Examining the Quality of Early GDP Component Estimates

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Abstract

In this paper we examine the quality of the initial estimates of headline GDP and 10 major components of both real and nominal U.S. GDP. We ask a number of questions about various characteristics of the differences between the initial estimates available one month after the end of the quarter to the estimates available three months after the end of the quarter. Do the first estimates have the same directional signs as the later numbers? Are the original numbers unbiased estimates of the later figures? Are any observed biases related to the state of the economy? Finally, we determine whether there is a significant difference between the vector of the 30 day estimates of the 10 major components and the vector of the 90 day estimates of the same components. We conclude that, despite the existence of some bias, under most circumstances, an analyst could use the early data to obtain a realistic picture of what had happened in the economy in the previous quarter.

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Examining the Quality of Early GDP Component Estimates
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Over the years, there has been considerable interest in both the financial and academic communities about the nature and extent of the revisions of the GDP data. The financial interest is observed in the way that announcements of data revisions are reported and dissected by the media. Usually the focus has been on the headline numbers, rather than on an extensive analysis of the underlying components of GDP.

The previous academic studies have examined a wide variety of issues: Are the revisions of the US data so substantial that they prevent analysts from correctly interpreting either the state of the economy or the changes that have occurred? (Zellner, 1958; Morgenstern, 1963; Stekler, 1967). Are the early numbers optimal forecasts of the *final* data or are they figures which represent measurement errors, i.e. do the revisions represent news or noise? (Mankiw et al., 1984; Mankiw and Shapiro, 1986; Mork, 1987; de Leeuw, 1990; Neftci and Theodossiou, 1991; Faust et al., 2005; Aruoba, 2008).

There have also been studies which examine the effect that data problems might pose for nowcasting or forecasting.[2] In making predictions about the behavior of the economy, forecasters and policymakers need to know the state of the economy in recent past quarters as reflected in the early or flash estimates. This involves a tradeoff between accuracy and timeliness. How accurate are the early GDP data released 15-30 days after the end of the quarter relative to the revised figures released 30 or 60 days later? Are the early data accurate enough to provide correct information about the state of the economy, especially prior to and during

[2] For issues involved in nowcasting, see Stark and Croushore, (2002); Croushore, (2006, 2009, 2010). There have also been analyses of the real time conduct of monetary and fiscal policies. See Croushore (2009) for studies that have examined this issue; Groen et al. (2009) analyzed the Bank of England's real time forecasts.

recessions? (McNees, 1986; Zarnowitz 1982; Joutz and Stekler, 1998; Dynan and Elmendorf, 2001, Swanson and van Dijk, 2006).

In terms of our current knowledge about the relationship between revisions and real time analysis, the evidence is that the revisions are large and systematic. For example, the growth rate estimate for real GNP in 1977.1 varied between 4.9% and 9.6% depending on the vintage of the data. (Croushore, 2006). More recently, the estimates for GDP growth in 2008.4 were between -3.8% and -8.4%. The mean absolute revision in the growth rate of GDP has been around 1%.[3] Furthermore, Dynan and Elmendorf (2001) concluded that "…provisional estimates do not fully capture accelerations and decelerations, suggesting some tendency to miss economic turning points." Similarly, Joutz and Stekler (1998) concluded that while the early data were useful to forecasters, there were some turning point errors in the early data.

When the BEA releases its National Income and Product Account (NIPA) estimates, it does not just provide the headline numbers, the growth rates of real and nominal GDP. It also releases estimates of each of the major components of GDP. The aforementioned studies focused on the headline GDP numbers and did not investigate how the revisions affected the *components* of a particular vintage of GDP data.[4] The main topic of this paper is to determine whether the first available estimates of the components of GDP differ substantially from later data. We, therefore, undertake an ex post descriptive analysis of the differences in the components of two vintages of real-time data: the 30 day and 90 day numbers. The users of the

[3] The revisions are substantial even in evaluating five year average growth rates (Croushore, 2009).

[4] The US Bureau of Economic Analysis (BEA) that publishes these data has, however, examined the extent of the data revisions in the components that aggregate to GDP (Young, 1987; de Leeuw, 1990; Young, 1993; Grimm and Parker, 1998; Fixler and Grimm, 2002, 2005, 2008). These analyses primarily focused on the differences between the early estimates and the numbers that were available at the time the research was done. These studies usually did not discuss the extent of the revisions between the data that were released approximately 30, 60, and 90 days after the end of the quarter to which they refer. The paper by Fixler and Grimm (2008) is an exception but it only analyses the mean and mean absolute revisions of current dollar GDP. There is no discussion of the revisions to the real variables.

data need to know whether the first estimates of the components reflect the underlying structural movements of the economy as reported by the 90 day numbers, for the early data are frequently used in policy analyses. In addition, it is important to know whether any differences that might exist are associated with the phases of the business cycle.

We ask a number of questions about various characteristics of the differences between the 30 and 90 day estimates of headline GDP and 10 major components. Do the first estimates have the same directional signs as the later numbers? Are the original numbers unbiased estimates of the later figures? Are any observed biases related to the state of the economy? Finally, we determine whether there is a significant difference between (1) the vector of the 30 day estimates of the 10 major components and (2) the vector of the 90 day estimates of the same components. This last question asks whether there has been a major revision in the composition of the changes in the headline GDP number and requires us to introduce a measure that has not previously been used in analyses of the GDP data. However, we do not present any methodology for adjusting the earliest data so that they correspond more closely to the later real-time data. That is beyond the scope of this paper.

The next section presents the methodology for measuring the bias and the statistics that are used to measure the changes in estimates of the components in the various vintages of data. This is followed by a description of the data and the results. The implications of our results comprise the concluding section.

I. Methodology

As mentioned above, most of the focus in past analyses has been on headline GDP estimates rather than on the estimates of the underlying components of GDP. It matters why a

change in our estimate of GDP occurred. We currently do not know whether there is a significant change in the estimates of any of the underlying components of GDP when the data are revised. If the initial estimates of headline GDP display systematic errors, we may learn something about the cause of those errors based on our analysis of the underlying components. Even if the headline GDP estimates do not display systematic errors, there may be interesting offsetting errors in the underlying components. While we do investigate whether the earliest estimates of headline GDP are systematically related to the data that are available two months later, we specifically examine and focus on the changes in the estimates of the underlying components. We also examine the role of the business cycle by dividing our sample into expansionary and recessionary quarters.

A. Directional Errors

A very important and desirable characteristic of any statistical estimate is that it should provide a correct picture of the direction in which the economy is moving. Thus the signs of the reported changes of each of the variables must be examined. We are not comparing the data to estimates that would be generated by no-change or same-change models. Rather, we follow Joutz and Stekler (1998) and, for each variable, compare the signs of the estimated changes of the 30 day numbers with the sign of the changes reported two months later. Joutz and Stekler had only done this for the headline GDP numbers. We undertake a more complete analysis by not only examining the headline numbers but also the estimates of ten major components. This is important because our knowledge about the economy's direction is enhanced when we have accurate estimates of the sectors that are causing the directional movements.

B. Systematic Error (Bias)

Even if there are not a substantial number of differences in signs in either the headline or component estimates, there may still be a systematic error- a bias. We use three separate approaches to determine whether the earliest nominal and real GDP estimates are systematically related to the numbers available two months later or whether there is a bias in the first estimate. First, we test this relationship using Mincer-Zarnowitz (1969) regression. We then question whether there are systematic errors related to the state of the economy. All of these tests are applied to both the nominal and real headline GDP data as well as the estimates of the ten major components of both nominal and real GDP. Finally, in order to examine the interconnectedness of the estimates we jointly examine the revisions of the data using a first-order vector autoregression (VAR(1)).

