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Rebeca de la Rocque Palis

Quarterly Accounts Team of the Brazilian Institute for Geography and
Statistics (IBGE)

Roberto Luis Olinto Ramos

Quarterly Accounts Team of the Brazilian Institute for Geography and
Statistics (IBGE)

Patrice Robitaille

Board of Governors of the Federal Reserve System

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News or Noise? An Analysis of Brazilian GDP Announcements*

Rebeca de la Rocque Palis[†], Roberto Luis Olinto Ramos[‡], and Patrice Robitaille[§]

Abstract: Revisions to GDP announcements in many countries are often large, and Faust, Rogers, and Wright (2003) have found that G-7 GDP revisions are predictable to varying degrees. In this paper, we extend FRW to study revisions to Brazilian GDP announcements. We document that revisions to Brazilian GDP are large relative to those of G-7 countries. Brazilian GDP revisions are also somewhat predictable, which is consistent with the view that GDP revisions correct errors in preliminary GDP rather than reflect news. However, GDP revisions are far from being entirely predictable. Although GDP revisions are largest only one year following the initial GDP release, those revisions are nearly unpredictable.

Keywords: vintage data, preliminary data, final data, revision, GDP, Brazil

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[†] Economist, Quarterly Accounts Team of the Brazilian Institute for Geography and Statistics (IBGE)

[‡] Head of Quarterly Accounts Team at the Brazilian Institute for Geography and Statistics (IBGE) (ramosrob@ibge.gov.br)

[§] Staff economist, International Finance Division, Federal Reserve Board (patrice.robitaille@frb.gov)

I. Introduction

In late February 2002, the Brazilian Institute for Geography and Statistics, the IBGE, announced that seasonally adjusted real GDP in the fourth quarter of 2001 declined 1.67 percent—about 6.5 percent at an annual rate. However, when GDP growth in first quarter of 2002 was announced the following May, GDP growth in fourth quarter of 2001 was revised up to 0.1 percent—0.4 percent at an annual rate. This large upward revision in real GDP gave a dramatically different picture of how the economy fared in late 2001 and prompted some commentary (O Estado de Sao Paulo, 2002, JP Morgan 2002). While a revision of that magnitude was unusual, Brazilian GDP has undergone even larger revisions. It is also now well documented that GDP announcements can undergo sizeable revisions in many countries.

As the 2002 episode described above suggests, GDP revisions can present complications for policy makers and analysts who hope for timely, but accurate information on the state of the economy. Therefore, concern about the reliability of the data has been one reason why the GDP revision process has been studied in a number of countries.¹ That history is in a sense “rewritten” each time data undergo revisions has also raised other issues. In particular, a number of authors have questioned whether it is appropriate to use data that have undergone revisions when evaluating past economic policies and assessing forecasting performance. They argue that is more appropriate to use “real-time” data—data available to policy makers and the private sector at the time they made their decisions. This argument has been raised convincingly in various contexts: in the assessment of the forecasting properties of the U.S. Composite Index of Leading Indicators (Diebold and Rudebusch 1991); when comparing model-based forecasts of exchange rates (Faust, Rogers, and Wright 2003a); and in studies of the U.S. monetary experience (Evans 1998, Orphanides 2001). In each of these studies, the results using only the data available at the time that decisions were made differed dramatically from the results using revised data.

¹ Revisions to U.S. GDP have been studied extensively (see Mankiw and Shapiro 1986, Young 1993, and Fixler and Grimm 2002). On the UK experience, see Barklem (2000). Oller and Hansson (2002) look at revisions to annual and quarterly nonseasonally adjusted GDP in Sweden and at revisions to annual GDP of other industrialized countries. The authors survey studies on GDP revisions in Australia and the Netherlands.

As Faust, Rogers, and Wright (2003b, hereafter FRW) emphasize, when researchers use revised data for assessments of forecast performance or for *ex post* analysis of policy, they implicitly make an additional assumption that can be lost on the casual reader—they assume that revisions are perfectly anticipated. That is, decision makers are assumed to know that there are systematic inefficiencies in the methods used by data collection agencies to construct GDP announcements and act on that knowledge. Decision makers therefore would have to make adjustments to preliminary GDP and even make adjustments to GDP revisions, at least up to the moment when the time series on GDP is pulled from the statistical agency’s database into the researcher’s database. The assumptions implicitly made by users of revised data seem quite strong and should be subjected to empirical verification.

FRW do find that GDP revisions in several G-7 countries have been predictable to varying degrees over the period they study, suggesting some inefficiencies, but GDP revisions have not been perfectly predictable. Because it is common for data collection agencies to change their procedures in an effort to improve the quality of the data, however, it is not clear what these results imply about future predictability of revisions. For these two reasons—because GDP revisions are typically less than perfectly predictable and because evidence of predictability from past GDP revisions may not imply future predictability—on balance, there is a strong argument for using real-time data more often in empirical work than has been the case thus far. Real-time datasets are so far available only for the United States (Croushore and Stark 2001) and the United Kingdom (Castle and Ellis 2002).²

Although all of the studies cited above pertain to industrialized countries, the same issues confront many users of data from developing countries and transition economies. The lack of timely and accurate data is thought to have contributed to the 1995 Mexican crisis and to the crises in developing Asia in the late 1990s.³ As a result, over the past decade, the International Monetary Fund has led a number of initiatives that have been aimed at improving data quality. As of February 2004, the IMF’s Data Quality

² The Castle and Ellis dataset covers only national income accounts while the Croushore and Stark dataset covers a broader set of economic variables.

³ In an article that predates the crises of the 1990s, Heston (1994) highlights data quality problems in national income accounts of developing countries and makes a plea that researchers flag data quality issues in their research.

Reference Site provided links to its assessments of data quality in 30 countries.⁴ One question asked in these assessments is whether a country conducts and publishes an analysis of data revisions (IMF 2003a and b; see also Carson, Khawaja, and Morrison 2003). Few GDP revisions studies have been conducted and published thus far.⁵

The fact that many macroeconomic data series undergo revisions has also received scant attention in the rapidly expanding empirical literature on monetary policy experiences in developing countries. For example, the analyzes of monetary policy in various countries by Miskin and Schmidt-Hebbel (2001), Corbo (2002), Caputo (2002), Goldfajn et al (2002), Torres (2002), and Clavijo (2003) all employ revised data. It is not yet clear how sensitive the results of these studies are to using revised data versus using real-time data.

Thus, in this paper, where we extend FRW to study revisions to Brazilian GDP announcements, we have two main objectives. Our first objective is to determine whether there is any evidence of inefficiencies in the procedures used to produce the initial GDP estimate. Although quantifying how large revisions to Brazilian GDP are relative to those of industrialized countries is of independent interest, the size of the revision does not tell us anything about whether the preliminary GDP is being compiled in the most efficient manner. Second, we aim to shed some light on the question of whether real-time GDP rather than revised GDP should be used in empirical work.

