In addition to choosing the series to include in equation 1, we need a criterion to choose the number of lags of inflation and the regressors that appear on the right-hand side of equation 1. For the first three models, we rely on the Bayesian information criterion to make a selection.[11]

For the indicator model, the Bayesian information criterion may select different lag lengths depending on the variable that we use; we thus simply fix p^* and q^*, which we choose to be 5.

Models in levels

There is evidence that inflation has been less persistent in recent years than in the past.[12] For this reason, we experiment with a different specification, where inflation is treated as a stationary process:

$$2) \quad \pi^{12}_{t+h} = \alpha + \omega\pi^{12}_{t} + \sum_{j=0}^{p^*} \gamma_j \Delta\pi^{1}_{t-j} + \sum_{j=0}^{q^*} \beta_j x_{t-j} + \varepsilon_{t+h}.$$

Compared with equation 1, equation 2 allows the effect of past inflation to decay over time and long-run inflation to revert to a constant.

Thus, we repeat our exercise for each model, replacing equation 1 with equation 2.

Results

Models in differences

To begin, we estimate the four models using data from January 1985 to December 2007, before the Great Recession. Using this output, we forecast the predicted change in year-over-year inflation at each point in our sample. Up to 2007, this is an in-sample prediction: The coefficients of the statistical model are estimated to fit the data as well as possible. From 2008 onward, this becomes an out-of-sample forecast, where we explore whether the coefficients that we estimated on previous data are helpful in accounting for inflation during and after the Great Recession.

Figure 4 shows results for PCE in the post-1984 sample at the 12-month horizon, where the blue line is the actual change in inflation and the red line is the predicted change. All four models predict a drop in inflation from late 2009 to early 2010. Measures of slack are greatest after the recession has taken its toll on economic activity and the labor market, and this is when the statistical relationship of equation 1 would imply the greatest downward pressure on inflation. However, inflation actually dropped contemporaneously with the deterioration in economic activity and labor market conditions. By 2010, inflation was instead *recovering*. In other words, the models were predicting the greatest decrease at precisely the time when inflation was increasing. Further, none of the models predicted an increase in inflation at all: Inflation was expected to decrease and continue to decrease throughout the early 2010s.

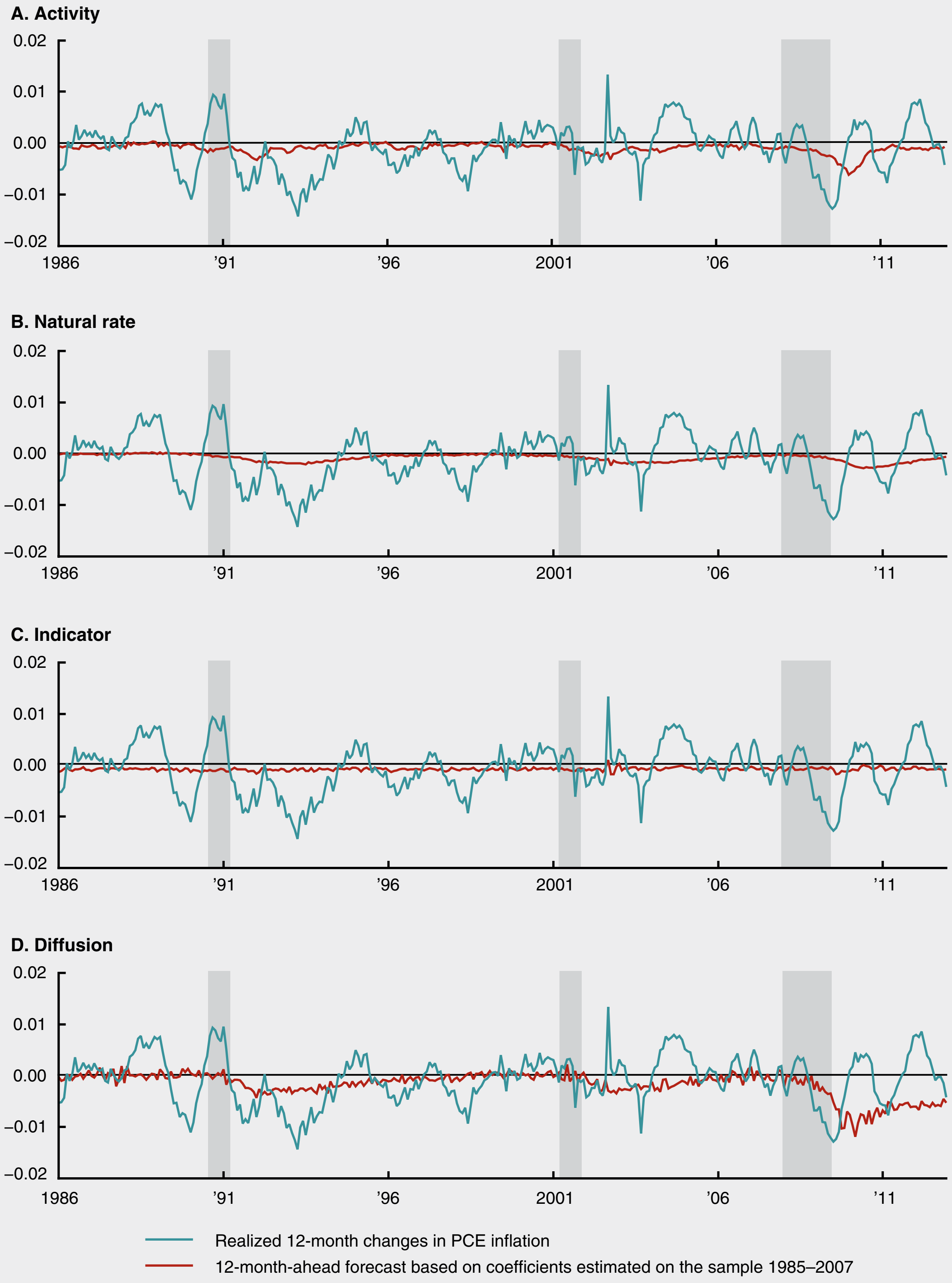
Next, we examine the forecast errors (the difference between the blue line and the red line in figure 4) to understand how this miss compares with past episodes. These errors are shown in figure 5. This figure shows that the forecast errors were large but not unprecedented by historical standards. The only exception is the diffusion model (panel D), which performed particularly poorly during the Great Recession. However, returning to figure 4, we see that a noticeable difference emerges in the *source* of these errors in the later period. Previously, forecast errors were due to movements in inflation that the models failed to predict. During the Great Recession, the models predicted a large change that never occurred.

We now reestimate the models by adding five more years of data, so that the sample covers the period from January 1985 to December 2012, and we recompute our forecasts based on the estimates obtained on this new sample. Figure 6 adds these new forecasts (represented by the black lines) to those that were already included in figure 4. In the activity and diffusion models (panels A and D, respectively), the forecasts become much flatter, indicating that the CFNAI and the diffusion factors appear to be less predictive of inflation changes in the wake of the Great Recession. The indicator model stayed roughly equal, but the aggregation of the indicators in this model was never particularly informative of inflation changes, resulting in a flat forecast line throughout. The change in coefficients is particularly stark in the case of the natural rate model: The inflation forecast almost becomes a constant. Estimating the models using the additional data shows a much more muted response of inflation.

Why do the forecasts become flatter when we add the more recent data? The forecasts are composed of a constant, current and lagged values of monthly changes in inflation, and current and lagged values of measures of economic activity (or labor/financial market conditions). In figure 7, we isolate the component of the forecast that is due to the measure of economic activity. As before, the red line refers to the coefficients estimated on data up to 2007, and the black line includes data up to 2012. This figure shows that the large drop in inflation the models predicted in late 2009 and 2010 that never occurred was indeed due to weakness in the measures of economic activity. It is this failed prediction that mutes the response of the forecasts when coefficients are estimated on the entire sample of data to December 2012. For the natural rate model, this revision is so large that unemployment almost completely loses its predictive power for inflation.

FIGURE 4

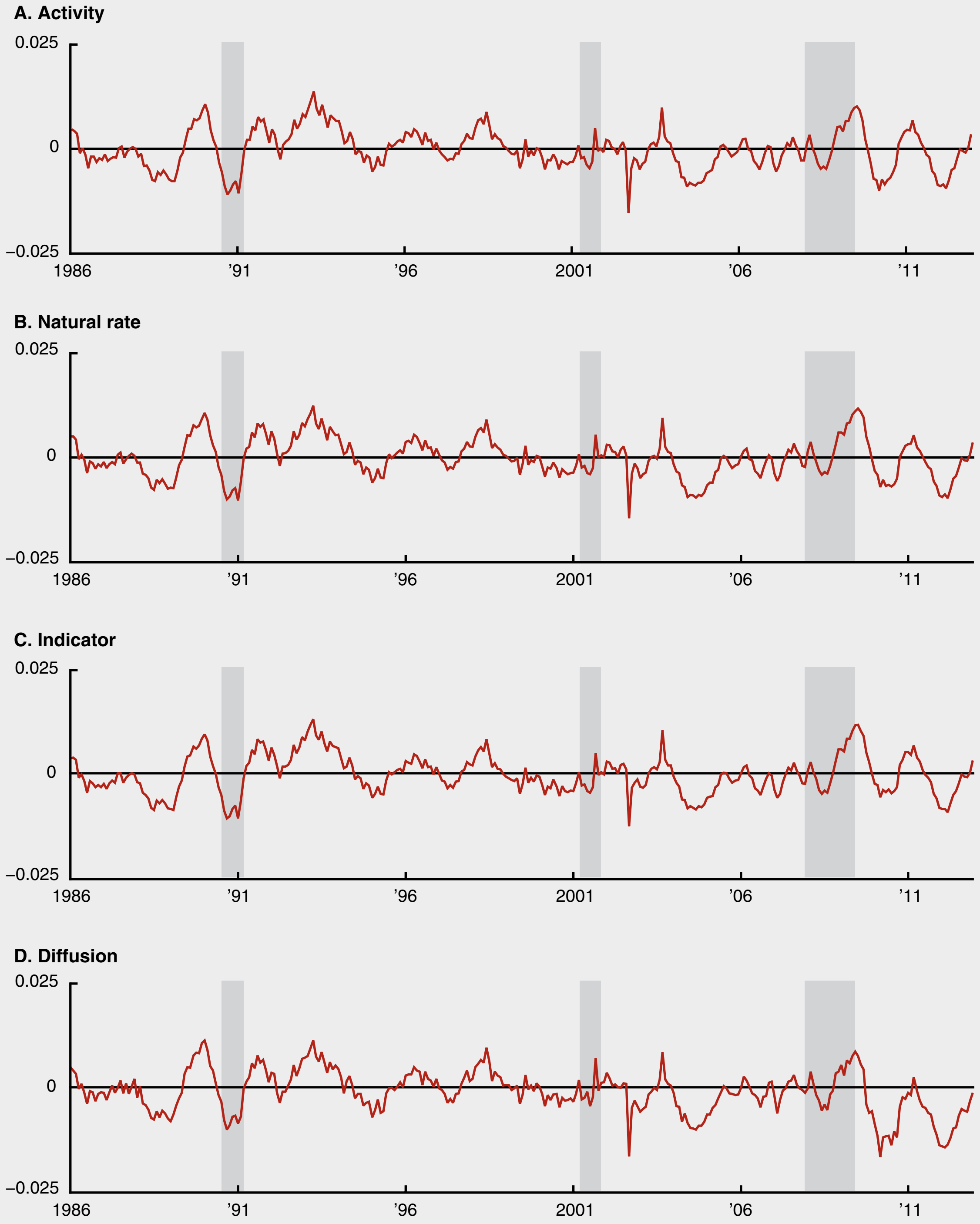
Realized 12-month PCE inflation changes vs. forecast, 1985–2007 coefficients



Note: PCE indicates Personal Consumption Expenditures Price Index.
Source: U.S. Bureau of Economic Analysis and Haver Analytics.

