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The Case for Higher Frequency Inflation Expectations

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Abstract:

I present evidence that higher frequency measures of inflation expectations outperform lower frequency measures of inflation expectations in tests of accuracy, predictive power, and rationality. For decades, the academic literature has focused on three survey measures of expected inflation: the Livingston Survey, the Survey of Professional Forecasters, and the Michigan Surveys of Consumers. While these measures have been useful in developing models of forecasting inflation, the data are low frequency measures that are anachronistic in the modern era of high frequency and real-time data. I present a collection of 37 different measures of inflation expectations, including many previously unexploited monthly and real-time measures of inflation expectations. These higher frequency measures tend to outperform the standard three low frequency survey measures in tests of accuracy, predictive power, and rationality, indicating that there are benefits to using higher frequency measures of inflation expectations. Out of sample forecasts confirm the findings.

The Case for Higher Frequency Inflation Expectations

I. Introduction

The importance of inflation expectations, for the real economy as well as for financial markets, cannot be overstated. Inflation expectations play a critical role in the Federal Reserve's determination of monetary policy and in establishing the Fed's credibility among market participants. Expectations of inflation are embedded in the investment and financing decisions of firms, the labor contract negotiations of managers and employees, and the consumption, investment, and savings decisions of individuals. For decades, economists have relied on a standard set of three survey measures of expected inflation, namely the semiannual Livingston Survey, the quarterly Survey of Professional Forecasters, and the quarterly Michigan Surveys of Consumers.[2] These three low frequency survey measures have been useful in developing models of inflation expectations formation, and in testing the rational expectations hypothesis.[3] Given the importance of inflation expectations, and the considerable attention the subject has received in the academic literature, it is somewhat surprising that economists have not endeavored to look beyond the standard set of three surveys to develop a more comprehensive set of measures to gauge inflation expectations. In particular, it seems odd that in a world driven by real-time information, economists are still relying on quarterly and semi-annual measures of inflation expectations, when higher frequency measures exist and are readily available.

In this paper, I introduce a collection of monthly and real-time measures of inflation expectations, and compare the performance of these higher frequency measures with the standard three quarterly and semi-annual surveys. I run a horserace between all the measures and compare their accuracy, predictive content, and rationality. The paper follows the spirit and methodology set forth in Thomas (1999), Grant and Thomas (1999), and Mehra (2002). I examine two types of measures – numerical forecasts of the inflation rate (survey-based and market-implied) and diffusion-style indexes (survey based) of the expected direction of inflation. The numerical forecasts are tested for accuracy by comparing summary statistics of the forecasting errors. A test of equal forecast accuracy is performed to evaluate competing numerical forecasts. The predictive content of both the numerical forecast and diffusion index inflation expectations measures are assessed with a test for Granger causality. Rationality for all measures is evaluated with tests for unbiasedness and efficiency. Out of sample tests of forecast accuracy are also conducted. By performing this analysis, I seek to answer the following questions:

[2] Data were quarterly prior to 1976 and monthly thereafter, but most researchers use only the quarterly data.

[3] Term-structure models, ARIMA time series models, and Phillips Curve motivated models of inflation expectations are important tools as well, but those are not emphasized here since the focus is mainly on survey expectations.

1) Are the higher frequency measures of inflation expectations accurate, predictive and rational compared to the standard three low-frequency surveys?

2) How does the out-of-sample forecasting performance of these higher frequency indicators compare to the low-frequency inflation expectations survey data?

3) Does it pay to venture beyond the status quo in terms of the economists' data set, or are economists correct in sticking with data that are tried and true?

The goal is to evaluate a set of unexploited measures of inflation expectations and determine if the academic literature has been correct in ignoring these measures, or if some of these measures could potentially replace or enhance the standard economists' data set on inflation expectations. The paper is organized as follows: Section II provides a brief review of related literature, Section III contains a description of the inflation expectations measures, Section IV describes the methodology, Section V presents the results, and Section VI concludes.

II. Literature Review

For decades, the academic literature has devoted significant efforts to developing and evaluating methods of forecasting inflation. In addition to other methods of forecasting inflation, a large body of literature has evolved on the subject of survey-based inflation expectations, with researchers debating and discussing the rationality, accuracy, and predictive power of these measures. The vast majority of these studies focus on three surveys: the Livingston Survey, the Michigan Survey, and the Survey of Professional Forecasters (SPF). Thomas (1999) examines consensus forecasts of economists from the Livingston Survey and households from the Michigan Survey, and finds that these surveys outperform benchmark forecasts generated by a naïve model of lagged inflation and by the Fisher relation. In addition, households outperform economists in tests of accuracy and unbiasedness. Grant and Thomas (1999) provide evidence that the Livingston and Michigan survey measures of expected inflation are cointegrated with actual inflation realizations, supporting weak-form rationality of these survey respondents. Mehra (2002) examines the accuracy, predictive content, and rationality of the Livingston, Michigan, and SPF surveys, and reports that Michigan outperforms Livingston and SPF.

The Phillips curve has long been a standard tool for economists in forecasting inflation. Stock and Watson (1999) present an authoritative study of Phillips curve models and find that inflation forecasts generated by the Phillips curve produce the most accurate and reliable forecasts over the 1970-1996 period, compared with inflation forecasts using other macroeconomic variables and economic indicators. In addition, the authors find that the best-performing Phillips curve specification is one that uses a new composite index of aggregate economic activity comprising 168 individual activity measures, including surveys.

Indeed, an extensive literature has evolved on empirical factor models that exploit information from large data sets to predict key economic quantities such as inflation. Stock and Watson (2002) show that, when compared to standard benchmark models such as autoregressive, leading indicator, Phillips curve, and vector autoregressive models, the best forecast of inflation is obtained from a model employing lagged inflation and a single composite factor, constructed from a large set of indicators, including surveys. Other researchers, such as Guzmán (2003) have demonstrated that composite factors extracted from large data sets that include surveys along with other macroeconomic indicators can be effectively used to forecast aggregate stock returns. Guzmán (2008) shows how a composite factor constructed from a collection of surveys can improve both nowcasts and forecasts of aggregate stock returns as well as GDP growth. Similarly, Giannone, Reichlin, and Small (2008) show that composite factors obtained from high-frequency macroeconomic indicators and soft information such as surveys can significantly improve both nowcasts and forecasts of GDP growth. Surveys are gaining credibility as an important economic forecasting tool.

Economists currently rely on four primary methods of forecasting inflation: time series ARIMA models, forecasting regressions using variables motivated by the Phillips curve, term structure models, and inflation expectations derived from surveys of households and economists. Presumably, those economists participating as survey respondents are using some variation of the three non-survey methods to forecast inflation. Ang, Bekaert, and Wei (2007) compare and contrast these four methods of inflation forecasting and find that surveys outperform the other three methods. Adjustments to account for linear and non-linear bias in the survey data produce worse out-of-sample forecasting results than using the unadjusted survey median forecasts. In addition, the authors investigate models of combined forecasts and find that surveys outperform other model combinations, and when combined with other forecasts, the data tend to overweight survey forecasts and underweight the other forecasting methods.

However, Ang et. al. (2007), like others before them, examine only the three standard low frequency surveys – the quarterly Michigan Survey, the quarterly Survey of Professional Forecasters, and the semiannual Livingston Survey. Because of the long tradition these surveys have in the academic literature, many researchers are mistakenly under the impression that these three surveys are the *only available* surveys containing data on inflation expectations. In fact, there are at least 36 different survey measures of U.S. inflation expectations, available from a variety of sources, covering a wide range of respondent universes – households, businesses, economists, investors, manufacturers, retailers, and others. I examine a total of 37 different measures of inflation expectations, subjecting these measures to a battery of tests for accuracy, predictive content, and rationality, following the methods set forth in Thomas (1999), Grant and Thomas (1999), and Mehra (2002).[4]

[4] I examine 37 different measures of inflation expectations in this paper, but only 36 are survey-based measures, as the TIPS spread is a market-implied measure.

III. Description of Inflation Expectations Measures

In total, I examine 37 measures of inflation expectations from 14 sources. There are 36 survey measures and one market-implied measure. Table 1 contains the complete list and description of the indicators. A brief description of each data source follows, with an indication of the respondent universe and whether the measure is a diffusion-style index (D) or a numerical forecast (N).

1. Small Business Optimism Index (Businesses) (D) - The National Federation of Independent Business, the leading small business association representing small and independent businesses, began surveys of its members in October, 1973. Surveys were conducted in the first month of each quarter through 1985, when monthly surveys were instituted. The survey conducted in the first month of each quarter is based on between 1,200 and 2,000 respondents, while the following two monthly surveys contain between 400 and 700 respondents. Respondents are asked about current business conditions and their expectations for business conditions three months hence.[5]

2. Philadelphia Federal Reserve (Manufacturers) (D) – The *Business Outlook Survey* is a monthly survey of manufacturers in the Third Federal Reserve District (Philadelphia Federal Reserve). Participants indicate the direction of change in overall business activity and in the various measures of activity at their plants: employment, working hours, new and unfilled orders, shipments, inventories, delivery times, prices paid, prices received, and expectations for business conditions six months hence. The survey has been conducted each month since May, 1968.[6]

3. Richmond Federal Reserve (Manufacturers) (D) – The Fifth District (Richmond Federal Reserve) conducts the Survey of Manufacturing Activity. Each month, the Survey of Manufacturing Activity is sent electronically or by mail to about 220 contacts whose firm type, firm size and location collectively match the profile of overall manufacturing in the District. In a typical month, approximately 100 contacts respond to the survey. Respondents provide information on current activity, including shipments, new orders, order backlogs, and inventories. In addition, manufacturers inform the Richmond Fed about employment conditions, prices and their expectations of business activity for the next six months. The summary results of each survey are provided to the public on the fourth Tuesday of the month.

4. Richmond Federal Reserve (Services) (D) – The Fifth District conducts the Survey of Services and Retail Activity. The monthly Survey of Services and Retail Activity is available electronically and by mail to retailers and services firms, which are selected for participation according to their type of business, location, and firm size. About 200 contacts receive questionnaires and approximately 90 to 95 of those surveyed respond in a typical month. Retailers provide information on sales revenues, big-ticket sales, inventories, and shopper traffic.

[5] Source: National Federation of Independent Business Owners
[6] Source: Philadelphia Federal Reserve

Respondents at services firms also report on their revenues. In addition, both sets of respondents provide information on employment and wages, prices, and expectations for customer demand during the next six months. Respondents indicate whether measures of activity rose, were unchanged, or decreased since the last survey. The responses are converted into diffusion indexes by subtracting the percentage of reported decreases from the percentage of increases. The summary results of each survey are provided to the public on the fourth Tuesday of the month.[7]

5. Kansas City Federal Reserve (Manufacturers) (D) – The Tenth District (Kansas City Federal Reserve) conducts the Survey of Manufacturers. The Bank's monthly Survey of Manufacturers provides information on current manufacturing activity in the Tenth District. The accumulated results also help trace longer term trends. The survey monitors manufacturing plants selected according to geographic distribution, industry mix, and size. Survey results reveal changes in several indicators of manufacturing activity, including production and shipments, and identify changes in prices of raw materials and finished products, and expectations for six months hence.[8]

6. New York Federal Reserve (Manufacturers) (D) – The New York Federal Reserve conducts the Empire State Manufacturing Survey. Participants from across the state in a variety of industries respond to a questionnaire and report the change in a variety of indicators from the previous month. Respondents also state the likely direction of these same indicators six months ahead. April 2002 is the first report, although survey data date back to July 2001. The survey is sent on the first day of each month to the same pool of about 200 manufacturing executives in New York State, typically the president or CEO. About 100 responses are received. Most are completed by the tenth, although surveys are accepted until the fifteenth day of the month.[9]

7. Dallas Federal Reserve (Manufacturers) (D) – The Dallas Federal Reserve conducts The Texas Manufacturing Outlook Survey. The Texas Manufacturing Outlook Survey is a monthly survey based on manufacturers responses to questions about their Texas operations. For all questions, participants are asked whether the indicator has increased, decreased, or remained unchanged. Answers cover changes over the previous month and expectations for activity six months into the future. Over 120 manufacturers regularly participate in the Dallas Fed survey, which began collecting data in May 2004. Respondents come from all sectors of manufacturing and no one industry dominates the respondent pool.[10]

8. The Michigan Surveys (Consumers) (N) – The Michigan Surveys of Consumers are conducted by the Survey Research Center at the University of Michigan and were developed in 1946 under the direction of George Katona. Each monthly survey contains approximately 50

[7] Source: Richmond Federal Reserve
[8] Source: Kansas City Federal Reserve
[9] Source: New York Federal Reserve
[10] Source: Dallas Federal Reserve

core questions covering three broad areas of consumer sentiment and expectations: personal finances, business and economic conditions, and buying conditions. The survey is based on approximately 500 telephone interviews of adult men and women living in households in the coterminous United States. The sample is designed to maximize the study of change by incorporating a rotating panel sample design in an ongoing monthly survey program. This design provides for the regular assessment of change in attitudes and behavior, both at the aggregate and at the individual level.[11] The data set is monthly, from January, 1978 to November, 2008.

9. The Conference Board (Consumers) (N) – The Conference Board Consumer Confidence Survey is conducted monthly by TNS.[12] The questionnaires are mailed to a nationwide representative sample of 5,000 households, of which roughly 3,500 typically respond. Each month, a different panel of 5,000 households is surveyed. The survey asks respondents to give their appraisal of current economic and business conditions, and their expectations for six months hence. The data set is monthly from June, 1977 to October, 2008.

10. UBS/Gallup (Investors) (D) – Union Bank of Switzerland and The Gallup Organization formed a partnership in October, 1996, to create a new index that would systematically track investor perceptions of the economy and expectations for one year hence on a monthly basis. For the UBS/Gallup Index of Investor Optimism, an investor is defined as a male or female head of household with investments totaling $10,000 or more.[13] "Average investors" are those having between $10,000 and $100,000 of investible assets and represent about two-thirds of all investor households, while households having investments of more than $100,000 are classified as "substantial investors" and account for one-third of all investor households. Gallup interviewed a random sample of approximately 1,000 U.S. investor households during the first two weeks of every month, and the results were reported at the end of the month. The survey methodology is the same as that used for the Gallup poll.[14] The questions are designed to measure two dimensions of optimism; three questions measure the Personal dimension and four measure the Economic dimension. The data set is monthly from October 1996 to December 2007.[15]

11. Blue Chip Economic Indicators (Economists) (N) – Since 1976, Blue Chip Economic Indicators has conducted a monthly survey of macroeconomic forecasts from approximately 50

[11] Source: Surveys of Consumers, Survey Research Center at the University of Michigan.

[12] A caveat is in order regarding The Conference Board data. The data published by The Conference Board are revised data and the organization states it does not maintain the preliminary data. The Conference Board claims that the difference between the preliminary and final number is not statistically significant.

[13] According to UBS/Gallup, in 1996, about one in three households qualified as investors based upon this definition. By 2003, the proportion had increased to about 40%.

[14] Source: UBS/Gallup.

[15] Data from October, 1996 to January, 1999 are interpolated to fill missing observations. UBS and Gallup terminated their partnership in December, 2007 and the survey is now defunct.

business economists employed by America's leading banks, brokerage firms, insurance companies, manufacturers, universities, and economic forecasting firms.[16]

12. The TIPS Spread (Investors) (N) – The TIPS spread is the yield difference between conventional Treasury securities and the Treasury Inflation Protected Securities. The measure is calculated as the difference in yield between the ten-year constant maturity bond and the ten-year inflation protected bond, and this difference is an implied inflation expectation.[17]

13. Survey of Professional Forecasters (Economists) (N) – The Survey of Professional Forecasters is the oldest quarterly survey of macroeconomic forecasts in the United States. The survey began in 1968 and was conducted by the American Statistical Association and the National Bureau of Economic Research. The Federal Reserve Bank of Philadelphia took over the survey in 1990.