We proceed by investigating whether Brazilian GDP announcements can be characterized as news, noise, or somewhere in between (as in Mankiw and Shapiro op. cit.). Under the news characterization, the data collection agency bases preliminary GDP

⁴ In 1996, International Monetary Fund's Special Data Dissemination Standards (SDDS) was established, requiring subscribing countries to meet certain standards on data quality and timeliness. See the SDDS's website, <http://dsbb.imf.org/Applications/web/sddshome/>. Countries that do not meet the SDDS, but have plans to do so, can become subscribers to the General Data Dissemination System (GDDS), giving their blueprint for their eventual graduation to the SDDS. The GDDS was created in 1997 (see <http://dsbb.imf.org/Applications/web/gdds/gddshome/>). The reports made available on the Data Quality Reference Site provide delve more deeply into data quality issues (see IMF 2003a and 2003b).

⁵ GDP revisions in developing countries did get some attention in the 1970s and 1980s. Glejser and Schavey (1974) characterized annual GDP revisions in 40 countries, about half of which were classified as developing countries; that study was in its preliminary phase. Urdaneta (1974) describes reasons for revisions in Venezuelan national accounts. Meller and Arrau's 1985 paper, which we have not been able to locate, study the case of Chile. We have found only two recent studies of revisions to GDP or other indicators of economic activity. Van de Eng (1999) explores possible explanations for revisions to Indonesian annual national accounts. Chumacero and Gallego (2001) study the revision process for Chile's Monthly Activity Index (IMACEC).

on all available information; the revisions therefore reflect news. In contrast, under the noise characterization, preliminary GDP is measured with error, and the errors are uncorrelated with the true values. Information available at the time of the GDP announcement, therefore, would be useful in predicting the GDP revision. Forecast rationality tests are employed to distinguish between these two views.

Our quarterly data span the period 1994Q2 to 2001Q4 (31 quarters). Given our small sample, we allow less time to elapse following the last GDP announcement than do FRW for most of the countries they study, meaning that the data have had relatively less time to be revised.⁶ This, in itself, should weaken the case against forecast rationality, as one might expect that with less time to revise the data, there would be less variability in the revisions to distinguish between the noise versus news hypotheses. We compare our results with the results that FRW report under their smaller sample (covering 1988Q1-1997Q4, i.e., 40 quarters). FRW find that revisions to quarterly seasonally adjusted GDP in their ten-year sample have been large for G-7 countries, although not as large as in their larger sample, and are predictable to varying degrees.

We find that revisions to Brazilian GDP are large relative to the G-7 countries and that revisions to quarterly Brazilian GDP are somewhat predictable, consistent with the noise view of GDP announcements. Nevertheless, although GDP revisions are largest one year following the initial GDP release, those revisions are not all that predictable. In contrast, over 30 percent of the variance in revisions two years after the initial GDP announcement can be accounted for by information that is available at the time of the GDP release. In alternative specifications, the degree of predictability in GDP revisions is even greater. In most specifications, the variable with the most predictive power is the GDP announcement; extreme announcements tend to be revised towards more reasonable estimates. For very short-term revisions, however, the variable best able to predict revisions is the mean; initial estimates tend to be pessimistic. We extend our results to look at successive (quarter-to-quarter) GDP revisions, following Mankiew and Shapiro (op. cit.), but we find little evidence of predictability in those revisions. Overall, while we see these results as reinforcing the case for using real-time data rather than revised

⁶ In FRW, 2¾-5½ years separated the last GDP announcement in the sample (1997 Q4) from the “final” revision. In this paper, we allow 2 years to elapse after the last GDP announcement.

data in empirical work, we do find a high degree of predictability in some types of revisions.

The rest of this paper is organized as follows. In the section below, we provide a descriptive overview of the GDP revisions process at the IBGE since the mid-1990s. In Section III, we present summary statistics, followed by a more in-depth look at the GDP revisions process in Section IV. In Section V, we examine whether a change in the definition of GDP in 2000 may be driving our results. In Section VI, we study incremental revisions.

*II. Brazilian GDP Revisions: An Overview*⁷

Our data sources are the press releases of the IBGE, beginning with the press release for 1994Q2.⁸ From each hard copy of the IBGE's press releases, we collected data on real GDP growth for the most recent quarter as well as the revised estimates for earlier quarters.⁹ In this study, GDP announcement and GDP growth announcement are used interchangeably for reasons that will be clearer below. We follow FRW and others by studying revisions to seasonally adjusted GDP growth rates.

Generally, Brazilian GDP revisions have occurred for the same reasons they have occurred in the United States, where GDP revisions have been studied extensively. U.S. GDP revisions have reflected the arrival of new or more comprehensive source data; the replacement of projections with actual data; changes in methodology; and the updating of weights (Young 1993).¹⁰ One additional and important source of GDP revisions in Brazil is the updating of the seasonal factors every quarter, a practice known as concurrent seasonal adjustment. In the remainder of this section, we highlight how the IBGE has attempted to balance the objective of providing as timely and accurate a picture of economic activity as possible against the objective of minimizing GDP revisions.

⁷ This overview is based in part on Cardoso, Ramos, and Zani (2002).

⁸ The IBGE assumed the responsibility for compiling quarterly GDP in the late 1980s. It no longer has records of press releases for quarterly GDP prior to the 1994Q2 announcement.

⁹ We ignored the press releases for current price GDP, which were introduced in late 2001 and which currently are made available one month after the release of real GDP. The current price GDP releases may contain small revisions to real GDP, but in practice, those revisions have been negligible.

¹⁰ As one perhaps extreme example of the delayed arrival of source information, the lag in the availability in data for the telecommunications sector has been at times as great as one year.

From their inception through the mid-1990s, the quarterly national accounts were developed separately from the annual national income and product accounts, which had a much longer history. Quarterly GDP was computed as a weighted average of volume indicators of output, and current price measures of quarterly GDP were not available. The reliance on volume indicators was largely a result of the inflationary environment that prevailed over the period; high inflation made it very difficult to decompose changes in nominal values into changes in prices and changes in quantities. At times, changes in measured prices were even sensitive to the time of the month that the data were collected. As a result, volume indices were considered more reliable, and most of the source data arrived at the IBGE in this form. Quarterly GDP growth as of the mid-1990s was also computed from fixed base year weights.

It was well recognized that GDP growth estimates based on volume indicators of output and fixed base year weights were subject to potentially large measurement errors. Changes in the macroeconomic environment in the 1990s that were induced by trade liberalization and privatization induced shifts in consumption and production patterns, in part because of relative price changes. The unstable macroeconomic environment over the 1980s and 1990s most likely also led to changes in relative prices, and consequently, to changes in consumption and production patterns.

Comprehensive revisions to the quarterly national accounts in February 1998 and November 2000 were aimed at addressing these shortcomings. In the 1998 revision, while quarterly real GDP growth was still derived as a weighted average of output indices, a chain-linked index was introduced; it was hoped that this move would reduce the bias in growth that can be substantial when the reference year is far away from the base year.¹¹ The 1998 comprehensive revision resulted in revisions to quarterly GDP back to 1990. In late 2000, quarterly GDP became a measure of value-added and the availability of information on taxes enabled the IBGE to switch to a broader measure of GDP. The 2000 comprehensive revision resulted in revisions to GDP back to 1991.¹²

¹¹ The growth rates have been computed from a Laspeyres index with the weights being updated yearly. The resulting growth rates are subsequently “chained” together to form an index. Because the preliminary annual accounts for year t-1 have been released, in recent years, some time between August and October of year t, quarterly GDP is typically based initially on the weights in the annual accounts for year t-2.

¹² Quarterly GDP and its production components in current prices were released for the first time in late 2001.