FIGURE 5

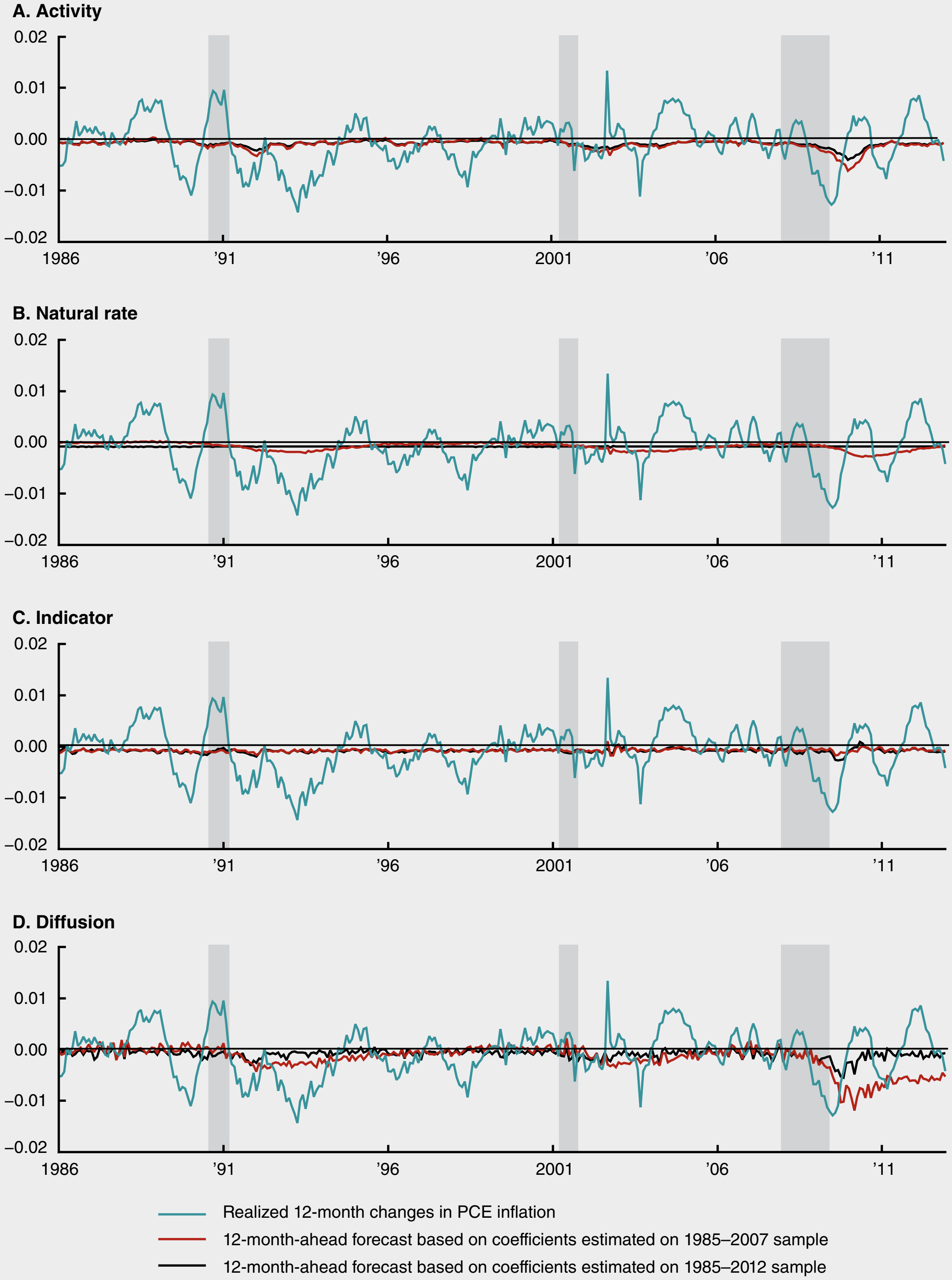
Errors from 12-month-ahead PCE forecast, 1985–2007 coefficients



Note: PCE indicates Personal Consumption Expenditures Price Index.

FIGURE 6

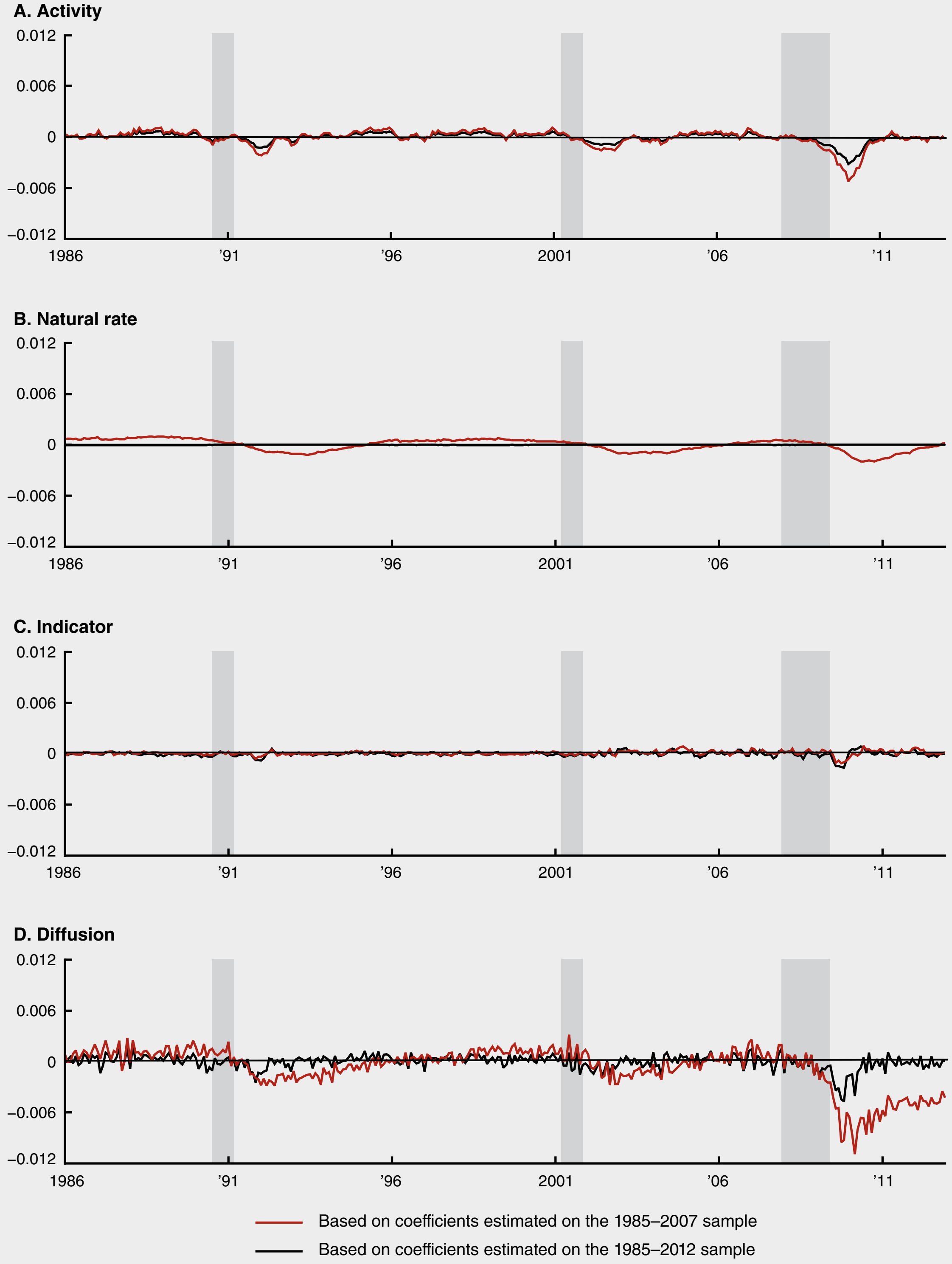
Realized 12-month PCE inflation changes vs. forecast, 1985–2007 and 1985–2012 coefficients



Note: PCE indicates Personal Consumption Expenditures Price Index.
Source: U.S. Bureau of Economic Analysis and Haver Analytics.

FIGURE 7

Contribution of economic activity variables, 1985–2007 and 1985–2012 coefficients



We now explore the robustness of our findings along several dimensions. First, in figure 8, we repeat the experiment forecasting CPI inflation, rather than PCE inflation. Here, the mismatch between forecasts and outcomes is less jarring, in that inflation remained constant when the models predicted the largest drop (March 2010 in the activity and indicator models [panels A and C, respectively], November 2010 in the natural rate model [panel B], and March 2011 in the diffusion model [panel D] in the extended sample), rather than actually increasing as was the case for PCE; by the time actual CPI inflation recovered, the model forecasted changes were close to zero. Nonetheless, the discrepancy between the red and black lines shows that adding the years of the Great Recession reduces the magnitude of estimated changes in inflation. As was the case for PCE, the diffusion model (panel D) performed particularly poorly during the Great Recession; accordingly it saw the biggest revisions in its coefficients with the addition of the new data.

Figure 9 reverts to forecasting PCE inflation and extends the horizon of the forecast to 24 months. This longer window has the effect of smoothing the ups and downs that inflation experienced, and the forecast based on using the CFNAI now appears less out of line with the realized outcomes in the period 2008–12. As we saw at the 12-month horizon, the natural rate model (panel B) suggests that deviations of unemployment from its filtered path have hardly any predictive power for inflation changes when data up to 2012 are included in the estimation; and the diffusion model (panel D) remains the worst-performing model for the period, resulting in the largest revisions.

In figure 10 we take a broader perspective, estimating the models on a sample from January 1969 onward. When we include the high inflation of the 1970s and the 1980s disinflation, the models suggest that economic activity has more predictive power for changes in inflation: This finding is most likely due to the fact that, in those periods, inflation expectations were less well anchored and it was easier for real shocks to propagate to persistent inflation. As a consequence, the activity, natural rate, and diffusion models (panels A, B, and D, respectively) imply a bigger forecasted disinflation after the Great Recession and generally perform worse. The bigger forecast errors would lead to bigger revisions in coefficients, but this effect is tempered by the fact that five years of additional data have less of an effect when models are estimated on a 45-year sample than when they are estimated on a shorter, 28-year sample.

The figures provide consistent evidence of a qualitative change in the forecasting relationships, but they do not provide a quantitative answer as to how much flatter the relationship between inflation changes and economic activity has become. We now turn to this question.

