EVALUATING A VECTOR OF THE FED'S FORECASTS

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Abstract

In this paper we present a multivariate analysis of the Federal Reserve's forecasts. First, we evaluate the Fed's forecasts of the ten major expenditure categories of real GDP. Second, we present a new methodology for evaluating multivariate forecasts. Finally, we use the same methodology to determine whether the Fed's forecasts of GDP growth, inflation, and unemployment taken together present an accurate overall view of the economic situation and compare the Fed's forecasts to those of the Survey of Professional Forecasters. We find that the Fed's forecasts were generally consistent with the overall conditions that actually occurred. We also find that the Fed's forecasts and those of the Survey of Professional Forecasters are quite similar overall.

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There have been many evaluations of the Greenbook forecasts prepared by the staff of the Board of Governors of the Federal Reserve System. Most evaluations have separately examined the Fed's forecasts of select variables such as GDP, inflation, and unemployment. This is the approach that has been previously used by Clements et al., 2007; Joutz and Stekler, 2000; Romer and Romer, 2000; Sims, 2002; and Stekler, 1994.[1] Two concerns arise from this univariate evaluation approach: one is that there are other forecasts produced by the Fed that, to our knowledge, have not been evaluated, the other is that forecasts prepared by the Fed are often produced and used *jointly*. For example, past examinations of the Fed's real GDP growth rate forecasts have only focused on the headline GDP projections, and, to the best of our knowledge, the Fed's forecast of the ten main components of GDP have never been evaluated either singly or jointly.

Using a new methodology, we will present a multivariate analysis of the Fed's forecasts. We argue that forecasts should be judged on whether they provide an accurate comprehensive view of the various sectors of the economy. This view is especially important if the forecast is used in making policy and suggests that the forecasts should be evaluated jointly in a multivariate framework.[2]

There have been two previous studies that have considered some multivariate characteristics of the Fed's forecasts. Sinclair, Stekler and Kitzinger (SSK, 2010) examined the

[1] Groen et al. (2009) analyzed the Bank of England's real time forecasts of inflation and growth.

[2] Our analysis differs from that of Komunjer and Owyang (forthcoming) who use forecast errors in a multivariate framework to derive the weights of a utility function. In any event, their analysis did not use the Fed forecasts.

joint *directional* forecasts of GDP and inflation using contingency tables. Sinclair, Gamber, Stekler, and Reid (SGSR, forthcoming) calculated the costs of jointly misestimating GDP and inflation within the context of a Taylor type rule. These studies, however, did not develop a general approach for jointly evaluating quantitative forecasts.

While both of these studies considered some aspects of the forecast errors made in jointly predicting growth and inflation, these studies were not comprehensive enough. *Those analyses did not determine whether when all the forecasts were considered together, they accurately described the current or future states of the economy.* The new approach that we present is based on the methodology that Sinclair and Stekler (2011) utilized to analyze data revisions but is applied here to determine the accuracy of a vector of forecasts.

The Sinclair and Stekler methodology determined whether the first vintage of BEA estimates of all the major GDP components was similar to a later vintage of BEA estimates of the same components. The set of estimates of the growth rates of the components can be viewed as a vector comprising a particular vintage of data relating to that particular quarter. When all the estimates for that quarter are subsequently revised, the components of that vintage of data comprise a different vector. Thus, in order to determine whether the two set of estimates are related, it is necessary to compare the difference between the two vectors.

To measure the difference between these two vectors, the Sinclair-Stekler study utilized a technique, a distance measure, which is well established in the natural sciences for measuring the relationship of two vectors. They used a generalization of the Euclidean distance, the Mahalanobis measure, which allows for interdependence of the vectors.[3] In order to test whether

[3] See Abdi (2007) for a discussion of different distance measures.

there was a difference between the two vintages of estimates, they focused on the difference between the mean vectors of each vintage relative to the common within-group variation. In addition, Sinclair and Stekler used a vector generalization of the Holden and Peel (1990) test for unbiasedness to examine whether taking into account the revisions to other variables might have improved the forecasts.