While striving to improve its estimates of economic activity, the IBGE has also taken steps aimed at minimizing revisions. Beginning in early 1998, the IBGE announced that it would introduce major methodological revisions once a year. Methodological changes have, however, been introduced more frequently when it was deemed relatively more important to provide as timely and accurate an estimate of GDP as possible. In late 2000, the IBGE adopted the Denton Method (Denton 1971), which minimizes revisions when quarterly GDP are reconciled with annual totals. The move in late 2001 to increase the lag in the GDP announcement from 45 to 60 days following the end of the reference quarter was aimed, in part, at eliminating revisions associated with the reconciliation of the production-based and expenditure-based measures of output (although the expenditure components were not introduced until late 2002).

This brief overview highlights a drawback to our evaluation of the GDP revision process; especially with our small sample, we have no way of assessing the extent to which methodological changes have improved the GDP revision process over time. Thus, it is not clear that our results for the entire sample period apply to future GDP revisions. This caveat also applies to other studies of the GDP revision process.

III. Summary Statistics

All reported growth rates are seasonally adjusted real GDP growth at quarterly rates. Figure 1 plots the first revision to GDP (the revision one quarter after the first release). The large upward revision to growth in the fourth quarter of 2001—from -1.7 percent to 0.1 percent—was the largest revision since the mid-1990s. However, the attention to that large upward revision overlooks the fact that subsequent GDP revisions can also give a dramatically different picture of economic activity for a particular quarter.

This fact is borne out by Figure 2, which plots three other definitions of revisions. The solid line displays what we call the very short-term revision, which compares preliminary GDP growth with the revised estimate one year later. The dotted line displays the short-term revision, which compares preliminary GDP growth with the revised estimate two years later. Finally, the ball-and-chain displays the long-term revision, which compares preliminary GDP growth with the so-called final version. FRW study the short-term and long-term revisions. As our final version of GDP growth,

we downloaded data on the most recent vintage of GDP growth from the IBGE's website on February 27, 2004, after GDP for the fourth quarter of 2003 was released. Final is shorthand for the latest estimate of real GDP growth, as in practice, in Brazil, as in other countries, revisions to national income accounts typically continue for many years.

We include the very short-term revisions for two reasons. First, we did not have the luxury of allowing more time to elapse after the last GDP announcement. (Recall that our sample has at most 31 observations—small enough as it is.) Therefore, the closer we are to the end of the sample period, the more short-term and long-term revisions are being driven by the same types of revisions. Second, there may be more revisions in Brazilian seasonally adjusted GDP than in other countries owing to the concurrent seasonal adjustment procedure and Brazil's history of macroeconomic instability.

Table 1 reports summary data on the GDP revisions, and shows, for comparison, the statistics for Germany, Japan, the United Kingdom, and the United States for the ten-year period 1988Q1-1997Q4 that were reported by FRW. Note that the sample period for Brazilian GDP revisions is smaller and is more recent. That said, it may still be worth noting that for both short-term and long-term revisions, the root mean squared and mean absolute revisions to Brazilian GDP are relatively high. They are closest to those of Germany, which were among the higher of those in the FRW study of the G-7 countries.¹³

The mean revisions are positive for all Brazilian GDP revisions. One can reject the hypothesis that the very short-term revisions have mean zero at the five percent level.¹⁴ (The standard errors used in the t-tests were adjusted for heteroskedasticity and autocorrelation with a lag truncation parameter of 4). However, the mean short-term and long-term revisions are smaller, and at least in this small sample, one cannot reject the hypothesis that these revisions have mean zero.

¹³ This is even though the U.K. and U.S. GDP announcements are released with a shorter lag. The U.K. and U.S. GDP announcements were announced, on average 26 days and 30 days after the end of the reference quarter over the second half of the 1990s (see fn 8, p. 6 of FRW's 2000 version of their paper, published as International Finance Discussion Paper No. 690, available from the Federal Reserve Board's website.)

¹⁴ Given our small sample, we use the 10 percent level to judge statistical significance, but note where the results are statistically significant at the 5 percent level. In FRW's paper, the 5 percent level is used to judge statistical significance.

IV. Forecast Efficiency Tests

Figure 3 displays scatter plots of preliminary GDP against the very short-term, short-term, and long-term revisions. If GDP revisions only incorporate news, then there should be no systematic relationship between preliminary GDP and revisions. The plots give a hint of some reversion to the mean, particularly for very-short term revisions. Relatively high preliminary GDP growth tends to be revised downward, while relatively low initial GDP releases tend to be revised upward. An inverse relationship between GDP announcements and revisions was found by FRW in several G-7 countries; for several countries, the pattern was far more striking than it is here.

To investigate the relationship between the revised data and the preliminary data more systematically, adopting FRW's notation, let X_t^p and X_t^f denote preliminary and final GDP growth. The revision between final and preliminary GDP growth is defined as $R(t) \equiv X_t^f - X_t^p$. Testing for forecast efficiency (rationality) in the baseline case involves estimating the following equation¹⁵

$$R_t = \alpha + \beta X_t^p + u_t$$

and testing whether $\alpha = \beta = 0$. Acceptance of the null hypothesis that $\alpha = \beta = 0$ is an acceptance of the hypothesis of forecast rationality, i.e., data revisions incorporate news. If GDP revisions are predictable, that would be consistent with the notion that GDP announcements have substantial measurement errors (noise) that are corrected in subsequent revisions. These forecast efficiency equations are employed to study the very short-term, short-term, and long-term revisions.

As is suggested by the scatter plot, we first regressed GDP revisions on an intercept term and the GDP announcement. We then compared the results of these regressions with the regressions that add seasonal dummies. The addition of seasonal dummies is one means of testing for inefficiencies in seasonal adjustment. Inefficiencies in seasonal adjustment are of independent interest because it has been our impression that

¹⁵ Also called the Mincer-Zarnowitz test (1969) for forecast efficiency.

analysts have considered seasonally adjusted Brazilian GDP to be “unreliable.” In the episode highlighted at the beginning of this paper, the large revision to Brazilian GDP for the fourth quarter of 2001 largely reflected the updating of the seasonal factors.¹⁶ This large change in the seasonal factor in fact prompted IBGE economists to investigate the effects of alternative seasonal adjustment methods, but the results were inconclusive.¹⁷

For this reason, until relatively recently, many analysts tended to focus solely on four-quarter changes in real GDP. A major drawback of the focus on four-quarter changes is that they can identify turning points only with a delay. That drawback has spawned attempts in the commentary to adjust implicitly for seasonal movements. Thus, in the end, analysts are at least as interested in the evolution of seasonally adjusted changes in output as they are in four-quarter changes.¹⁸

Table 2 displays the results. For all revisions, the p-value for the F statistic of the joint hypothesis that $\alpha = \beta = 0$ is less than 0.02, a rejection of the hypothesis of forecast rationality. The degree of predictability is relatively low for the very short-term revisions, but is not much higher for the long-term revisions. The seasonal dummies are jointly significantly different from zero in the short-term revisions.¹⁹ The inclusion of the seasonal dummies increases the explanatory power of the regression somewhat (the adjusted R squared rises from 0.27 to 0.34).