When the estimated model does not include any lags on the measure of economic activity, the ratio of the (absolute value of) coefficients on the measure of economic activity is a straightforward measure of how much flatter the relationship has become. However, the structure of our models allows for the selection of any number of lags, and some models estimate different numbers of lags depending on the period used. To summarize the changes in the coefficients into a single measure, we take the time series of the predicted contributions to the forecast of the independent variable and calculate the maximum and the median of those values. Formally, for the case of the maximum, this means that we compute the following object:

$$3) \quad \frac{max_t\left\{\left|\sum_{j=0}^{q^*}\beta_j^{2012}x_{t-j}\right|\right\}}{max_t\left\{\left|\sum_{j=0}^{q^*}\beta_j^{2007}x_{t-j}\right|\right\}}.$$

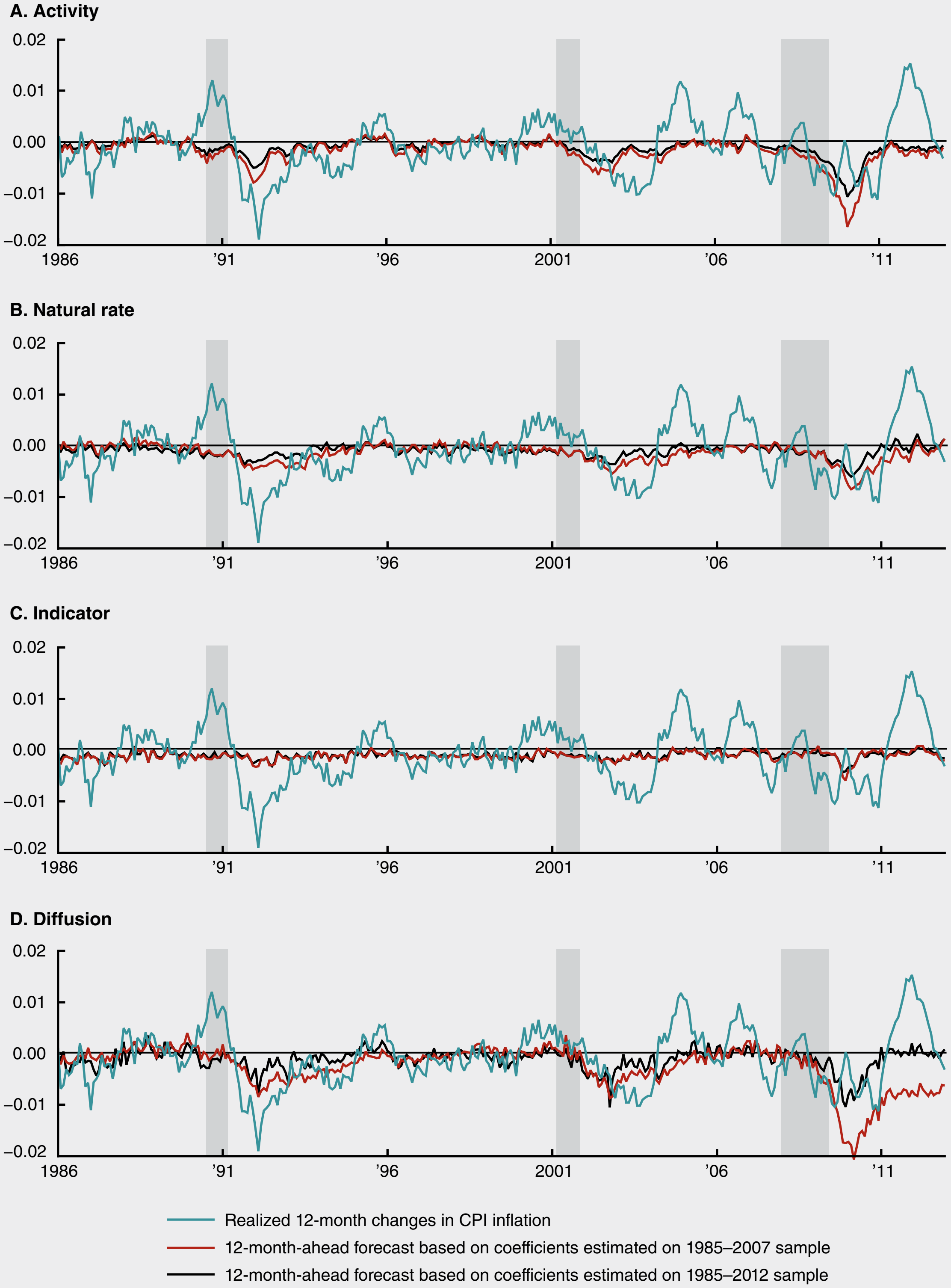
In equation 3, t varies over the sample period (1985–2012 for the post-1984 sample, 1969–2012 for PCE over the full sample, and December 1979–2012 for CPI over the full sample), β_j^{2012} represents the estimates of the coefficients of equation 1 based on data up to 2012, and β_j^{2007} represents the estimates of the same coefficients based on data up to 2007.

The results are presented in table 1 (p. 92). The table confirms the visual impression from the figures. With the exception of the indicator models, where the relationship between economic indicators and inflation was already estimated to be weak as of 2007, all other ratios are considerably less than 1, indicating a flatter relationship in the wake of the Great Recession.

In most cases, the ratios imply a flattening out of at least 20–30 percent—a large change considering that the additional five years of data represent just 18 percent of the post-1984 sample, and 11 percent and 14 percent of the full sample for PCE and CPI, respectively. To better understand the source of the large changes observed in this table, we observe that there are two ways in which including new observations can have large effects in estimating a linear relationship in equation 1. First, observations for $\Delta\pi_{t-j}^1$ and x_{t-j} could be very far from their mean in the new period. In this case, their effect could be uncovered much more clearly, because it would be more difficult for the error ε_{t+h} to mask it. Thus, large changes would simply reflect the fact that

FIGURE 8

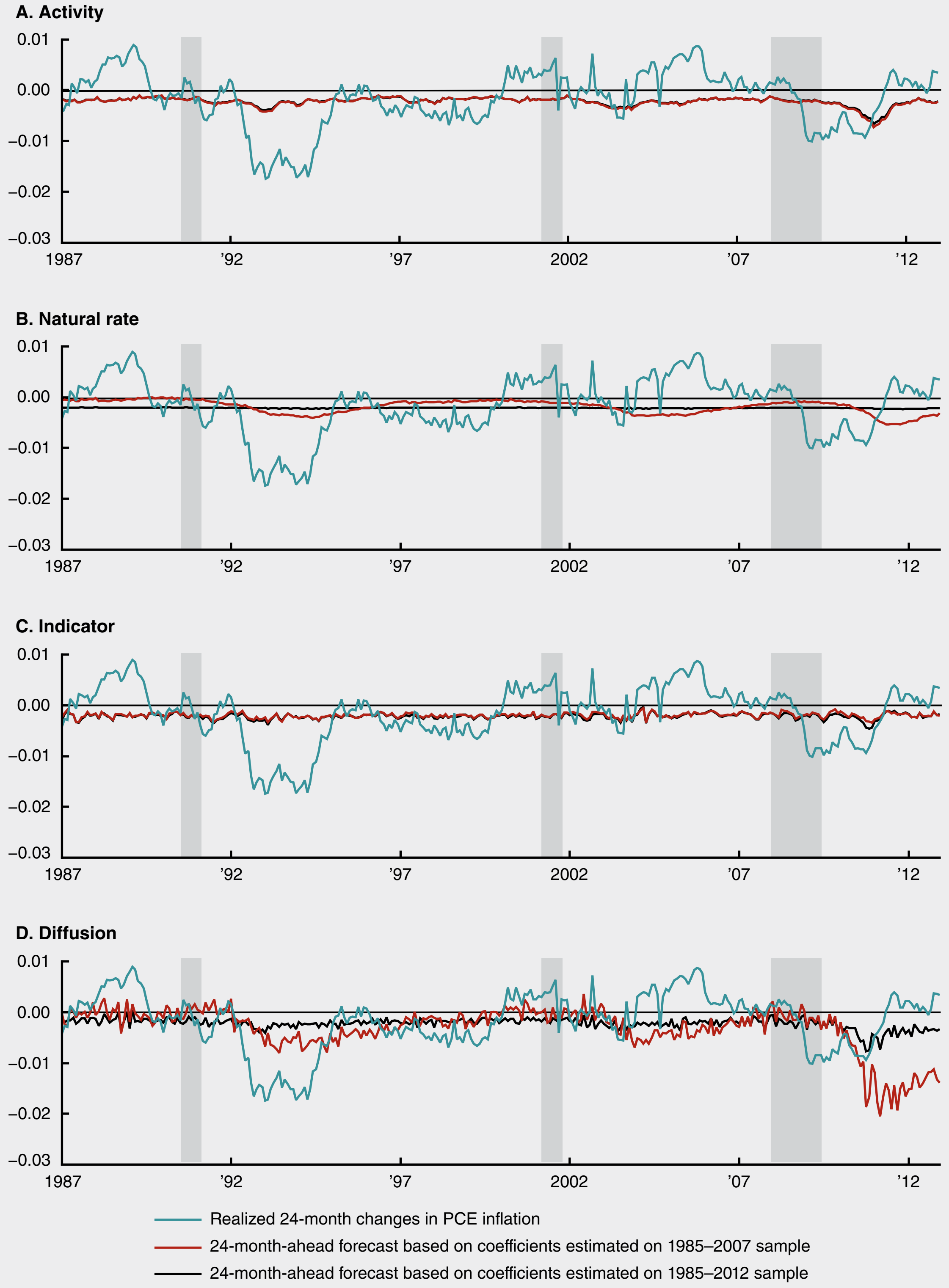
Realized 12-month CPI inflation changes vs. forecast, 1985–2007 and 1985–2012 coefficients



Note: CPI indicates Consumer Price Index.
Source: U.S. Bureau of Labor Statistics and Haver Analytics.