In this paper we will utilize the same methodology, but apply it to the Fed's forecasts rather than BEA estimates. In our analysis, one vector will consist of the forecasts of all the variables that the Fed made at one time that refer to a particular point in time. The other vector will be comprised of the actual outcomes for those variables.

There are several contributions of this paper to the literature of forecast evaluation. First, we evaluate the Fed's forecasts of the ten main components of GDP. Previous analyses of the Fed's forecasts have only focused on the headline GDP projections. Second, we present a new methodology for evaluating multivariate forecasts. Finally, we use the same methodology to determine whether the Fed's forecasts of GDP growth, inflation, and unemployment taken together present an accurate overall view of the economic situation and compare the Fed's forecasts to those of the Survey of Professional Forecasters.

The rest of the paper proceeds in this way: We first describe the data and the new methodology and then evaluate the Fed's forecasts of ten major expenditure categories of GDP. As a second example, we also conduct a multivariate analysis of the forecasts of three variables, the GDP growth rate, the rate of inflation, and the unemployment rate, that together describe the overall condition of the economy. Finally, using the same methodology, we compare the Fed's

forecasts of those three variables with the consensus predictions of the same variables obtained from the Survey of Professional Forecasters.

I. Data

The projections used in this analysis are the Federal Reserve's Greenbook forecasts for (1) the growth rates of the ten major components of GDP that the Fed staff predicted from 1986.3 through 2004.4,[4] and (2) the growth rates of real output, the inflation rate, and the unemployment rate for the period 1965.4 – 2005.4.[5] In each quarter the Fed staff makes multiple predictions for many quarters into the future. We use the last set of forecasts made in each quarter but only analyze the projections that are made for the current quarter and one quarter ahead.

We focus on short horizons because the Fed staff has, at times, based its Greenbook forecasts on an assumed (possibly varying) path for monetary policy. At other times, however, the Fed has assumed that monetary policy would remain unchanged over its forecast horizon (see Reifschneider and Tulip, 2007, for further discussion). Since the assumed path for monetary policy associated with each Greenbook forecast is not known, a possible complication arises when analyzing longer-term forecasts. The current quarter and one-quarter ahead forecasts are too short of a time horizon, however, to be affected by the Fed's future path for monetary policy. Therefore, regardless of whether the Fed assumes a constant path or a time-varying path for

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[4] The Greenbook data are only available with a 5-year lag. We obtained our dataset from the PDF files on the Federal Reserve Bank of Philadelphia Website: http://www.philadelphiafed.org/econ/forecast/greenbook-data/index.cfm. The beginning dates are chosen based on when the Fed first began forecasting these variables. The ten components are: Durable consumption, non-durable consumption, services consumption, non-residential investment, residential investment, private inventories, exports, imports, federal government spending, and state and local government spending.

[5] For output growth we use GNP from 1965 to 1991 and GDP from 1992 on. The last forecast in the fourth quarter of 1991 was the first forecast of GDP. The inflation rate is based on the implicit price deflator through the first quarter of 1996, then the chain-weighted price index from 1996.2 on.

monetary policy, the current and one-quarter-ahead forecasts will be unaffected by those assumptions.

The actual values were the real-time data published approximately 90 days after the end of the quarter to which they refer. The use of the real-time data avoids definitional and classification changes.

II. Methodology

A. Single Variable Analysis

We first analyze the forecast errors of each variable separately and focus on two topics: directional accuracy and systematic error.

1. Directional Accuracy

A desirable characteristic of any forecast is that it should provide a correct picture of the direction in which the economy is moving. Thus the signs of the predicted changes of each of the ten components will be compared with the sign of the actual changes reported 90 days after the end of the quarter to which they refer.