¹⁶ Non-seasonally adjusted GDP declined 3.4 percent in the fourth quarter of 2001, not annualized, and suffered little revision in the May 2002 GDP release. Non-seasonally adjusted GDP in other quarters suffered some small revisions.

¹⁷ Concurrent seasonal adjustment (followed by the IBGE) has been considered preferable to updating seasonal factors once a year. This is because concurrent seasonal adjustment produces smaller revisions in the most recently estimated seasonal factors once more observations become available (see Kenny and Durbin 1982). Since 1998, the IBGE has used X-12-ARIMA (X-11 before 1998) to seasonally adjust GDP. The large revision to 2001Q4 GDP growth prompted IBGE economists Palis, Ramos, and Zani (2003) to conduct a counterfactual experiment, asking what growth estimates they would have obtained had they instead been using an alternative seasonal adjustment procedures. The TRAMO/SEATS seasonal adjustment procedure, for example, produced a much larger decline in GDP in 2001Q4. Nevertheless, the results were inconclusive because one cannot formally compare the size of GDP revisions under the two seasonal adjustment methods. That is because each seasonally adjusted GDP converges to a different “final” estimate.

¹⁸ Consider, for example, the comment of one analyst following the release of Brazilian GDP and its production components for the first quarter of 2002: “The decline of 3.91 percent in industry in the first quarter from a year earlier is a recovery because in the fourth quarter it fell 4 percent and something. The decline is decelerating, although it will take some time to turn around and show growth.” (Reuters, May 28, 2002.)

¹⁹ In FRW, as a robustness check, outliers were dropped because of possible errors (typos) in the secondary source they relied on for their data. Here, since we rely on the primary source, we see no case for dropping outliers; dropping extreme observations may omit information that is relevant to assessing the GDP revisions process.

Following FRW and others, we then considered as additional explanatory variables the international price of oil (in dollars), the stock price index (the Bovespa index), and the GDP announcement lagged one quarter. The oil price and Bovespa index are similar to the business cycle indicators used by FRW and other authors. The business cycle indicators are aimed at testing whether there are inefficiencies in the data revision process that are correlated with the state of the business cycle.

The oil price and Bovespa index are measured as the percentage change in the average daily closing value for the quarter. Because the change in the Bovespa index in the second and third quarters of 1994 mainly reflected the rise in nominal stock prices during the hyperinflation Brazil experienced until a stabilization plan was enacted in July 1994, we dropped those two quarters from the regressions that included the Bovespa index.²⁰ We also restrict the number of additional explanatory variables to two at most.

Given that our time series was already a short one, we also were concerned that the results in Table 2 might be sensitive to dropping even two observations. Thus, the first two columns for each revision in Table 3 is a repeat of Table 2, only dropping the second and third quarters of 1994. In all specifications, forecast rationality is rejected, and the GDP announcement is statistically significant from zero. The coefficient on the oil price is significantly different from zero at the five percent level in the regression for short-term revisions. However, the coefficient is not only very small, but is also negative—a counterintuitive result. The lagged GDP announcement is never statistically significant and results of regressions with this variable are not shown here.

We also tried additional specifications, adding to the specification with seasonal dummies (separately) the sovereign credit risk spread (the Brazilian EMBI+ spread over U.S. Treasuries) and the U.S. three-month T-bill rate, both in levels. We considered both the contemporaneous EMBI+ spread as well as its one-quarter lag, given the evidence that risk spreads can both respond to and contribute to macroeconomic fluctuations in

²⁰ We would have preferred to use a domestic energy price index rather the international price of oil because domestic prices of energy (both petroleum and electricity) were controlled in Brazil over the period. However, we were unable to obtain a consistent index covering the sample period. In 1999, there was a major revision in the survey used to compile the consumer price index. As a result, classifications in the energy categories, even at a fairly aggregated level, differed markedly beginning in August 1999. Changes in the international price of oil should still affect economic activity in Brazil, even though it has been a small net oil importer, but via more complex channels of transmission that include the effect on the fiscal budget balance.

Brazil and other emerging market economies (see Uribe and Yue 2003). None of these additional macroeconomic indicators are significantly different from zero either, and the results are not reported here.²¹

V. Accounting for the Change in the Definition of GDP in 2000

One objection that could be raised is that the results above are difficult to interpret because there were two comprehensive revisions of quarterly GDP over the sample period. One response to this criticism is that, as noted by FRW, any comprehensive revision can be thought of as a revision in the statistical authority's "best estimate" of GDP. Nevertheless, we investigated whether the results would differ if the IBGE had not changed its definition of GDP in 2000 by re-estimating the forecast efficiency equations using the previous definition of GDP. We did not attempt, however, to control for other methodological changes that were introduced under the 2000 revision.

The 2000 comprehensive revision employed new data on taxes, enabling GDP to be defined more broadly as GDP at market prices (following the United Nation's System of National Accounts, 1993 version). Previously, value-added at basic prices was the proxy for GDP. We call this the previous definition of GDP the "old" definition of GDP below. Figure 4 compares the quarterly changes in the old and new definitions of GDP at the time of the 2000 comprehensive revision, which was released along with GDP for the third quarter of 2000. Had the IBGE continued to use the old definition of GDP, reported GDP growth for some quarters would have been very different.

Using the old definition of GDP affects the last 10 very short-term revisions in our sample (beginning with the GDP release for 1999Q3), the last 14 short-term revisions (beginning with the GDP release for 1998Q3), and all of the long-term revisions. The results of our forecast efficiency regressions for both the very short-term and short-term revisions are virtually unchanged and are not reported here. Very short-term revisions

²¹ We also considered whether to include the U.S. GDP announcement (the advance release) from the Croushore-Stark dataset for real-time macroeconomic variables for the United States. The U.S. GDP advance release has been made available 15 to 30 days before the release of Brazilian GDP for that same reference quarter. However, to interpret any results, we would have needed to consider first whether the U.S. GDP announcement can be better characterized as news or noise. Because this seemed to needlessly complicate our task, we did not proceed further. FRW (op. cit.) accept the null of forecast rationality in short-term revisions to U.S. GDP, but reject forecast rationality in long-term revisions in regressions that include business cycle indicators.

remain practically unpredictable. Using the old definition of GDP alters considerably the results for long-term revisions. As seen in Table 4, forecast efficiency is not only again rejected in all three specifications, but also, GDP revisions are highly predictable. The variable with the most predictive power is the GDP announcement; the adjusted R^2 in the first specification is nearly 50 percent. None of the other additional explanatory variables increase the explanatory power of the regression relative to this baseline specification. These results lend further support to the view that there is predictability in GDP revisions, although very short-term revisions are largely unpredictable.

VI. Analysis of Incremental Revisions

Statistical agencies are also interested in achieving the most efficient GDP estimate at any given GDP vintage. We therefore study incremental GDP revisions, following Mankiw and Shapiro (op. cit.). Let the first GDP release for quarter t be denoted by Y_1 , the second release of GDP for quarter t by Y_2 , the third release of GDP for quarter t by Y_3 , and so on, up to Y_9 . Y_2 is the preliminary release for Y_3 , Y_3 the preliminary release for Y_4 , and so on. The first revision is $Y_2 - Y_1$, the second revision is $Y_3 - Y_2$, and so on up to the eighth revision ($Y_9 - Y_8$). That is, we study GDP revisions up to two years following the GDP release.