FIGURE 9

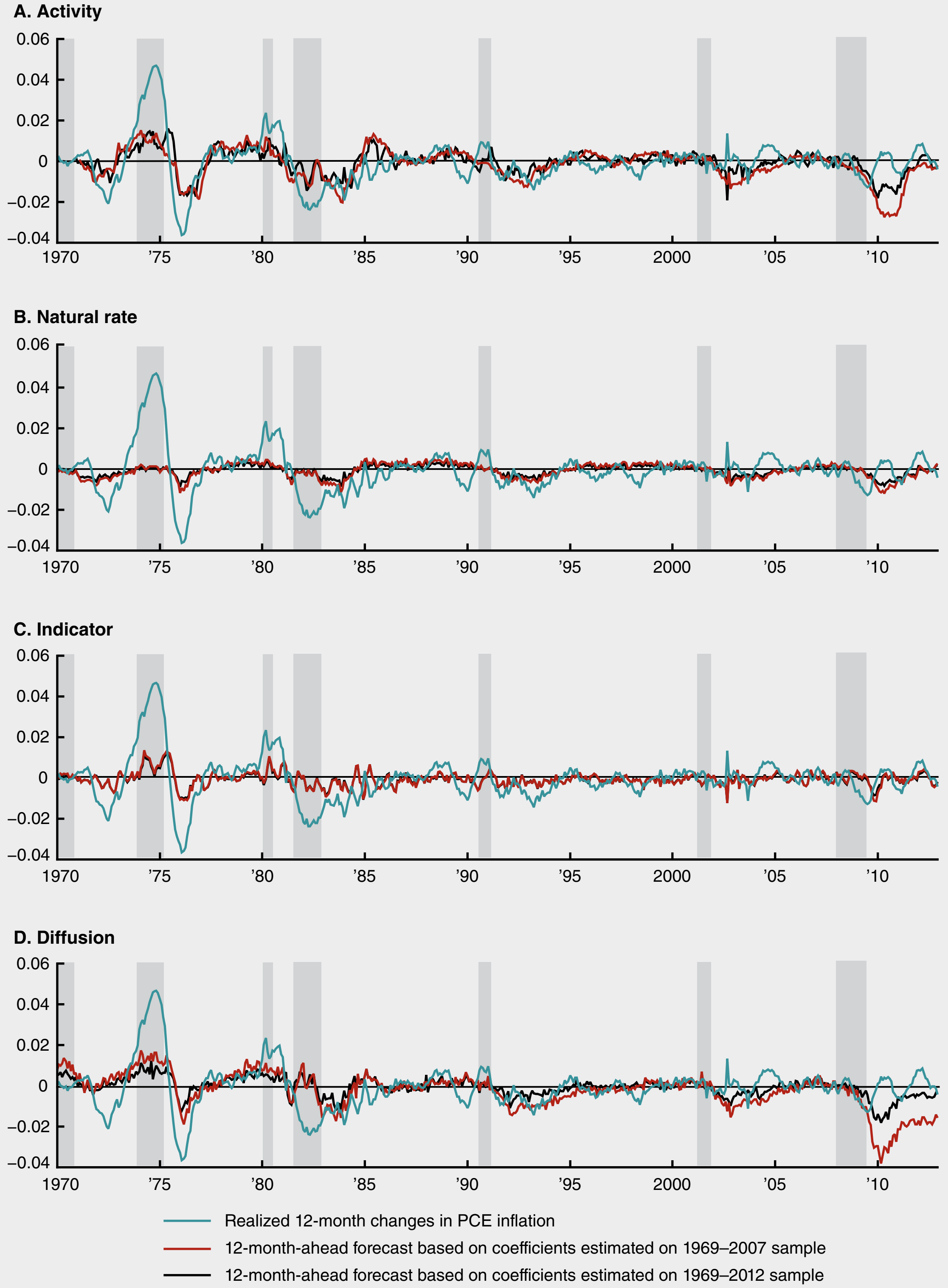
Realized 24-month PCE inflation changes vs. forecast, 1985–2007 and 1985–2012 coefficients



Note: PCE indicates Personal Consumption Expenditures Price Index.
Source: U.S. Bureau of Economic Analysis and Haver Analytics.

FIGURE 10

Realized 12-month PCE inflation changes vs. forecast, 1969–2007 and 1969–2012 coefficients



Note: PCE indicates Personal Consumption Expenditures Price Index.
Source: U.S. Bureau of Economic Analysis and Haver Analytics.

TABLE 1

Contribution of economic activity to forecasts of 12-month and 24-month inflation changes (coefficients estimated on the period to 2012 vs. the period to 2007)

	Post-1984							
Horizon	CPI12				CPI24			
Model	Activity	Natural	Indicator	Diffusion	Activity	Natural	Indicator	Diffusion
Max	0.66	0.71	0.68	0.51	0.72	0.50	1.16	0.46
Median	0.66	0.57	0.66	0.57	0.72	0.46	0.93	0.59

	Post-1984							
Horizon	PCE12				PCE24			
Model	Activity	Natural	Indicator	Diffusion	Activity	Natural	Indicator	Diffusion
Max	0.61	0.02	1.51	0.43	0.88	0.05	1.59	0.31
Median	0.61	0.02	1.12	0.43	0.88	0.05	1.17	0.25

	All							
Horizon	CPI12				CPI24			
Model	Activity	Natural	Indicator	Diffusion	Activity	Natural	Indicator	Diffusion
Max	0.76	0.80	0.66	0.41	0.60	0.65	0.87	0.40
Median	0.76	0.59	0.80	0.45	0.51	0.50	0.81	0.45

	All							
Horizon	PCE12				PCE24			
Model	Activity	Natural	Indicator	Diffusion	Activity	Natural	Indicator	Diffusion
Max	0.69	0.70	0.65	0.49	0.72	0.77	0.82	0.95
Median	0.57	0.70	0.62	0.54	0.59	0.72	0.69	0.99

Notes: Post-1984 refers to the sample from 1985 onwards. All refers to a sample that starts in 1969 for PCE (Personal Consumption Expenditures Price Index) and 1979 for CPI (Consumer Price Index). Numbers smaller than one imply that the contribution shrank.

the new period was very informative about the statistical relationship, increasing confidence in the estimates. Alternatively, large changes could follow if the data exhibited a very different statistical relationship in the recent period than in past observations; in this case, the relationship could be unstable. As we observed earlier, the first explanation is certainly a possibility for 2008–12, since all measures of economic activity were far away from their usual ranges during the Great Recession. In the experiment of figure 11, we show some evidence against the second explanation. Specifically, we estimate the activity index model at the 12-month horizon on a rolling sample of five years and plot the coefficient on the activity index.[13] The figure shows that the coefficient estimated over the last five years (the last point of the line) is not very different from estimates from previous five-year windows. Thus, we do not see obvious signs that the statistical relationship changed; the lack of predictive power that measures of economic activity exhibit against inflation changes in the latest period holds true throughout the sample and simply becomes more apparent at times of large swings in activity.

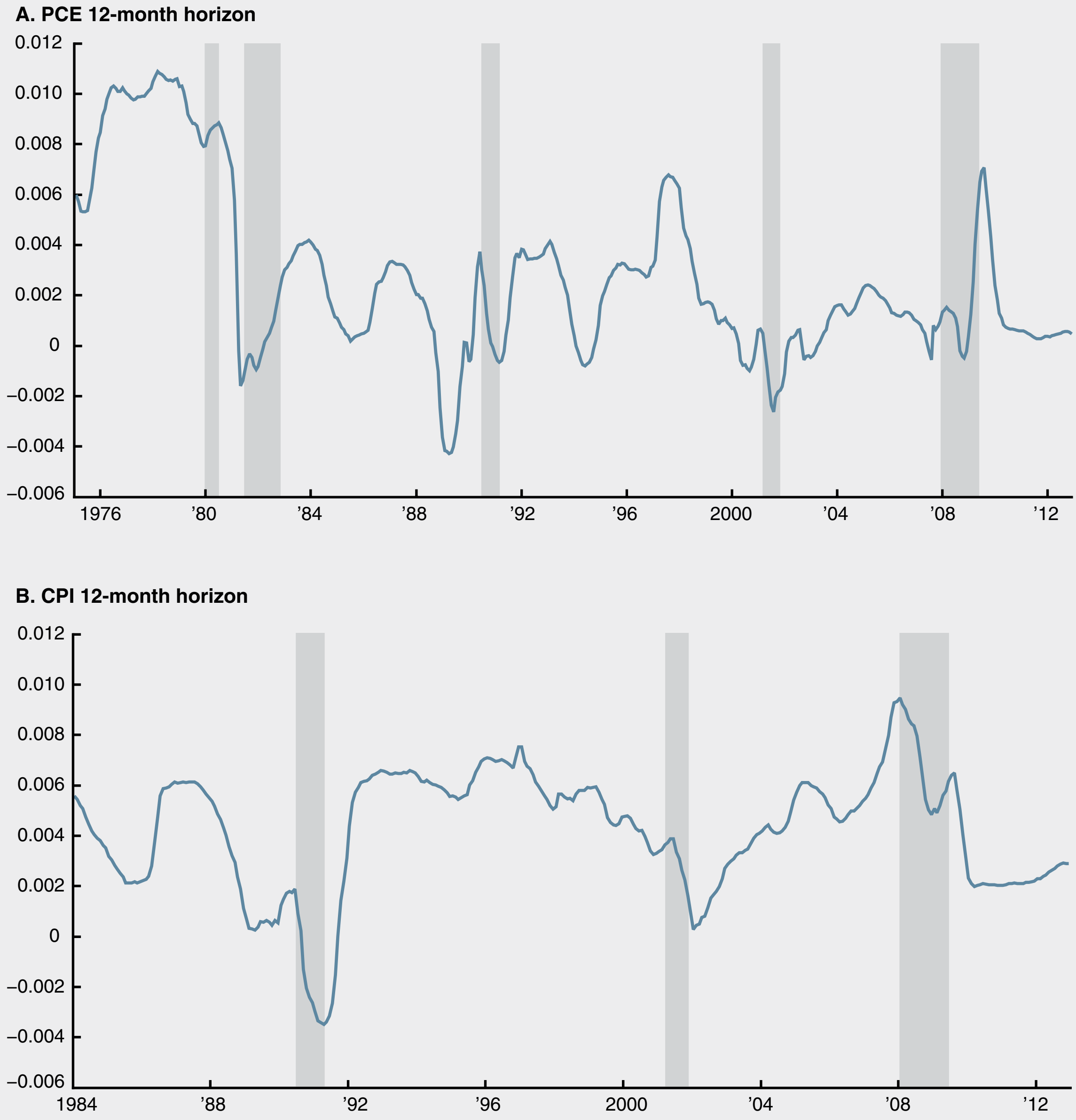
Models in levels

In this section, we consider whether a stationary model of inflation, whereby inflation is expected to always revert to a constant long-run mean, is better able to account for the inflation experience of the Great Recession. For the sake of brevity, we only consider our baseline case, which aims to forecast core PCE inflation 12 months ahead, using data from 1985 onward.

Our estimate of the autoregressive coefficient ω varies between 0.82 and 0.86 across the four models when we estimate them up to 2007: These estimates suggest a substantial amount of mean reversion. However, as shown in figure 12, estimating the model in levels rather than differences has only very subtle effects on the forecasts of inflation 12 months ahead.[14] In figure 13, we again compare the performance of the models estimated in levels and differences, but we look at the forecast of the change in inflation rather than the forecast of inflation itself. These pictures are more