14. The Livingston Survey (Economists) (N) – The Livingston Survey was started in 1946 by the late columnist Joseph Livingston. It is the oldest continuous survey of economists' expectations. It summarizes the macroeconomic forecasts of economists from industry, government, banking, and academia. The Federal Reserve Bank of Philadelphia took responsibility for the survey in 1990.

The usual caveats regarding survey data apply in this analysis. Some concerns regarding survey data are that they are subjective, and respondents may not have any incentive to answer questions truthfully. In addition, they may be uninformed or indifferent about the quality of their forecasts. Similarly, professional forecasters may have ulterior motives and career concerns that color their forecasts. For example, a professional forecaster may not want to deviate too much from the consensus response, if they are concerned about perception among clients; alternatively they may seek to deviate significantly from the consensus forecast in order to draw publicity.

III. Methodology

III.a. Accuracy

In order to test the inflation expectations measures for accuracy, I calculate and compare forecast errors over the full sample period for each numerical forecast. The forecast error e_i is calculated as the forecast inflation rate minus the actual inflation rate that subsequently occurred. One complication is that many of the surveys and other measures do not specify which rate of inflation is being forecast; they simply ask about changes in price levels, or about a general concept of inflation. In addition, the respondents are consumers, investors, economists, businesses, retailers, or manufacturers, and the definition of inflation surely varies depending on

[16] Source: Blue Chip Economic Indicators
[17] Data source: St. Louis Federal Reserve.

the profile of the respondent. Due to this vagueness, I calculate the errors comparing the forecasted rate with the actual rate of the Consumer Price Index (CPI), the Personal Consumption Expenditures deflator (PCE), and the Producer Price Index (PPI). A description of the inflation measures and data sources is contained in Appendix A. I use the forecast errors to identify the best actual rate of inflation that is being forecast by the inflation expectation measure, as well as the best horizon if no horizon is specified in the survey question.

I calculate three summary statistics of the forecast errors for each indicator: the mean error (ME), mean absolute error (MAE), and the root mean square error (RMSE). The mean error can be interpreted as a basic measure of forecasting bias, and represents the average magnitude of the forecast error over the *n* periods being forecast. A positive mean error indicates a propensity to overestimate inflation; whereas a negative mean error indicates a propensity to underestimate inflation. The mean absolute error measures the accuracy of forecasts, as does the root mean square error. However, the RMSE amplifies the effect of large forecast errors.

The ME, MAE, and RMSE are calculated in the standard fashion, as follows:

$$ME = \frac{1}{n}\sum_{i=1}^{n} e_i \tag{1}$$

$$MAE = \frac{1}{n}\sum_{i=1}^{n} |e_i| \tag{2}$$

$$RMSE = \left[\frac{1}{n}\sum_{i=1}^{n} e_i^2\right]^{1/2} \tag{3}$$

III.b. Forecast Comparison Tests

With measures of inflation expectations from so many different sources, it is inevitable that there will be apparent differences in forecast accuracy within the sample. This raises the question as to whether the outcome is due to pure chance. A test of equal predictive accuracy is performed to determine whether these observed differences are statistically significant or not.

Since the information set is limited, i.e., available data only include a set of forecasts and actual values of the predictand, a model-free test is appropriate. I employ a variant of the Morgan-Granger-Newbold (1977) (MGN) test, proposed by Harvey, Leybourne, and Newbold (1997) (HLN). The test will allow an objective evaluation of the forecast accuracy of each of the numerical forecasts and determine whether the observed differences are due to chance or due to superior forecasting ability. The methodology is described as follows.

Let y_t represent the actual values of inflation observed for period $t = 1, 2, 3,\ldots T$, and let $\hat{y}_{it}$ represent the forecast of indicator i for $i = 1, 2$. Then the forecast error is defined as:

$$e_{it} = \hat{y}_{it} - y_t \tag{4}$$

The loss depends on forecast and actual values only through the forecast error:

$$g(y_t, \hat{y}_{it}) = g(\hat{y}_{it} - y_t) = g(e_{it}) \tag{5}$$

And the loss differential between the two forecasts is given by:

$$d(t) = g(e_{1t}) - g(e_{2t}) \tag{6}$$

Two forecasts have equal accuracy if and only if the loss differential has zero expectation for all t. Therefore, we can test the null hypothesis:

H_0: $E(d_t) = 0$ *for all* t

versus the alternative hypothesis:

H_1: $E(d_t) = \mu \neq 0$.[18]

The MGN test assumes that: A(1) the loss is quadratic; and A(2) forecast errors are (a) zero mean, (b) Gaussian, and (c) serially uncorrelated. Then, the null hypothesis of equality of forecast mean squared errors is equivalent to equality of forecast error variances.

Let:

$$x_t = e_{1t} - e_{2t} \tag{7}$$

$$z_t = e_{1t} + e_{2t} \tag{8}$$

The MGN test statistic is given by:

$$S = [(1-r^2)/(n-1)]^{-1/2} r \tag{9}$$

where

$$r = [\Sigma x_t^2 \Sigma z_t^2]^{-1/2} \Sigma x_t z_t$$

The HLN test casts the MGN test in a regression framework:

$$z_t = \beta x_t + \varepsilon_t \tag{10}$$

such that (9) is identical to the null hypothesis that $\beta = 0$, i.e.:

[18] Mariano and Preve (2008).

$$S = [\hat{\sigma}^2/\Sigma x_t^2]^{-1/2}\hat{\beta} \tag{11}$$

where

$\hat{\beta} = \Sigma x_t z_t / \Sigma x_t^2$

$\hat{\sigma}^2 = (n-1)^{-1} \Sigma(z_t - \hat{\beta} x_t)^2$

and $\hat{\sigma}^2$ estimates the variance σ^2 of ε_t.[19]

I perform the HLN test of equal forecast accuracy by designating a benchmark forecast for each of the 12-month CPI, PPI, and PCE tests.[20] The benchmark selection rule is as follows: the monthly indicator with the median RMSE is chosen, and in the case of a tie, i.e., if there is an even number of indicators, then the series with the longest available history is chosen. The benchmark forecast is then converted to either quarterly or semiannual frequency as needed to perform the regression test.

III.c. Predictive Power

Predictive content is measured by a test of Granger Causality. This test evaluates the possibility that inflation expectations and inflation realizations may be co-integrated, in the sense of Engle and Granger (1987). One would expect that actual inflation rates may influence inflation expectations. But, if inflation expectations influence actual future rates of inflation, this would be of significant interest to policymakers, as it implies a bilateral feedback effect between inflation and inflation expectations.

The tests for Granger Causality are specified as follows:

$$\Delta\pi_t = g_0 + \lambda_\pi(\pi_{t-1} - \pi^e{}_{t-1}) + \sum_{k=1}^{n} g_{1k}\Delta\pi_{t-s} + \sum_{k=1}^{n} g_{2k}\Delta\pi^e{}_{t-s} + \varepsilon_{1t} \tag{12}$$

$$\Delta\pi^e{}_t = g_0 + \lambda_{\pi e}(\pi_{t-1} - \pi^e{}_{t-1}) + \sum_{k=1}^{n} g_{3k}\Delta\pi_{t-s} + \sum_{k=1}^{n} g_{4k}\Delta\pi^e{}_{t-s} + \varepsilon_{2t} \tag{13}$$

where π_t is the actual rate of inflation and $\pi^e{}_t$ is the expected rate of inflation, and ε_{it} is a white noise error. The null hypothesis is $\lambda_\pi = 0$ and $\lambda_{\pi e}=0$. If both λ_π and $\lambda_{\pi e}$ are significantly different from zero then forecasters respond to the behavior of inflation, and in addition, inflation

[19] Harvey, Leybourne, and Newbold (1997).

[20] The HLN test is not performed for diffusion indexes. Similarly, it is not performed for the 6-month Livingston forecasts or the 5-year Michigan forecasts because the measures are too few and from a single source.

responds to the behavior of forecasters. This is a fundamental proposition of the rational expectations paradigm.[21]

III.d. Rationality – Unbiasedness and Efficiency

According to Thomas (1999), "If inflation expectations are fully rational, they should exhibit two fundamental characteristics. First, they should be unbiased – that is, agents should forecast inflation correctly on average. Second, forecasts should be efficient – that is, agents should employ all relevant information for which the marginal benefit of gathering and utilizing the information exceeds the marginal cost."

The test for bias is estimated by OLS and specified as follows:[22]

$$\pi_t = \alpha + \beta \pi_t^e + e_t \tag{14}$$

The equation is estimated by regressing the actual inflation rate π_t on the previously made forecast of inflation π^e_t and testing the joint null hypothesis that $\alpha=0$ and $\beta=1$. Forecasts are considered unbiased if the null hypothesis cannot be rejected. The joint null hypothesis is tested with a Chi-squared test. The Chi-squared test only applies to the numerical forecasts, since the hypothesis that $\beta=1$ would be meaningless for a diffusion index.

The test for efficiency is estimated by OLS and specified as follows:[23]

$$e_t = \delta + \phi I_t + \upsilon_t \tag{15}$$

The equation is estimated by regressing the forecast error e_t on the information set I_t either individually or jointly. The information set includes those variables that are pertinent to a comprehensive model of inflation. The variables are tested for significance first individually, then jointly. If any or all of the variables in the information set are significantly negatively correlated with the forecast error, this implies that agents failed to take all relevant information into account when forming their inflation expectations. Weak-form efficiency implies that agents have taken into consideration only the information contained in past inflation rates, while strong-form efficiency implies that agents have considered information about all variables that are germane to forecasting inflation.

Following Thomas (1999) and Mehra (2002), the variables employed in the information set I_t are: the lagged 12-month rate of CPI inflation, a measure for the output gap, M1 and M2

[21] Grant and Thomas (1999).

[22] Model is estimated by OLS with Newey-West HAC standard errors with lag truncation parameter set to equal forecast horizon in order to avoid overlapping standard errors.

[23] Model is estimated by OLS with Newey-West HAC standard errors with lag truncation parameter set to equal forecast horizon in order to avoid overlapping standard errors.

growth, and a measure for oil price inflation. Since most of the data have a monthly frequency, the unemployment rate is used as a proxy for the output gap, with this substitution following Gramlich (1983). The measure for oil price inflation is the lagged 12-month rate of change for the producer price index for fuels. A description of the variables and data sources is contained in Appendix A.

III.e. Out of Sample Forecasts

Out of sample forecasts are performed using a basic predictive model for actual inflation regressed on expected inflation and past inflation. Due to the high serial correlation in the rate of inflation, the model is specified to test whether the survey forecasts have any predictive power for the future rate of inflation beyond the information contained in past inflation data. The model is estimated by OLS as follows:[24]

$$\pi_t = \alpha + \beta \pi_t^e + \delta \pi_{t-1} + e_t \tag{16}$$

A static forecast is produced by estimating parameters using data available through December 2005. The estimated parameters are then used to fit the equation over the out-of-sample period, January 2006 to October 2008. For the five-year inflation forecasts, parameters are estimated with data through September 2003 and the out-of-sample period is October 2003 to October 2008. The forecasts are then evaluated by comparing the Root Mean Squared Errors to determine the accuracy of the forecasts.

IV. Results

IV.a. Accuracy

Accuracy is evaluated for numerical forecasts only. Table 2 presents the results for the accuracy test using the CPI as the actual inflation rate. The inflation forecast with the lowest RMSE is the Michigan Median 5-year inflation forecast, with RMSE = 0.7939. The inflation forecast with the highest RMSE is the Livingston Mean PPI forecast, with RMSE = 2.9680.

Table 3 presents the results for the accuracy test using the PCE as the actual inflation rate. The inflation forecast with the lowest RMSE is again the Michigan Median 5-year inflation forecast, with RMSE = 0.7668. The inflation forecast with the highest RMSE is the Conference Board inflation forecast, with RMSE = 2.6679. The PCE results are of particular interest given that the

[24] Model is estimated by OLS with Newey-West HAC standard errors with lag truncation parameter set to equal forecast horizon in order to avoid overlapping standard errors.

PCE deflator is frequently the preferred inflation indicator used by the Federal Reserve in conducting monetary policy.

Table 4 presents the results for the accuracy test using the PPI as the actual inflation rate. The inflation forecast with the lowest RMSE is once again the Michigan Median 5-year inflation forecast, with RMSE = 1.8169. The inflation forecast with the highest RMSE is again the Conference Board inflation forecast, with RMSE = 3.4189. Notice that the RMSE of the Livingston Survey forecasts for mean and median PPI are 3.1096 and 3.1110, respectively, when forecasting the PPI. However, the same Livingston Survey forecasts for mean and median PPI have RMSEs of 2.9680 and 2.9566, respectively, when forecasting the CPI, and 2.0144 and 2.0405, respectively, when used to forecast the PCE. Thus, the Livingston Survey forecasts of the PPI are better predictors of the CPI and the PCE than they are for the PPI.

IV.b. Forecast Comparison

The HLN (1997) variation of the MGN (1977) test is performed to test for equal forecasting accuracy, i.e., equality of forecast error variances. Table 5 presents results of the HLN test of numerical forecasts for the CPI over a 12-month horizon. The benchmark selection rule indicates that the Michigan Survey's 1-year median inflation forecast is the benchmark measure. The null hypothesis of $\beta = 0$ can be decisively rejected for all the measures of inflation expectations except for the Survey of Professional Forecasters. This means that the null hypothesis of equal forecasting accuracy is rejected for the majority of the measures.

Table 6 presents results of the HLN test of numerical forecasts for the PCE over a 12-month horizon. The benchmark selection rule indicates that the Michigan Survey's 1-year median inflation forecast is again the benchmark measure. The null hypothesis of $\beta = 0$ is rejected for the Blue Chip GDP Deflator, the Blue Chip CPI, the TIPS Spread, Michigan 1-year mean, and the Conference Board 1-year inflation forecasts. The null hypothesis fails to be rejected for the SPF 1-year CPI forecast and all of the Livingston forecasts.

Table 7 presents results of the HLN test of numerical forecasts for the PPI over a 12-month horizon. The benchmark selection rule indicates that the Blue Chip 1-year CPI inflation forecast is the benchmark measure. The null hypothesis of $\beta = 0$ is rejected for the Blue Chip GDP Deflator, the Michigan 1-year median, Michigan 1-year mean, and the Conference Board 1-year inflation forecasts. The null hypothesis fails to be rejected for the SPF 1-year CPI forecast, the TIPS Spread, and all of the Livingston forecasts.

IV.c. Predictive Power

It is natural to expect that inflation expectations would be influenced by the past actual inflation rate. However, if inflation expectations influence the future actual inflation rate, then this would be of interest to policymakers and investors alike. Tables 8 and 9 present results for the test of predictive power, using a Granger Causality test at 3 and 12 lags, respectively. The null hypothesis for Equations (4) and (5) is that the actual inflation rate does not Granger Cause inflation expectations and inflation expectations do not Granger Cause the actual inflation rate.