Table 5a reports summary statistics on incremental revisions, while Table 5b reports results of the baseline regression for the entire sample period (1994Q2-2001Q4). In Table 5a, the average first revision ($Y_2 - Y_1$) is positive and is significantly different from zero at the five percent level, while the second revision ($Y_3 - Y_2$) is negative and is significantly different from zero at the ten percent level. We reject the hypothesis that the other incremental revisions are statistically significant from zero. The mean absolute first revision is over a third of a percentage point at a quarterly rate, and does not show signs of falling until about a year and a half after the initial release ($Y_7 - Y_6$).

Table 5b reports the results of the baseline regressions for incremental revisions. Forecast rationality is rejected for the third revision ($Y_4 - Y_3$) and the seventh revision ($Y_8 - Y_7$). The degree of predictability in revisions is low in all cases except for the third revision, where the adjusted R^2 is nearly 20 percent. The average continues to be the best predictor of the first and second revisions. Adding seasonal dummies and macro

variables do not alter these results markedly, and the results are not shown to conserve space.

VII. Conclusion

Policy changes and the increased attention given to data quality were two responses to the economic crises seen in Latin America and developing Asia in the 1990s. Nevertheless, while revisions to GDP and other economic data have attracted increasing attention in industrialized countries, the implications of data revisions in developing countries and transition economies for policy analysis and forecasting are virtually unexplored territory. These considerations motivate this paper, where we study revisions to Brazilian GDP. We find that revisions to Brazilian GDP are large relative to those of industrialized countries. Brazilian GDP revisions are somewhat predictable, but not in the very short run. Because the sample size is small, the results should be treated with caution. All told, we view the results of this study as strengthening the case for using real-time data rather than revised data in empirical work.

One possible extension to our analysis is to study the revisions in the components of seasonally adjusted GDP. However, interpretation of any results would be complicated by the fact that the IBGE constructs seasonally adjusted GDP via the direct method, i.e., GDP is run through a seasonal filter (X-12) to arrive at seasonally adjusted GDP. Under the indirect method, in contrast, seasonally adjusted GDP is built up from its seasonally adjusted components. Some have favored the argument that national GDP be constructed via the indirect method (Astolfi, Ladiray, and Massi 2001) because users put a high weight on consistency between changes in the components and changes in the aggregate. To give one example of why such a move may be desirable in the Brazilian case, in the announcement for 2003Q1, the news that GDP declined only slightly (0.2 percent at an annual rate) was puzzling given the large declines in the components. This issue could be addressed in future research, and it highlights the fact that the GDP can continue to undergo revisions far after the initial release.

Table 1: Summary Statistics on Data Revisions

	Brazil 1994Q2-2001Q4	Germany	Japan 1988Q1-1997Q4	UK	US
Very Short-Term Revision					
Mean	0.23	na	na	na	na
t-stat	2.05*	na	na	na	na
root mean square	0.91	na	na	na	na
mean absolute	0.70	na	na	na	na
prelim mean growth	0.49	0.37	0.61	0.30	0.60
Short-Term Revision					
Mean	0.15	0.08	-0.00	0.15	-0.01
t-stat	1.07	0.71	-0.04	1.70	-0.13
root mean square	0.87	1.14	0.60	0.64	0.30
mean absolute	0.67	0.67	0.49	0.31	0.23
Long-Term Revision					
Mean	0.13	0.22	0.05	0.25	0.11
t-stat	0.89	1.81	0.68	2.35	2.58
root mean square	1.11	1.05	0.84	0.75	0.37
mean absolute	0.88	0.72	0.67	0.44	0.31

Notes: Figures for Germany, Japan, U.K. and U.S. from Table 1 in Faust, Rogers and Wright (2003b). The preliminary data and revisions are quarter-over-quarter growth rates, in percent. Preliminary refers to the first release of the quarterly growth rate. The very short-term revision is reported GDP growth one year after the preliminary GDP release minus preliminary GDP growth. The short-term revision is reported GDP growth two years after the preliminary GDP release minus preliminary GDP growth. Final refers to data downloaded from the IBGE's website on February 27, 2004. Long-term revision is final GDP growth minus preliminary GDP growth rate. The t-statistics are based on heteroskedasticity and autocorrelation consistent standard errors and are for the hypothesis that the mean is zero.

* indicates that coefficient is statistically different from zero at the 5 percent level.

Table 2: Forecast Efficiency Regressions, Sample period 1994:2 - 2001:4

	Very short-term	Very short-term	Short-term	Short-term	Long-term	Long-term
Constant	0.33 2.84 *	0.45 1.72 **	0.29 2.70 *	0.62 3.64 *	0.28 2.09 *	0.24 0.84
prelim	-0.20 2.00 *	-0.22 -2.52 *	-0.28 -2.24 *	-0.30 -3.44 *	-0.30 -3.34 *	-0.29 -3.19 *
dummy Q1		0.30 0.83		-0.04 -0.12		-0.37 -0.88
dummy Q2		-0.34 -0.82		-0.74 -2.96 *		0.24 0.69
dummy Q3		-0.36 -0.97		-0.47 -1.68 **		0.22 0.41
R_U^2	0.20	0.29	0.31	0.44	0.22	0.27
\bar{R}^2	0.12	0.12	0.27	0.34	0.18	0.14
F	8.73	13.6	12.90	29.0	17.50	34.3
p-val	0.01	0.02	0.00	0.00	0.00	0.00
F (seasonal)		3.3		9.16		1.48
p-val		0.35		0.03		0.69

Notes: See notes to Table 1. The t-statistic below each coefficient is for the hypothesis that the coefficient is zero. ** denotes significant at the 10 percent level, and * denotes significant at the 5 percent level. The F-statistic is for the hypothesis that the coefficients for the intercept and slope terms are zero, with the p-value for this statistic shown in the following row. F (seasonal) and F (price) is for the hypothesis that the seasonal dummy variables (price variables) are jointly zero, with the p-values for these statistics shown in the following row. The rows labeled R_U^2 and \bar{R}^2 report the uncentered R squared and the adjusted R squared.

Table 3: Forecast Efficiency Regressions, Sample period 1994:4 - 2001:4

	Very short-term	Very short-term	Very short-term	Short-term	Short-term	Short-term	Long-term	Long-term	Long-term
Constant	0.28 2.23 *	0.46 1.78 **	0.44 1.72 **	0.23 2.13 *	0.63 3.68 *	0.65 3.38 *	0.19 1.92 **	0.27 0.86	0.31 0.95
prelim	-0.22 -2.08 *	-0.23 -2.88 *	-0.22 -2.29 *	-0.29 -2.36 *	-0.31 -4.51 *	-0.34 -5.38 *	-0.33 -3.79 *	-0.33 -3.93 *	-0.36 -4.28 *
dummy Q1		0.30 0.83	0.30 0.79		-0.04 -0.13	0.09 0.26		-0.38 -0.88	-0.48 -1.02
dummy Q2		-0.45 -1.03	-0.38 -0.79		-0.88 -3.56 *	-0.93 -4.37 *		0.15 0.40	0.01 0.03
dummy Q3		-0.57 -1.73 **	-0.51 -1.54		-0.70 -3.24 *	0.79 -3.06 *		-0.11 -0.18	-0.20 -0.32
stock price			-0.00 -0.25			-0.01 -1.64			0.01 1.05
oil			-0.01 -0.89			0.02 3.27 *			0.01 0.72
R_U^2	0.20	0.34	0.36	0.35	0.56	0.63	0.28	0.31	0.34
\bar{R}^2	0.14	0.20	0.15	0.32	0.48	0.53	0.25	0.20	0.16
F	6.17	13.5	57.4	8.46	33.8	62.3	16.9	35.6	50.6
p-val	0.05	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
F (seasonal)		9.30	6.02		17.2	22.7		1.17	1.35
p-val		0.03	0.11		0.00	0.00		0.76	0.72
F (price)			1.25			12.1			2.62
p-val			0.54			0.00			0.27