2. Systematic Error (Bias)

Even if there are not a substantial number of differences in signs between the forecast and actual changes, there may still be a systematic error- a bias. We use two approaches to determine whether the forecasts are systematically related to the actual data. First, we test this relationship using the Mincer-Zarnowitz (1969) regression. We then question whether there are systematic errors related to the state of the economy. These two tests are applied *individually* to each of the

ten components of GDP.[6] Customarily, the Mincer-Zarnowitz (1969) regression has been used to test for bias in the forecasts of a single variable:

(1)

where A_t and F_t are the actual real-time data and the Fed's forecasts, respectively. For a test of informational efficiency, the null hypothesis is: $\beta_0 = 0 \; and \; \beta_1 = 1$. A rejection of this hypothesis indicates that the forecasts are biased and/or inefficient. The Wald test and the F distribution are used to test this null.[7]

Recent research has shown that forecasts sometimes contain systematic errors (Joutz and Stekler, 2000, Hanson and Whitehorn, 2006). Forecasters overestimated the rate of growth during slowdowns and recessions and underestimated it during recoveries and booms. Similarly, inflation was under-predicted when it was rising and over-predicted when it was declining. In some cases, these systematic errors, associated with the stages of the business cycle, may offset each other. Consequently, the use of (1) in the presence of these offsetting errors may yield regression estimates that do not reject the null of bias when in fact there are systematic errors that are associated with the state of the economy.

In order to determine whether the Fed's forecasts similarly failed to incorporate information about the state of the economy, we modified (1) as in Sinclair, Joutz, and Stekler (2010). The modified Mincer-Zarnowitz regression (2) now becomes:

(2)

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[6] These tests for the growth rate and inflation forecasts were already done in Sinclair, Joutz, and Stekler (2010). We therefore do not replicate them here.

[7] An alternative procedure for testing for bias has been to use equation suggested by Holden and Peel (1990): . In this case, the slope is imposed to be one and the test examines whether or not the forecast error has a zero mean, i.e. a simple test of statistical significance for the constant in this equation.

where D_t is a dummy that reflects the state of the economy. It takes on the value 1 if during one month of a particular quarter the economy was in a recession. Otherwise, the value of the dummy is zero. The quarters that constituted the recession were those defined by the NBER.[8] The joint null hypothesis now is: $\beta_0 = 0$, $\beta_1 = 1$, *and* $\beta_2 = 0$. If any of the coefficients associated with the dummies are non-zero, the dummies contain information that can explain the forecst errors. If this were the case, it would indicate that the Fed did not fully incorporate information about the state of the economy into the forecasts.

B. Multivariate Analysis

1. Bias

We have described the procedures that are used to test for the existence of systematic errors in the forecasts of each variable. We next investigate the properties of the errors of the forecasts of the same ten variables, but use a new joint framework. To do this we construct a first-order vector autoregression (VAR(1)) of the errors made in forecasting each of the ten components. If the forecasts are unbiased estimates of the outcomes, then none of the coefficients in the VAR should be significant. In other words, the constant estimates should be zero; the coefficients on the own lags should be zero; and none of the errors made in forecasting the other variables should Granger-cause any of the other errors. We, therefore, construct an eleven equation VAR (1) consisting of the forecast errors of GDP and its ten major components (where $\boldsymbol{FE_t}$ is a vector of the forecast errors for time *t*).

. (3)

[8] The NBER dates are available at: http://www.nber.org/cycles/cyclesmain.html. Even though the NBER data are not known in real time, there is ample justification for using them, because this is an ex post analysis to determine whether data during recessions were fully incorporated into the forecasts.

In this case, is then a vector of the constant terms and is a matrix of coefficients on the lags of the forecast errors. Under the null hypothesis, all of the elements of both and are zero. In section IV below we also undertake a multivariate analysis of the forecasts of growth, inflation and unemployment to determine whether these predictions accurately capture the overall view of the economy.

2. Accuracy

As mentioned above, we use a distance measure to determine the accuracy or difference of the vectors. There are two common measures of distance, Euclidean and Mahalanobis, that differ in the assumptions made about the statistical independence of the vectors. Assume that we have two independent vectors, $\boldsymbol{F_t}$ and $\boldsymbol{A_t}$, representing the forecasts and outcomes consisting of n variables in each vector. The difference between the two vectors can be measured by the Euclidean distance between them:

(4)

This procedure is only applicable to vectors that are independent and that are scaled so that they have unit variances. These assumptions do not apply in this analysis. Thus, we will use a generalization of the Euclidian distance that allows for the scale to differ across the different variables and for nonzero correlation between the variables. In order to test if there is a difference between the forecasts and the outcomes, we will focus on the difference between the mean vectors of each set of data relative to the common within-group variation. This measure is called the Mahalanobis Distance, D^2:[9]

[9]Mahanalobis distance is also associated with discriminant analysis. For other economic forecast applications of this measure, see Banternghansa and McCracken (2009) and Jordá et al (2010).