FIGURE 11

Coefficient on CFNAI, five-year rolling windows

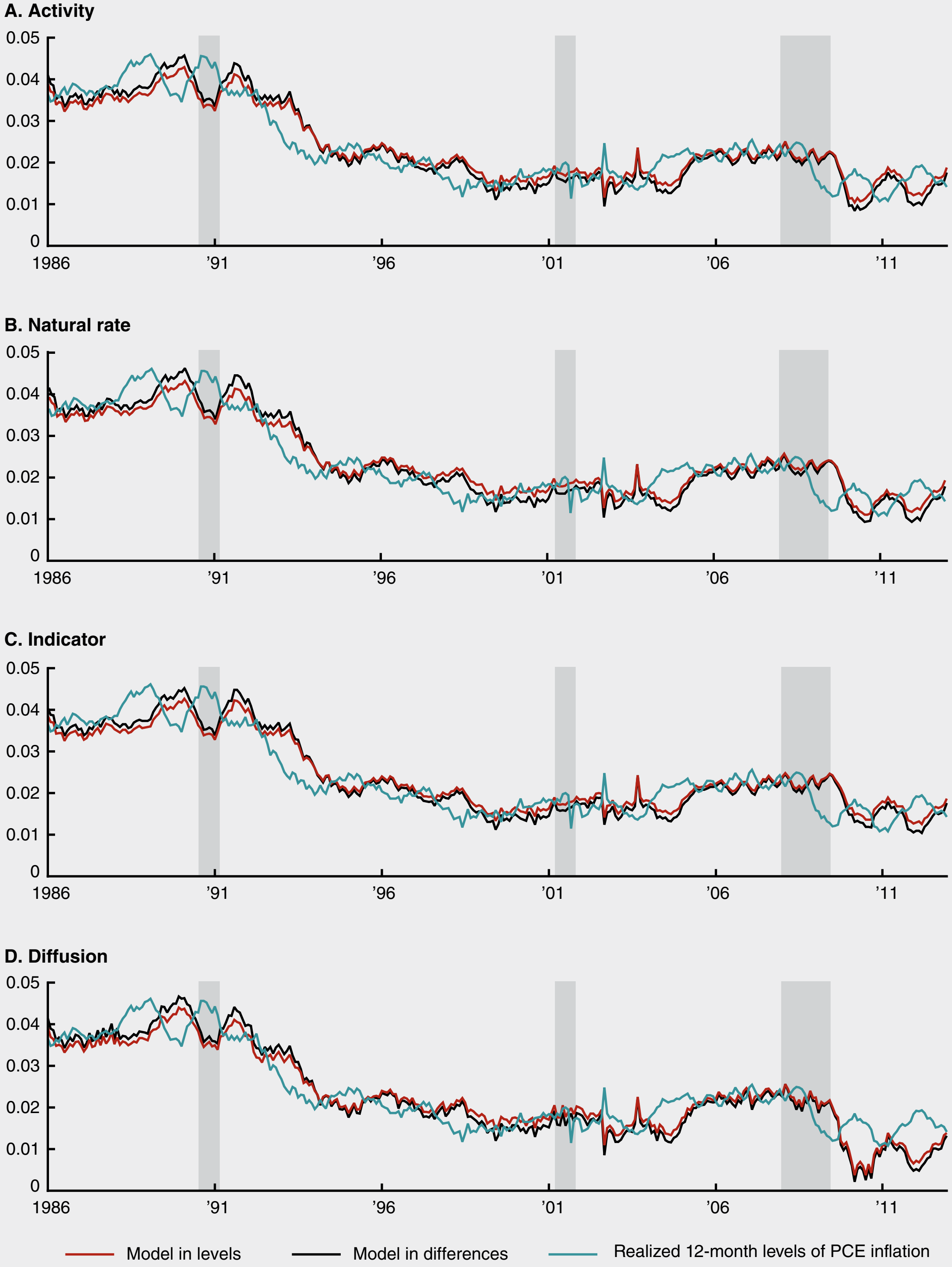


comparable to those that we introduced earlier; they also make it easier to notice the difference between the two estimation strategies. Not surprisingly, the models in levels predict lower inflation in the early part of our sample and higher inflation in the later part. This happens because inflation was higher in the first part of the sample than in the second part of the sample: Models based on differences in inflation start from a baseline assumption that inflation will stay at its current value, while models in levels predict that inflation will revert to the mean and thus trend lower when it is above its sample mean and higher in the opposite case. The predicted mean reversion contributes to moderating the forecast errors since the Great Recession, but it does not qualitatively alter our conclusion that the models predicted the most disinflation at a time in which inflation was instead increasing.

In figure 14 (p. 96), we repeat the exercise of figure 7 for the models estimated in inflation levels. Specifically, we look at the contribution that the economic activity

FIGURE 12

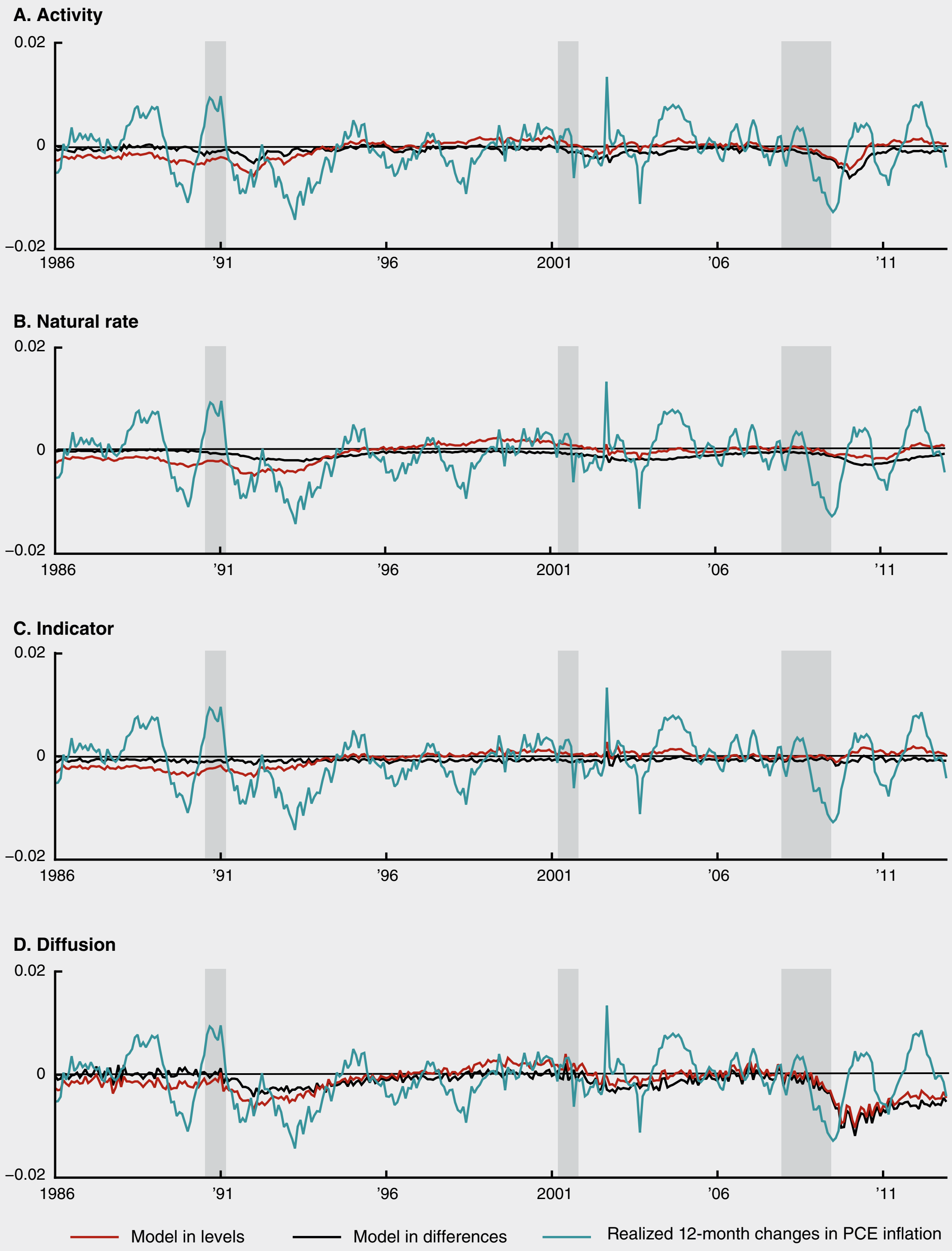
Realized 12-month PCE inflation levels vs. forecast, 1985–2007 coefficients



Note: PCE indicates Personal Consumption Expenditures Price Index.
Source: U.S. Bureau of Economic Analysis and Haver Analytics.

FIGURE 13

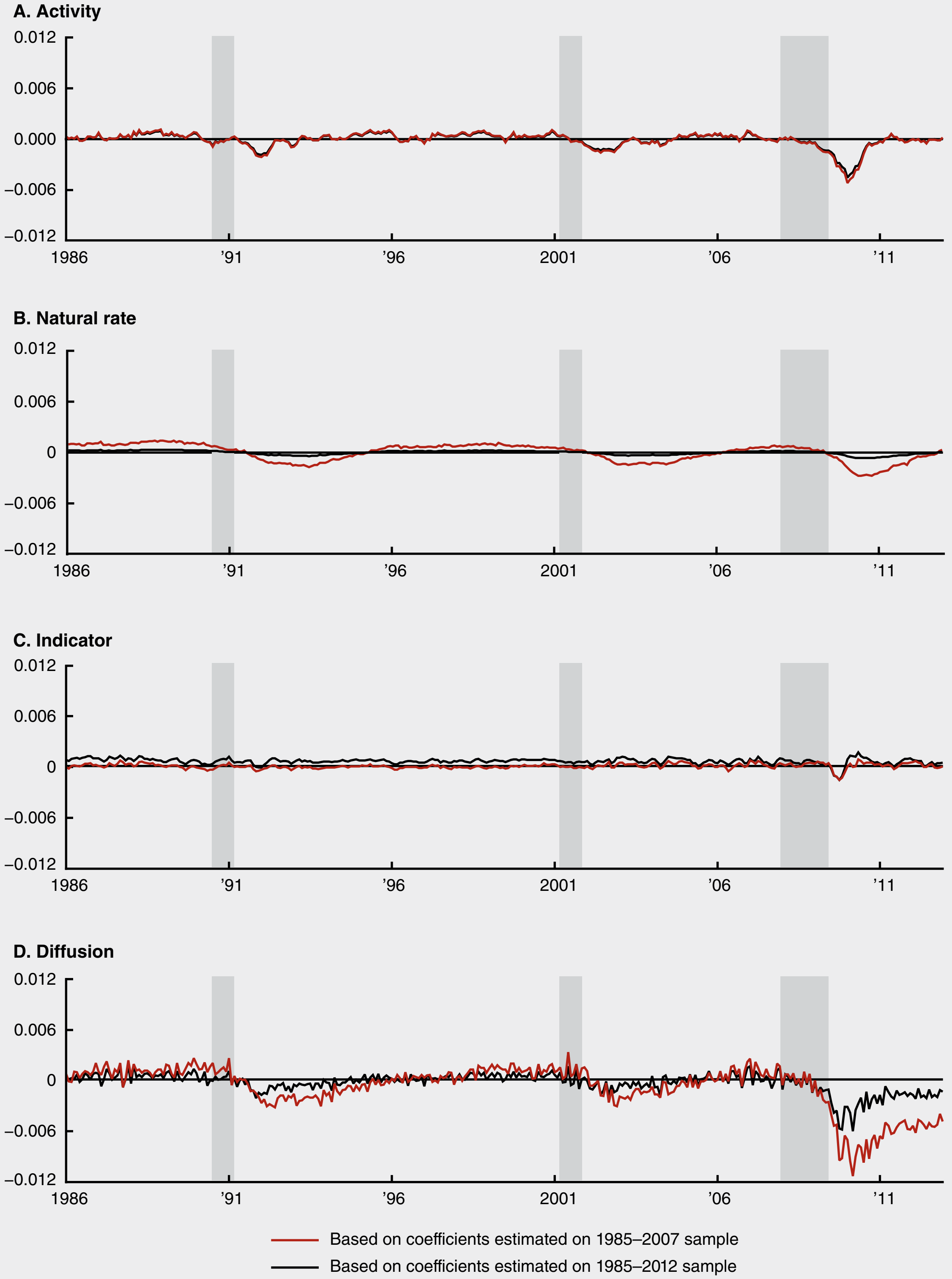
Realized 12-month PCE inflation changes vs. forecast, 1985–2007 coefficients, levels and differences



Note: PCE indicates Personal Consumption Expenditures Price Index.
Source: U.S. Bureau of Economic Analysis and Haver Analytics.