Notes: See notes to Table 1. The t-statistic below each coefficient is for the hypothesis that the coefficient is zero. ** denotes significant at the 10 percent level, and * denotes significant at the 5 percent level. The F-statistic is for the hypothesis that the coefficients for the intercept and slope terms are zero, with the p-value for this statistic shown in the following row. F (seasonal) and F (price) is for the hypothesis that the seasonal dummy variables (price variables) are zero, with the p-values for these statistics shown in the following row. The rows labeled R_U^2 and \bar{R}^2 report the uncentered R squared and the adjusted R squared.

**Table 4: Forecast Efficiency Regressions, Old Definition of GDP
Long-term Revision, Sample period 1994:4 - 2001:4**

Constant	0.18	0.24	0.28
	2.34 *	0.87	0.97
prelim	-0.42	-0.42	-0.45
	-6.29 *	-6.24 *	-7.28 *
dummy Q1		-0.36	-0.48
		-0.88	-1.17
dummy Q2		0.05	-0.11
		0.15	-0.30
dummy Q3		0.08	-0.02
		0.17	-0.04
stock price			0.01
			1.58
oil			0.01
			0.95
R_U^2	0.50	0.53	0.57
\bar{R}^2	0.48	0.45	0.46
F	51.4	119	212
p-val	0.00	0.00	0.00
F (seasonal)		2.70	4.11
p-val		0.44	0.25
F (price)			6.7
p-val			0.03

Notes: See notes to Table 1. The t-statistic below each coefficient is for the hypothesis that the coefficient is zero. * indicates that coefficient is significant at the 5 percent level. The F-statistic is for the hypothesis that the coefficients for the intercept and slope terms are zero, with the p-value for this statistic shown in the following row. F (seasonal) and F (price) is for the hypothesis that the seasonal dummy variables (price variables) are zero, with the p-values for these statistics shown in the following row. The rows labeled R_U^2 and \bar{R}^2 report the uncentered R squared and the adjusted R squared.

Table 5a: Incremental Revisions

	Y2-Y1	Y3-Y2	Y4-Y3	Y5-Y4	Y6-Y5	Y7-Y6	Y8-Y7	Y9-Y8
average	0.18	-0.20	0.06	0.19	-0.10	-0.03	0.07	-0.01
t-stat	2.03 *	-1.65 **	0.79	1.56	-1.04	-0.67	0.98	-0.24
root mean square	0.54	0.76	0.64	0.59	0.50	0.31	0.38	0.38
mean absolute	0.35	0.38	0.46	0.39	0.33	0.23	0.24	0.25

Notes: Y1 denotes the preliminary (first) GDP release, Y2 denotes the second GDP release, and so on up to Y9, which denotes the ninth GDP release (exactly two years after the first GDP release). The t-statistic below each is for the hypothesis that the coefficient is zero. * indicates that the coefficient is statistically different from zero at the 5 percent level; ** denotes significant at the 10 percent level.

Table 5b: Incremental Revisions

	Y2-Y1	Y3-Y2	Y4-Y3	Y5-Y4	Y6-Y5	Y7-Y6	Y8-Y7	Y9-Y8
intercept	0.19 1.95 **	-0.12 -1.68 **	0.15 1.64	0.20 1.44	-0.03 -0.42	-0.03 -0.63	0.10 1.79 **	0.04 0.82
Y1	-0.01 -0.21							
Y2		-0.13 -1.45						
Y3			-0.17 -3.21 *					
Y4				-0.02 -0.37				
Y5					-0.10 -1.56			
Y6						0.00 0.05		
Y7							-0.05 -1.07	
Y8								-0.08 -1.50
R_U^2	0.11	0.16	0.21	0.10	0.13	0.01	0.08	0.10
\bar{R}^2	-0.03	0.06	0.18	-0.03	0.06	-0.03	0.02	0.07
F	4.25	3.20	10.60	2.80	2.60	0.48	6.56	2.34
p-val	0.12	0.20	0.01	0.25	0.27	0.79	0.04	0.31

Notes: See notes to Table 5a. The t-statistic below each coefficient is for the hypothesis that the coefficient is zero. ** denotes significant at the 10 percent level, and * denotes significant at the 5 percent level.

The F-statistic is for the hypothesis that the coefficients for the intercept and slope terms are zero, with the p-value for this statistic shown in the following row. The rows labeled R_U^2 and \bar{R}^2 report the uncentered R squared and the adjusted R squared.