, (5)

where $\boldsymbol{W}$ is the inverse of the pooled sample variance-covariance matrix, and and are the mean vectors of the forecasts and outcomes, respectively.[10] Under the assumption of normality, we can construct an F-statistic based on this measure to test the null hypothesis that the forecasts and outcomes have the same population means.[11]

In addition, we will split the sample into periods when the economy was expanding and when the economy was in recession. From this we can see if the difference between the forecasts of the ten GDP components and their outcomes is significant during expansions, during recessions, or in both cyclical phases.

III. Results

A. Directional Accuracy

Among the 10 major components, the sign of the change in consumption services was always positive in both the forecasts and the actual data. The accuracy of the current quarter forecasts of the direction of change of the remaining nine GDP components ranged from 79-89%; it was 68-83% for the t+1 predictions.[12] (See Table 1). The quarter-ahead forecasts displayed a clustering of incorrect signs during the recession of 2001; otherwise there was no obvious clustering.

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[10] We estimate the sample covariance matrix as the weighted average of the two (bias-corrected) sample covariance matrices from the two sets of data. It is assumed that the two sets of data have a common covariance matrix in the population.

[11] $F = \frac{(n-1-p)n_1 n_2}{p(n-2)(n_1+n_2)} D^2$, with p and n-p-1 degrees of freedom (McLachlan, 1999).

[12] There were thirty quarters in which the signs of the forecasts of at least one component differed from the signs of the actual changes. In seven of those quarters the signs of three or more components disagreed.

B. Bias

Tables 2A and 2B present the results from the tests that we used to determine whether the forecasts of the ten components were biased. We show the p-values obtained from the two Mincer-Zarnowitz equations and from the joint test using the 11-equation VAR. [13] We found that at least one of the tests found evidence of bias in six of the component current-quarter forecasts and in nine of the one quarter-ahead projections. Thus in the 1986-2004 period, not only is the headline GDP forecast biased but so are many of the estimated components.

C. Accuracy

Despite the evidence of these biases in the forecasts, we needed to determine whether the forecasts of the ten components, taken together, provided an overall view of the growth of the economy that was consistent with the condition that actually occurred. For this analysis, we used the Mahalanobis Distance measure to jointly evaluate the component forecasts. The null was that the Fed forecasts failed to provide an overall view of the growth of the various sectors of the economy that was consistent with the observed data. (Tables 3A-3C). We did not reject the null for the current quarter forecasts in either the entire sample or in the recession/expansion subsamples. However, the null was rejected for the quarter-ahead forecasts for both the entire sample and for expansionary periods. The p values of the F statistics were 0.05 and 0.02, respectively. These results indicate that the Fed had a good understanding of the composition of the GDP changes that were occurring in the current quarter but not how these sectors were likely to change next period.[14]

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[13] In many cases, the null of unbiasedness was rejected when the state of the economy dummy was included in the Mincer-Zarnowitz equation.

[14] The null was not rejected in the recessionary quarters. This may be due either to a better understanding of what can occur in recessions or to the fact that the number of observations was too small to be able to reject the hypothesis.

D. Comparison with BEA Results

It is possible to make a benchmark comparison of these component forecasts. The Bureau of Economic Analysis publishes estimates of all of these components 30 days after the quarter to which they refer. Since the Fed's current quarter forecasts were made during the quarter, they were available at least 30 days before the BEA's first estimates. Sinclair and Stekler (2011) examined the 30 day vintage of BEA's estimates of the GDP components. They found that at least one test rejected the null of no bias for every single variable, be it headline GDP or one of the components. Although none of the tests rejected the null for the Fed's forecast of four components, these results are basically comparable to ours.[15] Thus the Fed's forecasts made in the current quarter seem to be as good as the BEA's estimates released at least 30 days later.