Customarily, the basic procedure for testing for bias has been to use the Mincer-Zarnowitz (1969) regression.

$$y_{3t} = \beta_0 + \beta_1 y_{1t} + e_t, \tag{1}$$

where y_{3t} and y_{1t} are the U.S. Bureau of Economic Analysis (BEA)'s estimates for time t available 3 months and 1 month after the quarter, 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 initial estimates are biased and/or inefficient. The Wald test and the F distribution are used to test this null.[5]

Recent research has shown that forecasts sometimes contain systematic errors (Joutz and Stekler, 2000, Hanson and Whitehorn, 2006). Forecasters overestimated the rate of growth

[5] An alternative procedure for testing for bias has been to use equation suggested by Holden and Peel (1990): $y_{3t} - y_{1t} = \beta_0 + e_t$. In this case, the slope is imposed to be one and the test examines whether or not the data revision has a zero mean, i.e. a simple test of statistical significance for the constant in this equation.

during slowdowns and recessions and underestimated it during recoveries and booms. 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. Similarly, we may find a bias exists but that it may simply due to the BEA not having information on the state of the economy in time for the first release.

In order to determine whether the GDP estimates similarly failed to incorporate information about the state of the economy, we modified (1) as in Sinclair et al. (2010). The modified Mincer-Zarnowitz regression (2) now becomes

$$y_{3t} = \beta_0 + \beta_1 y_{1t} + \beta_2 D_t + e_t, \tag{2}$$

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. For this calculation, the data for the quarter before the peak and the quarter after the trough were included with the numbers for the quarters that constituted the recession as defined by the National Bureau of Economic Research (NBER).[6] The justification for this procedure comes from Young (1987, p. 29) who considered those to be the most critical quarters from the BEA's perspective. 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 initial estimation errors. If this were the case, it would indicate that the BEA

[6] The NBER dates are available here: 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. First, this is an ex post analysis to determine whether data during recessions were fully incorporated. In addition, the BEA, itself, has used this procedure to evaluate its headline GDP numbers.

did not have the information about the state of the economy in the initial estimates.[7]

These tests for the existence of systematic error were applied to the estimates of GDP and the component separately. We next investigate the properties of the *revisions* to both nominal and real GDP and their components between the first and third estimates. We define the revision for time t (rev_t) for each component as: $rev_t = y_{3t} - y_{1t,}$ where y_{3t} and y_{1t} are the BEA's estimates for time t available 90 days and 30 days after the quarter, respectively. While the traditional Holden-Peel (1990) test for unbiasedness would involve a regression of this revision on a constant, a more general test is that this revision should not depend on past revisions to either the component itself or to other components.

We, therefore, construct a first-order vector autoregression (VAR(1)) for both the nominal and the real system. In each case, the vector includes 11 revisions: one for each of the 10 components and also the revision to the headline number. If the first releases are unbiased estimates of the third releases, 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-component lags should be zero; and none of the revisions to the other components or to the headline numbers should Granger-cause any of the other revisions.

C. Compositional Changes: Difference of Two Vectors

When the BEA releases its National Income and Product Account (NIPA) estimates, it does not just provide the headline numbers, the growth rates of real and nominal GDP. It also releases estimates of each of the major components of GDP. These numbers which show the

[7] We also tested whether the slope of the relationship differed depending upon the state of the economy with the following equation: $y_{3t} = \beta_0 + \beta_1 y_{1t} + \beta_2 D_t + \beta_3 D_t y_{1t} + e_t$. Based on these estimates we found that the conclusions were not substantially different than those presented here. Estimates are available from the authors upon request.

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 data for that quarter are subsequently revised, the components of that vintage of data comprise a different vector. Thus, if we are concerned with how well the estimates reflect the *composition* of the actual changes that have occurred in the economy, we must compare the difference in the vectors of the different vintages.[8]

We utilize a technique, a distance measure, which is well established in the natural sciences for measuring the relationship or difference of two vectors.[9] We could utilize two different measures of distance: Euclidean and Mahalanobis. They differ in the assumptions made about the statistical independence of the vectors.[10]

Assume that we have two independent vectors, X_1 and X_3, representing two vintages of data consisting of n components in each vector. The difference between the two vectors can be measured by the Euclidean distance between them:

$$d(X_1, X_3) = \sqrt{(X_1 - X_3)'(X_1 - X_3)}. \tag{3}$$

[8]Under some circumstances, the weighted sum of the changes of these elements will add up to the total change in GDP. Under these conditions and if in addition all of the changes are strictly positive, there are methods for comparing the composition of two vintages of data referring to the same time period. Theil (1966) developed an information inaccuracy measure that compared forecasts with outcomes. In our context, this approach would measure the value of the original data given the information in the revised data. It is called the information inaccuracy of the earliest data. The more value that is associated with the newer data, the less valuable were the earlier statistics. Patterson and Heravi (1991) used this method to measure the value of the revisions to the components of UK GDP, but their analysis was in the levels (not changes) of these components. They include the net change in inventories as part of the investment component and also make an adjustment for imports. Patterson and Heravi (2004) applied cointegration tests to the various vintages of the US data as an alternative measure of accuracy for the early data. Öller and Teterukovsky (2007) use a different information concept to analyze the quality of some Swedish statistics.

[9]Spearman Rank Correlation and Kendal's Tau are both concerned with the rankings of the growth rates of the components of the two vectors relative to each other. However, the former merely considers the two sets of ranks while the latter also shows whether the components of the vector have a tendency to move together. These correlation measures are affected by the properties of the growth rates of each of the components as well as the properties of the revisions. There may be substantial revisions of each component but their relative growth rates may not have been affected. This could occur if the size of the growth rates were large relative to the magnitude of the revisions. Thus it is possible that even with if there were substantial revisions, the correlation coefficients may be unity. Using the distance measures would not pose this problem.

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

This procedure is only applicable to vectors that are independent and that are scaled so that they have unit variances. Thus, we will use a generalization of the Euclidian distance that allows for the scale to differ across the different components and for nonzero correlation between the components. In order to test if there is a difference between the two vintages we will focus on the difference between the mean vectors of each vintage relative to the common within-group variation. This measure is called the Mahalanobis Distance, D^2:[11]

$$D^2 = (\bar{x}_1 - \bar{x}_3)' W (\bar{x}_1 - \bar{x}_3), \tag{4}$$

where W is the inverse of the pooled sample variance-covariance matrix, and $\bar{x}_1$ and $\bar{x}_3$ are the mean vectors of vintages 1 and 3 respectively.[12] Under the assumption of normality, we can construct an F-statistic based on this measure to test the null hypothesis that the two vintages have the same population means.[13]

In addition, we will split the sample into periods when the economy was expanding and when the economy was in recession. For this calculation, we again follow Young (1987) and combine the data for the quarter before the peak and the quarter after the trough with the numbers for the quarters that constituted the recession as defined by the NBER. From this we can see if the difference in the vintages is significant in expansions, recessions, or both.

[11] 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).

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

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

II. Data

We analyze the US nominal and real GNP/GDP data for the period 1970Q1-2010Q3. Since we are concerned with the compositional accuracy of the various vintages of the data, we examine both the headline GNP/GDP estimates and the ten components of GNP/GDP that have been published in real time in the *Survey of Current Business* throughout this period. These variables are: (1) durable consumption expenditures, (2) nondurable consumption expenditures, (3) personal services consumption expenditures, (4) nonresidential fixed investment, (5) residential fixed investment, (6) changes in business inventories, (7) exports, (8) imports, (9) federal government purchases, and (10) state and local government purchases.