Table 8 shows that, at 3 lags, the actual inflation rate influences most of the measures of inflation expectations, and this is not a surprise, as one would expect agents to form expectations based in part on recent past experience. What is intriguing is that several of the measures of inflation expectations influence the future actual inflation rate. In this case the null hypothesis for the absence of Granger Causality is rejected. Significant predictive power is demonstrated by the following measures of inflation expectations: Small Business 3-month Price Plans, Richmond Fed 6-month Retail Prices, Michigan Vehicles Price Conditions, Blue Chip 1-year CPI forecast, Survey of Professional Forecasters 1-year CPI forecast, Livingston 1-year Median CPI forecast and the Michigan 5-year mean inflation forecast. Since many of these indicators are available at a monthly frequency, there is a clear advantage to using them instead of or in addition to the quarterly and semi-annual frequency measures.

Table 9 shows that, at 12 lags, the actual inflation rate once again influences many of the measures of inflation expectations. In addition, several measures of inflation expectations demonstrate predictive power over the actual future inflation rate. The Livingston 6-month mean PPI forecast, the Blue Chip 1-year CPI forecast, the Survey of Professional Forecasters 1-year CPI forecast and the Michigan median 1-year inflation forecast all demonstrate a statistically significant ability to anticipate the future actual inflation rate.

The results of the Granger Causality tests lend support to some alternative theoretical macroeconomic models. For instance, the finding that inflation expectations of businesses and retailers Granger cause future inflation rates makes sense to the extent that there may exist strategic complementarities between the price-setting decisions of manufacturers or suppliers of different goods, in the sense suggested by Calvo (1983). This theory of pricing can justify an aggregate supply relation that takes the form of an expectations-augmented Phillips curve relation, where the location of the short-run Phillips curve is determined by expectations regarding future inflation. Indeed, in many macroeconomic models of the New Keynesian variety, current inflation is mainly determined by current expectations of future inflation. This is because price-setters will optimally adjust their prices such that current prices reflect a mark-up above their expected average nominal marginal costs for the duration that prices are expected to remain fixed. Therefore, expected future inflation will affect current inflation because current prices are aligned with average expected future nominal marginal costs. Thus, inflation

expectations can lead to self-fulfilling deflations or inflations, i.e., there is convergence to a rational-expectations equilibrium as a result of adaptive learning dynamics.[25]

Alternatively, the results could be explained by a sticky information model as proposed by Mankiw and Reis (2002), rather than the sticky prices underlying the New Keynesian models. In the sticky information model, current inflation is determined by past expectations of current inflation.[26] Some researchers, most notably Carroll (2003) and Lanne, Luoma, and Luoto (2009), argue that the inflation expectations data from the Michigan Survey is consistent with a sticky information model and that agents are slow to update their beliefs, thus providing the microfoundations for the model proposed by Mankiw and Reis.

Finally, another alternative for the Granger Causality results could be that the apparent cointegration could be explained by a common shock affecting both current and future inflation. For example, even if actual inflation and expected inflation are unrelated, a commodity price shock could induce a revision of today's expectations of inflation one year from now, and also affect inflation every month from now on. While this explanation is possible, it is not probable due to the fact that many of the sample periods occur over a time span during which there was no major commodity price shock.

IV.d. Rationality – Unbiasedness and Efficiency

Table 10 contains the results of the test for unbiasedness, where the joint null hypothesis $\alpha=0$ and $\beta=1$ is tested for Equation (6), for the 17 numerical forecasts of inflation expectations.[27] The results of the Chi-squared tests indicate that the null hypothesis is decisively rejected for 16 of the 17 numerical forecasts. This means that each of these 16 indicators systematically either overestimate or underestimate the actual inflation rate. The only measure of inflation expectations where the null hypothesis fails to be rejected is the Blue Chip Indicators Survey one-year forecast for CPI inflation. In this case, the Chi-squared p-value is 0.3093, and we fail to reject the joint null hypothesis $\alpha=0$ and $\beta=1$.

Tables 11 through 16 present results for the tests for efficiency, to find out if agents employed relevant information in forming inflation expectations. In this test, forecast errors are regressed on inflation-related variables to determine if there is a correlation. The variables are first tested separately and then together in a joint specification. Testing whether agents used knowledge of lagged inflation in forming expectations is a test of weak-form efficiency. To test for strong-form efficiency, four variables were tested: the unemployment rate (a substitute measure for the output gap), the lagged 12-month growth rate of the narrow (M1) and broad (M2) monetary

[25] Woodford (2003)

[26] In a sense, the sticky information model is like a Phillips curve with backward-looking expectations instead or forward-looking expectations.

[27] The Chi-squared test is not applicable to the 20 diffusion indexes of inflation expectations.

aggregates, and a measure for energy price inflation (the 12-month rate of change of the producer price index for fuels). In each case, the independent variable is defined so that failure of agents to take account of the variable in the manner suggested by conventional economic theory would result in a negative and statistically significant coefficient on the variable.[28] That is, if agents fail to account for past inflation, money growth, etc., they would underestimate inflation and have a negative forecasting error, resulting in a negative sign on the coefficient for the variable. Conversely, if agents take too much account for past inflation, money growth, etc., they would overestimate inflation and have a positive forecasting error, resulting in a positive sign on the coefficient for the variable.

Table 11 contains the results for the efficiency test with respect to the most recent 12-month rate of CPI inflation known to agents at the time the inflation expectations are measured. The table indicates that most agents adequately took into account the past rate of CPI inflation, but respondents to some surveys did not. Specifically, the Small Business Price Plans, the Philadelphia Fed's, Dallas Fed's, New York Fed's, and Kansas City Fed's expectations for Prices Paid, and the Livingston Mean and Median CPI forecasts all failed to consider adequately the lagged inflation rate in forming inflation expectations. Due to the insufficient use of information concerning the past inflation rate, weak-form efficiency can be rejected for these measures of inflation expectations.

Conversely, Table 11 indicates that some measures of inflation expectations attributed too much influence to the past CPI inflation rate, resulting in a positive forecasting error. The Richmond Fed's survey expectations for 6-month prices paid, prices received, retail prices, non-retail prices, and services prices all have a positive and statistically significant coefficient on lagged CPI. Similarly, the Blue Chip 1-year GDP deflator and 1-year CPI forecasts, the Michigan 1-year median and 5-year mean and median inflation forecasts, the Survey of Professional Forecasters 1-year CPI, and the Livingston survey's 6-month mean and median CPI and PPI forecasts all have forecast errors that are positively correlated with the lagged inflation rate. This indicates that respondents to these surveys overestimated the impact of past inflation when forming their expectations for future inflation.

Table 11 indicates that weak-form efficiency is supported for the majority of the inflation expectations measures. The Philadelphia Fed 6-month prices received, Richmond Fed 6-month wages, Kansas City Fed 6-months prices received, New York Fed 6-months prices received, Dallas Fed 6-months prices received, and Dallas Fed 6-month wages, are all measures of inflation expectations that adequately took account of the lagged CPI inflation rate. The same is true for the Michigan Survey's price conditions for durable goods, vehicles, and housing. In addition, the UBS/Gallup 1-year inflation forecast, the Michigan 1-year mean inflation forecasts, the TIPS spread, the Conference Board 1-year inflation forecast, and the Livingston survey's 1-

[28] Thomas (1999)

year mean and median PPI forecasts are also weak-form efficient measures of inflation expectations.

Table 12 presents the results of the efficiency test with respect to the lagged 12-month growth rate of the narrow monetary aggregate (M1). Expectations for the Blue Chip 1-year GDP deflator, Michigan 1-year median inflation and Livingston 1-year mean and median CPI forecasts all have negative and statistically significant coefficients, meaning that they fail to take sufficient account of M1 growth. Because these survey measures failed to take adequate account of M1 growth, strong-form efficiency can be rejected for these measures of inflation expectations. Conversely, the Kansas City Fed's 6-month prices received, New York Fed's 6-month prices paid, and the Michigan 5-year mean and median inflation forecasts all have forecast errors that are positively correlated with lagged M1 growth, indicating that respondents to these surveys overestimated the influence of lagged M1 growth when forming their inflation expectations.

Strong-form efficiency with respect to lagged M1 growth is supported for several measures of inflation expectations. The Small Business 3-month price plans, the Philadelphia Fed's 6-month prices paid and prices received, the Richmond Fed's 6-month prices paid, prices received, retail prices, non-retail prices, services prices, and wages all take into account the lagged growth rate of the narrow monetary aggregate. The Kansas City Fed's 6-month prices paid, the New York Fed's 6-month prices received, the Dallas Fed's 6-month prices paid, prices received, and wages, and the Livingston Survey's 6-month mean and median CPI and PPI also efficiently incorporate information about lagged M1 growth, as do the Michigan Survey's price conditions for durable goods, vehicles, and housing. The UBS/Gallup 1-year inflation forecast, the Michigan 1-year mean inflation, the Blue Chip 1-year CPI forecast, the TIPS spread, the Conference Board 1-year inflation forecast, the SPF 1-year CPI forecast, and the Livingston survey mean and median 1-year PPI forecasts adequately take M1 growth into account as well. Strong-form efficiency is supported for all these measures of inflation expectations.

Table 13 contains the results of the efficiency test with respect to the lagged 12-month growth rate of the broad monetary aggregate (M2). The Richmond Fed Survey's expectations for 6-month prices paid and prices received, the Livingston Survey's 1-year mean and median CPI expectations, and the Michigan 5-year mean and median inflation forecasts all fail to take proper account of the lagged 12-month growth rate of the broad monetary aggregate, as indicated by the significant negative correlation between the forecasting error and lagged M2 growth. Because these survey measures failed to take adequate account of M2 growth, strong-form efficiency can be rejected for these measures of inflation expectations. Conversely, the Philadelphia Federal Reserve's 6-month prices received and the Richmond Fed's 6-month Retail prices, as well as the Michigan Survey's durable goods and housing price conditions, and the UBS/Gallup 1-year inflation forecast are measures of inflation expectations with forecast errors that are positively significantly correlated with M2 growth, suggesting that forecasters attributed too much influence of M2 growth on the future inflation rate.

Strong-form efficiency with respect to M2 growth is supported for several of the measures of inflation expectations. The Small Business price plans, Philadelphia Fed's 6-month prices paid, Richmond Fed's 6-month non-retail prices, services prices, and wages, Kansas City Fed's 6-month prices paid and prices received, New York Fed's 6-month prices paid and prices received, and the Dallas Fed's 6-month prices paid, prices received, and wages all efficiently incorporate information about M2 growth,, thus exhibiting strong-form efficiency. Similarly, the Michigan Survey's price conditions for vehicles, the Blue Chip Survey's 1-year forecast for the GDP deflator and CPI, the Michigan Survey 1-year mean and median inflation forecast, the TIPS spread, the Conference Board Survey's 1-year inflation forecast, the Survey of Professional Forecasters 1-year CPI forecast, and the Livingston Survey's mean and median 6-month CPI and PPI, and mean and median 1-year PPI forecasts are also strong-form efficient with respect to M2 growth.

The results for the efficiency test with respect to oil price inflation are displayed in Table 14. Survey expectations for 6-month prices paid from neither the Philadelphia Fed, nor the Kansas City Fed, nor the Dallas Fed adequately took into account the lagged oil price inflation, as indicated by the negative and statistically significant coefficient. Due to the inadequate use of information concerning energy price inflation, strong-form efficiency can be rejected for these survey measures of inflation expectations. Conversely, a positive correlation between oil price inflation and the forecast error is noted for the Richmond Fed's 6-month prices paid, prices received, retail, non-retail, and services prices, the New York Fed's 6-month prices received, and the Livingston Survey's 6-month mean and median CPI forecasts, indicating that these measures of inflation expectations attributed too much importance to oil price inflation in forming expectations for future inflation.

Several of the measures demonstrate strong-form efficiency with respect to oil price inflation. The Small Business price plans, Philadelphia Fed's 6-month prices received, Richmond Fed's 6-month wage expectations, Kansas City Fed's 6-month prices received, New York Fed's 6-month prices paid, and the Dallas Fed's 6-month prices received and wage expectations all adequately took account of oil price inflation in forming expectations for future inflation. The Michigan Survey's price conditions for durable goods, vehicles, and housing prices, as well as the mean and median 1-year and 5-year inflation forecasts, also sufficiently incorporate information regarding oil price inflation, thereby exhibiting strong-form efficiency. The Blue Chip 1-year GDP deflator and CPI forecasts, the UBS/Gallup 1-year inflation forecast, the TIPS spread, the Conference Board 1-year inflation forecast, the SPF 1-year CPI forecast, and the Livingston Survey's mean and median 6-month PPI, and 1-year PPI and CPI forecasts are also strong-form efficient with respect to oil price inflation.

Table 15 presents the results for the efficiency test with respect to the lagged unemployment rate, a proxy for the output gap. The table indicates that none of the Richmond Fed's measures of inflation expectations for the services sector effectively incorporates information about the unemployment rate. The Richmond Federal Reserve Surveys of expectations for retail prices,

non-retail prices, and service sector prices all have a negative and statistically significant coefficient on the lagged unemployment rate. Due to the inadequate use of information concerning the unemployment rate, strong-form efficiency can be rejected for the Richmond Fed's service sector surveys. Conversely, Small Business price plans, the Blue Chip 1-year CPI forecast, the Survey of Professional Forecasters 1-year CPI forecast, and the Michigan 5-year mean and median inflation forecasts, all have forecast errors that are positively correlated with the unemployment rate, suggesting that forecasters attributed too much influence from the unemployment rate on their forecasts of future inflation.

Strong-form efficiency with respect to the unemployment rate is indicated for several of the measures. The Philadelphia, Kansas City, and New York Fed's 6-month prices paid and prices received, and the Dallas and Richmond Fed's 6-month prices paid, prices received, and wages all efficiently incorporated information about the unemployment rate in forming inflation expectations. Additionally, the Michigan survey's price conditions for durable goods, vehicles, housing, 1-year mean and median inflation forecasts, the Blue Chip 1-year GDP deflator forecast, the UBS/Gallup 1-year inflation forecast, the TIPS spread, the Conference Board 1-year inflation forecast, and the Livingston Survey's mean and median 6-month and 1-year CPI and PPI forecasts also display strong-form efficiency with respect to the lagged unemployment rate.

Table 16 presents the results for the efficiency test using the joint specification, with the lagged CPI, M1 and M2 growth, oil price inflation, and unemployment rate tested together. The table indicates that most of the measures do not efficiently incorporate information from all of these variables simultaneously, refuting strong-form efficiency. Note that only the Conference Board Survey 1-year inflation expectations and the Michigan Survey median 1-year inflation expectations pass the joint specification test with statistical significance, indicating strong-form efficiency for these two survey measures.

IV.e. Out of Sample Forecasts

Table 17 presents results for out-of-sample forecasts using a basic predictive model for actual inflation regressed on expected inflation and past inflation.[29] The table reveals that the most accurate out of sample forecast is given by the Philadelphia Fed's 6-month Prices Received index, with RMSE = 1.1989. The standard economists' data set does not perform as well, with the SPF 1-year CPI forecast registering a RMSE of 1.5430, the Michigan Mean 1-year inflation forecast registering a RMSE of 2.5405 and the Livingston mean 1-year CPI forecast registering a RMSE of 3.4935. Most of the monthly measures of inflation expectations outperform the standard quarterly and semiannual survey measures, indicating that there are benefits to using higher frequency data.

[29] Out-of-sample tests for the Michigan 5-year forecasts cannot be analyzed due to insufficient data.