Figure 1: First Revision to GDP

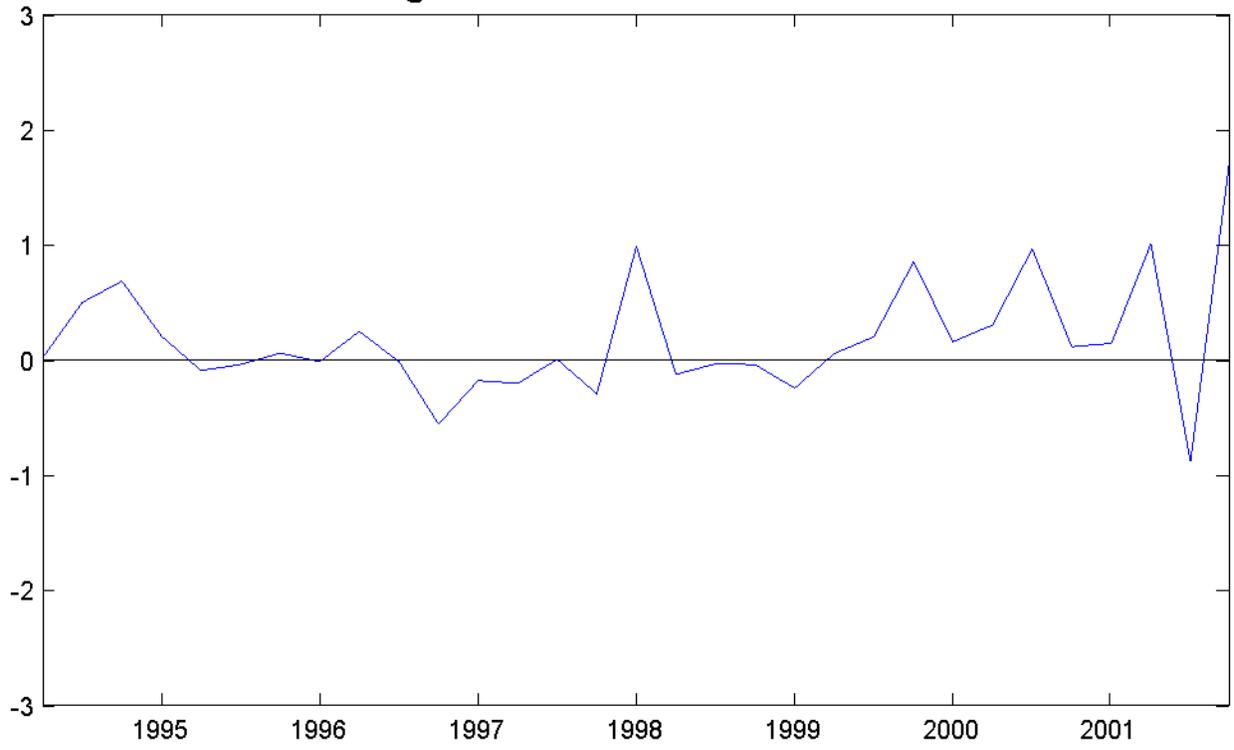


Figure 2: Other Revisions to GDP

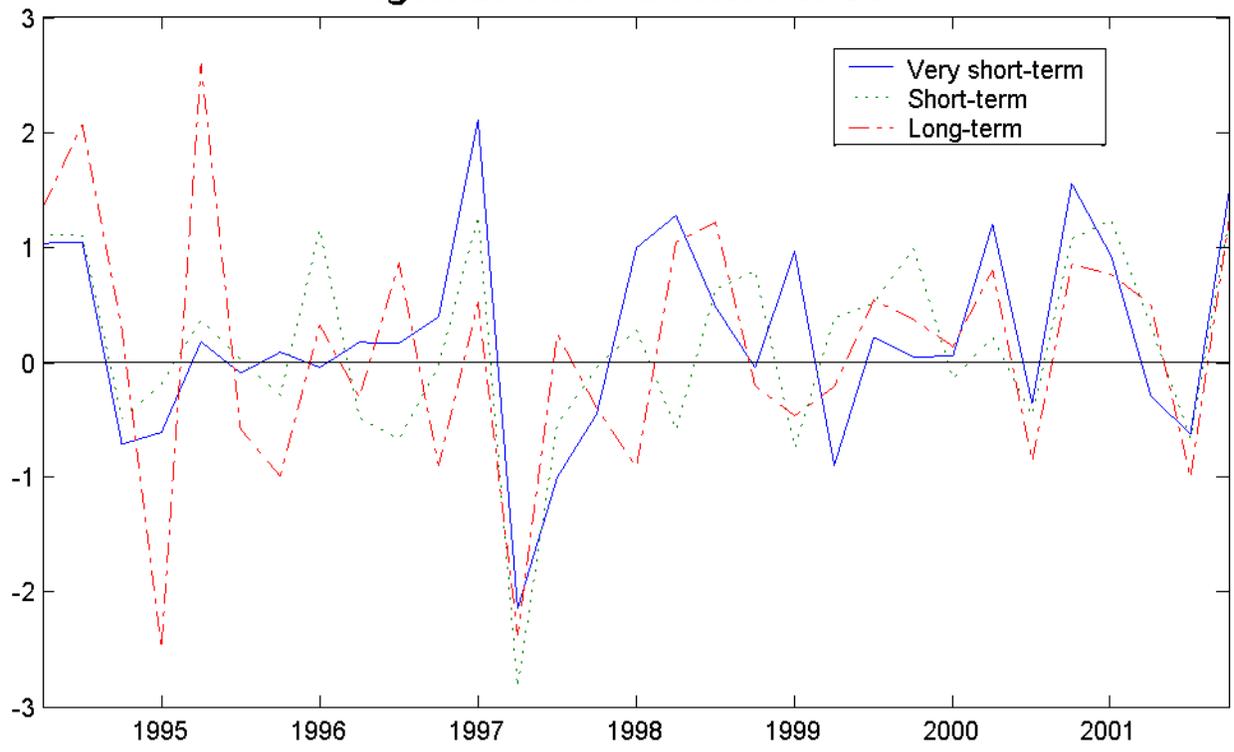


Figure 3: Preliminary GDP Growth and Revisions

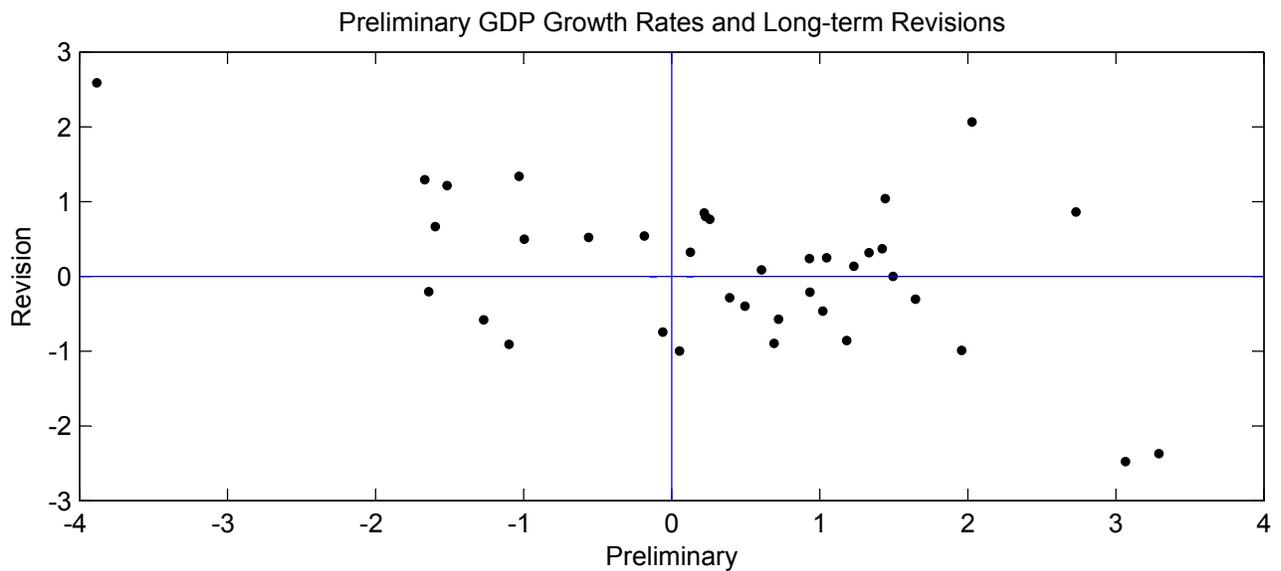
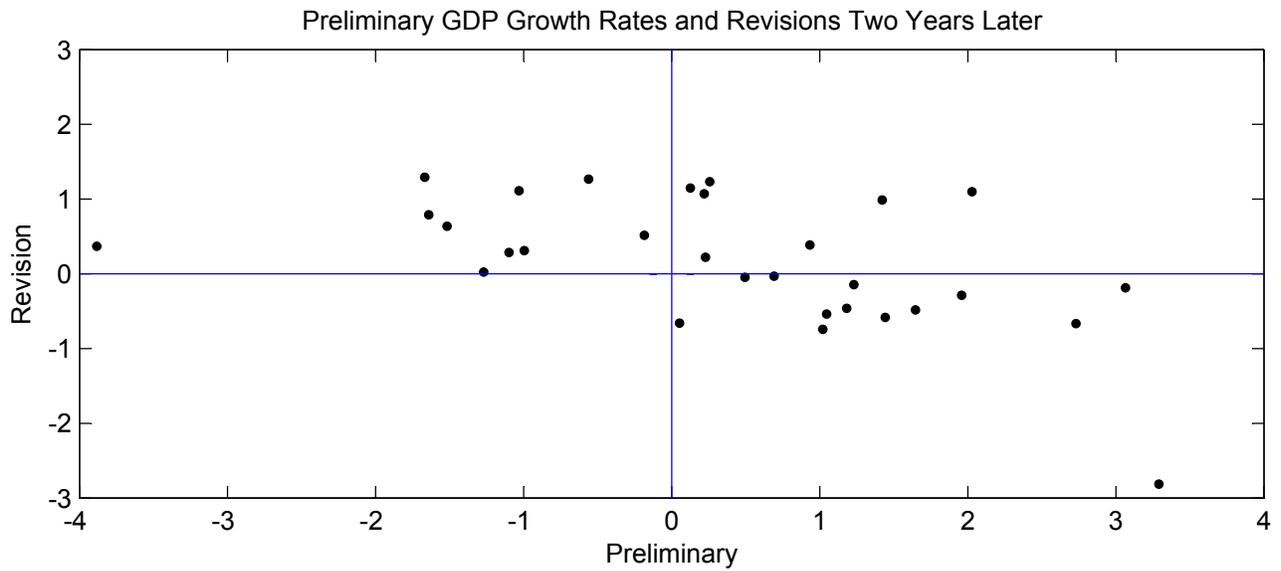
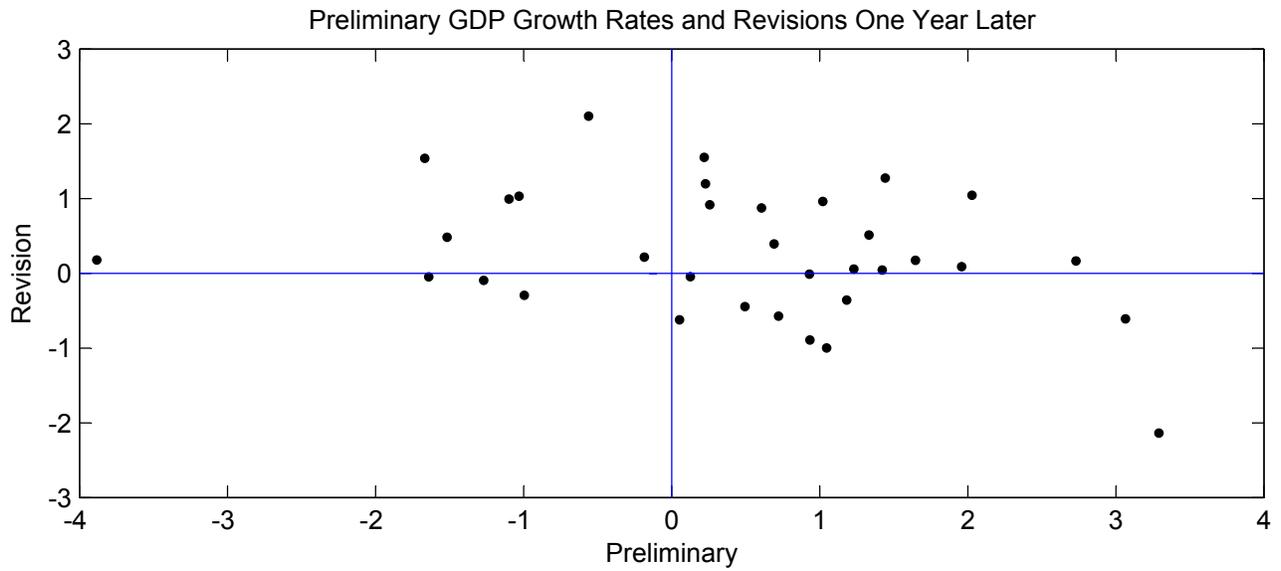