FIGURE 14

Contribution of economic activity variables, 1985–2007 and 1985–2012 coefficients, levels model



measures make at each point in time to the inflation forecast.[15] As was the case in the previous section, we see that the economic activity measures aggregated using the indicator model have almost no predictive power; for this reason, it does not matter whether the model is estimated with data up to 2007 (the red line) or 2012 (the black line). The conclusions for the natural rate and diffusion models (panels B and D, respectively) are also similar to those of the previous section: Even when we estimate inflation in levels, unemployment and the four factors of the diffusion index lose a notable fraction of their forecasting power when we include data from 2008 to 2012 in the estimation. Only the activity index model seems to perform better—while the black line is still flatter than the red line, the difference is now minor.

Figure 15 shows the contribution to the forecasted inflation change coming from the current position of inflation, that is, the value of $-(1-\omega)(\pi_t^{12}-\bar{\pi})$ in equation 2, where $\bar{\pi}$ is the sample mean of inflation, to which inflation is expected to revert in the long run. When inflation reached a low of 1.2 percent in July 2009, this contribution was positive and pointed the models toward a recovery in inflation; this force, which was not present by construction when we estimated the models in differences, gave the estimates based on equation 2 a slight edge over those based on equation 1. Nonetheless, the magnitude of the contribution in figure 15 is much smaller than that in figure 14. With the exception of the indicator model (panel C), economic weakness remained the dominant force driving forecasts of inflation changes, with further disinflation predicted throughout the period to 2012.

To complete our analysis of estimates based on mean-reverting models of inflation, we perform the analogous computation from table 1 in table 2. Here, we look at the contributions that economic indicators make to forecasted inflation changes based on data up to 2012 versus data up to 2007. The shrinkage in the estimated importance of activity measures is less pronounced than in table 1, confirming that our models perform better when we allow for mean reversion in inflation. Nonetheless, the ratios in table 2 remain largely well below 1; so even accounting for mean reversion, in the last five years inflation responded less to economic weakness than the models would have predicted. The natural rate model, based on unemployment, is subject to the most dramatic revision. The indicator model stands out as an exception; as noted earlier, even with data up to 2007, its indicator variables as a group had no predictive power for inflation.

Conclusion

We have shown that measures of economic activity and labor market conditions have not been helpful in predicting the evolution of inflation since 2008. This phenomenon is usually interpreted as a "flattening" of the Phillips curve, the relationship between unemployment (or other measures of economic activity) and inflation. A flattening of this curve would imply that unemployment would have to change more than in the past to have a detectable impact on inflation. Our analysis was based on purely statistical models, which cannot be used to analyze the consequences of alternative monetary and fiscal policies. However, when a flat Phillips curve is embedded in a full general equilibrium model, such as that of Smets and Wouters (2003), it implies that monetary policy can be most effective at stabilizing output, with minimal consequences for inflation, at least as long as interest rates do not drop to the zero lower bound. The converse of this observation is that a flat Phillips curve presents a difficult challenge for monetary policy should inflation drift up from the central bank target, because it would then take an extreme downturn to rein inflation in.

However, our results offer an alternative explanation. Specifically, the degree by which the statistical relationship between economic activity and output has become flatter—as well as the fact that models would often predict not only the wrong magnitude of the response of inflation, but also the wrong *direction*—may offer support to the idea of a *vertical* Phillips curve, where the determinants of (forecastable) inflation changes are unrelated to economic activity, such as in the model of Lucas (1972). This model would have diametrically opposed implications for policy, suggesting that (the systematic component of) monetary policy can be most effective at controlling inflation, while having little or no direct impact on measures of economic activity. The policy implications of a situation in which a central bank misperceives the policy-relevant trade-off between inflation and unemployment have been studied by Sargent (1999) and Cogley and Sargent (2005).

The two competing explanations for the behavior of inflation in recent years also offer different assessments of how monetary policy has fared in its quest to achieve maximum employment and stable prices. Under the first explanation, inflation was bound to remain more or less stable with little effort on the part of monetary authorities. In normal circumstances, monetary policy could have done more to stimulate aggregate demand and overcome weakness in economic activity, but recently it was hamstrung by the zero bound on nominal interest rates, which forced the use

FIGURE 15

Contribution of inflation level to forecasted inflation changes, 1985–2007 and 1985–2012 coefficients, levels model

Note: PCE indicates Personal Consumption Expenditures Price Index.

TABLE 2

Contribution of economic activity to forecasts of 12-month and 24-month inflation changes (coefficients estimated on the period to 2012 vs. the period to 2007, model in levels)

	Post-1984							
Horizon	**CPI12**				**CPI24**			
Model	**Activity**	**Natural**	**Indicator**	**Diffusion**	**Activity**	**Natural**	**Indicator**	**Diffusion**
Max	0.86	0.80	0.74	0.59	0.89	0.56	1.98	0.56
Median	0.86	0.53	1.23	0.60	0.89	0.54	1.21	0.57

	Post-1984							
Horizon	**PCE12**				**PCE24**			
Model	**Activity**	**Natural**	**Indicator**	**Diffusion**	**Activity**	**Natural**	**Indicator**	**Diffusion**
Max	0.87	0.24	1.62	0.53	1.03	0.58	1.53	0.47
Median	0.87	0.24	1.17	0.48	1.03	0.30	1.56	0.43

	All							
Horizon	**CPI12**				**CPI24**			
Model	**Activity**	**Natural**	**Indicator**	**Diffusion**	**Activity**	**Natural**	**Indicator**	**Diffusion**
Max	0.85	0.78	0.62	0.51	0.97	0.69	0.72	0.49
Median	0.85	0.63	1.05	0.57	0.97	0.44	0.93	0.51

	All							
Horizon	**PCE12**				**PCE24**			
Model	**Activity**	**Natural**	**Indicator**	**Diffusion**	**Activity**	**Natural**	**Indicator**	**Diffusion**
Max	0.70	0.69	0.77	0.59	0.75	0.87	0.86	0.61
Median	0.58	0.69	0.72	0.61	0.63	0.69	0.78	0.60

Notes: Post-1984 refers to the sample from 1985 onwards. All refers to a sample that starts in 1969 for PCE (Personal Consumption Expenditures Price Index) and 1979 for CPI (Consumer Price Index). Numbers smaller than one imply that the contribution shrank.

of alternative, less effective policy measures. If instead the second interpretation of the data is correct, stable inflation in the wake of economic turbulence was not a given, but rather a successful outcome of monetary policy that maintained control of the price level even in the face of severe adverse shocks. This stands in contrast with the experience of the 1970s, when severe economic disturbances were accompanied by increasing bouts of inflation; by avoiding a repeat of that experience, monetary policy might have contributed to mitigating uncertainty and lessening the impact of other shocks that exacted their unavoidable toll on economic activity.

NOTES

[1]More recently, Stock and Watson (2010) have suggested a new unemployment-gap metric that could be useful in forecasting inflation—this measure is the maximum between zero and the difference between the current unemployment level and the lowest unemployment observed over the previous 11 quarters. As figure A1 (p. 101) in appendix 1 shows, the relationship between this metric and changes in inflation has broken down in the past few years since Stock and Watson's paper was published.

[2]The difference between a full economic model and a purely statistical model is that the former should yield correct predictions even when policymakers adopt new rules of behavior, while the latter only yields appropriate forecasts if policymakers react to new developments following the same rules of conduct that they used in the past.

[3]The PCE Price Index is published by the U.S. Bureau of Economic Analysis, whereas the CPI is published by the U.S. Bureau of Labor Statistics.

[4]We rely on data published as of June 13, 2013.

[5]With the model in differences, a constant translates into a trend in inflation. This trend is relevant to account for the evolution of inflation since 1984. However, it is unlikely that this (negative) trend would persist into the future, with current inflation hovering between 1 percent and 2 percent. We thus experimented with removing the effect of the trend in evaluating the model forecasts for the Great Recession. This change does not have a material effect on the conclusions that we draw.

[6]For more information on the Chicago Fed National Activity Index, see www.chicagofed.org/webpages/publications/cfnai/index.cfm.

[7]The aggregation is done by taking the principal component of the series.

[8]Formally, this split is achieved by means of a band-pass filter, where we retain for forecasting purposes frequencies between two months and 12 years.

[9]As an example, unemployment in December 2008 was 7.3 percent. If we construct the trend including all the data up to 2012, we would estimate the trend to be 7.3 percent, and we would thus conclude that December 2008 was not a period of high cyclical unemployment. This is due to the fact that unemployment rose much higher in 2009 and stayed high for a protracted period of time. In contrast, if we only use data up to December 2008, the trend measure is estimated at 6.4 percent, and cyclical unemployment appears elevated. Finally, the unemployment series that we decompose into a trend and a cyclical component is itself subject to revisions over time.

[10]See appendix 2 for the list of series.

[11]The number of selected lags is as follows:

	PCE								CPI							
Sample period	***p** 12-mo**		***p** 24-mo**		***q** 12-mo**		***q** 24-mo**		***p** 12-mo**		***p** 24-mo**		***q** 12-mo**		***q** 24-mo**	
	'07	**'12**	**'07**	**'12**	**'07**	**'12**	**'07**	**'12**	**'07**	**'12**	**'07**	**'12**	**'07**	**'12**	**'07**	**'12**
Act Post-1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Act Full	0	7	0	0	11	9	10	3	0	0	0	0	0	0	4	0
Nat Post-1984	0	0	0	0	0	0	1	0	0	0	0	0	3	3	3	3
Nat Full	0	0	0	0	3	2	4	4	0	0	0	0	2	3	3	3
Diff Post-1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diff Full	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

[12]See, e.g., Stock and Watson (2007).

[13]We choose this model because it has few coefficients to estimate; in particular, we impose $p^* = q^* = 0$, as chosen by the information criterion for the full sample. With rolling five-year windows, estimates of models that feature more coefficients will become more and more unreliable.

[14]Of course, the differences would become more pronounced for forecasts of inflation over a longer time horizon.

[15]Note that the contribution to the inflation forecast is the same as the contribution to the inflation forecast *change*, since the current level of inflation from which the change occurs is known.