Our real-time data were obtained from the ArchivaL Federal Reserve Economic Data (ALFRED®), maintained by the Federal Reserve Bank of St. Louis.[14] For both the nominal and real data, we create two vectors of these ten series. They are constructed as the compound annual rate of change for each series, except for changes in business inventories which are measured in billions of dollars. The first vector represents the first release by the Bureau of Economic Analysis (BEA) of the estimates (prepared in the first month after the end of the quarter). The second vector represents the data available at the end of the third month after the end of the quarter. We will use the current BEA terminology for these different vintages by calling the first vector the "advance estimates" and the second vector the "third estimates."[15]

[14] To complete our dataset we supplemented what was available on ALFRED® with additional information available from the BEA's Survey of Current Business from the BEA's website for 1994 – 2010 (http://www.bea.gov/scb/date_guide.asp) and archived online back to 1921 by the Federal Reserve Archival System for Economic Research (FRASER®) maintained by the Federal Reserve Bank of St. Louis (http://fraser.stlouisfed.org/publications/SCB/).

[15] The timing and terminology of vintages of data released by the BEA have evolved over time. The current terminology is "advance" for the estimate released approximately 30 days after the end of the quarter, "second" for the estimate released approximately 60 days after the end of the quarter, and "third" for the estimate released approximately 90 days after the end of the quarter was adopted with the comprehensive revision released in July 2009 (Seskin and Smith, 2009). Previously, both the terminology as well as the timing of the releases varied. From 1988 until 2009, the timing of the three releases was similar to the current schedule, but the terminology was

III. Results

A. Directional Errors

When we compared the signs of the estimated changes of both real and nominal headline GNP/GDP between the two sets of real-time data releases, we found that they agreed over 98% of the time (Table 1). As for the components, there was agreement in the signs of the changes at least 90% of the time for all of the nominal components and for seven of the ten real variables. (While there is no definitive way of stating that this is a good performance, we generally give students an A- at worst if they achieve this record). However, some of these discrepancies occurred at the same time. About 20% of the time (30 instances) the signs of more than two or more components differed between the two sets of real-time estimates for the real data. In these instances, the errors might have led to misinterpretations about the state of the economy. While some of these discrepancies occurred during recessions or slowdowns, there was no obvious cyclical pattern.

B. Bias

1. Mincer-Zarnowitz Regressions

a. Nominal Variables

The bias test for the headline nominal GDP estimates yielded mixed results. The constant in the Mincer-Zarnowitz regression (1) was not significantly different from zero, but the slope did not equal one. The Wald test rejected the joint null indicating that the earliest nominal GDP

"advance" then "preliminary" then "final." Until 1988, the three estimates were released after each quarter on a 15-day, 45-day, and 75-day cycle. They were referred to alternatively as the 15-day, 45-day, and 75-day releases or "preliminary," "first revision," and "second revision." Prior to 1974 there were only the first two releases which were referred to simply as "preliminary" for the 15-day release and "final" for the 45-day release. The estimates began to be released later in the month in 1988 in response to a change in the schedule for processing monthly merchandise trade forms (Young, 1993).

estimates were biased estimates of the numbers available 90 days after the quarter to which they refer (Table 2; line 1). What is perhaps more important is *that information about the state of the economy was incorporated into the earliest estimates*. This result is observed in the first line of Table 3 because the estimated coefficient associated with the dummy was not significantly different from zero.[16]

Turning now to the estimates of the components, if the state of the economy is not considered, the null hypothesis, that there is no bias, was rejected at the 10% level for all but three of the components: inventories and both federal and state and local government expenditures (Table 2). If the state of the economy is included in the analysis, the null is again rejected in seven of the ten cases. The inventory estimates were now biased, but non-durable consumption no longer appears biased. The coefficient of the dummy variable was significant in several of the equations, indicating that the state of the economy affected estimates of those variables. (Table 3).

b. Real Variables

Similar to the results for nominal GDP, the Mincer-Zarnowitz equation shows that the first real GDP estimates were biased estimates of the third numbers (Table 4, line 1) but that the coefficient on the dummy was not significant (Table 5, line 1). We further find that the mean absolute size of the revisions is 0.6% which is 25% of the mean absolute change in real GDP. With respect to the components, when the state of the economy was not taken into account, the estimates of only three variables were biased at the 10% level. (Table 4). When the effect of the state of the economy was taken into account, the null was rejected for six components at the 10%

[16] The results were similar using the Holden-Peel test applied to the data revisions.

level[17], and the coefficient on the dummy variable was significant in three cases (Table 5). We conclude that information about the state of the economy was not incorporated into the estimates of these particular components. It is interesting that the government estimates were never found to be biased, showing that BEA had more accurate information about these variables.

2. VAR Regressions

The results relating to the VAR regressions are presented in Tables 6 through 10. For both nominal GDP (Table 6, last line) and real GDP (Table 7, last line), the constants are significant indicating the existence of a bias. This result is also true for two nominal and real components. Moreover, in some cases the coefficients on the components own past revisions are also significant. However, the state of the economy dummy variable is only significant in two nominal regressions (Table 8) and three real regressions (Table 9). This result indicates that the discrepancies in the estimates are not due in general to the state of the economy. Finally, turning to the Granger causality tests, we found that the null that other revisions do not Granger cause revisions in the estimates of headline GDP or in specific components is rejected at the 10% level for five nominal regressions and three real variables (Table 10).

3. Summary of Bias Results

Because we have run so many bias test and because the results sometimes are in conflict, we present a tabular summary of the results. (Tables 11 and 12). The tables show that at least one test rejects the null of no bias for every single variable- be it headline GDP or one of the components. This has been an ex post analysis and does not indicate whether information would have been available in real time to correct this bias.

[17] For the expanded regression in footnote 7 we found that, in most cases, the coefficient on the interaction term capturing a possible change in the slope between recessions and expansions was not significant for either the nominal or real variables. These results are available from the authors.

C. Compositional Changes: Mahalanobis Distance

We now present the results related to the difference in the composition of the changes in all variables between the two vintages of the data. We noted above that there were two distance measures that could be used in this analysis. Because the two vintages of data are so closely related, we use the Mahalanobis distance measure. There is no significant difference between the vectors of the two components (Tables 13). There is also no difference between periods of expansion and recession (Tables 14 and 15). Thus the evidence indicates that there is no compositional difference between the two vintages of data.[18]

IV. Conclusions

In terms of evaluating the value of the earliest data, there is a tradeoff involving two considerations. The early data are timelier but may be less accurate. This tradeoff involves each user's loss function. This is our perspective: *In terms of the timeliness-accuracy tradeoff, we postulate that the earliest data are valuable if they are systematically related to the later data, if there are no significant compositional changes between the two sets of estimates and if there are no significant differences between the results for periods of expansion and recession.*

Given our perspective, the results are mixed. There are few directional errors- none in the headline GDP estimates. We have found that the headline nominal and real GNP/GDP numbers are both biased. But this bias is not attributable to BEA failing to include information about the state of the economy in its initial estimates. A number of the early estimates of both the nominal

[18] If we instead test the null hypothesis that the revisions are the same in recessions and expansions then we reject this hypothesis. As can be seen in Tables 6 and 7, the means are substantially different in recessions versus expansions, as would be expected, which will affect the relative size of the revisions in the two cases. We may further expect that the assumption of the same covariance between the two groups would be inappropriate for comparing revisions in recessions with revisions in expansions.

and real GDP components were also biased. Some of the component estimates were affected by the failure to include information about the state of the economy.