V. Conclusion

I have shown that the higher frequency survey measures of inflation expectations tend to outperform the standard three low frequency surveys – the quarterly Michigan Survey, the quarterly Surveys of Professional Forecasters, and the semiannual Livingston Survey – in terms of accuracy, predictive power, rationality, and out-of-sample forecasts. While there is no single winner that consistently outperforms all of the other measures on the complete battery of tests, the results indicate that several of the surveys conducted by the regional Federal Reserve banks perform well, as do the Small Business Survey, the Conference Board Survey, the Blue Chip Survey and the TIPS spread. It is worth noting that the Blue Chip survey is the only indicator that passes the test for unbiasedness.

What is interesting is that many of the surveys that are not typically used in the academic literature perform better relative to those that are typically used. In particular, given that other authors have found that inflation forecasts from the standard three low frequency surveys outperform inflation forecasts generated by time series ARIMA models, regression models using Phillips curve-derived real activity measures, and term-structure models, then by the transitive property, since the higher frequency surveys examined in this paper outperform the standard three low frequency surveys, we can surmise that the higher frequency surveys would likely outperform inflation forecasts generated from the aforementioned other methods as well.

More research is needed to understand better the efficacy of these higher frequency measures of inflation expectations to determine if they should replace or enhance the standard three low frequency survey measures. There are many obvious benefits to using monthly or real-time measures versus quarterly or semiannual data for forecasters who wish to have their models reflect the most up-to-date information possible. The academic literature has been myopic in ignoring the availability of these higher frequency measures of inflation expectations.

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Appendix A. Data List

Series ID: CPIAUCSL
Title: Consumer Price Index For All Urban Consumers: All Items
Source: U.S. Department of Labor: Bureau of Labor Statistics
Release: Consumer Price Index
Units: Index 1982-84=100
Frequency: Monthly
Seasonal Adjustment: Seasonally Adjusted

Series ID: PCEPI
Title: Personal Consumption Expenditures: Chain-type Price Index
Source: U.S. Department of Commerce: Bureau of Economic Analysis
Release: Personal Income and Outlays
Units: Index 2005=100
Frequency: Monthly
Seasonal Adjustment: Seasonally Adjusted

Series ID: PPIFGS
Title: Producer Price Index: Finished Goods
Source: U.S. Department of Labor: Bureau of Labor Statistics
Release: Producer Price Index
Units: Index 1982=100
Frequency: Monthly
Seasonal Adjustment: Seasonally Adjusted

Series ID: PPIENG
Title: Producer Price Index: Fuels & Related Products & Power
Source: U.S. Department of Labor: Bureau of Labor Statistics
Release: Producer Price Index
Units: Index 1982=100
Frequency: Monthly
Seasonal Adjustment: Not Seasonally Adjusted

Title: Money Supply M1
Release: M1 - MONEY SUPPLY - CURRENCY, DEMAND DEPOSITS, OTHER CHECKABLE DEPOSITS (H6),US MONEY STOCK MEASURES, LIQUID ASSETS AND THEIR COMPONENTS M1
SOURCE: FR H.6 Money Stock Measures NOTE: Currency, Travelers Checks, Demand Deposits, Other Checkable Deposits. Federal Reserve Board of Governors
UNITS: Billions of Dollars
Frequency: Monthly
Seasonal Adjustment: Not Seasonally Adjusted

Title: Money Supply M2
Release: MONEY STOCK MEASURES, LIQUID ASSETS AND THEIR COMPONENTS Non-M1 M2 Component (Total Non-M1 M2)
SOURCE: FR H.6 Money Stock Measures. Federal Reserve Board of Governors
UNITS: Billions of Dollars
Frequency: Monthly
Seasonal Adjustment: Not Seasonally Adjusted

Title: Unemployment Rate
Release: The Current Population Survey (CPS)
Source: Bureau of Census for the Bureau of Labor Statistics
Units: Percent
Frequency: Monthly
Seasonal Adjustment: Not Seasonally Adjusted
Age: 16 years and over

TABLE 1 - MEASURES OF INFLATION EXPECTATIONS

Source	Data Type	Data Concept	Short Name	Code	Period	Horizon	Frequency
National Federation of Independent Business Owners	Diffusion Index	Price Plans	Small Business 3-mo Price Plans	SBPP	1986:02 - 2008:10	3	M
Philadelphia Federal Reserve	Diffusion Index	Business Outlook Survey Expected Prices Paid 6-month	Philly 6-mo Prices Paid	PXPP	1968:06 - 2008:10	6	M
Philadelphia Federal Reserve	Diffusion Index	Business Outlook Survey Expected Prices Received 6-month	Philly 6-mo Prices Received	PXPR	1968:06 - 2008:10	6	M
Richmond Federal Reserve	Diffusion Index	Expected Prices paid 6-month	Richmond 6-mo Prices Paid	RXPP	1993:11 - 2008:10	6	M
Richmond Federal Reserve	Diffusion Index	Expected Prices received 6-month	Richmond 6-mo Prices Received	RXPR	1993:11 - 2008:10	6	M
Richmond Federal Reserve - Retail	Diffusion Index	Expected Prices 6-month	Richmond 6-mo Retail Prices	RRXP	1993:11 - 2008:10	6	M
Richmond Federal Reserve - Non-Retail Services	Diffusion Index	Expected Prices 6-month	Richmond 6-mo Non-Retail Prices	RNXP	1993:11 - 2008:10	6	M
Richmond Federal Reserve- Overall Services	Diffusion Index	Expected Prices 6-month	Richmond 6-mo Services Prices	RSXP	1993:11 - 2008:10	6	M
Richmond Federal Reserve	Diffusion Index	Expected Wages 6-month	Richmond 6-mo Wages	RWGE	2002:04 - 2008:10	6	M
Kansas City Fed Survey of Manufacturers	Diffusion Index	Expected Prices paid for raw materials 6-month	Kansas 6-mo Prices Paid	KXPP	2001:08 - 2008:10	6	M
Kansas City Fed Survey of Manufacturers	Diffusion Index	Expected Prices received for finished product 6-month	Kansas 6-mo Prices Received	KXPR	2001:08 - 2008:10	6	M
New York Federal Reserve	Diffusion Index	Empire State - Expected Prices Paid 6-month	NY 6-mo Prices Paid	NXPP	2001:08 - 2008:10	6	M
New York Federal Reserve	Diffusion Index	Empire State - Expected Prices Received 6-month	NY 6-mo Prices Received	NXPR	2001:08 - 2008:10	6	M
Dallas Federal Reserve	Diffusion Index	Texas Mnfg - Expected Prices Paid for Raw Materials	Dallas 6-mo Prices Paid	DPPM	2004:07 - 2008:10	6	M
Dallas Federal Reserve	Diffusion Index	Texas Mnfg - Expected Prices Received for Finished Goods	Dallas 6-mo Prices Received	DPRG	2004:07 - 2008:10	6	M
Dallas Federal Reserve	Diffusion Index	Texas Mnfg - Expected Wages and Benefits	Dallas 6-mo Wages	DWGS	2004:07 - 2008:10	6	M
Michigan Survey Research Center	Diffusion Index	Buying Conditions for Durable Goods - DURRN_NP - prices	Durable Goods Price Conditions	MDUP	1978:02 - 2008:10	6	M
Michigan Survey Research Center	Diffusion Index	Buying Conditions for Vehicles - VEHRN_NP - prices	Vehicles Price Conditions	MVHP	1978:03 - 2008:10	6	M
Michigan Survey Research Center	Diffusion Index	Buying Conditions for Houses - HOMRN_NP - prices	Housing Price Conditions	MHOP	1980:05 - 2008:10	6	M
Blue Chip Consensus	Numerical Forecast	GDP Deflator 1-yr Ahead	Blue Chip 1-yr GDP Deflator	BDFD	1991:01 - 2008:10	12	M
The Gallup Organization/UBS	Diffusion Index	Expectations for Inflation	UBS/Gallup 1-yr	GXIN	1996:11 - 2007:12	12	M
Michigan Survey Research Center	Numerical Forecast	Expected Change in Prices During the Next 12 Months - Mean	Michigan 1-yr Mean	M1PA	1978:01 - 2008:10	12	M
Michigan Survey Research Center	Numerical Forecast	Expected Change in Prices During the Next 12 Months - Median	Michigan 1-yr Median	M1PM	1978:01 - 2008:10	12	M
Blue Chip Consensus	Numerical Forecast	Consumer Price Index 1-yr Ahead	Blue Chip 1-yr CPI	BCPI	1979:06 - 2008:10	12	M
St. Louis Federal Reserve	Numerical Forecast	TIPS spread - TIPS-implied inflation expectation	TIPS Spread 1-yr	TIPS	2003:01 - 2008:10	12	R
Conference Board	Numerical Forecast	Expectations for Inflation	Conference Board 1-yr	CXIN	1987:08 - 2008:10	12	M
Michigan Survey Research Center	Numerical Forecast	Expected Annual Change in Prices During the Next 5 years - Mean	Michigan 5-yr Mean	M5PA	1990:04 - 2008:10	60	M
Michigan Survey Research Center	Numerical Forecast	Expected Annual Change in Prices During the Next 5 years - Median	Michigan 5-yr Median	M5PM	1990:04 - 2008:10	60	M
Philadelphia Federal Reserve	Numerical Forecast	Survey of Professional Forecasters - CPI	Survey of Professional Forecasters CPI	SPF	1981:09 - 2008:06	12	Q
Philadelphia Federal Reserve	Numerical Forecast	Livingston Survey - Median CPI 6-month	Livingston Median 6-mo CPI	LV_MD_CPI_6	1947:06 - 2008:06	6	S
Philadelphia Federal Reserve	Numerical Forecast	Livingston Survey - Median PPI 6-month	Livingston Median 6-mo PPI	LV_MD_PPI_6	1979:06 - 2008:06	6	S
Philadelphia Federal Reserve	Numerical Forecast	Livingston Survey - Mean CPI 6-month	Livingston Mean 6-mo CPI	LV_MN_CPI_6	1947:06 - 2008:06	6	S
Philadelphia Federal Reserve	Numerical Forecast	Livingston Survey - Mean PPI 6-month	Livingston Mean 6-mo PPI	LV_MN_PPI_6	1979:06 - 2008:06	6	S
Philadelphia Federal Reserve	Numerical Forecast	Livingston Survey - Median CPI 12-month	Livingston Median 1-yr CPI	LV_MD_CPI_12	1947:06 - 2008:06	12	S
Philadelphia Federal Reserve	Numerical Forecast	Livingston Survey - Median PPI 12-month	Livingston Median 1-yr PPI	LV_MD_PPI_12	1979:06 - 2008:06	12	S
Philadelphia Federal Reserve	Numerical Forecast	Livingston Survey - Mean CPI 12-month	Livingston Mean 1-yr CPI	LV_MN_CPI_12	1947:06 - 2008:06	12	S
Philadelphia Federal Reserve	Numerical Forecast	Livingston Survey - Mean PPI 12-month	Livingston Mean 1-yr PPI	LV_MN_PPI_12	1979:06 - 2008:06	12	S

TABLE 2 - FORECASTING ACCURACY OF NUMERICAL FORECASTS VS. CPI

			CPI		
INDICATOR	FREQUENCY	HORIZON	ME	MAE	RMSE
Livingston Mean 6-mo CPI	S	6	0.0015	0.8334	1.2172
Livingston Median 6-mo CPI	S	6	0.0659	0.8854	1.4191
Livingston Mean 6-mo PPI	S	6	-0.3411	1.2550	1.7528
Livingston Median 6-mo PPI	S	6	-0.3325	1.2298	1.7550
Blue Chip 1-yr GDP Deflator	M	12	-0.2600	0.8492	1.1257
Survey of Professional Forecasters 1-yr CPI	Q	12	0.4026	1.0406	1.3661
Blue Chip 1-yr CPI	M	12	0.4400	1.1439	1.4793
TIPS Spread 1-yr	M	12	-0.4547	1.2280	1.5294
Michigan 1-yr Median Inflation	M	12	-0.0986	1.0976	1.5316
Michigan 1-yr Mean Inflation	M	12	0.8293	1.3195	1.7282
Conference Board 1-yr Inflation	M	12	1.6434	1.7317	2.1601
Livingston Mean 1-yr CPI	S	12	-1.7606	2.0873	2.6912
Livingston Median 1-yr CPI	S	12	-1.6806	2.1303	2.7913
Livingston Median 1-yr PPI	S	12	-2.1198	2.4721	2.9566
Livingston Mean 1-yr PPI	S	12	-2.1376	2.4620	2.9680
Michigan 5-yr Mean Inflation	M	60	1.4101	1.4355	1.6657
Michigan 5-yr Median Inflation	M	60	0.5920	0.6721	0.7939

TABLE 3 - FORECASTING ACCURACY OF NUMERICAL FORECASTS VS. PCE

			PCE		
INDICATOR	FREQUENCY	HORIZON	ME	MAE	RMSE
Livingston Mean 6-mo CPI	S	6	0.2939	0.6112	0.9646
Livingston Median 6-mo CPI	S	6	0.2907	0.6212	0.9639
Livingston Mean 6-mo PPI	S	6	0.2189	1.1439	1.7168
Livingston Median 6-mo PPI	S	6	0.2219	1.1470	1.7307
Blue Chip 1-yr GDP Deflator	M	12	0.0030	0.8579	1.0218
Survey of Professional Forecasters 1-yr CPI	Q	12	0.4027	0.9486	1.1776
Blue Chip 1-yr CPI	M	12	0.4199	0.9336	1.1306
TIPS Spread 1-yr	M	12	-0.2442	0.8742	1.1037
Michigan 1-yr Median Inflation	M	12	0.8007	1.0275	1.3793
Michigan 1-yr Mean Inflation	M	12	1.4174	1.4810	1.8555
Conference Board 1-yr Inflation	M	12	2.4041	2.4041	2.6679
Livingston Mean 1-yr CPI	S	12	-0.7550	1.1841	1.4363
Livingston Median 1-yr CPI	S	12	-0.7558	1.1611	1.3986
Livingston Median 1-yr PPI	S	12	-0.8317	1.5784	2.0405
Livingston Mean 1-yr PPI	S	12	-0.8345	1.5292	2.0144
Michigan 5-yr Mean Inflation	M	60	1.3724	1.3748	1.5511
Michigan 5-yr Median Inflation	M	60	0.5214	0.5467	0.7668

TABLE 4 - FORECASTING ACCURACY OF NUMERICAL FORECASTS VS. PPI

			PPI		
INDICATOR	FREQUENCY	HORIZON	ME	MAE	RMSE
Livingston Mean 6-mo CPI	S	6	0.3200	1.3585	1.9600
Livingston Median 6-mo CPI	S	6	0.3843	1.4064	2.0786
Livingston Mean 6-mo PPI	S	6	0.1330	1.4880	2.2804
Livingston Median 6-mo PPI	S	6	0.1416	1.5221	2.3011
Blue Chip 1-yr GDP Deflator	M	12	0.2860	2.2377	2.6785
Survey of Professional Forecasters 1-yr CPI	Q	12	1.3304	2.4739	2.9835
Blue Chip 1-yr CPI	M	12	1.3744	2.5375	3.0622
TIPS Spread 1-yr	M	12	-1.2229	2.7551	3.3290
Michigan 1-yr Median Inflation	M	12	0.8045	2.1624	2.7322
Michigan 1-yr Mean Inflation	M	12	1.7324	2.5845	3.1906
Conference Board 1-yr Inflation	M	12	2.2233	2.6401	3.4189
Livingston Mean 1-yr CPI	S	12	-1.1317	2.4033	3.3131
Livingston Median 1-yr CPI	S	12	-1.0517	2.4452	3.3710
Livingston Median 1-yr PPI	S	12	-1.1706	2.4771	3.1110
Livingston Mean 1-yr PPI	S	12	-1.1884	2.5167	3.1096
Michigan 5-yr Mean Inflation	M	60	2.0207	2.2637	2.6398
Michigan 5-yr Median Inflation	M	60	1.2026	1.5763	1.8169