IV. Overall View of the Economy

A good forecast should provide an accurate picture or *overall view* of the state of the economy at a particular point in time. While we have, so far, focused on the GDP forecasts, the Fed also projects the rate of inflation rate and the unemployment rate at the same time that it predicts GDP. A combination of these three individual forecasts can be viewed as a vector representing an *overall view* of the future condition of the economy. The actual outcomes of the three variables comprise a different vector. Thus, if we are concerned with how well the forecasts reflect the actual changes that have occurred in the economy, we must compare the difference in the two vectors, representing the forecasts and the actual outcomes of the three variables. Our

[15] The components were consumption services, fixed non-residential investment, and the two government sectors. (See Table 2A.) It should be noted that the time periods for the two studies were different.

methodology permits us to analyze this issue, and we again used the Mahalanobis Distance measure, this time to jointly evaluate the growth, unemployment, and inflation forecasts.

The null was that the Fed forecasts provide an overall view of the economy that was consistent with the observed data. We did not reject this null for either the current or the quarter-ahead forecasts. We obtained the same results when we divided the sample into expansionary and recessionary periods. The p-values of the F statistic associated with the Mahalanobis Distance measure were always greater than 0.40. (Tables 4A-4C)

From these results we can conclude that the Greenbook forecasts are consistent with the *overall* conditions that actually occurred. However, given the results obtained from the ten component projections, the quarter-ahead estimates made for *particular* sectors may not always reflect actuality.

V. Benchmark Comparison

Our analysis to this point has been exclusively on the Fed's forecasts. This raises an obvious question: In terms of an overall view of the economy, how do these forecasts compare with other predictions? As the benchmark for this comparison, we used the median forecasts of growth, inflation and unemployment obtained from the Survey of professional Forecasters (SPF). Beginning in 1968.4, these forecasts span a period nearly as long as the entire sample of the Fed's predictions. The comparison is based on data for forecasts made from 1968.4 through 2005.4. As before we construct two vectors from the predictions of these three variables and use the Mahalanobis Distance measure to determine whether there was a significant difference in the average overall views of these two sets of forecasts. The results are presented in Table 5 and show that there is little difference between the two sets of forecasts. This suggests that the use of

the SPF forecasts as a proxy for the unavailable recent Greenbook forecasts, as used by some researchers, may be appropriate.

V. Conclusions

In this paper we evaluated some of the Fed's Greenbook forecasts. We argued that a macro forecast is intended to provide an overall view of the economy and it is, therefore, necessary that the forecasts of all important variables should be evaluated jointly in a multivariate framework. We then showed how a new approach for evaluating economic forecasts permitted us to evaluate the predictions of several variables jointly. We first applied this approach to the Fed's forecasts of the growth rates of ten components of real GDP. We showed that the Fed had a good understanding of the composition of the GDP changes that were occurring in the current quarter but not how these sectors were likely to change next period. Moreover, the Fed's forecasts for the current quarter were comparable in quality to the BEA estimates published at least 30 days after the quarter ended.

We then used the same method to examine the Fed's Greenbook forecasts of growth, inflation and unemployment to determine whether together they presented a substantially correct view of the state of the economy. We found that the Fed's forecasts were generally consistent with the *overall* conditions that actually occurred. We also compared the Fed's forecasts to those of the Survey of Professional Forecasters and found that they were quite similar overall.

Table 1

Percentage of Time the Signs of the Forecasts of GDP and Components Agreed with the Actuals

	Current Quarter	1 Quarter Ahead
GNP/GDP	95%	93%
Consumption Durable Goods	80%	69%
Consumption Non-Durable Goods	82%	72%
Consumption Services	100%	100%
Fixed Investment Nonresidential	83%	77%
Fixed Investment Residential	79%	68%
Private Inventories	86%	72%
Exports	83%	83%
Imports	84%	71%
Government Spending Federal	87%	83%
Government Spending State and Local	89%	80%

Table 2A
Summary of Rejections of the Null of No Bias for Real GDP and Components of Current Quarter Forecasts (Sample 1986Q3 – 2004Q4)