Our analysis of the measure estimates showed that the early data usually reflected the composition of the changes in GDP that was observed in the later data. Thus, under most circumstances, an analyst could use the early data to obtain a realistic picture of what had happened in the economy in the previous quarter. The next step in the analysis is to determine whether the same results apply to the differences between the real time and some version of the historical data, especially for recessions, because it is in those periods when accurate information is most vital for nowcasting and forecasting.

Table 1
Percentage of Time the Signs of the Estimates of GDP and Components Agreed Between the 30 Day and 90 Day Numbers

	Real Data	Nominal Data
GNP/GDP	98%	99%
Consumption Durable Goods	96%	97%
Consumption Non-Durable Goods	90%	97%
Consumption Services	99%	100%
Fixed Investment Nonresidential	90%	94%
Fixed Investment Residential	94%	94%
Private Inventories	94%	94%
Exports	88%	93%
Imports	90%	92%
Government Spending Federal	91%	91%
Government Spending State and Local	89%	98%

Table 2
Mincer-Zarnowitz Regressions: Nominal GDP and Components
1970I – 2010III (Newey-West Standard Errors in Parentheses)

	Constant	Slope	Wald Test Probability
Nominal GNP/GDP (growth)	-0.059 (0.121)	1.056††† (0.019)	<0.001
Nominal Consumption Durable Goods (growth)	-0.095 (0.162)	1.037†† (0.017)	0.097
Nominal Consumption Non-Durable Goods (growth)	0.333* (0.181)	0.986 (0.021)	0.079
Nominal Consumption Services (growth)	0.358** (0.163)	0.948†† (0.023)	0.074
Nominal Fixed Investment Nonresidential (growth)	0.806*** (0.307)	1.021 (0.020)	0.002
Nominal Fixed Investment Residential (growth)	0.242 (0.246)	1.040††† (0.015)	0.017
Nominal Private Inventories (change in)	-0.167 (0.842)	0.988 (0.024)	0.832
Nominal Exports (growth)	1.843*** (0.501)	1.056 (0.042)	<0.001
Nominal Imports (growth)	0.942 (0.595)	1.027 (0.025)	0.065
Nominal Government Spending Federal (growth)	0.057 (0.244)	0.999 (0.037)	0.971
Nominal Government Spending State and Local (growth)	0.204 (0.184)	0.991 (0.023)	0.289
SUR of 10 Components			<0.001

*, **, ***: statistically significantly different from zero at the 10%, 5%, and 1% level respectively
†, ††, †††: statistically significantly different from one at the 10%, 5%, and 1% level respectively

Table 3
Modified Mincer-Zarnowitz Regressions: Nominal GDP and Components
1970I – 2010III (Newey-West Standard Errors in Parentheses)

	Constant	Slope	Recession Dummy	Wald Test Probability
Nominal GNP/GDP (growth)	-0.067	1.057†††	0.017	<0.001
	(0.159)	(0.021)	(0.163)	
Nominal Consumption Durable Goods (growth)	0.093	1.034†	-0.592	0.012
	(0.211)	(0.019)	(0.423)	
Nominal Consumption Non-Durable Goods (growth)	0.386*	0.985	-0.171	0.138
	(0.188)	(0.020)	(0.218)	
Nominal Consumption Services (growth)	0.384**	0.955††	-0.289**	0.020
	(0.153)	(0.022)	(0.139)	
Nominal Fixed Investment Nonresidential (growth)	1.036***	1.008	-0.551	0.002
	(0.354)	(0.023)	(0.728)	
Nominal Fixed Investment Residential (growth)	0.081	1.0435†††	0.487	0.027
	(0.342)	(0.016)	(0.517)	
Nominal Private Inventories (change in)	1.810	0.956	-5.515***	0.071
	(1.119)	(0.029)	(2.083)	
Nominal Exports (growth)	1.757***	1.057	0.268	<0.001
	(0.670)	(0.045)	(1.058)	
Nominal Imports (growth)	1.900**	1.013	-2.874**	0.011
	(0.740)	(0.031)	(1.170)	
Nominal Government Spending Federal (growth)	-0.138	0.995	0.804	0.575
	(0.314)	(0.037)	(0.627)	
Nominal Government Spending State and Local (growth)	0.229	0.992	-0.105	0.459
	(0.202)	(0.023)	(0.204)	
SUR of 10 Components				<0.001

*, **, ***: statistically significantly different from zero at the 10%, 5%, and 1% level respectively
†, ††, †††: statistically significantly different from one at the 10%, 5%, and 1% level respectively

Table 4
Mincer-Zarnowitz Regressions: Real GDP and Components
970I – 2010III (Newey-West Standard Errors in Parentheses)

	Constant	Slope	Wald Test Probability
Real GNP/GDP (growth)	0.069 (0.077)	1.045††† (0.016)	<0.001
Real Consumption Durable Goods (growth)	-0.043 (0.150)	1.036†† (0.016)	0.072
Real Consumption Non-Durable Goods (growth)	0.216 (0.148)	0.988 (0.035)	0.236
Real Consumption Services (growth)	0.169 (0.117)	0.937† (0.035)	0.197
Real Fixed Investment Nonresidential (growth)	1.011*** (0.324)	0.994 (0.025)	0.001
Real Fixed Investment Residential (growth)	0.302 (0.311)	1.037†† (0.018)	0.134
Real Private Inventories (change in)	-0.363 (0.779)	0.992 (0.025)	0.810
Real Exports (growth)	1.683*** (0.478)	0.964 (0.031)	0.002
Real Imports (growth)	0.946* (0.534)	1.007 (0.025)	0.118
Real Government Spending Federal (growth)	-0.298 (0.262)	0.976 (0.026)	0.444
Real Government Spending State and Local (growth)	0.204* (0.113)	0.961 (0.026)	0.180
SUR of 10 Components			<0.001

*, **, ***: statistically significantly different from zero at the 10%, 5%, and 1% level respectively
†, ††, †††: statistically significantly different from one at the 10%, 5%, and 1% level respectively

Table 5
Modified Mincer-Zarnowitz Regressions: Real GDP and Components
1970I – 2010III (Newey-West Standard Errors in Parentheses)

	Constant	Slope	Recession Dummy	Wald Test Probability
Real GNP/GDP (growth)	0.062	1.046††	0.015	<0.001
	(0.101)	(0.022)	(0.168)	
Real Consumption Durable Goods (growth)	0.132	1.031†	-0.535	0.011
	(0.191)	(0.018)	(0.393)	
Real Consumption Non-Durable Goods (growth)	0.366**	0.975	-0.429*	0.121
	(0.162)	(0.033)	(0.234)	
Real Consumption Services (growth)	0.343**	0.912††	-0.342***	0.011
	(0.132)	(0.035)	(0.110)	
Real Fixed Investment Nonresidential (growth)	1.143***	0.985	-0.340	0.003
	(0.356)	(0.023)	(0.678)	
Real Fixed Investment Residential (growth)	0.033	1.044††	0.894	0.155
	(0.359)	(0.020)	(0.654)	
Real Private Inventories (change in)	1.337	0.963	-4.743**	0.090
	(1.024)	(0.029)	(1.899)	
Real Exports (growth)	2.006***	0.952	-0.981	0.003
	(0.595)	(0.033)	(1.063)	
Real Imports (growth)	2.278***	0.966	-3.782***	<0.001
	(0.608)	(0.027)	(0.992)	
Real Government Spending Federal (growth)	-0.327	0.976	0.103	0.617
	(0.298)	(0.026)	(0.737)	
Real Government Spending State and Local (growth)	0.236	0.959	-0.103	0.335
	(0.146)	(0.027)	(0.179)	
SUR of 10 Components				<0.001

*, **, ***: statistically significantly different from zero at the 10%, 5%, and 1% level respectively
†, ††, †††: statistically significantly different from one at the 10%, 5%, and 1% level respectively