TABLE 5 - HLN Test of Equal Forecasting Accuracy - NUMERICAL FORECASTS VS. CPI

	Coefficient	Standard Err.	t-statistic	Sig.	R-squared	Nobs
Blue Chip 1-yr GDP Deflator	-0.3696	0.1761	-2.0991	**	0.0194	210
Survey of Professional Forecasters 1-yr CPI	-0.0480	0.0685	-0.7005		-0.0091	108
Blue Chip 1-yr CPI	0.4628	0.1292	3.5833	***	-0.0069	349
TIPS Spread 1-yr	-1.3283	0.3828	-3.4700	***	0.1557	66
Michigan 1-yr Median Inflation	BENCHMARK					
Michigan 1-yr Mean Inflation	0.5807	0.1510	3.8444	***	-0.0179	366
Conference Board 1-yr Inflation	1.2571	0.1013	12.4061	***	0.0948	251
Livingston Mean 1-yr CPI	0.9440	0.2108	4.4782	***	0.0211	61
Livingston Median 1-yr CPI	0.9316	0.2126	4.3819	***	0.0092	61
Livingston Median 1-yr PPI	0.9399	0.1442	6.5173	***	0.2137	59
Livingston Mean 1-yr PPI	0.9205	0.1418	6.4904	***	0.2040	59

TABLE 6 - HLN Test of Equal Forecasting Accuracy - NUMERICAL FORECASTS VS. PCE

	Coefficient	Standard Err.	t-statistic	Sig.	R-squared	Nobs
Blue Chip 1-yr GDP Deflator	-0.9264	0.1672	-5.5400	***	0.0346	162
Survey of Professional Forecasters 1-yr CPI	-0.0597	0.1717	-0.3474		-0.4195	40
Blue Chip 1-yr CPI	-1.3210	0.2580	-5.1197	***	-0.1512	162
TIPS Spread 1-yr	-1.4177	0.2729	-5.1944	***	0.2812	66
Michigan 1-yr Median Inflation	BENCHMARK					
Michigan 1-yr Mean Inflation	3.2300	0.2612	12.3681	***	0.0107	162
Conference Board 1-yr Inflation	1.8921	0.1105	17.1268	***	-0.0805	162
Livingston Mean 1-yr CPI	-0.1188	0.2853	-0.4164		0.004474	27
Livingston Median 1-yr CPI	-0.1572	0.2808	-0.5599		0.009735	27
Livingston Median 1-yr PPI	0.3936	0.2616	1.5049		0.0800	27
Livingston Mean 1-yr PPI	0.3685	0.2586	1.4248		0.072287	27

TABLE 7 - HLN Test of Equal Forecasting Accuracy - NUMERICAL FORECASTS VS. PPI						
	Coefficient	Standard Err.	t-statistic	Sig.	R-squared	Nobs
Blue Chip 1-yr GDP Deflator	-2.3392	0.8656	-2.7025	***	0.0014	210
Survey of Professional Forecasters 1-yr CPI	-0.0045	0.1429	-0.0315		-0.5434	103
Blue Chip 1-yr CPI	BENCHMARK					
TIPS Spread 1-yr	-3.7501	3.0083	-1.2466		-0.1262	66
Michigan 1-yr Median Inflation	-2.0349	0.2672	-7.6164	***	-0.0454	349
Conference Board 1-yr Inflation	1.4707	0.1833	8.0249	***	-0.0602	251
Michigan 1-yr Mean Inflation	0.9589	0.3231	2.9677	***	-0.3615	349
Livingston Mean 1-yr CPI	-0.3907	0.2784	-1.4030		0.019251	59
Livingston Median 1-yr CPI	-0.4149	0.2796	-1.4840		0.022886	59
Livingston Median 1-yr PPI	0.0073	0.2212	0.0332		-0.001074	59
Livingston Mean 1-yr PPI	0.0063	0.2174	0.0289		-0.000879	59

TABLE 8 - PREDICTIVE POWER - GRANGER CAUSALITY - 3 LAGS

Indicator	Type	Null Hypothesis	Obs	F-Statistic	Sig.	Prob.
Small Business 3-mo Price Plans	D	PPIFGS_3MF does not Granger Cause SBPP	270	15.8056	***	0.0000
		SBPP does not Granger Cause PPIFGS_3MF		4.4259	***	0.0047
Richmond 6-mo Services Prices	D	PCEPI_6MF does not Granger Cause RSXP	163	0.9715		0.4078
		RSXP does not Granger Cause PCEPI_6MF		0.4953		0.6861
Richmond 6-mo Non-Retail Prices	D	PCEPI_6MF does not Granger Cause RNXP	163	0.5544		0.6459
		RNXP does not Granger Cause PCEPI_6MF		0.5817		0.6279
Richmond 6-mo Prices Received	D	PCEPI_6MF does not Granger Cause RXPR	163	7.1535	***	0.0002
		RXPR does not Granger Cause PCEPI_6MF		0.7084		0.5483
Richmond 6-mo Retail Prices	D	CPIAUCSL_6MF does not Granger Cause RRXP	177	0.5882		0.6235
		RRXP does not Granger Cause CPIAUCSL_6MF		2.1872	**	0.0914
Livingston Mean 6-mo CPI	N	CPIAUCSL_6MF does not Granger Cause LV_MN_CPI_6	120	131.5060	***	0.0000
		LV_MN_CPI_6 does not Granger Cause CPIAUCSL_6MF		0.4603		0.7106
Livingston Median 6-mo CPI	N	CPIAUCSL_6MF does not Granger Cause LV_MD_CPI_6	120	146.9670	***	0.0000
		LV_MD_CPI_6 does not Granger Cause CPIAUCSL_6MF		0.3679		0.7763
Richmond 6-mo Prices Paid	D	PCEPI_6MF does not Granger Cause RXPP	163	7.2333	***	0.0001
		RXPP does not Granger Cause PCEPI_6MF		1.5791		0.1966
Livingston Mean 6-mo PPI	N	PPIFGS_6MF does not Granger Cause LV_MN_PPI_6	56	58.6129	***	0.0000
		LV_MN_PPI_6 does not Granger Cause PPIFGS_6MF		0.2717		0.8455
Livingston Median 6-mo PPI	N	PPIFGS_6MF does not Granger Cause LV_MD_PPI_6	56	68.8452	***	0.0000
		LV_MD_PPI_6 does not Granger Cause PPIFGS_6MF		0.3151		0.8144
Michigan Housing Price Conditions	D	PCEPI_6MF does not Granger Cause MHOP	163	0.4955		0.6859
		MHOP does not Granger Cause PCEPI_6MF		0.6524		0.5826
Michigan Vehicles Price Conditions	D	PCEPI_6MF does not Granger Cause MVHP	163	1.9254	*	0.1277
		MVHP does not Granger Cause PCEPI_6MF		2.3082	**	0.0787
Michigan Durable Goods Price Conditions	D	PCEPI_6MF does not Granger Cause MDUP	163	1.2333		0.2996
		MDUP does not Granger Cause PCEPI_6MF		1.4278		0.2368
Dallas 6-mo Wages	D	PCEPI_6MF does not Granger Cause DWGS	49	1.0787		0.3685
		DWGS does not Granger Cause PCEPI_6MF		0.1965		0.8982
Kansas 6-mo Prices Received	D	PCEPI_6MF does not Granger Cause KXPR	84	5.1005	***	0.0028
		KXPR does not Granger Cause PCEPI_6MF		0.5409		0.6557
Richmond 6-mo Wages	D	PCEPI_6MF does not Granger Cause RWGE	76	1.0031		0.3968
		RWGE does not Granger Cause PCEPI_6MF		1.0514		0.3755
Kansas 6-mo Prices Paid	D	PCEPI_6MF does not Granger Cause KXPP	84	7.5387	***	0.0002
		KXPP does not Granger Cause PCEPI_6MF		1.0851		0.3605
Philly 6-mo Prices Received	D	PCEPI_6MF does not Granger Cause PXPR	163	6.4607	***	0.0004
		PXPR does not Granger Cause PCEPI_6MF		1.1779		0.3200
Philly 6-mo Prices Paid	D	CPIAUCSL_6MF does not Granger Cause PXPP	482	1.5849		0.1922
		PXPP does not Granger Cause CPIAUCSL_6MF		0.4498		0.7176
Dallas 6-mo Prices Paid	D	CPIAUCSL_6MF does not Granger Cause DPPM	49	12.3910	***	0.0000
		DPPM does not Granger Cause CPIAUCSL_6MF		0.3243		0.8077
NY 6-mo Prices Paid	D	PCEPI_6MF does not Granger Cause NXPP	84	3.3563	***	0.0231
		NXPP does not Granger Cause PCEPI_6MF		0.8791		0.4557
NY 6-mo Prices Received	D	PCEPI_6MF does not Granger Cause NXPR	84	3.5077	***	0.0192
		NXPR does not Granger Cause PCEPI_6MF		0.3027		0.8233
Dallas 6-mo Prices Received	D	CPIAUCSL_6MF does not Granger Cause DPRG	49	10.9678	***	0.0000
		DPRG does not Granger Cause CPIAUCSL_6MF		1.0631		0.3750
Blue Chip 1-yr GDP Deflator	N	PCEPI_12MF does not Granger Cause BDFD	159	2.4584	**	0.0651
		BDFD does not Granger Cause PCEPI_12MF		0.4128		0.7441
Survey of Professional Forecasters 1-yr CPI	N	CPIAUCSL_12MF does not Granger Cause SPF_INFCPI1YR	105	5.0930	***	0.0026
		SPF_INFCPI1YR does not Granger Cause CPIAUCSL_12MF		3.3315	***	0.0227
Blue Chip 1-yr CPI	N	CPIAUCSL_12MF does not Granger Cause BCPI	346	11.3965	***	0.0000
		BCPI does not Granger Cause CPIAUCSL_12MF		2.6171	***	0.0509
TIPS Spread 1-yr	N	PCEPI_12MF does not Granger Cause TIPS	63	0.3706		0.7745
		TIPS does not Granger Cause PCEPI_12MF		0.5691		0.6377
Michigan 1-yr Median Inflation	N	PCEPI_12MF does not Granger Cause M1PM	159	1.0079		0.3910
		M1PM does not Granger Cause PCEPI_12MF		0.5927		0.6207
Michigan 1-yr Mean Inflation	N	CPIAUCSL_12MF does not Granger Cause M1PA	363	17.3789	***	0.0000
		M1PA does not Granger Cause CPIAUCSL_12MF		0.1287		0.9430
Conference Board 1-yr Inflation	N	CPIAUCSL_12MF does not Granger Cause CXIN	248	0.7038		0.5506
		CXIN does not Granger Cause CPIAUCSL_12MF		0.5857		0.6249
Livingston Mean 1-yr CPI	N	CPIAUCSL_12MF does not Granger Cause LV_MN_CPI_12	120	103.1850	***	0.0000
		LV_MN_CPI_12 does not Granger Cause CPIAUCSL_12MF		0.6849		0.5631
Livingston Median 1-yr CPI	N	CPIAUCSL_12MF does not Granger Cause LV_MD_CPI_12	120	130.4300	***	0.0000
		LV_MD_CPI_12 does not Granger Cause CPIAUCSL_12MF		2.3180	**	0.0793
Livingston Median 1-yr PPI	N	PPIFGS_12MF does not Granger Cause LV_MD_PPI_12	56	23.7341	***	0.0000
		LV_MD_PPI_12 does not Granger Cause PPIFGS_12MF		1.2235		0.3111
Livingston Mean 1-yr PPI	N	PPIFGS_12MF does not Granger Cause LV_MN_PPI_12	56	24.6043	***	0.0000
		LV_MN_PPI_12 does not Granger Cause PPIFGS_12MF		1.0985		0.3587
UBS/Gallup 1-yr Inflation	D	PCEPI_12MF does not Granger Cause GXIN	131	1.9864	**	0.1195
		GXIN does not Granger Cause PCEPI_12MF		0.6236		0.6011
Michigan 5-yr Mean Inflation	N	PCEPI_60MF does not Granger Cause M5PA	111	0.7470		0.5265
		M5PA does not Granger Cause PCEPI_60MF		2.4428	**	0.0683
Michigan 5-yr Median Inflation	N	PCEPI_60MF does not Granger Cause M5PM	111	1.9278	*	0.1296
		M5PM does not Granger Cause PCEPI_60MF		1.4455		0.2339