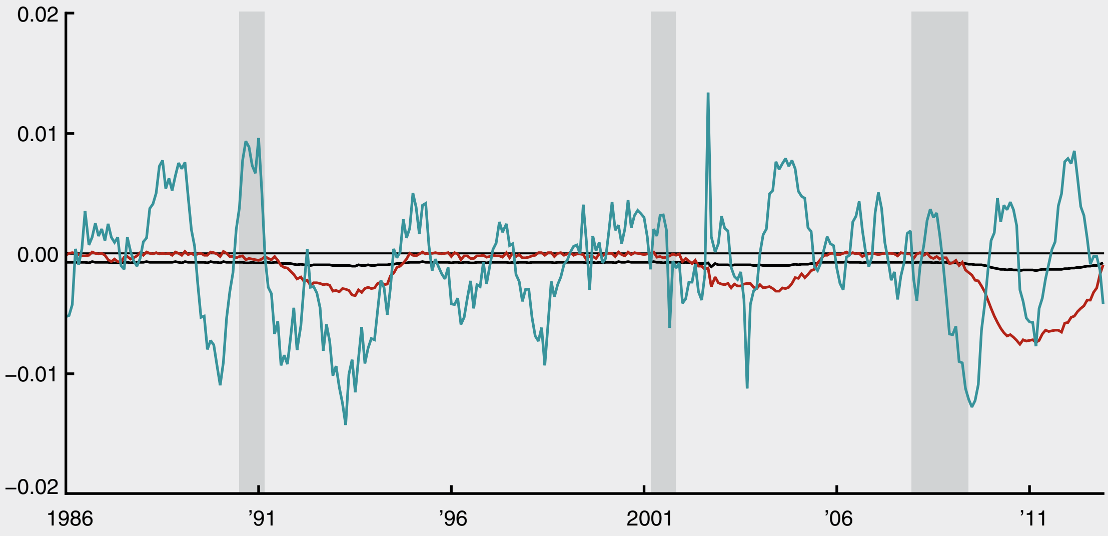
APPENDIX 1: ALTERNATIVE UNEMPLOYMENT GAP

In their quest to find a robust relationship between unemployment and expected inflation changes, Stock and Watson (2010) have suggested a new unemployment-gap metric: the maximum between zero and the difference between the current unemployment level and the lowest unemployment has been over the previous 11 quarters. Inspired by their suggestion, we changed the natural rate model to see whether this alternative measure of cyclical unemployment, active only during downturns, would help to recover a role for unemployment in predicting inflation. Since our model is based on monthly data, we change 11 quarters to 35 months. Figure A1 presents our results.[1] Stock and Watson used data up to the second quarter of 2010. Up to this point, their measure of unemployment is far from a perfect predictor of inflation, but it forecasts dips that are correctly associated with disinflation most of the time. Unfortunately, the period right after their model was designed yields very large forecast errors: As of late 2010 and early 2011, unemployment was substantially above its level of three years earlier, forecasting further disinflation, whereas inflation in fact accelerated in late 2011 and in 2012. When estimated on data from 1985 to 2012, even this new measure of cyclical unemployment loses its predictive power for inflation.

[1]It is worth noting that our model is simpler than Stock and Watson's, in which inflation is the sum of transitory and permanent components; nonetheless, we expect that the observations included here would also apply to their richer environment.

FIGURE A1

Realized 12-month PCE inflation changes vs. forecast, 1985-2007 and 1985-2012 coefficients, alternative unemployment gap



Realized 12-month changes in PCE inflation
12-month-ahead forecast based on coefficients estimated on 1969–2007 sample
12-month-ahead forecast based on coefficients estimated on 1985–2012 sample

Note: Our alternative unemployment gap uses the difference between the current unemployment level and the lowest unemployment has been over the previous 35 months. PCE indicates Personal Consumption Expenditures Price Index.
Source: U.S. Bureau of Economic Analysis and Haver Analytics.

APPENDIX 2: MONTHLY DATA, JANUARY 1969–DECEMBER 2012

Model	Mnemonic	Haver description	Haver database
Activity	le	Civilian employment: Sixteen years & over: 16 yr + (SA, 000s)	usecon
Activity	lrm25	Civilian unemployment rate: Men, 25–54 years (SA, %)	usecon
Activity	a0m005	Average weekly initial claims unemployment insurance (SA, 000s)	bci
Activity, diffusion	cbhm	Personal consumption expenditures (SAAR, chained 2000$bil.)	usecon
Activity, diffusion	cdbhm	Personal consumption expenditures: Durable goods (SAAR, chained 2000$bil.)	usecon
Activity, diffusion	cnbhm	Personal consumption expenditures: Nondurable goods (SAAR, chained 2000$bil.)	usecon
Activity, diffusion	csbhm	Personal consumption expenditures: Services (SAAR, chained 2000$bil.)	usecon
Activity, diffusion	ypdhm	Real disposable personal income (SAAR, chained 2000$bil.)	usecon
Activity, diffusion	hsm	Manufacturers' shipments of mobile homes (SAAR, units in 000s)	usecon
Activity, diffusion	hst	Housing starts (SAAR, units in 000s)	usecon
Activity, diffusion	hstmw	Housing starts: Midwest (SAAR, units in 000s)	usecon
Activity, diffusion	hstne	Housing starts: Northeast (SAAR, units in 000s)	usecon
Activity, diffusion	hsts	Housing starts: South (SAAR, units in 000s)	usecon
Activity, diffusion	hstw	Housing starts: West (SAAR, units in 000s)	usecon
Activity, diffusion	ip	Industrial Production Index (SA, 1997=100)	usecon
Activity, diffusion	ip51	Industrial Production: Consumer goods (SA, 1997=100)	usecon
Activity, diffusion	ip511	Industrial Production: Durable consumer goods (SA, 1997=100)	usecon
Activity, diffusion	ip512	Industrial Production: Nondurable consumer goods (SA, 1997=100)	usecon
Activity, diffusion	ip521	Industrial Production: Business equipment (SA, 1997=100)	usecon
Activity, diffusion	ip53	Industrial Production: Materials (SA, 1997=100)	usecon
Activity, diffusion	ip531	Industrial Production: Durable goods materials (SA, 1997=100)	usecon
Activity, diffusion	ip532	Industrial Production: Nondurable goods materials (SA, 1997=100)	usecon
Activity, diffusion	ip54	Industrial Production: Nonindustrial supplies (SA, 1997=100)	usecon
Activity, diffusion	ipb0	Industrial Production: Mining (SA, 1997=100)	usecon
Activity, diffusion	ipfp	Industrial Production: Final products (SA, 1997=100)	usecon
Activity, diffusion	ipmdg	Industrial Production: Durable goods [NAICS] (SA, 1997=100)	usecon
Activity, diffusion	ipmfg	Industrial Production: Manufacturing [SIC] (SA, 1997=100)	usecon
Activity, diffusion	ipmnd	Industrial Production: Nondurable manufacturing (SA, 1997=100)	usecon
Activity, diffusion	iptp	Industrial Production: Final products and nonindustrial supplies (SA, 1997=100)	usecon
Activity, diffusion	iputl	Industrial Production: Electric and gas utilities (SA, 1997=100)	usecon
Activity, diffusion	laconsa	All employees: Construction (SA, 000s)	usecon
Activity, diffusion	ladurga	All employees: Durable goods manufacturing (SA, 000s)	usecon
Activity, diffusion	lafirea	All employees: Financial activities (SA, 000s)	usecon
Activity, diffusion	lagooda	All employees: Goods-producing industries (SA, 000s)	usecon
Activity, diffusion	lagovta	All employees: Government (SA, 000s)	usecon
Activity, diffusion	lamanua	All employees: Manufacturing (SA, 000s)	usecon
Activity, diffusion	laminga	All employees: Mining (SA, 000s)	usecon
Activity, diffusion	lanagra	All employees: Total nonfarm (SA, 000s)	usecon
Activity, diffusion	landura	All employees: Nondurable goods manufacturing (SA, 000s)	usecon
Activity, diffusion	lapriva	All employees: Total private industries (SA, 000s)	usecon
Activity, diffusion	lawtrda + lartrda	All employees: Wholesale and Retail trade (SA, 000s)	usecon
Activity, diffusion	laserpa	All employees: Service-providing industries (SA, 000s)	usecon
Activity, diffusion	lainfoa + lapbsva + laeduha + laleiha + lasrvoa	All employees: Aggregate of categories	usecon
Activity, diffusion	lattula - lawtrda - lartrda	All employees: Aggregate of categories	usecon
Activity, diffusion	lena	Civilian employment: Nonagricultural Industries: 16yr + (SA, 000s)	usecon
Activity, diffusion	lhelpr	Ratio: Help-wanted advertising in newspapers/Number unemployed (SA)	usecon
Activity, diffusion	lomanua	Average weekly hours: Overtime: Manufacturing (SA, Hrs)	usecon

APPENDIX 2: MONTHLY DATA, JANUARY 1969–DECEMBER 2012 *(continued)*

Model	Mnemonic	Haver description	Haver database
Activity, diffusion	lrmanua	Average weekly hours: Manufacturing (SA, Hrs)	usecon
Activity, diffusion	napmc	ISM Mfg: PMI Composite Index (SA, 50+ = Econ Expand)	usecon
Activity, diffusion	napmei	ISM Mfg: Employment Index (SA, 50+ = Econ Expand)	usecon
Activity, diffusion	napmii	ISM Mfg: Inventories Index (SA, 50+ = Econ Expand)	usecon
Activity, diffusion	napmni	ISM Mfg: New Orders Index (SA, 50+ = Econ Expand)	usecon
Activity, diffusion	napmoi	ISM Mfg: Production Index (SA, 50+ = Econ Expand)	usecon
Activity, diffusion	rsdh	Real retail sales: Durable goods (SA, chained 2000$mil.)	usecon
Activity, diffusion	rsh, rsh2	Retail sales: Retail trade (SA, Spliced, chained 2000$mil.)	usecon
Activity, diffusion	rsnh	Real retail sales: Nondurable goods (SA, chained 2000$mil.)	usecon
Activity, diffusion	timdh, timdh2	Real inventories: Mfg: Durable goods industries (SA, EOP, spliced, chained 2000$mil.)	usecon
Activity, diffusion	timh, timh2	Real manufacturing & trade inventories: Mfg industries (SA, EOP, spliced, chained 2000$mil.)	usecon
Activity, diffusion	timnh, timnh2	Real mfg inventories: Nondurable goods industries (SA, EOP, spliced, chained 2000$mil.)	usecon
Activity, diffusion	tirh, tirh2	Real inventories: Retail trade industries (SA, EOP, spliced, chained 2000$mil.)	usecon
Activity, diffusion	tith, tith2	Real manufacturing & trade inventories: Industries (SA, EOP, spliced, chained 2000$mil.)	usecon
Activity, diffusion	tiwh, tiwh2	Real inventories: Merchant wholesale trade industries (SA, EOP, spliced, chained 2000$mil.)	usecon
Activity, diffusion	trmh, trmh2	Real inventories/sales ratio: Manufacturing industries (SA, spliced, chained 2000$)	usecon
Activity, diffusion	trrh, trrh2	Inventories/sales ratio: Retail trade industries (SA, spliced, chained 2000$)	usna
Activity, diffusion	trth, trth2	Real manufacturing & trade: Inventories/sales ratio (SA, spliced, chained 2000$)	usna
Activity, diffusion	trwmh, trwmh2	Inventories/sales ratio: Merchant wholesale trade industries(SA, spliced, chained 2000$)	usna
Activity, diffusion	tsmdh, tsmdh2	Real sales: Mfg: Durable goods industries(SA, spliced, chained 2000$mil.)	usna
Activity, diffusion	tsmh, tsmh2	Real sales: Manufacturing industries (SA, spliced, chained 2000$mil.)	usna
Activity, diffusion	tsmnh, tsmnh2	Real sales: Mfg: Nondurable goods industries (SA, spliced, chained 2000$mil.)	usna
Activity, diffusion	tsth, tsth2	Real manufacturing & trade sales: All industries (SA, spliced, chained 2000$mil.)	usna
Activity, diffusion	tswmdh	Real sales: Merchant wholesalers: Durable goods inds. (SA, spliced, chained 2000$mil.)	usna
Activity, diffusion	tswmh, tswmh2	Real sales: Merchant wholesale trade industries (SA, spliced, chained 2000$mil.)	usna
Activity, diffusion	tswmnh, tswmnh2	Real sales: merchant wholesale: Nondurable goods inds. (SA, spliced, chained 2000$mil.)	usna
Activity, diffusion	ypltpmh	Real personal income less transfer payments (SAAR, chained 2000$bil.)	usecon
Activity, diffusion	cdvhm, cdvh	PCE: Durable goods: Motor vehicles and parts (SAAR, spliced and interpolated, chained 2000$mil.)	usna
Activity, diffusion	a0m007	Manufacturers’ new orders: Durable goods (SA, chained 2000$mil.)	bci
Activity, diffusion	a0m008	Manufacturers’ new orders: Consumer goods & materials (SA, 1982$mil.)	bci
Activity, diffusion	a0m027	Manufacturers’ new orders: Nondefense capital goods (SA, 1982$mil.)	bci
Activity, diffusion, indicators	hpt	New private housing units authorized by building permit (SAAR, units in 000s)	usecon
Activity, diffusion, indicators	cumfg	Capacity utilization: Manufacturing [SIC] (SA, % of capacity)	usecon
Activity, diffusion	lhelp	Index of help-wanted advertising in newspapers (SA, 1987=100)	usecon
Activity, diffusion	lr	Civilian unemployment rate: 16yr + (SA, %)	usecon
Activity, indicators	napmvdi	ISM: Mfg: Vendor Deliveries Index (SA, 50+ = Econ Expand)	usecon
Diffusion	cexp	University of Michigan: Consumer expectations (NSA, 66Q1=100)	usecon
Diffusion	lu0	Civilians unemployed for less than 5 weeks (SA, 000s)	usecon
Diffusion	lu15	Civilians unemployed for 15–26 weeks (SA, 000s)	usecon
Diffusion	lu5	Civilians unemployed for 5–14 weeks (SA, 000s)	usecon
Diffusion	luad	Average {Mean} duration of unemployment (SA, weeks)	usecon
Diffusion	lut15	Civilians unemployed for 15 weeks and over (SA, 000s)	usecon
Diffusion	lut27	Civilians unemployed for 27 weeks and over (SA, 000s)	usecon
Diffusion	faram	Adjusted monetary base (SA, $mil.)	usecon
Diffusion	farat	Adjusted reserves of depository institutions (SA, $mil.)	usecon
Diffusion	farmsr	Adj. monetary base including deposits to satisfy clearing balance contracts (SA, $bil.)	usecon
Diffusion	fm1	Money stock: M1 (SA, $bil.)	usecon