Table 6: VAR Estimates of Revisions: Nominal GDP and Components (Standard errors in parentheses)

	GNP/GDP	Durables	Non-Durables	Services	Non-Res. Inv.	Res. Investment	Inventories	Exports	Imports	Federal	State & Local
	REV_NGDP	REV_NPCDG	REV_NPCND	REV_NPCESV	REV_NPNFI	REV_NPRFI	REV_NCBI	REV_NEXPGS	REV_NIMPGS	REV_NFGCE	REV_NSLCE
REV_NGDP(-1)	-0.189	0.127	0.126	-0.100	-0.372	0.526	-1.751	-0.201	1.038	1.033*	0.008
	(0.148)	(0.388)	(0.184)	(0.144)	(0.477)	(0.536)	(1.680)	(0.850)	(0.934)	(0.537)	(0.184)
REV_NPCDG(-1)	0.006	0.028	-0.006	0.082	0.053	0.095	0.191	-0.148	0.111	-0.468***	0.043
	(0.033)	(0.088)	(0.042)	(0.033)	(0.108)	(0.121)	(0.380)	(0.192)	(0.211)	(0.122)	(0.042)
REV_NPCND(-1)	0.236***	-0.368**	0.081	-0.017	0.221	-0.051	0.899	0.535	-0.629	-0.102	0.075
	(0.070)	(0.184)	(0.087)	(0.068)	(0.226)	(0.254)	(0.796)	(0.403)	(0.443)	(0.255)	(0.087)
REV_NPCESV(-1)	0.111	-0.121	0.196*	0.057	-0.018	-0.212	0.174	0.783	-0.306	-0.958***	0.065
	(0.090)	(0.236)	(0.112)	(0.088)	(0.291)	(0.327)	(1.023)	(0.518)	(0.569)	(0.327)	(0.112)
REV_NPNFI(-1)	0.057**	0.052	0.019	0.021	0.144	-0.019	0.217	0.287*	-0.115	-0.130	-0.038
	(0.028)	(0.073)	(0.034)	(0.027)	(0.089)	(0.100)	(0.315)	(0.159)	(0.175)	(0.101)	(0.035)
REV_NPRFI(-1)	0.001	0.072	0.030	-0.033	0.063	0.140*	0.015	-0.023	-0.066	-0.055	-0.016
	(0.023)	(0.060)	(0.028)	(0.022)	(0.073)	(0.082)	(0.258)	(0.130)	(0.143)	(0.082)	(0.028)
REV_NCBI(-1)	0.011	-0.002	0.004	0.008	0.031	-0.042	0.119	-0.009	-0.042	-0.045	-0.006
	(0.011)	(0.028)	(0.013)	(0.011)	(0.035)	(0.039)	(0.123)	(0.062)	(0.068)	(0.039)	(0.013)
REV_NEXPGS(-1)	0.012	-0.030	0.044*	0.006	0.035	-0.061	-0.002	0.288***	0.109	-0.087	0.040*
	(0.019)	(0.049)	(0.023)	(0.018)	(0.061)	(0.068)	(0.214)	(0.108)	(0.119)	(0.068)	(0.023)
REV_NIMPGS(-1)	-0.016	0.007	0.026	0.020	-0.017	0.051	0.035	-0.203*	0.247**	0.134*	-0.007
	(0.019)	(0.051)	(0.024)	(0.019)	(0.062)	(0.070)	(0.220)	(0.111)	(0.122)	(0.070)	(0.024)
REV_NFGCE(-1)	0.014	-0.004	-0.049*	0.002	-0.109	-0.088	0.105	0.098	-0.293**	-0.092	-0.013
	(0.023)	(0.060)	(0.029)	(0.022)	(0.074)	(0.084)	(0.262)	(0.132)	(0.146)	(0.084)	(0.029)
REV_NSLCE(-1)	-0.026	-0.129	0.002	0.105*	0.182	0.096	-0.915	0.045	0.794*	0.028	0.143*
	(0.065)	(0.171)	(0.081)	(0.063)	(0.210)	(0.236)	(0.740)	(0.374)	(0.411)	(0.237)	(0.081)
C	0.245***	0.197	0.042	-0.078	0.757***	0.335	-0.129	1.567***	0.49	-0.082	0.052
	(0.083)	(0.217)	(0.103)	(0.080)	(0.267)	(0.300)	(0.940)	(0.476)	(0.523)	(0.301)	(0.103)

Table 7: VAR Estimates of Revisions: Real GDP and Components (Standard errors in parentheses)

	GNP/GDP	Durables	Non-Durables	Services	Non-Res. Inv.	Res. Investment	Inventories	Exports	Imports	Federal	State & Local
	REV_RGDP	REV_RPCDG	REV_RPCND	REV_RPCESV	REV_RPNFI	REV_RPRFI	REV_RCBI	REV_REXPGS	REV_RIMPGS	REV_RFGCE	REV_RSLCE
REV_RGDP(-1)	-0.122	-0.266	0.085	-0.082	0.165	0.599	-2.235	0.643	0.840	0.666	0.043
	(0.138)	(0.391)	(0.210)	(0.133)	(0.528)	(0.732)	(1.601)	(0.830)	(0.933)	(0.611)	(0.224)
REV_RPCDG(-1)	0.009	0.067	0.044	0.063**	0.180	0.188	0.195	-0.337*	0.189	-0.463***	-0.022
	(0.032)	(0.090)	(0.048)	(0.031)	(0.121)	(0.168)	(0.368)	(0.191)	(0.215)	(0.141)	(0.052)
REV_RPCND(-1)	0.089	-0.179	0.103	-0.068	-0.124	-0.250	0.537	0.282	-0.249	-0.071	-0.035
	(0.058)	(0.164)	(0.088)	(0.056)	(0.221)	(0.306)	(0.671)	(0.348)	(0.391)	(0.256)	(0.094)
REV_RPCESV(-1)	0.131	0.073	0.392	-0.087	-0.119	-0.325	0.232	0.865	0.216	-0.797**	-0.067
	(0.091)	(0.258)	(0.139)	(0.088)	(0.349)	(0.484)	(1.058)	(0.549)	(0.617)	(0.404)	(0.148)
REV_RPNFI(-1)	0.039*	0.106	0.009	0.013	0.107	0.001	0.209	0.209	-0.097	-0.118	-0.045
	(0.024)	(0.067)	(0.036)	(0.023)	(0.091)	(0.126)	(0.276)	(0.143)	(0.161)	(0.105)	(0.039)
REV_RPRFI(-1)	-0.005	0.044	-0.020	-0.005	0.076	-0.010	-0.052	-0.067	-0.110	-0.008	0.003
	(0.016)	(0.045)	(0.024)	(0.015)	(0.060)	(0.084)	(0.183)	(0.095)	(0.107)	(0.070)	(0.026)
REV_RCBI(-1)	0.005	0.015	0.008	0.011	0.017	-0.023	0.119	-0.074	-0.023	-0.028	-0.008
	(0.010)	(0.028)	(0.015)	(0.010)	(0.038)	(0.053)	(0.116)	(0.060)	(0.068)	(0.044)	(0.016)
REV_REXPGS(-1)	0.007	0.002	0.054*	-0.007	0.026	-0.092	0.023	0.185*	0.104	-0.024	-0.016
	(0.018)	(0.052)	(0.028)	(0.018)	(0.070)	(0.097)	(0.211)	(0.110)	(0.123)	(0.081)	(0.030)
REV_RIMPGS(-1)	-0.003	-0.035	0.031	0.018	0.015	-0.028	-0.002	-0.060	0.170	0.068	0.017
	(0.017)	(0.049)	(0.027)	(0.017)	(0.067)	(0.092)	(0.202)	(0.105)	(0.118)	(0.077)	(0.028)
REV_RFGCE(-1)	0.002	0.028	-0.031	0.005	-0.109	-0.113	0.086	0.101	-0.223*	-0.055	-0.014
	(0.019)	(0.054)	(0.029)	(0.018)	(0.073)	(0.102)	(0.223)	(0.115)	(0.130)	(0.085)	(0.031)
REV_RSLCE(-1)	0.021	0.079	0.002	0.002	0.067	0.143	-0.380	-0.119	0.056	0.235	0.026
	(0.052)	(0.148)	(0.080)	(0.050)	(0.200)	(0.278)	(0.608)	(0.315)	(0.354)	(0.232)	(0.085)
C	0.151**	0.147	0.035	-0.019	0.734***	0.395	-0.26	1.055**	0.547	-0.414	0.16
	(0.070)	(0.199)	(0.107)	(0.067)	(0.268)	(0.372)	(0.814)	(0.422)	(0.474)	(0.311)	(0.114)