	Wald Test		VAR of Forecast Errors			
	MZ	MZ with Dummy	Signif. Constant	Signif. Own Lags	Granger Causality	Signif. Dummy
Real GNP/GDP	**0.005**	**0.014**	**0.000**	0.073	0.053	0.813
Real Consumption Durable Goods	**0.035**	**0.045**	**0.045**	0.346	0.821	0.340
Real Consumption Non-Durable Goods	**0.004**	**0.011**	**0.011**	0.679	0.637	0.624
Real Consumption Services	0.299	0.446	0.979	0.156	0.264	0.996
Real Fixed Investment Nonresidential	0.141	0.261	0.158	0.954	0.353	0.816
Real Fixed Investment Residential	**0.068**	**0.049**	0.259	0.516	0.321	0.327
Real Private Inventories	0.156	**0.003**	0.161	**0.077**	**0.096**	**0.020**
Real Exports	**0.084**	0.177	0.395	0.530	0.643	0.514
Real Imports	**0.004**	**0.000**	**0.064**	0.719	0.764	0.190
Real Government Federal Spending	0.878	0.964	0.518	0.588	0.248	0.892
Real Government State and Local Spending	0.359	0.440	0.584	0.303	0.187	0.197

Table 2B
Summary of Rejections of the Null of No Bias for Real GDP and Components of One-quarter Ahead Forecasts (Sample 1986Q3 – 2004Q4)

	Wald Test		VAR of Forecast Errors			
	MZ	MZ with Dummy	Signif. Constant	Signif. Own Lags	Granger Causality	Signif. Dummy
Real GNP/GDP	**0.014**	**0.000**	0.433	0.175	0.265	**0.003**
Real Consumption Durable Goods	**0.006**	**0.012**	**0.004**	0.796	0.213	0.751
Real Consumption Non-Durable Goods	0.317	0.461	0.677	0.228	0.216	0.315
Real Consumption Services	**0.006**	**0.002**	**0.070**	0.427	**0.071**	0.298
Real Fixed Investment Nonresidential	0.301	**0.068**	0.232	0.540	**0.050**	0.195
Real Fixed Investment Residential	**0.024**	**0.010**	0.328	0.278	0.576	**0.048**
Real Private Inventories	0.936	**0.000**	0.368	0.637	**0.022**	**0.000**
Real Exports	0.933	0.113	0.451	**0.084**	0.009	**0.034**
Real Imports	**0.086**	**0.000**	0.124	**0.034**	0.377	**0.000**
Real Government Federal Spending	**0.096**	0.188	0.116	**0.005**	0.893	0.710
Real Government State and Local Spending	0.210	0.279	0.184	0.152	**0.079**	0.964

Table 3A
Mahalanobis Distance – Entire Sample, 1986Q3 – 2004Q4

	Current Quarter Forecast		One Quarter Ahead Forecast	
	Mean Forecast	**Mean Actual**	**Mean Forecast**	**Mean Actual**
Durable Goods Consumption	4.525	6.329	2.573	6.423
Non-Durable Consumption	1.632	2.295	2.376	2.237
Services Consumption	3.167	3.168	2.856	3.169
Nonresidential Fixed Investment	5.087	6.271	5.219	6.532
Residential Fixed Investment	2.545	3.670	1.209	3.589
Private Inventories	18.080	21.695	21.333	21.513
Exports	5.622	6.762	6.705	6.764
Imports	5.975	8.093	6.271	8.169
Federal Gov. Spending	0.449	0.636	-0.623	1.045
State & Local Gov.Spending	2.122	2.321	1.896	2.315
Mahalanobis Distance (D^2)	0.129		0.539	
F-statistic	0.462		1.898	
p-value	0.912		**0.050**	

Table 3B
Mahalanobis Distance for Recessions – Entire Sample, 1986Q3 – 2004Q4

	Current Quarter Forecast		One Quarter Ahead Forecast	
	Mean Forecast	**Mean Actual**	**Mean Forecast**	**Mean Actual**
Durable Goods Consumption	1.157	5.514	-6.714	1.771
Non-Durable Consumption	-0.743	0.057	-0.129	0.800
Services Consumption	2.100	2.100	2.314	2.514
Nonresidential Fixed Investment	-7.214	-6.043	-4.600	-8.271
Residential Fixed Investment	-7.629	-8.371	-4.929	-3.729
Private Inventories	-29.271	-40.771	-15.457	-47.414
Exports	-3.100	-3.443	2.900	-3.257
Imports	-4.343	-6.757	2.200	-3.357
Federal Gov. Spending	2.543	3.000	1.071	5.414
State & Local Gov.Spending	2.800	3.514	1.886	3.057
Mahalanobis Distance (D^2)	3.678		6.622	
F-statistic	0.322		0.579	
p-value	0.924		0.775	