TABLE 9 - PREDICTIVE POWER - GRANGER CAUSALITY - 12 LAGS

Indicator	Type	Null Hypothesis	Obs	F-Statistic	Sig.	Prob.
Small Business 3-mo Price Plans	D	PPIFGS_3MF does not Granger Cause SBPP	261	6.8630	***	0.0000
		SBPP does not Granger Cause PPIFGS_3MF		1.1672		0.3077
Richmond 6-mo Services Prices	D	PCEPI_6MF does not Granger Cause RSXP	154	1.8022	*	0.0541
		RSXP does not Granger Cause PCEPI_6MF		1.3797		0.1836
Richmond 6-mo Non-Retail Prices	D	PCEPI_6MF does not Granger Cause RNXP	154	1.2899		0.2320
		RNXP does not Granger Cause PCEPI_6MF		1.6048		0.0978
Richmond 6-mo Prices Received	D	PCEPI_6MF does not Granger Cause RXPR	154	1.9626	**	0.0328
		RXPR does not Granger Cause PCEPI_6MF		1.5004		0.1319
Richmond 6-mo Retail Prices	D	CPIAUCSL_6MF does not Granger Cause RRXP	168	1.0702		0.3896
		RRXP does not Granger Cause CPIAUCSL_6MF		0.7366		0.7137
Livingston Mean 6-mo CPI	N	CPIAUCSL_6MF does not Granger Cause LV_MN_CPI_6	111	31.6852	***	0.0000
		LV_MN_CPI_6 does not Granger Cause CPIAUCSL_6MF		0.4705		0.9268
Livingston Median 6-mo CPI	N	CPIAUCSL_6MF does not Granger Cause LV_MD_CPI_6	111	34.4215	***	0.0000
		LV_MD_CPI_6 does not Granger Cause CPIAUCSL_6MF		0.6588		0.7856
Richmond 6-mo Prices Paid	D	PCEPI_6MF does not Granger Cause RXPP	154	2.5967	***	0.0040
		RXPP does not Granger Cause PCEPI_6MF		1.1616		0.3176
Livingston Mean 6-mo PPI	N	PPIFGS_6MF does not Granger Cause LV_MN_PPI_6	47	20.3581	***	0.0000
		LV_MN_PPI_6 does not Granger Cause PPIFGS_6MF		1.7039	*	0.1344
Livingston Median 6-mo PPI	N	PPIFGS_6MF does not Granger Cause LV_MD_PPI_6	47	25.8090	***	0.0000
		LV_MD_PPI_6 does not Granger Cause PPIFGS_6MF		1.4933		0.2001
Housing Price Conditions	D	PCEPI_6MF does not Granger Cause MHOP	154	0.8622		0.5868
		MHOP does not Granger Cause PCEPI_6MF		0.6835		0.7649
Vehicles Price Conditions	D	PCEPI_6MF does not Granger Cause MVHP	154	1.2644		0.2475
		MVHP does not Granger Cause PCEPI_6MF		0.9650		0.4856
Durable Goods Price Conditions	D	PCEPI_6MF does not Granger Cause MDUP	154	2.0082	**	0.0283
		MDUP does not Granger Cause PCEPI_6MF		0.8047		0.6451
Dallas 6-mo Wages	D	PCEPI_6MF does not Granger Cause DWGS	40	0.8501		0.6062
		DWGS does not Granger Cause PCEPI_6MF		0.5339		0.8606
Kansas 6-mo Prices Received	D	PCEPI_6MF does not Granger Cause KXPR	75	2.3000	**	0.0200
		KXPR does not Granger Cause PCEPI_6MF		1.1800		0.3228
Richmond 6-mo Wages	D	PCEPI_6MF does not Granger Cause RWGE	67	1.4800		0.1703
		RWGE does not Granger Cause PCEPI_6MF		1.5378		0.1490
Kansas 6-mo Prices Paid	D	PCEPI_6MF does not Granger Cause KXPP	75	3.8063	***	0.0004
		KXPP does not Granger Cause PCEPI_6MF		0.9917		0.4700
Philly 6-mo Prices Received	D	PCEPI_6MF does not Granger Cause PXPR	154	2.5946	***	0.0040
		PXPR does not Granger Cause PCEPI_6MF		0.7489		0.7012
Philly 6-mo Prices Paid	D	CPIAUCSL_6MF does not Granger Cause PXPP	473	3.3321	***	0.0001
		PXPP does not Granger Cause CPIAUCSL_6MF		1.0146		0.4340
Dallas 6-mo Prices Paid	D	CPIAUCSL_6MF does not Granger Cause DPPM	40	4.9867	***	0.0022
		DPPM does not Granger Cause CPIAUCSL_6MF		0.5654		0.8376
NY 6-mo Prices Paid	D	PCEPI_6MF does not Granger Cause NXPP	75	2.9743	***	0.0034
		NXPP does not Granger Cause PCEPI_6MF		0.5271		0.8869
NY 6-mo Prices Received	D	PCEPI_6MF does not Granger Cause NXPR	75	1.9371	*	0.0519
		NXPR does not Granger Cause PCEPI_6MF		1.0363		0.4320
Dallas 6-mo Prices Received	D	CPIAUCSL_6MF does not Granger Cause DPRG	40	5.2042	***	0.0018
		DPRG does not Granger Cause CPIAUCSL_6MF		0.9480		0.5299
Blue Chip 1-yr GDP Deflator	N	PCEPI_12MF does not Granger Cause BDFD	150	2.4711	**	0.0062
		BDFD does not Granger Cause PCEPI_12MF		1.0571		0.4020
Survey of Professional Forecasters 1-yr CPI	N	CPIAUCSL_12MF does not Granger Cause SPF_INFCPI1YR	96	2.4268	**	0.0106
		SPF_INFCPI1YR does not Granger Cause CPIAUCSL_12MF		1.6672	*	0.0929
Blue Chip 1-yr CPI	N	CPIAUCSL_12MF does not Granger Cause BCPI	337	2.7673	***	0.0014
		BCPI does not Granger Cause CPIAUCSL_12MF		4.1184	***	0.0000
TIPS Spread 1-yr	N	PCEPI_12MF does not Granger Cause TIPS	54	1.7917	*	0.0977
		TIPS does not Granger Cause PCEPI_12MF		1.3571		0.2418
Michigan 1-yr Median Inflation	N	PCEPI_12MF does not Granger Cause M1PM	150	4.6099	***	0.0000
		M1PM does not Granger Cause PCEPI_12MF		1.4371		0.1577
Michigan 1-yr Mean Inflation	N	CPIAUCSL_12MF does not Granger Cause M1PA	354	6.5117	***	0.0000
		M1PA does not Granger Cause CPIAUCSL_12MF		3.0370	***	0.0005
Conference Board 1-yr Inflation	N	CPIAUCSL_12MF does not Granger Cause CXIN	239	3.1262	***	0.0004
		CXIN does not Granger Cause CPIAUCSL_12MF		0.9440		0.5040
Livingston Mean 1-yr CPI	N	CPIAUCSL_12MF does not Granger Cause LV_MN_CPI_12	111	28.0804	***	0.0000
		LV_MN_CPI_12 does not Granger Cause CPIAUCSL_12MF		0.3520		0.9761
Livingston Median 1-yr CPI	N	CPIAUCSL_12MF does not Granger Cause LV_MD_CPI_12	111	30.1134	***	0.0000
		LV_MD_CPI_12 does not Granger Cause CPIAUCSL_12MF		0.5711		0.8596
Livingston Median 1-yr PPI	N	PPIFGS_12MF does not Granger Cause LV_MD_PPI_12	47	12.2624	***	0.0000
		LV_MD_PPI_12 does not Granger Cause PPIFGS_12MF		1.1600		0.3669
Livingston Mean 1-yr PPI	N	PPIFGS_12MF does not Granger Cause LV_MN_PPI_12	47	8.6754	***	0.0000
		LV_MN_PPI_12 does not Granger Cause PPIFGS_12MF		1.3706		0.2514
UBS/Gallup 1-yr Inflation	D	PCEPI_12MF does not Granger Cause GXIN	122	1.5559		0.1177
		GXIN does not Granger Cause PCEPI_12MF		0.8737		0.5758
Michigan 5-yr Mean Inflation	N	PCEPI_60MF does not Granger Cause M5PA	102	1.0362		0.4254
		M5PA does not Granger Cause PCEPI_60MF		0.9595		0.4943
Michigan 5-yr Median Inflation	N	PCEPI_60MF does not Granger Cause M5PM	102	1.4188		0.1757
		M5PM does not Granger Cause PCEPI_60MF		0.5718		0.8583

TABLE 10 - TEST FOR UNBIASEDNESS

Dependent Variable	Independent Variable	Type	Coeff	Std err	t-stat	Sig.	R-squared	D-W	Chi-sq	Chi-sq p-val
PPIFGS_3MF	C		0.5641	0.1187	4.7532	***	0.0734	0.6630	NA	NA
	Small Business 3-mo Price Plans	D	0.1103	0.0370	2.9774	***				
PCEPI_6MF	C		0.8270	0.1717	4.8177	***	0.0138	0.1799	NA	NA
	Richmond 6-mo Services Prices	D	0.1305	0.0930	1.4034					
PCEPI_6MF	C		0.8198	0.1624	5.0478	***	0.0295	0.1884	NA	NA
	Richmond 6-mo Non-Retail Prices	D	0.1599	0.0913	1.7510	*				
PCEPI_6MF	C		1.0997	0.2781	3.9547	***	0.0037	0.1701	NA	NA
	Richmond 6-mo Prices Received	D	-0.0583	0.2200	-0.2652					
CPIAUCSL_6MF	C		1.2837	0.2850	4.5034	***	0.0003	0.1897	NA	NA
	Richmond 6-mo Retail Prices	D	-0.0247	0.1602	-0.1545					
CPIAUCSL_6MF	C		0.6165	0.1275	4.8341	***	0.5261	1.7467	NA	NA
	Livingston Mean 6-mo CPI	N	0.6639	0.0792	8.3827	***				
CPIAUCSL_6MF	C		0.7713	0.1997	3.8616	***	0.4551	1.6330	15.2546	0.0005
	Livingston Median 6-mo CPI	N	0.5601	0.1219	4.5942	***				
PCEPI_6MF	C		1.1055	0.2342	4.7207	***	0.0042	0.1704	98.9156	0.0000
	Richmond 6-mo Prices Paid	D	-0.0393	0.1208	-0.3250					
PPIFGS_6MF	C		0.7767	0.2331	3.3316	***	0.1432	1.7491	NA	NA
	Livingston Mean 6-mo PPI	N	0.3858	0.2202	1.7523	*				
PPIFGS_6MF	C		0.7956	0.2500	3.1821	***	0.1287	1.7197	10.3540	0.0056
	Livingston Median 6-mo PPI	N	0.3709	0.2357	1.5735					
PCEPI_6MF	C		1.0258	0.1443	7.1085		0.0012	0.1756	2961.1060	0.0000
	Michigan Housing Price Conditions	D	0.0149	0.0182	0.8217					
PCEPI_6MF	C		1.0252	0.1417	7.2367	***	0.0001	0.1726	NA	NA
	Michigan Vehicles Price Conditions	D	0.0039	0.0076	0.5205					
PCEPI_6MF	C		1.0253	0.1575	6.5102	***	0.0003	0.1730	NA	NA
	Michigan Durable Goods Price Conditions	D	0.0064	0.0131	0.4860					
PCEPI_6MF	C		1.2031	0.1684	7.1444	***	0.0085	0.2013	NA	NA
	Dallas 6-mo Wages	D	0.0209	0.0069	3.0300	***				
PCEPI_6MF	C		1.1607	0.2040	5.6902	***	0.0373	0.2464	NA	NA
	Kansas 6-mo Prices Received	D	0.0317	0.0122	2.6011	***				
PCEPI_6MF	C		1.1811	0.3616	3.2663	***	0.0134	0.1902	NA	NA
	Richmond 6-mo Wages	D	-0.0201	0.0101	-1.9934	**				
PCEPI_6MF	C		1.1626	0.7522	1.5457		0.0665	0.3315	NA	NA
	Kansas 6-mo Prices Paid	D	0.0338	0.1645	0.2056					
PCEPI_6MF	C		1.0263	0.1276	8.0442	***	0.0104	0.2064	NA	NA
	Philly 6-mo Prices Received	D	0.0118	0.0037	3.1838	***				
CPIAUCSL_6MF	C		2.2305	0.5773	3.8638	***	0.0029	0.0613	NA	NA
	Philly 6-mo Prices Paid	D	0.0140	0.0063	2.2269	**				
CPIAUCSL_6MF	C		1.3160	4.5636	0.2884		0.1263	0.4241	NA	NA
	Dallas 6-mo Prices Paid	D	0.0727	0.7398	0.0983					
PCEPI_6MF	C		1.1612	0.1800	6.4504	***	0.0035	0.1941	NA	NA
	NY 6-mo Prices Paid	D	0.0065	0.0112	0.5834					
PCEPI_6MF	C		1.1653	0.1545	7.5426	***	0.0020	0.1822	NA	NA
	NY 6-mo Prices Received	D	-0.0048	0.0041	-1.1472					
CPIAUCSL_6MF	C		1.2870	0.3860	3.3343	***	0.0307	0.2470	NA	NA
	Dallas 6-mo Prices Received	D	0.0285	0.0190	1.5010					
PCEPI_12MF	C		3.2584	0.5522	5.9004	***	0.0478	0.1374	37.6270	0.0000
	Blue Chip 1-yr GDP Deflator	N	-0.5428	0.2515	-2.1580	**				
PCEPI_12MF	C		4.2747	0.9127	4.6839	***	0.1150	0.6488	24.8053	0.0000
	Survey of Professional Forecasters 1-yr CPI	N	-0.8713	0.3803	-2.2910	**				
CPIAUCSL_12MF	C		0.4027	1.2055	0.3340		0.6160	0.1280	2.3471	0.3093
	Blue Chip 1-yr CPI	N	0.7882	0.4086	1.9287	*				
PCEPI_12MF	C		2.8791	0.7525	3.8260	***	0.0008	0.1607	25.4105	0.0000
	TIPS Spread 1-yr	N	-0.1244	0.3190	-0.3900					
PCEPI_12MF	C		2.9875	0.6497	4.5984	***	0.0349	0.1220	172.1551	0.0000
	Michigan 1-yr Median Inflation	N	-0.3010	0.1758	-1.7120	*				
CPIAUCSL_12MF	C		-1.1358	0.4337	-2.6191	***	0.6883	0.2963	42.9786	0.0000
	Michigan 1-yr Mean Inflation	N	1.0647	0.1079	9.8634	***				
CPIAUCSL_12MF	C		4.0577	2.7632	1.4685		0.0144	0.0869	65.7507	0.0000
	Conference Board 1-yr Inflation	N	-0.2461	0.5646	-0.4360					
CPIAUCSL_12MF	C		1.6358	0.3214	5.0896	***	0.4943	1.2347	69.4308	0.0000
	Livingston Mean 1-yr CPI	N	1.0665	0.2000	5.3330	***				
CPIAUCSL_12MF	C		1.9560	0.3874	5.0485	***	0.4021	1.0192	60.4020	0.0000
	Livingston Median 1-yr CPI	N	0.8593	0.2584	3.3250	***				
PPIFGS_12MF	C		1.6389	0.4012	4.0850	***	0.1970	1.0480	19.6105	0.0001
	Livingston Median 1-yr PPI	N	0.6750	0.3453	1.9547	*				
PPIFGS_12MF	C		1.6577	0.4050	4.0927	***	0.2066	1.0901	18.9074	0.0001
	Livingston Mean 1-yr PPI	N	0.6702	0.3308	2.0261	**				
PCEPI_12MF	C		2.2073	0.1628	13.5607	***	0.0003	0.1592	NA	0.0000
	UBS/Gallup 1-yr Inflation	D	-0.0017	0.0042	-0.4134					
PCEPI_60MF	C		4.1944	0.4730	8.8674	***	0.3715	0.2976	212.0440	0.0000
	Michigan 5-yr Mean Inflation	N	-0.5802	0.1236	-4.6931	***				
PCEPI_60MF	C		6.1750	0.8816	7.0043	***	0.3778	0.3694	253.9082	0.0000
	Michigan 5-yr Median Inflation	N	-1.3724	0.2890	-4.7485	***				

TABLE 11 - TEST FOR EFFICIENCY - CPI

Variable	Type	CPI Coeff	CPI Std err	CPI t-stat	Sig.	R-squared	Nobs
Small Business 3-mo Price Plans	D	-0.2182	0.1061	-2.0569	**	0.0072	273
Richmond 6-mo Services Prices	D	0.4739	0.1496	3.1674	***	0.2327	166
Richmond 6-mo Non-Retail Prices	D	0.4197	0.1649	2.5449	**	0.1633	166
Richmond 6-mo Prices Received	D	0.5391	0.1021	5.2831	***	0.2167	166
Richmond 6-mo Retail Prices	D	0.6828	0.1666	4.0977	***	0.2813	180
Livingston Mean 6-mo CPI	N	0.0861	0.0257	3.3471	***	0.0444	120
Livingston Median 6-mo CPI	N	0.0818	0.0252	3.2440	***	0.0429	120
Richmond 6-mo Prices Paid	D	0.8580	0.1658	5.1755	***	0.3076	166
Livingston Mean 6-mo PPI	N	0.0996	0.0455	2.1880	**	0.0141	59
Livingston Median 6-mo PPI	N	0.0928	0.0456	2.0365	**	0.0121	59
Michigan Housing Price Conditions	D	0.1424	0.1329	1.0715		0.0055	166
Michigan Vehicles Price Conditions	D	0.2149	0.1721	1.2488		0.0093	166
Michigan Durable Goods Price Conditions	D	0.1214	0.1836	0.6614		0.0027	166
Dallas 6-mo Wages	D	0.0734	0.4702	0.1560		0.0002	52
Kansas 6-mo Prices Received	D	-0.2849	0.3215	-0.8862		0.0033	87
Richmond 6-mo Wages	D	0.5853	0.3726	1.5710		0.0130	79
Kansas 6-mo Prices Paid	D	-0.9989	0.5972	-1.6727	*	0.0265	87
Philly 6-mo Prices Received	D	-0.3520	0.2274	-1.5482		0.0028	166
Philly 6-mo Prices Paid	D	-0.4702	0.0648	-7.2582	***	0.0463	485
Dallas 6-mo Prices Paid	D	-1.9979	0.6149	-3.2492	***	0.0671	52
NY 6-mo Prices Paid	D	-0.8122	0.3600	-2.2558	**	0.0119	87
NY 6-mo Prices Received	D	0.1234	0.2525	0.4886		0.0003	87
Dallas 6-mo Prices Received	D	-0.7353	0.4845	-1.5175		0.0053	52
Blue Chip 1-yr GDP Deflator	N	0.4777	0.2089	2.2867	**	0.1325	162
Survey of Professional Forecasters 1-yr CPI	N	0.4473	0.0852	5.2481	***	0.2755	108
Blue Chip 1-yr CPI	N	0.1424	0.0562	2.5361	**	0.0700	349
TIPS Spread 1-yr	N	1.0097	2.0022	0.5043		0.5596	66
Michigan 1-yr Median Inflation	N	0.7276	0.2586	2.8140	***	0.2545	162
Michigan 1-yr Mean Inflation	N	-0.0311	0.1602	-0.1938		0.0031	366
Conference Board 1-yr Inflation	N	0.0280	0.4761	0.0588		0.0004	251
Livingston Mean 1-yr CPI	N	-0.1577	0.0859	-1.8360	*	0.0515	120
Livingston Median 1-yr CPI	N	-0.1717	0.0800	-2.1466	**	0.0657	120
Livingston Median 1-yr PPI	N	-0.1197	0.1141	-1.0495		0.0128	59
Livingston Mean 1-yr PPI	N	-0.1152	0.1099	-1.0477		0.0119	59
UBS/Gallup 1-yr Inflation	D	0.3909	0.4396	0.8892		0.0013	134
Michigan 5-yr Mean Inflation	N	0.4010	0.0964	4.1609	***	0.2445	223
Michigan 5-yr Median Inflation	N	0.3044	0.0642	4.7413	***	0.4151	223