Table 8: VAR Estimates of Revisions with Exogenous Recession Dummy: Nominal GDP and Components (SE in parentheses)

	GNP/GDP	Durables	Non-Durables	Services	Non-Res. Inv.	Res. Investment	Inventories	Exports	Imports	Federal	State & Local
	REV_NGDP	REV_NPCDG	REV_NPCND	REV_NPCESV	REV_NPNFI	REV_NPRFI	REV_NCBI	REV_NEXPGS	REV_NIMPGS	REV_NFGCE	REV_NSLCE
REV_NGDP(-1)	-0.188	0.154	0.124	-0.094	-0.362	0.526	-1.661	-0.18	1.124	1.029*	0.012
	(-0.148)	(-0.385)	(0.185)	(0.143)	(0.479)	(0.538)	(1.672)	(0.852)	(0.914)	(0.539)	(0.185)
	[-1.27259]	[0.39949]	[0.66905]	[-0.65303]	[-0.75585]	[0.97791]	[-0.99300]	[-0.21092]	[1.23002]	[1.90709]	[0.06676]
REV_NPCDG(-1)	0.005	0	-0.004	0.075**	0.042	0.095	0.094	-0.171	0.018	-0.463***	0.039
	(0.034)	(0.088)	(0.042)	(0.033)	(0.110)	(0.123)	(0.383)	(0.195)	(0.209)	(0.123)	(0.042)
	[0.14196]	[-0.00526]	[-0.08362]	[2.29583]	[0.38676]	[0.77137]	[0.24621]	[-0.87681]	[0.08707]	[-3.74794]	[0.91890]
REV_NPCND(-1)	0.235***	-0.399**	0.084	-0.024	0.209	-0.051	0.792	0.51	-0.732*	-0.096	0.071
	(0.070)	(0.183)	(0.088)	(0.068)	(0.228)	(0.256)	(0.795)	(0.405)	(0.434)	(0.256)	(0.088)
REV_NPCESV(-1)	0.11	-0.177	0.2*	0.044	-0.039	-0.212	-0.018	0.739	-0.49	-0.948***	0.057
	(0.091)	(0.236)	(0.113)	(0.088)	(0.293)	(0.330)	(1.025)	(0.522)	(0.560)	(0.331)	(0.113)
REV_NPNFI(-1)	0.057**	0.047	0.02	0.02	0.142	-0.019	0.201	0.283*	-0.131	-0.129	-0.039
	(0.028)	(0.072)	(0.035)	(0.027)	(0.090)	(0.101)	(0.313)	(0.160)	(0.171)	(0.101)	(0.035)
REV_NPRFI(-1)	0.001	0.062	0.031	-0.036	0.059	0.14*	-0.02	-0.031	-0.099	-0.054	-0.017
	(0.023)	(0.059)	(0.028)	(0.022)	(0.074)	(0.083)	(0.257)	(0.131)	(0.141)	(0.083)	(0.028)
REV_NCBI(-1)	0.011	-0.008	0.004	0.007	0.029	-0.042	0.098	-0.014	-0.062	-0.043	-0.007
	(0.011)	(0.028)	(0.014)	(0.011)	(0.035)	(0.040)	(0.123)	(0.063)	(0.067)	(0.040)	(0.014)
REV_NEXPGS(-1)	0.012	-0.031	0.044*	0.006	0.035	-0.061	-0.006	0.287***	0.105	-0.086	0.04*
	(0.019)	(0.049)	(0.024)	(0.018)	(0.061)	(0.069)	(0.213)	(0.108)	(0.116)	(0.069)	(0.024)
REV_NIMPGS(-1)	-0.017	-0.005	0.027	0.017	-0.021	0.051	-0.006	-0.212*	0.208*	0.137*	-0.009
	(0.020)	(0.051)	(0.024)	(0.019)	(0.063)	(0.071)	(0.220)	(0.112)	(0.120)	(0.071)	(0.024)
REV_NFGCE(-1)	0.015	0.01	-0.05*	0.005	-0.103	-0.088	0.155	0.11	-0.245*	-0.094	-0.011
	(0.023)	(0.060)	(0.029)	(0.022)	(0.075)	(0.084)	(0.262)	(0.134)	(0.143)	(0.085)	(0.029)
REV_NSLCE(-1)	-0.025	-0.109	0	0.11*	0.189	0.096	-0.846	0.061	0.86**	0.024	0.146*
	(0.065)	(0.170)	(0.081)	(0.063)	(0.211)	(0.237)	(0.737)	(0.376)	(0.403)	(0.238)	(0.082)
C	0.252***	0.465*	0.02	-0.012	0.857***	0.336	0.793	1.782***	1.374**	-0.13	0.093
	(0.097)	(0.253)	(0.121)	(0.094)	(0.315)	(0.354)	(1.099)	(0.560)	(0.601)	(0.355)	(0.122)
DUMMY	-0.025	-0.883**	0.071	-0.217	-0.328	-0.003	-3.037	-0.707	-2.913***	0.158	-0.135
	(0.169)	(0.438)	(0.210)	(0.163)	(0.545)	(0.613)	(1.905)	(0.970)	(1.041)	(0.614)	(0.211)

Table 9: VAR Estimates of Revisions with Exogenous Recession Dummy: Real GDP and Components (SE in parentheses)