Table 3C
Mahalanobis Distance for Expansions – Entire Sample, 1986Q3 – 2004Q4

	Current Quarter Forecast		One Quarter Ahead Forecast	
	Mean Forecast	**Mean Actual**	**Mean Forecast**	**Mean Actual**
Durable Goods Consumption	5.216	6.997	3.529	6.901
Non-Durable Consumption	1.796	2.545	2.634	2.385
Services Consumption	3.174	3.191	2.912	3.237
Nonresidential Fixed Investment	5.825	7.154	6.229	8.056
Residential Fixed Investment	3.413	4.672	1.841	4.343
Private Inventories	19.904	24.996	25.121	28.609
Exports	6.299	7.812	7.097	7.796
Imports	6.825	9.371	6.690	9.356
Federal Gov. Spending	0.423	0.261	-0.797	0.596
State & Local Gov.Spending	2.088	2.286	1.897	2.238
Mahalanobis Distance (D^2)	0.253		0.695	
F-statistic	0.815		2.203	
p-value	0.615		**0.022**	

Table 4A
Mahalanobis Distance of the Fed Forecasts of Growth, Unemployment and Inflation – Entire Sample, 1965Q4-2005Q4

	Current Quarter Forecast 1965.4 – 2005.4		One Quarter Ahead Forecast 1966.1 – 2006.1	
	Mean Forecast	Mean Actual	Mean Forecast	Mean Actual
Real GDP Growth	2.595	2.904	2.783	2.891
Unemployment Rate	5.949	5.937	6.013	5.940
Inflation	4.068	4.065	3.973	4.073
Mahalanobis Distance (D^2)	0.010		0.008	
F-statistic	0.271		0.224	
p-value	0.846		0.879	

Table 4B
Mahalanobis Distance for Recessions of the Fed Forecasts of Growth, Unemployment and Inflation – Entire Sample, 1965Q4 – 2005Q4

	Current Quarter Forecast 1965.4 – 2005.4		One Quarter Ahead Forecast 1966.1 – 2006.1	
	Mean Forecast	Mean Actual	Mean Forecast	Mean Actual
Real GDP Growth	-1.878	-1.722	-0.274	-1.722
Unemployment Rate	6.363	6.363	6.281	6.363
Inflation	6.204	6.548	5.907	6.548
Mahalanobis Distance (D^2)	0.023		0.220	
F-statistic	0.102		0.954	
p-value	0.959		0.422	

Table 4C
Mahalanobis Distance for Expansions of the Fed Forecasts of Growth, Unemployment and Inflation – Entire Sample, 1965Q4 – 2005Q4

	Current Quarter Forecast 1965.4 – 2005.4		One Quarter Ahead Forecast 1966.1 – 2006.1	
	Mean Forecast	**Mean Actual**	**Mean Forecast**	**Mean Actual**
Real GDP Growth	3.496	3.836	3.399	3.821
Unemployment Rate	5.866	5.851	5.959	5.855
Inflation	3.637	3.564	3.584	3.574
Mahalanobis Distance (D^2)	0.024		0.042	
F-statistic	0.534		0.933	
p-value	0.659		0.425	

Table 5
Mahalanobis Distance Between the SPF and the Fed Forecasts of Growth, Unemployment and Inflation

	Current Quarter Forecast 1968.4 – 2005.4		One Quarter Ahead Forecast 1969.1 – 2006.1	
	Mean SPF Forecast	**Mean Fed Forecast**	**Mean SPF Forecast**	**Mean Fed Forecast**
Real GDP Growth	2.428	2.453	2.749	2.687
Unemployment Rate	6.147	6.121	6.175	6.193
Inflation	4.097	4.146	4.031	4.046
Mahalanobis Distance (D^2)	0.001		0.001	
F-statistic	0.035		0.026	
p-value	0.991		0.994	

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