APPENDIX 2: MONTHLY DATA, JANUARY 1969–DECEMBER 2012 *(continued)*

Model	Mnemonic	Haver description	Haver database
Diffusion	fm2c	Real money stock: M2 (SA, chained 2000$bil.)	usecon
Diffusion	fm3	Money stock: M3 (SA, $bil.)	usecon
Diffusion	fxtwb	Nominal broad trade-weighted exchange value of US$ (JAN 97=100)	usecon
Diffusion	fxuk	Foreign exchange rate: United Kingdom (US$/Pound)	usecon
Diffusion	faaa	Moody's seasoned Aaa corporate bond yield (% p.a.)	usecon
Diffusion	fbaa	Moody's seasoned Baa corporate bond yield (% p.a.)	usecon
Diffusion	faaa - ffed	Moody's seasoned Aaa corporate bond yield – fed funds rate(% p.a.)	usecon
Diffusion	fbaa - ffed	Moody's seasoned Baa corporate bond yield – fed funds rate (% p.a.)	usecon
Diffusion	sdy5comm	S&P: Composite 500, dividend yield (%)	usecon
Diffusion	sp500	Stock Price Index: Standard & Poor's 500 Composite (1941–43=10)	usecon
Diffusion	spe5comm	S&P: 500 Composite, P/E ratio, 4-qtr trailing earnings	usecon
Diffusion	spny	Stock Price Index: NYSE Composite (Avg, Dec. 31, 2002=5000)	usecon
Diffusion	spspi	Stock Price Index: Standard & Poor's 400 Industrials (1941–43=10)	usecon
Diffusion	ftbs3	3-month Treasury bills, secondary market (% p.a.)	usecon
Diffusion	ftbs6	6-month Treasury bills, secondary market (% p.a.)	usecon
Diffusion	ftbs3 - ffed	3-month Treasury bills – fed funds rate, (% p.a.)	usecon
Diffusion	ftbs6 - ffed	6-month Treasury bills – fed funds rate (% p.a.)	usecon
Diffusion	fcm1	1-year Treasury bill yield at constant maturity (% p.a.)	usecon
Diffusion	fcm5	5-year Treasury note yield at constant maturity (% p.a.)	usecon
Diffusion	fcm1 - ffed	1-year Treasury bill yield at constant maturity – fed funds rate (% p.a.)	usecon
Diffusion	fcm5 - ffed	5-year Treasury note yield at constant maturity – fed funds rate (% p.a.)	usecon
Diffusion	fcm10 - ffed	10-year Treasury note yield at constant maturity – fed funds rate (% p.a.)	usecon
Diffusion	sp1000	PPI: Crude materials for further processing (SA, 1982=100)	usecon
Diffusion	sp3100	PPI: Finished consumer goods (SA, 1982=100)	usecon
Diffusion	pcua	CPI-U: Apparel (SA, 1982–84=100)	usecon
Diffusion	pcucc	CPI-U: Commodities (SA, 1982–84=100)	usecon
Diffusion	pcuccd	CPI-U: Durables (SA, 1982–84=100)	usecon
Diffusion	pcucs	CPI-U: Services (SA, 1982–84=100)	usecon
Diffusion	pcum	CPI-U: Medical care (SA, 1982–84=100)	usecon
Diffusion	pcu	CPI-U: All Items (SA, 1982–84=100)	usecon
Diffusion	pcuslf	CPI-U: All items less food (SA, 1982–84=100)	usecon
Diffusion	pcuslm	CPI-U: All items less medical care (SA, 1982–84=100)	usecon
Diffusion	pcusls	CPI-U: All items less shelter (SA, 1982–84=100)	usecon
Diffusion	pcut	CPI-U: Transportation (SA, 1982–84=100)	usecon
Diffusion	jcdm	PCE: Durable goods: Chain Price Index (SA, 2000=100)	usna
Diffusion	jcm	PCE: Personal consumption expenditures: Chain Price Index (SA, 2000=100)	usna
Diffusion	jcnm	PCE: Nondurable goods: Chain Price Index (SA, 2000=100)	usna
Diffusion	jcsm	PCE: Services: Chain Price Index (SA, 2000=100)	usna
Diffusion	leconsa	Avg hourly earnings: Construction (SA, $/Hr)	usecon
Diffusion	lemanua	Avg hourly earnings: Manufacturing (SA, $/Hr)	usecon
Diffusion	a0m101	Commercial & industrial loans outstanding (EOP, SA, chained 2000$mil.)	bci
Diffusion	mom	Manufacturers' New Orders (SA, Mil. $)	usecon
Diffusion	mum	Manufacturers' Unfilled Orders (EOP, SA, Mil. $)	usecon
Diffusion	modgu	Mfrs' New Orders: Durable Goods Industries With Unfilled Orders (SA, Mil. $)	usecon
Diffusion	mudg	Mfrs' Unfilled Orders: Durable Goods Industries (EOP, SA, Mil. $)	usecon
Diffusion	mong	Mfrs' New Orders: Nondurable Goods Industries (SA, Mil. $)	usecon
Diffusion	fxjap	Foreign exchange rate: Japan (Yen/US$)	usecon
Diffusion	fxcan	Foreign exchange rate: Canada (C$/US$)	usecon

APPENDIX 2: MONTHLY DATA, JANUARY 1969–DECEMBER 2012 *(continued)*

Model	Mnemonic	Haver description	Haver database
Diffusion	fxsw	Foreign exchange rate: Switzerland (Franc/US$)	usecon
Diffusion	fxger	Foreign exchange rate: Germany (D. Mark/US$)	usecon
Activity, diffusion	jfns, cpv, cpvr	Value of private construction put in place (SAAR, chained $mil.)	usna
Activity, diffusion	gfnis, gfnisq, gsis, gsisq, cpg	Value of public construction put in place (SAAR, chained $mil.)	usecon
Diffusion, indicators	fm2	Money stock: M2 (SA, $bil.)	usecon
Diffusion, indicators	fcm10	10-year Treasury note yield at constant maturity (% p.a.)	usecon
Diffusion	ffed	Federal funds [effective] rate (% p.a.)	usecon
Diffusion, indicators	sp2000	PPI: Intermediate materials, supplies, and components (SA, 1982=100)	usecon
Diffusion, indicators	sp3000	PPI: Finished goods (SA, 1982=100)	usecon
Diffusion, indicators	napmpi	ISM: Mfg: Prices Index (NSA, 50+ = Econ Expand)	usecon
Indicators	zlead	Composite Index of 10 Leading Indicators (1996=100)	bci
Indicators	jfns, cpv, cpvr, gfnis, gfnisq, gsis, gsisq, cpg	New construction put in place (SAAR, 2000$mil.)	usecon, usna
Indicators	hn1us	New single-family houses sold: United States (SAAR, 000s)	usecon
Indicators	chm	Personal consumption expenditures (SAAR, chained 2000$mil.) (spliced from usna96 before 1990)	usna
Indicators	fcm3 - fcm1	3-year/1-year T-bill spread	usecon
Indicators	fxtwm	Nominal trade-weighted exch value of US$/major currencies (MAR 73=100)	usecon
Indicators	pzgld	Cash prices: gold, Handy & Harman Base Price (avg, spliced, $/Troy oz)	weekly
Indicators	pzsil	Cash price: silver, troy oz, Handy & Harman Base Price (avg, $/troy oz)	weekly
Indicators	pzall	KR-CRB Spot Commodity Price Index: All commodities	usecon
Indicators	spwpc	SPOT COMMODITY PRICE - PLYWOOD, CROWS (PUIWMWPC_N.WT)	
Indicators	pfall	KR-CRB Futures: All commodities (avg, 1967=100)	weekly
Indicators	p101	PPI: Iron and steel (NSA, 1982=100)	usecon
Indicators	ueg	CPI-U: Energy (SA, 1982–84=100)	cpidata
Indicators	ffed - ffed{1}	Change in federal funds [effective] rate (% p.a.)	usecon
Natural rate	ra16	Unemployment gap constructed from 16+ unemployment rate (SA)	empl
Prices	jcxfem	PCE less food and energy: Price Index (SA) (2005=100)	usna
Prices	pculfer	CPI less food and energy: Price Index (SA) (Dec 1977 = 100)	usecon
		Indicator model groups:	
COMEX	http://www.wrenresearch.com.au/downloads/index.htm	1: Economic activity	
FSC	http://www.webspace4me.net/~blhill2/data/commodities	2: Slackness measures	
BCRB	http://economic-charts.com/em-cgi/data.exe/crb/crb01	3: Housing and building activity	
FAME	Federal Reserve Bank of San Francisco website	4: Industrial prices	
		5: Financial markets	

Source: Haver Analytics, FAME database.

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