	GNP/GDP	Durables	Non-Durables	Services	Non-Res. Inv.	Res. Investment	Inventories	Exports	Imports	Federal	State & Local
	REV_RGDP	REV_RPCDG	REV_RPCND	REV_RPCESV	REV_RPNFI	REV_RPRFI	REV_RCBI	REV_REXPGS	REV_RIMPGS	REV_RFGCE	REV_RSLCE
REV_RGDP(-1)	-0.121	-0.261	0.086	-0.081	0.165	0.599	-2.22	0.648	0.855	0.669	0.043
	(0.138)	(0.384)	(0.211)	(0.132)	(0.529)	(0.734)	(1.587)	(0.828)	(0.901)	(0.612)	(0.225)
REV_RPCDG(-1)	0.006	0.026	0.041	0.054*	0.186	0.196	0.062	-0.383**	0.052	-0.489***	-0.028
	(0.032)	(0.090)	(0.049)	(0.031)	(0.124)	(0.172)	(0.372)	(0.194)	(0.211)	(0.143)	(0.053)
REV_RPCND(-1)	0.084	-0.235	0.099	-0.08	-0.115	-0.238	0.355	0.219	-0.435	-0.107	-0.042
	(0.058)	(0.163)	(0.089)	(0.056)	(0.224)	(0.311)	(0.671)	(0.350)	(0.381)	(0.259)	(0.095)
REV_RPCESV(-1)	0.125	-0.003	0.386***	-0.103	-0.108	-0.309	-0.014	0.78	-0.035	-0.846**	-0.077
	(0.092)	(0.256)	(0.140)	(0.088)	(0.353)	(0.489)	(1.057)	(0.551)	(0.600)	(0.407)	(0.150)
REV_RPNFI(-1)	0.039*	0.106	0.009	0.013	0.107	0.001	0.207	0.208	-0.099	-0.118	-0.045
	(0.024)	(0.066)	(0.036)	(0.023)	(0.091)	(0.127)	(0.274)	(0.143)	(0.155)	(0.105)	(0.039)
REV_RPRFI(-1)	-0.005	0.046	-0.019	-0.005	0.076	-0.011	-0.044	-0.064	-0.101	-0.007	0.003
	(0.016)	(0.044)	(0.024)	(0.015)	(0.061)	(0.084)	(0.182)	(0.095)	(0.103)	(0.070)	(0.026)
REV_RCBI(-1)	0.004	0.007	0.007	0.01	0.018	-0.022	0.094	-0.083	-0.049	-0.033	-0.009
	(0.010)	(0.028)	(0.015)	(0.010)	(0.039)	(0.054)	(0.116)	(0.060)	(0.066)	(0.045)	(0.016)
REV_REXPGS(-1)	0.007	-0.002	0.053***	-0.008	0.026	-0.091	0.01	0.18*	0.091	-0.027	-0.017
	(0.018)	(0.051)	(0.028)	(0.017)	(0.070)	(0.097)	(0.210)	(0.109)	(0.119)	(0.081)	(0.030)
REV_RIMPGS(-1)	-0.004	-0.05	0.03	0.015	0.018	-0.025	-0.051	-0.077	0.12	0.058	0.015
	(0.018)	(0.049)	(0.027)	(0.017)	(0.067)	(0.094)	(0.202)	(0.105)	(0.115)	(0.078)	(0.029)
REV_RFGCE(-1)	0.003	0.032	-0.031	0.006	-0.11	-0.114	0.101	0.106	-0.207*	-0.052	-0.013
	(0.019)	(0.053)	(0.029)	(0.018)	(0.074)	(0.102)	(0.221)	(0.115)	(0.125)	(0.085)	(0.031)
REV_RSLCE(-1)	0.022	0.09	0.003	0.004	0.066	0.141	-0.345	-0.107	0.091	0.242	0.028
	(0.052)	(0.146)	(0.080)	(0.050)	(0.201)	(0.279)	(0.603)	(0.315)	(0.342)	(0.232)	(0.085)
C	0.178**	0.456*	0.06	0.046	0.688**	0.332	0.738	1.401***	1.572***	-0.214	0.2
	-0.084	-0.233	-0.128	-0.08	-0.321	-0.445	-0.962	-0.502	-0.546	-0.37	-0.136
DUMMY	-0.087	-0.998**	-0.078	-0.21	0.147	0.205	-3.23*	-1.121	-3.314***	-0.647	-0.131
	(0.147)	(0.410)	(0.225)	(0.141)	(0.564)	(0.783)	(1.692)	(0.883)	(0.960)	(0.652)	(0.239)

Table 10: Granger Causality Tests

Dependent Variable	Nominal Data P-Value	Real Data P-Value
Revision to GNP/GDP	0.091	0.666
Revision to Durable Goods Consumption	0.689	0.788
Revision to Non-Durable Goods Consumption	0.008	0.004
Revision to Services Consumption	0.030	0.085
Revision to Nonresidential Fixed Investment	0.688	0.551
Revision to Residential Fixed Investment	0.951	0.729
Revision to Private Inventories	0.737	0.845
Revision to Exports	0.185	0.102
Revision to Imports	0.099	0.559
Revision to Federal Government Spending	0.006	0.049
Revision to State and Local Government Spending	0.460	0.997

Table 11
Summary of Rejections of the Null of No Bias for Nominal GDP and Components

	Wald Test		VAR of Revisions			
	MZ	**MZ with Dummy**	**Signif. Constant**	**Signif. Own Lags**	**Granger Causality**	**Signif. Dummy**
Nominal GNP/GDP	X	X	X		X	
Nominal Consumption Durable Goods	X	X				X
Nominal Consumption Non-Durable Goods	X				X	
Nominal Consumption Services	X	X			X	
Nominal Fixed Investment Nonresidential	X	X	X			
Nominal Fixed Investment Residential	X	X		X		
Nominal Private Inventories		X				
Nominal Exports	X	X	X	X		
Nominal Imports	X	X		X	X	X
Nominal Government Federal Spending					X	
Nominal Government State and Local Spending				X		

Table 12
Summary of Rejections of the Null of No Bias for Real GDP and Components

	Wald Test		VAR of Revisions			
	MZ	**MZ with Dummy**	**Signif. Constant**	**Signif. Own Lags**	**Granger Causality**	**Signif. Dummy**
Real GNP/GDP	X	X	X			
Real Consumption Durable Goods	X	X				X
Real Consumption Non-Durable Goods					X	
Real Consumption Services		X			X	
Real Fixed Investment Nonresidential	X	X	X			
Real Fixed Investment Residential				X		
Real Private Inventories		X				X
Real Exports	X	X	X	X		
Real Imports		X		X		X
Real Government Federal Spending					X	
Real Government State and Local Spending				X		

Table 13
Mahalanobis Distance
Null Hypothesis: No Difference between Vintages

	Nominal		Real	
	Mean Vintage 1	**Mean Vintage 3**	**Mean Vintage 1**	**Mean Vintage 3**
Durable Goods Consumption	6.707	6.858	5.461	5.613
Non-Durable Consumption	6.019	6.269	2.155	2.344
Services Consumption	7.810	7.763	3.104	3.078
Nonresidential Fixed Investment	5.918	6.847	3.817	4.806
Residential Fixed Investment	6.556	7.060	2.279	2.666
Private Inventories	13.356	13.026	12.255	11.794
Exports	7.292	9.540	3.930	5.470
Imports	10.429	11.650	6.407	7.399
Federal Gov. Spending	6.541	6.594	2.258	1.873
State & Local Gov.Spending	6.812	6.953	2.021	2.101
Mahalanobis Distance (D^2)	0.033		0.030	
F-statistic	0.261		0.240	
p-value	0.988		0.992	

Table 14
Mahalanobis Distance for Recessions
Null Hypothesis: No Difference between Vintages

	Nominal		Real	
	Recession Mean Vintage 1	**Recession Mean Vintage 3**	**Recession Mean Vintage 1**	**Recession Mean Vintage 3**
Durable Goods Consumption	2.998	2.600	0.183	-0.215
Non-Durable Consumption	5.624	5.757	0.824	0.739
Services Consumption	8.598	8.309	2.567	2.343
Nonresidential Fixed Investment	-1.346	-0.872	-5.354	-4.470
Residential Fixed Investment	-4.920	-4.565	-8.328	-7.770
Private Inventories	-18.385	-21.287	-14.217	-17.091
Exports	3.193	5.400	-2.276	-1.141
Imports	5.015	4.104	-1.150	-2.615
Federal Gov. Spending	9.257	9.872	3.137	2.722
State & Local Gov.Spending	7.187	7.250	1.415	1.491
Mahalanobis Distance (D^2)	0.119		0.127	
F-statistic	0.246		0.263	
p-value	0.990		0.987	

Table 15
Mahalanobis Distance for Expansions
Null Hypothesis: No Difference between Vintages

	Nominal		Real	
	Expansion Mean Vintage 1	**Expansion Mean Vintage 3**	**Expansion Mean Vintage 1**	**Expansion Mean Vintage 3**
Durable Goods Consumption	8.165	8.532	7.537	7.904
Non-Durable Consumption	6.174	6.470	2.678	2.975
Services Consumption	7.500	7.549	3.315	3.367
Nonresidential Fixed Investment	8.774	9.882	7.423	8.452
Residential Fixed Investment	11.068	11.630	6.450	6.768
Private Inventories	25.836	26.516	22.662	23.150
Exports	8.903	11.168	6.370	8.069
Imports	12.557	14.616	9.379	11.336
Federal Gov. Spending	5.474	5.305	1.912	1.539
State & Local Gov.Spending	6.664	6.837	2.260	2.341
Mahalanobis Distance (D^2)	0.043		0.056	
F-statistic	0.242		0.313	
p-value	0.992		0.977	

References

Abdi, Herve (2007). Distance. In N.J. Salkind (Ed.) Encyclopedia of Measurement and Statistics. Thousand Oaks CA: Sage, pp. 280-284.