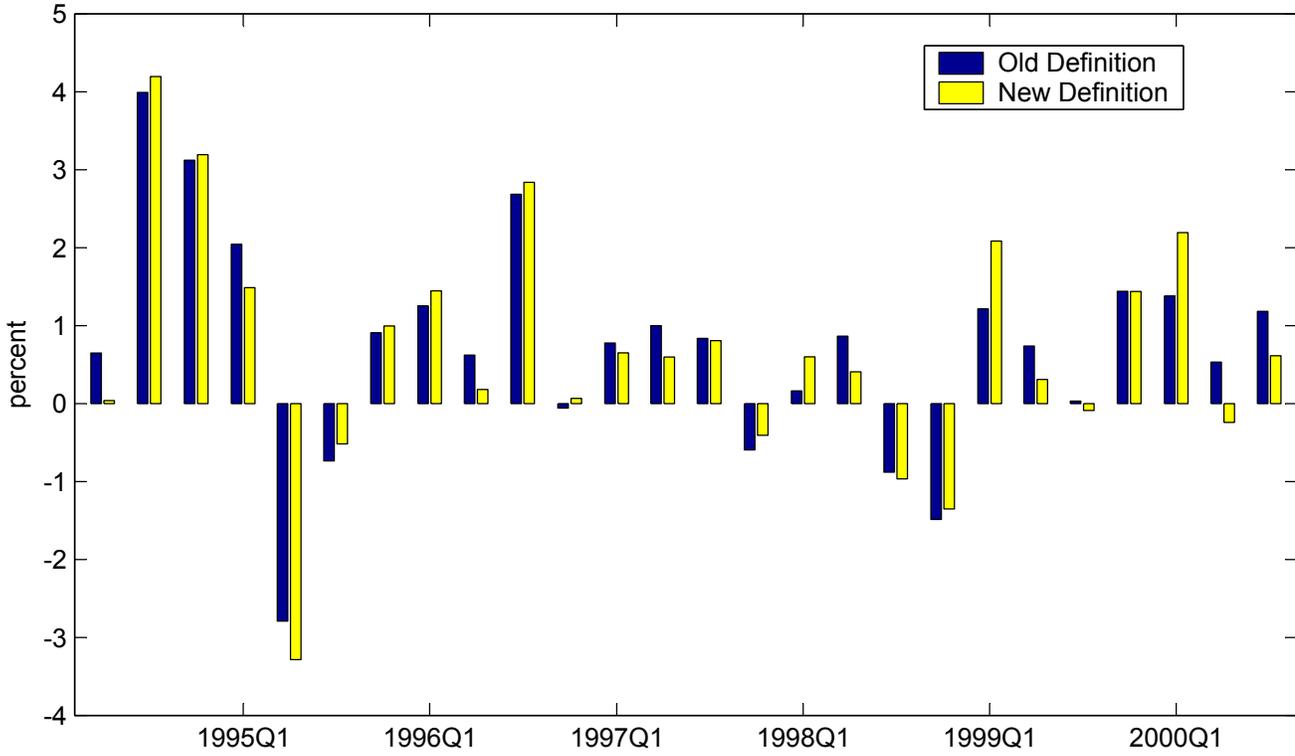


Figure 4: New vs Old Measures of GDP as of November 2000*



*New Measure of GDP is GDP at market prices. Old Measure of GDP is value-added at basic prices. Both estimates are from the November 2000 comprehensive revision of the quarterly national accounts.

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