TABLE 12 - TEST FOR EFFICIENCY - M1

Variable	Type	M1 Coeff	M1 Std err	M1 t-stat	Sig.	R-squared	Nobs
Small Business 3-mo Price Plans	D	0.0318	0.0205	1.5509		0.0030	273
Richmond 6-mo Services Prices	D	-0.0021	0.0619	-0.0347		0.0001	166
Richmond 6-mo Non-Retail Prices	D	0.0046	0.0497	0.0919		0.0003	166
Richmond 6-mo Prices Received	D	-0.0074	0.0525	-0.1419		0.0006	166
Richmond 6-mo Retail Prices	D	-0.0068	0.0521	-0.1313		0.0005	180
Livingston Mean 6-mo CPI	N	-0.0189	0.0203	-0.9292		0.0051	96
Livingston Median 6-mo CPI	N	-0.0189	0.0205	-0.9195		0.0051	96
Richmond 6-mo Prices Paid	D	-0.0183	0.1090	-0.1680		0.0020	166
Livingston Mean 6-mo PPI	N	-0.0263	0.0487	-0.5397		0.0029	59
Livingston Median 6-mo PPI	N	-0.0274	0.0490	-0.5588		0.0030	59
Michigan Housing Price Conditions	D	0.0080	0.0229	0.3478		0.0002	166
Michigan Vehicles Price Conditions	D	-0.0146	0.0184	-0.7933		0.0006	166
Michigan Durable Goods Price Conditions	D	0.0046	0.0219	0.2091		0.0001	166
Dallas 6-mo Wages	D	-0.2161	0.1510	-1.4314		0.0085	52
Kansas 6-mo Prices Received	D	0.1075	0.0644	1.6694	*	0.0041	87
Richmond 6-mo Wages	D	0.1190	0.0824	1.4449		0.0042	79
Kansas 6-mo Prices Paid	D	0.1649	0.1364	1.2085		0.0063	87
Philly 6-mo Prices Received	D	0.0381	0.0703	0.5421		0.0005	166
Philly 6-mo Prices Paid	D	-0.0164	0.0482	-0.3406		0.0001	485
Dallas 6-mo Prices Paid	D	-0.4994	0.7651	-0.6528		0.0205	52
NY 6-mo Prices Paid	D	0.4687	0.1021	4.5883	***	0.0343	87
NY 6-mo Prices Received	D	-0.0162	0.1751	-0.0928		0.0000	87
Dallas 6-mo Prices Received	D	-0.4298	0.3657	-1.1751		0.0088	52
Blue Chip 1-yr GDP Deflator	N	-0.1731	0.0501	-3.4565	***	0.2984	162
Survey of Professional Forecasters 1-yr CPI	N	0.0256	0.0347	0.7386		0.0087	108
Blue Chip 1-yr CPI	N	0.0304	0.0329	0.9232		0.0098	349
TIPS Spread 1-yr	N	-0.0681	0.0494	-1.3794		0.0316	66
Michigan 1-yr Median Inflation	N	-0.1548	0.0253	-6.1070	***	0.1976	162
Michigan 1-yr Mean Inflation	N	-0.0583	0.0407	-1.4344		0.0306	366
Conference Board 1-yr Inflation	N	-0.0403	0.0394	-1.0226		0.0145	251
Livingston Mean 1-yr CPI	N	-0.1422	0.0621	-2.2898	**	0.0902	96
Livingston Median 1-yr CPI	N	-0.1434	0.0622	-2.3056	**	0.0936	96
Livingston Median 1-yr PPI	N	-0.0788	0.0855	-0.9221		0.0160	59
Livingston Mean 1-yr PPI	N	-0.0708	0.0830	-0.8534		0.0130	59
UBS/Gallup 1-yr Inflation	D	-0.1002	0.2015	-0.4971		0.0015	134
Michigan 5-yr Mean Inflation	N	0.0731	0.0201	3.6444	***	0.1557	223
Michigan 5-yr Median Inflation	N	0.0358	0.0088	4.0805	***	0.1102	223

TABLE 13 - TEST FOR EFFICIENCY - M2

Variable	Type	M2 Coeff	M2 Std err	M2 t-stat	Sig.	R-squared	Nobs
Small Business 3-mo Price Plans	D	-0.0186	0.0256	-0.7276		0.0006	273
Richmond 6-mo Services Prices	D	0.0297	0.0354	0.8374		0.0059	166
Richmond 6-mo Non-Retail Prices	D	0.0278	0.0428	0.6482		0.0046	166
Richmond 6-mo Prices Received	D	-0.0693	0.0329	-2.1086	**	0.0231	166
Richmond 6-mo Retail Prices	D	0.0437	0.0245	1.7829	*	0.0159	180
Livingston Mean 6-mo CPI	N	-0.0273	0.0198	-1.3798		0.0102	96
Livingston Median 6-mo CPI	N	-0.0270	0.0196	-1.3753		0.0100	96
Richmond 6-mo Prices Paid	D	-0.1266	0.0518	-2.4461	**	0.0432	166
Livingston Mean 6-mo PPI	N	0.0425	0.0384	1.1055		0.0042	59
Livingston Median 6-mo PPI	N	0.0390	0.0380	1.0265		0.0035	59
Michigan Housing Price Conditions	D	0.0818	0.0194	4.2073	***	0.0116	166
Michigan Vehicles Price Conditions	D	0.0470	0.0300	1.5688		0.0029	166
Michigan Durable Goods Price Conditions	D	0.0444	0.0186	2.3923	**	0.0024	166
Dallas 6-mo Wages	D	-0.1589	0.1270	-1.2515		0.0019	52
Kansas 6-mo Prices Received	D	-0.0647	0.1253	-0.5167		0.0005	87
Richmond 6-mo Wages	D	-0.1026	0.1725	-0.5948		0.0008	79
Kansas 6-mo Prices Paid	D	0.1768	0.2274	0.7776		0.0026	87
Philly 6-mo Prices Received	D	0.1956	0.0631	3.0990	***	0.0055	166
Philly 6-mo Prices Paid	D	-0.0343	0.0387	-0.8856		0.0005	485
Dallas 6-mo Prices Paid	D	0.0141	0.4314	0.0327		0.0000	52
NY 6-mo Prices Paid	D	0.0997	0.2706	0.3686		0.0006	87
NY 6-mo Prices Received	D	-0.0193	0.1433	-0.1349		0.0000	87
Dallas 6-mo Prices Received	D	0.4787	0.5822	0.8221		0.0046	52
Blue Chip 1-yr GDP Deflator	N	0.0588	0.0639	0.9207		0.0159	162
Survey of Professional Forecasters 1-yr CPI	N	0.0531	0.0494	1.0758		0.0216	108
Blue Chip 1-yr CPI	N	0.0488	0.0804	0.6071		0.0149	349
TIPS Spread 1-yr	N	0.1562	0.1157	1.3505		0.0388	66
Michigan 1-yr Median Inflation	N	0.0558	0.0586	0.9519		0.0118	162
Michigan 1-yr Mean Inflation	N	-0.0128	0.0534	-0.2400		0.0009	366
Conference Board 1-yr Inflation	N	0.0315	0.0543	0.5807		0.0067	251
Livingston Mean 1-yr CPI	N	-0.1165	0.0580	-2.0078	**	0.0585	96
Livingston Median 1-yr CPI	N	-0.1199	0.0576	-2.0818	**	0.0632	96
Livingston Median 1-yr PPI	N	0.0430	0.0786	0.5466		0.0027	59
Livingston Mean 1-yr PPI	N	0.0513	0.0782	0.6569		0.0039	59
UBS/Gallup 1-yr Inflation	D	0.4182	0.2012	2.0788	**	0.0078	134
Michigan 5-yr Mean Inflation	N	-0.1345	0.0114	-11.8111	***	0.4145	223
Michigan 5-yr Median Inflation	N	-0.0592	0.0078	-7.6209	***	0.2369	223

TABLE 14 - TEST FOR EFFICIENCY - OIL PRICES

Variable	Type	OIL Coeff	OIL Std err	OIL t-stat	Sig.	R-squared	Nobs
Small Business 3-mo Price Plans	D	-0.0105	0.0072	-1.4493		0.0036	273
Richmond 6-mo Services Prices	D	0.0182	0.0083	2.1885	**	0.1189	166
Richmond 6-mo Non-Retail Prices	D	0.0170	0.0082	2.0773	**	0.0930	166
Richmond 6-mo Prices Received	D	0.0186	0.0078	2.3846	**	0.0896	166
Richmond 6-mo Retail Prices	D	0.0246	0.0116	2.1201	**	0.1310	180
Livingston Mean 6-mo CPI	N	0.0147	0.0083	1.7565	*	0.0378	96
Livingston Median 6-mo CPI	N	0.0147	0.0084	1.7532	*	0.0384	96
Richmond 6-mo Prices Paid	D	0.0307	0.0133	2.3035	**	0.1365	166
Livingston Mean 6-mo PPI	N	0.0201	0.0177	1.1386		0.0184	59
Livingston Median 6-mo PPI	N	0.0194	0.0181	1.0690		0.0168	59
Michigan Housing Price Conditions	D	0.0058	0.0080	0.7224		0.0032	166
Michigan Vehicles Price Conditions	D	0.0059	0.0076	0.7771		0.0025	166
Michigan Durable Goods Price Conditions	D	0.0059	0.0089	0.6613		0.0023	166
Dallas 6-mo Wages	D	0.0283	0.0240	1.1815		0.0064	52
Kansas 6-mo Prices Received	D	0.0078	0.0095	0.8197		0.0008	87
Richmond 6-mo Wages	D	0.0102	0.0217	0.4691		0.0008	79
Kansas 6-mo Prices Paid	D	-0.0343	0.0175	-1.9644	**	0.0098	87
Philly 6-mo Prices Received	D	0.0048	0.0147	0.3270		0.0002	166
Philly 6-mo Prices Paid	D	-0.0555	0.0128	-4.3487	***	0.0202	485
Dallas 6-mo Prices Paid	D	-0.0706	0.0266	-2.6607	***	0.0179	52
NY 6-mo Prices Paid	D	-0.0305	0.0222	-1.3790		0.0053	87
NY 6-mo Prices Received	D	0.0282	0.0146	1.9265	*	0.0041	87
Dallas 6-mo Prices Received	D	-0.0012	0.0339	-0.0350		0.0000	52
Blue Chip 1-yr GDP Deflator	N	0.0084	0.0111	0.7521		0.0163	162
Survey of Professional Forecasters 1-yr CPI	N	0.0062	0.0117	0.5312		0.0044	108
Blue Chip 1-yr CPI	N	0.0077	0.0081	0.9524		0.0073	349
TIPS Spread 1-yr	N	0.0512	0.0381	1.3439		0.3162	66
Michigan 1-yr Median Inflation	N	0.0241	0.0157	1.5324		0.1119	162
Michigan 1-yr Mean Inflation	N	0.0164	0.0199	0.8212		0.0277	366
Conference Board 1-yr Inflation	N	0.0316	0.0210	1.5045		0.0979	251
Livingston Mean 1-yr CPI	N	-0.0109	0.0107	-1.0209		0.0066	96
Livingston Median 1-yr CPI	N	-0.0106	0.0105	-1.0052		0.0064	96
Livingston Median 1-yr PPI	N	0.0132	0.0271	0.4855		0.0049	59
Livingston Mean 1-yr PPI	N	0.0091	0.0261	0.3501		0.0024	59
UBS/Gallup 1-yr Inflation	D	-0.0099	0.0220	-0.4510		0.0004	134
Michigan 5-yr Mean Inflation	N	-0.0059	0.0069	-0.8623		0.0121	223
Michigan 5-yr Median Inflation	N	-0.0009	0.0037	-0.2503		0.0008	223

TABLE 15 - TEST FOR EFFICIENCY - UNEMPLOYMENT

Variable	Type	UNEMP Coef	UNEMP Std ϵ	UNEMP t-sta	Sig.	R-squared	Nobs
Small Business 3-mo Price Plans	D	0.1812	0.0838	2.1622	**	0.0038	273
Richmond 6-mo Services Prices	D	-0.4313	0.1487	-2.9017	***	0.0987	166
Richmond 6-mo Non-Retail Prices	D	-0.3099	0.1757	-1.7634	*	0.0456	166
Richmond 6-mo Prices Received	D	-0.0156	0.1544	-0.1012		0.0001	166
Richmond 6-mo Retail Prices	D	-0.3740	0.0928	-4.0314	***	0.0674	180
Livingston Mean 6-mo CPI	N	-0.0483	0.0450	-1.0736		0.0045	97
Livingston Median 6-mo CPI	N	-0.0490	0.0447	-1.0953		0.0046	97
Richmond 6-mo Prices Paid	D	-0.2934	0.2223	-1.3197		0.0184	166
Livingston Mean 6-mo PPI	N	-0.0318	0.1379	-0.2304		0.0004	59
Livingston Median 6-mo PPI	N	-0.0294	0.1393	-0.2111		0.0003	59
Michigan Housing Price Conditions	D	0.0782	0.1151	0.6789		0.0008	166
Michigan Vehicles Price Conditions	D	0.0258	0.1237	0.2086		0.0001	166
Michigan Durable Goods Price Conditions	D	0.1122	0.1056	1.0624		0.0012	166
Dallas 6-mo Wages	D	0.2772	0.5617	0.4935		0.0006	52
Kansas 6-mo Prices Received	D	0.6189	0.4239	1.4601		0.0045	87
Richmond 6-mo Wages	D	0.4182	0.5163	0.8100		0.0017	79
Kansas 6-mo Prices Paid	D	0.2340	0.7770	0.3012		0.0004	87
Philly 6-mo Prices Received	D	-0.2383	0.3246	-0.7339		0.0007	166
Philly 6-mo Prices Paid	D	0.0197	0.1181	0.1665		0.0000	485
Dallas 6-mo Prices Paid	D	-0.5553	1.2394	-0.4480		0.0011	52
NY 6-mo Prices Paid	D	0.8554	0.6115	1.3988		0.0037	87
NY 6-mo Prices Received	D	0.3877	0.6942	0.5584		0.0007	87
Dallas 6-mo Prices Received	D	-1.6128	1.0347	-1.5587		0.0052	52
Blue Chip 1-yr GDP Deflator	N	-0.1839	0.4583	-0.4013		0.0123	162
Survey of Professional Forecasters 1-yr CPI	N	0.3185	0.1300	2.4492	**	0.1244	108
Blue Chip 1-yr CPI	N	0.4085	0.0927	4.4055	***	0.1643	349
TIPS Spread 1-yr	N	-0.3631	0.2290	-1.5858		0.0323	66
Michigan 1-yr Median Inflation	N	-0.2969	0.3027	-0.9807		0.0266	162
Michigan 1-yr Mean Inflation	N	0.0752	0.1142	0.6584		0.0046	366
Conference Board 1-yr Inflation	N	-0.1942	0.1813	-1.0708		0.0151	251
Livingston Mean 1-yr CPI	N	-0.1943	0.1328	-1.4624		0.0228	97
Livingston Median 1-yr CPI	N	-0.1926	0.1323	-1.4558		0.0229	97
Livingston Median 1-yr PPI	N	0.0371	0.2381	0.1558		0.0003	59
Livingston Mean 1-yr PPI	N	0.0335	0.2301	0.1457		0.0003	59
UBS/Gallup 1-yr Inflation	D	-0.1807	0.5800	-0.3115		0.0002	134
Michigan 5-yr Mean Inflation	N	0.5418	0.0522	10.3699	***	0.3918	223
Michigan 5-yr Median Inflation	N	0.2335	0.0311	7.4975	***	0.2144	223