Aruoba, S. Borağan (2008). Data Revisions Are Not Well Behaved. Journal of Money, Credit, and Banking, 40, 319–340.

Banternghansa, Chanont and Michael W. McCracken (2009). Forecast Disagreement Among FOMC Members. Federal Reserve Bank of St. Louis Working Paper No. 2009-059.

Croushore, Dean, (2006). Forecasting with Real-Time Macroeconomic Data. In: Graham Elliott, Clive W. J. Granger, and Allan Timmermann, eds., Handbook of Economic Forecasting (Amsterdam: North-Holland), pp. 961–982.

Croushore, Dean, (2009). Frontiers of Real-Time Data Analysis. Forthcoming in Journal of Economic Literature.

Croushore, Dean, (2010). Forecasting with Real-Time Data Vintages. Forthcoming in: M. Clements and D. Hendry, eds., Oxford Handbook of Forecasting.

de Leeuw, Frank (1990). The Reliability of U.S. Gross National Product. Journal of Business and Economic Statistics, 8, 191-203.

Dynan, Karen E. and Douglas W. Elmendorf (2001). Do Provisional Estimates of Output Miss Economic Turning Points? Federal Reserve Board Finance and Economics Discussion Series No. 2001-52.

Faust, Jon, John H. Rogers and Jonathan H. Wright (2005). News and Noise in G-7 GDP Announcements. Journal of Money, Credit, and Banking, 37(3), 403-419.

Fixler, Dennis J. and Bruce T. Grimm (2002). Reliability of GDP and Related NIPA Estimates. Survey of Current Business, 82, January, 9-27.

Fixler, Dennis J. and Bruce T. Grimm (2005). Reliability of the NIPA Estimates of U.S. Economic Activity. Survey of Current Business, 85, February, 9-19.

Fixler, Dennis J. and Bruce T. Grimm (2008). The Reliability of the GDP and GDI Estimates. Survey of Current Business, 88, February, 16-32.

Grimm, Bruce T. and Robert P. Parker (1998). Reliability of the Quarterly and Annual Estimates of GDP and Gross Domestic Income. Survey of Current Business, 78, December, 12-21.

Groen, Jan J. J., George Kapetanios and Simon Price (2009). Real Time Evaluation of Bank of England Forecasts for Inflation and Growth. International Journal of Forecasting, 25, 74-80.

Hanson, M. S. and J. Whitehorn (2006). Reconsidering the Optimality of Federal Reserve Forecasts. Manuscript.

Holden, K. and D.A. Peel (1990). On testing for unbiasedness and efficiency of forecasts. Manchester School, 48, 120–127.

Joutz, Frederick L. and H. O. Stekler (1998). Data Revisions and Forecasting. Applied Economics, 30, August, 1011-1016.

Joutz, F. and H. Stekler (2000). An evaluation of the predictions of the Federal Reserve. International Journal of Forecasting, 16, 17-38.

Jordá, Òscar, Malte Knüppel, and Massimiliano Marcellino (2010). Empirical Simultaneous Confidence Regions for Path-Forecasts. European University Institute Economics Working Papers No. ECO2010/18.

Mankiw, N. Gregory, David E. Runkle and Matthew D. Shapiro (1984). Are Preliminary Announcements of the Money Stock Rational Forecasts? Journal of Monetary Economics, 14, 15-27.

Mankiw, N. Gregory and Matthew D. Shapiro (1986). News or Noise: An Analysis of GNP Revisions. Survey of Current Business, 66, May, 20-25.

McLachlan, G. J. (1999) “Mahalanobis Distance” *Resonance*, pp. 20 -26.

McNees, Stephen K. (1986). Estimating GNP: The Trade-Off Between Timeliness and Accuracy. New England Economic Review, Jan./Feb., 3-10.

Mincer, J. and V. Zarnowitz (1969). The Evaluation of Economic Forecasts. In J. Mincer (Eds.) Economic Forecasts and Expectations. National Bureau of Economic Research, New York.

Morgenstern, Oskar (1963). On the Accuracy of Economic Observations, Princeton: Princeton University Press.

Mork, Knut A. (1987). Ain’t Behavin’: Forecast Errors and Measurement Errors in Early GNP Esimates. Journal of Business and Economic Statistics, 5, 165-175.

Neftci, S. N. and P. Theodossiou (1991). Properties and Stochastic Nature of B.E.A.'s Early Estimates of GNP. Journal of Economics and Business, 43, 231–239.

Noether, G. E. (1981). Why Kendall Tau? Teaching Statistics, 3, May, 41-43.

Öller, L.E. and A. Teterukovsky (2007). Quantifying the Quality of Macroeconomic Variables. International Journal of Forecasting, 23, 205-217.

Patterson, K. D. and S. M. Heravi (1991). The Information Content and Gain of Revisions to the Components of GDP. Applied Economics, 23, 90-912.

Patterson, K. D. and S. M. Heravi (2004). Revisions to Official Data on U.S. GNP: A Multivariate Assessment of Different Vintages. Journal of Official Statistics, 20, 573-602.

Sinclair, Tara M., Fred Joutz, and H. O. Stekler (2010). Can the Fed Predict the State of the Economy? Economics Letters, 108, 1, July, 28 – 32.

Seskin, Eugene P. and Shelly Smith (2009). Preview of the 2009 Comprehensive Revision of the National Income and Product Accounts: Changes in Definitions and Presentations. Survey of Current Business, 89, March, 10–27.

Swanson, N. R. and D. van Dijk (2006). Are Statistical Reporting Agencies Getting It Right? Data Rationality and Business Cycle Asymmetry, Journal of Business & Economic Statistics, 24(1), 24-42.

Stark, Tom and Dean Croushore (2002). Forecasting with a Real-Time Set for Macroeconomists. Journal of Macroeconomics, 24, 507-531.

Stekler, H. O. (1967). Data revisions and economic forecasting. Journal of the American Statistical Association**,** 62, 470–483.

Theil, Henri (1966). Applied Economic Forecasting, Amsterdam: North-Holland Publishing Company.

Young, Allan H. (1987). Evaluation of the GNP estimates. Survey of Current Business, 67, August, 18-42.

Young, Allan H. (1993). Reliability and Accuracy of the Quarterly Estimates of GDP. Survey of Current Business, 73, October, 29-43.

Zarnowitz, Victor (1982). On Functions, Quality, and Timeliness of Economic Information. Journal of Business, 55, 87–119.

Zellner, Arnold (1958). A Statistical Analysis of Provisional estimates of Gross national Product and its Components, of Selected National Income Components, and of Personal Saving. Journal of the American Statistical Association, 53, 54-65.