TABLE 16 - TEST FOR EFFICIENCY - JOINT SPECIFICATION

Variable	Type	CPI Coeff	CPI Std err	CPI t-stat	Sig.	M1 Coeff	M1 Std err	M1 t-stat	Sig.	M2 Coeff	M2 Std err	M2 t-stat	Sig.	OIL Coeff	OIL Std err	OIL t-stat	Sig.	UNEMP Coeff	UNEMP Std err	UNEMP t-stat	Sig.	R-squared	F-Stat	Sig.	Nobs
Small Business 3-mo Price Plans	D	-0.2304	0.0894	-2.5775	***	0.0018	0.0377	0.0479		0.0181	0.0428	0.4234		0.0033	0.0096	0.3378		0.2388	0.2349	1.0163		0.0111	0.5979		273
Richmond 6-mo Services Prices	D	0.5684	0.1933	2.9405	***	0.0475	0.0482	0.9844		0.0387	0.0482	0.8043		-0.0034	0.0067	-0.5072		-0.3166	0.2476	-1.2785		0.3355	16.1591	***	166
Richmond 6-mo Non-Retail Prices	D	0.5119	0.2505	2.0435	**	0.0470	0.0454	1.0357		0.0590	0.0469	1.2580		-0.0015	0.0100	-0.1516		-0.1626	0.2411	-0.6743		0.2274	9.4196	***	166
Richmond 6-mo Prices Received	D	0.7694	0.1659	4.6382	***	0.0316	0.0502	0.6304		0.0038	0.0447	0.0857		-0.0131	0.0072	-1.8299	*	0.0771	0.2240	0.3439		0.2420	10.2175	***	166
Richmond 6-mo Retail Prices	D	0.9933	0.1814	5.4770	***	0.0800	0.0428	1.8709	*	0.0900	0.0589	1.5275		-0.0132	0.0071	-1.8584	*	-0.1719	0.2875	-0.5981		0.3966	22.8749	***	180
Livingston Mean 6-mo CPI	N	0.0605	0.0370	1.6337		-0.0153	0.0251	-0.6070		-0.0291	0.0186	-1.5642		0.0055	0.0100	0.5541		-0.0418	0.0514	-0.8140		0.0623	1.1959		96
Livingston Median 6-mo CPI	N	0.0584	0.0377	1.5494		-0.0145	0.0252	-0.5769		-0.0287	0.0188	-1.5265		0.0060	0.0100	0.5949		-0.0421	0.0519	-0.8111		0.0619	1.1874		96
Richmond 6-mo Prices Paid	D	1.0161	0.3073	3.3065	***	0.0470	0.0555	0.8479		-0.1047	0.0741	-1.4136		-0.0147	0.0119	-1.2368		-0.3984	0.3777	-1.0549		0.3545	17.5719	***	166
Livingston Mean 6-mo PPI	N	0.0472	0.0717	0.6581		-0.0028	0.0553	-0.0507		0.0329	0.0435	0.7561		0.0146	0.0227	0.6414		-0.0157	0.1554	-0.1013		0.0238	0.2583		59
Livingston Median 6-mo PPI	N	0.0424	0.0729	0.5818		-0.0083	0.0556	-0.1485		0.0285	0.0436	0.6539		0.0140	0.0231	0.6060		-0.0005	0.1584	-0.0030		0.0211	0.2289		59
Michigan Housing Price Conditions	D	0.3928	0.1753	2.2414	**	0.0244	0.0214	1.1440		0.2040	0.0385	5.2925	***	-0.0034	0.0073	-0.4648		0.5242	0.1826	2.8711	***	0.0486	1.6339		166
Michigan Vehicles Price Conditions	D	0.4949	0.1640	3.0171	***	0.0057	0.0261	0.2191		0.1424	0.0367	3.8809	***	-0.0101	0.0070	-1.4557		0.3836	0.1464	2.6208	***	0.0266	0.8760		166
Michigan Durable Goods Price Conditions	D	0.2691	0.2033	1.3236		0.0147	0.0260	0.5635		0.1418	0.0429	3.3063	***	-0.0004	0.0091	-0.0432		0.4240	0.1790	2.3690	**	0.0182	0.5937		166
Dallas 6-mo Wages	D	-1.2097	1.9137	-0.6321		-1.1844	0.3842	-3.0826	***	0.5156	0.7853	0.6566		0.1107	0.1105	1.0021		5.6324	2.5471	2.2113	**	0.0735	0.7294		52
Kansas 6-mo Prices Received	D	-1.5003	0.8489	-1.7673	*	0.2274	0.1193	1.9071	*	-0.1887	0.2087	-0.9040		0.0907	0.0463	1.9590	*	-1.8583	1.3476	-1.3789		0.0234	0.3881		87
Richmond 6-mo Wages	D	2.9528	0.6200	4.7628	***	0.0712	0.1761	0.4045		0.2482	0.2041	1.2163		-0.1541	0.0492	-3.1289	***	2.9507	1.3020	2.2663	**	0.0657	1.0274		79
Kansas 6-mo Prices Paid	D	-2.1371	0.7808	-2.7373	***	0.1988	0.1885	1.0544		-0.1338	0.2735	-0.4890		0.0803	0.0501	1.6036		-2.2442	1.5748	-1.4251		0.0354	0.5940		87
Philly 6-mo Prices Received	D	-1.0197	0.5945	-1.7153	*	0.0199	0.0774	0.2573		0.1840	0.1130	1.6288		0.0547	0.0344	1.5922		-0.0474	0.3817	-0.1242		0.0156	0.5087		166
Philly 6-mo Prices Paid	D	-0.4860	0.0864	-5.6234	***	0.0016	0.0421	0.0389		0.0158	0.0325	0.4847		0.0010	0.0137	0.0696		0.1264	0.1051	1.2030		0.0474	4.7701	***	485
Dallas 6-mo Prices Paid	D	-5.2922	1.0865	-4.8708	***	-1.8363	1.1511	-1.5952		1.9960	0.9875	2.0212	**	0.2496	0.0489	5.1072	***	10.6263	7.3821	1.4395		0.1706	1.8917		52
NY 6-mo Prices Paid	D	-1.3721	0.4672	-2.9370	***	0.7374	0.1294	5.6993	***	-0.4323	0.2071	-2.0873	**	0.0730	0.0366	1.9956	**	-3.2806	0.9424	-3.4812	***	0.0447	0.7589		87
NY 6-mo Prices Received	D	-1.0757	0.8340	-1.2899		0.0525	0.3128	0.1677		0.0904	0.4891	0.1849		0.0891	0.0693	1.2855		-0.9367	2.1619	-0.4333		0.0089	0.1460		87
Dallas 6-mo Prices Received	D	-4.3128	6.4053	-0.6733		-0.8247	1.2152	-0.6787		1.2363	1.6060	0.7698		0.2783	0.4907	0.5671		2.8802	4.5839	0.6283		0.0498	0.4825		52
Blue Chip 1-yr GDP Deflator	N	0.8050	0.3228	2.4937	**	-0.1347	0.0438	-3.0762	***	0.1387	0.0725	1.9140	*	-0.0224	0.0076	-2.9381	***	0.3672	0.3470	1.0582		0.4247	23.0293	***	162
Survey of Professional Forecasters 1-yr CPI	N	0.4145	0.0956	4.3354	***	-0.0424	0.0448	-0.9479		0.0256	0.0376	0.6795		-0.0103	0.0125	-0.8249		0.2687	0.1236	2.1733	**	0.3488	10.9286	***	108
Blue Chip 1-yr CPI	N	0.0854	0.1364	0.6258		-0.0917	0.0504	-1.8187	*	0.0142	0.0598	0.2379		0.0026	0.0214	0.1195		0.5891	0.1638	3.5967	***	0.2559	23.5951	***	349
TIPS Spread 1-yr	N	1.3776	0.6594	2.0892	**	0.0640	0.0561	1.1402		0.2211	0.2170	1.0192		-0.0184	0.0136	-1.3503		0.4474	0.3571	1.2530		0.6350	20.8761	***	66
Michigan 1-yr Median Inflation	N	0.8770	0.7695	1.1397		-0.0954	0.0837	-1.1389		0.1573	0.2191	0.7181		-0.0077	0.0164	-0.4693		0.2612	0.6580	0.3970		0.4026	21.0271	***	162
Michigan 1-yr Mean Inflation	N	-0.1320	0.4637	-0.2848		-0.1183	0.0927	-1.2760		-0.0319	0.1693	-0.1882		0.0285	0.0770	0.3704		0.4599	0.1812	2.5379	**	0.1537	13.0780	***	366
Conference Board 1-yr Inflation	N	-0.2298	0.3138	-0.7323		-0.0024	0.0661	-0.0358		-0.0089	0.0874	-0.1014		0.0391	0.0348	1.1224		-0.0829	0.4237	-0.1956		0.1231	6.8818	***	251
Livingston Mean 1-yr CPI	N	-0.2225	0.0967	-2.2999	**	-0.1475	0.0589	-2.5035	**	-0.1281	0.0559	-2.2931	**	0.0075	0.0177	0.4236		0.1404	0.1137	1.2355		0.2476	5.9237	***	96
Livingston Median 1-yr CPI	N	-0.2282	0.0973	-2.3444	**	-0.1486	0.0586	-2.5379	**	-0.1317	0.0555	-2.3744	**	0.0085	0.0170	0.4995		0.1469	0.1133	1.2972		0.2610	6.3588	***	96
Livingston Median 1-yr PPI	N	-0.2917	0.1847	-1.5799		-0.1076	0.1027	-1.0471		0.0478	0.0913	0.5241		0.0389	0.0390	0.9970		0.4712	0.2620	1.7983	*	0.0748	0.8571		59
Livingston Mean 1-yr PPI	N	-0.2640	0.1774	-1.4879		-0.0962	0.0993	-0.9690		0.0565	0.0902	0.6257		0.0323	0.0377	0.8584		0.4181	0.2564	1.6305		0.0611	0.6898		59
UBS/Gallup 1-yr Inflation	D	2.3600	0.8739	2.7007	***	-0.0403	0.1803	-0.2237		0.8831	0.3223	2.7397	***	-0.0639	0.0370	-1.7263	*	1.9112	0.6158	3.1037	***	0.0256	0.6719		134
Michigan 5-yr Mean Inflation	N	0.5990	0.0745	8.0409	***	-0.0281	0.0123	-2.2816	**	-0.0439	0.0223	-1.9639	**	-0.0271	0.0039	-6.9782	***	0.3554	0.1042	3.4104	***	0.7528	132.1606	***	223
Michigan 5-yr Median Inflation	N	0.4602	0.0527	8.7256	***	-0.0028	0.0068	-0.4201		-0.0004	0.0106	-0.0420		-0.0179	0.0024	-7.3374	***	0.1579	0.0447	3.5349	***	0.7822	155.8334	***	223

Table 17 - Out of Sample Tests			
Dependent Variable	Independent Variable	Type	RMSE
PPIFGS_3MF	Small Business 3-mo Price Plans	D	2.2968
PCEPI_6MF	Richmond 6-mo Services Prices	D	1.2102
PCEPI_6MF	Richmond 6-mo Non-Retail Prices	D	1.2059
PCEPI_6MF	Richmond 6-mo Prices Received	D	1.2475
CPIAUCSL_6MF	Richmond 6-mo Retail Prices	D	1.7682
CPIAUCSL_6MF	Livingston Mean 6-mo CPI	N	3.4274
CPIAUCSL_6MF	Livingston Median 6-mo CPI	N	2.5174
PCEPI_6MF	Richmond 6-mo Prices Paid	D	1.2445
PPIFGS_6MF	Livingston Mean 6-mo PPI	N	6.4246
PPIFGS_6MF	Livingston Median 6-mo PPI	N	5.4521
PCEPI_6MF	Michigan Housing Price Conditions	D	1.2047
PCEPI_6MF	Michigan Vehicles Price Conditions	D	1.2014
PCEPI_6MF	Michigan Durable Goods Price Conditions	D	1.2017
PCEPI_6MF	Dallas 6-mo Wages	D	1.2835
PCEPI_6MF	Kansas 6-mo Prices Received	D	1.2219
PCEPI_6MF	Richmond 6-mo Wages	D	1.2193
PCEPI_6MF	Kansas 6-mo Prices Paid	D	1.2270
PCEPI_6MF	Philly 6-mo Prices Received	D	1.1989
CPIAUCSL_6MF	Philly 6-mo Prices Paid	D	2.1859
CPIAUCSL_6MF	Dallas 6-mo Prices Paid	D	1.8213
PCEPI_6MF	NY 6-mo Prices Paid	D	1.2213
PCEPI_6MF	NY 6-mo Prices Received	D	1.2151
CPIAUCSL_6MF	Dallas 6-mo Prices Received	D	1.8287
PCEPI_12MF	Blue Chip 1-yr GDP Deflator	N	1.5086
PCEPI_12MF	Survey of Professional Forecasters 1-yr CPI	N	1.5430
CPIAUCSL_12MF	Blue Chip 1-yr CPI	N	2.1227
PCEPI_12MF	TIPS Spread 1-yr	N	1.4619
PCEPI_12MF	Michigan 1-yr Median Inflation	N	1.4581
CPIAUCSL_12MF	Michigan 1-yr Mean Inflation	N	2.5405
CPIAUCSL_12MF	Conference Board 1-yr Inflation	N	2.3653
CPIAUCSL_12MF	Livingston Mean 1-yr CPI	N	3.4935
CPIAUCSL_12MF	Livingston Median 1-yr CPI	N	2.5700
PPIFGS_12MF	Livingston Median 1-yr PPI	N	5.4073
PPIFGS_12MF	Livingston Mean 1-yr PPI	N	6.2783
PCEPI_12MF	UBS/Gallup 1-yr Inflation	D	1.3037