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WORKING PAPER NO. 00-6

A REAL-TIME DATA SET FOR MACROECONOMISTS:

DOES DATA VINTAGE MATTER FOR FORECASTING?

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Abstract

This paper describes a real-time data set for macroeconomists that can be used for a variety of purposes, including forecast evaluation. The data set consists of quarterly vintages, or snapshots, of the major macroeconomic data available at quarterly intervals in real time. The paper explains the construction of the data set, examines the properties of several of the variables in the data set across vintages, and provides an example showing how data revisions can affect forecasts.

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I. INTRODUCTION

In creating models to use for forecasting, economists use the most recent vintage of

historical data available to them to develop and test alternative models. They often compare the

forecasts from a new model to forecasts from alternative models or to forecasts that were made

by others in real time. However, since the analysis of the new forecasts is often based on the

final, revised data, rather than the data that were available to economic agents who were making

forecasts in real time, the results of such exercises may be misleading.

To avoid such problems in creating forecasting models, we have developed a data set that

gives a modeler a snapshot of the macroeconomic data available at any given date in the past.

We call the information set available at a particular date a "vintage," and we call the collection of

such vintages a "real-time data set."

This paper explains the reasons for the construction of this data set, describes the data set,

and provides an empirical example demonstrating the extent to which the data vintage matters for

evaluating forecasts.[1] In creating our real-time data set, our goal is to provide a basic foundation

for research on issues related to data revision by allowing researchers to use a standard data set,

rather than collecting real-time data themselves for every different study. We begin with a brief

discussion of related research in section II. We provide details about the data set in section III.

In section IV, we examine several different variables, showing the degree to which the data are

affected by revisions. Section V provides an empirical forecasting example demonstrating how

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[1] In a companion paper, we analyze the degree to which data vintage matters for the robustness of
empirical studies in macroeconomics. See Croushore and Stark (1999b).

forecasts may be sensitive to the choice of data vintage. We draw conclusions from these results

in section VI.

II. RELATED RESEARCH

Research that deals with the fact that data are revised has been ongoing since the seminal

studies of Zellner (1958), Morgenstern (1963), and Cole (1969). Diebold and Rudebusch (1991)

provided a dramatic example of the importance of data revisions by showing that the index of

leading indicators does a much worse job of predicting future movements of industrial

production in real time than it does after the data are revised.[2]

The importance of being careful about the preliminary nature of some data has been

emphasized by numerous researchers, beginning with Stekler (1967), who found value in early

data releases even though they contained errors. Howrey (1978) showed how to adjust for the

fact that data within a particular vintage have been revised to differing degrees, while Harvey, et

al. (1981) showed how to deal with revisions that occur at irregular intervals.

A substantial body of research has been devoted to examining the efficiency of data

production or investigating the nature and statistical properties of data revisions. Conrad and

Corrado (1979) showed how a data user could improve on published data on retail sales.

Mankiw, Runkle, and Shapiro (1984) explored the efficiency of early releases of the money

supply. Mankiw and Shapiro (1986) did the same for real output data, and Mork (1987) found an

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[2] In support of this result, Robertson and Tallman (1998a) show that a VAR that uses real-time data from the index of leading indicators produces no better forecasts for industrial production than an AR model using just lagged data on industrial production. However, they also show that the leading indicators may be useful in forecasting real output (GNP/GDP) in real time.

improved empirical technique for performing such analysis. Pierce (1981) and Sargent (1989) described some theories on how to think about the data revision process. Patterson and Heravi (1991), Swanson, Ghysels, and Callan (1999), and Swanson (1996) have examined different aspects of data revisions, finding, among other results, that data revisions are somewhat forecastable.

Data revisions are important because they may affect policy decisions or the manner in which such decisions depend on the most recent data, as Maravall and Pierce (1986) investigated some years ago. Revisions may also affect people's expectations, as Boschen and Grossman (1982) found. Recently, a number of authors have investigated the role of data revisions in affecting monetary policy rules [Orphanides (1997, 1998), Evans (1998), and Ghysels, Swanson, and Callan (1999)], how measures of monetary policy shocks are affected by data revisions [Rudebusch (1998a) and Croushore and Evans (1999)], the empirical relationship between money and output [Amato and Swanson (1999)], the impact on policy research [Runkle (1998)], and how monetary policy responds to uncertainty [Rudebusch (1998b)].

Forecasting models may be particularly sensitive to data revisions, as Fair and Shiller (1990) pointed out. Denton and Kuiper (1965) found that the use of preliminary (rather than final) data led to large forecast errors, but Trivellato and Rettore (1986) found effects that were much more modest. Howrey (1996) showed that forecasts of the level of GNP are much more sensitive to data revisions than forecasts of growth rates. Swanson and White (1997) used real-time data to investigate optimal model selection for a number of variables. Robertson and Tallman (1998b) used a real-time data set to evaluate alternative VAR model specifications for forecasting unemployment, inflation, and output growth. Koenig and Dolmas (1997) developed

3

a method for forecasting real output growth using monthly data based on real-time analysis. A further development of that idea in a paper by Koenig, Dolmas, and Piger (1999) examined the question of what sets of real-time data forecasters should use: the fully revised series available at each date, or some unrevised series of initial releases, again in the context of forecasting real output growth.

Our real-time data set promises to facilitate all the types of empirical research discussed above, by making available a single source that's well documented and thoroughly investigated, containing real-time data for a large number of macroeconomic variables.

III. THE DATA SET

In concept, developing a real-time data set is simple—just enter old data into spreadsheets. But in reality, producing our real-time data set required a substantial amount of effort, including digging through old source data and figuring out what data were available at what time, a procedure that wasn't trivial, considering the lack of documentation for much of the data. As a result, the data-collection phase of this project has been going on for the past eight years.

Our real-time data set now includes data as they existed in the middle of each quarter (on the 15th day of the month, to be precise), from November 1965 to the present.[3] For each vintage date, the observations are identical to those one would have seen in published sources at that

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[3] Why the middle of each quarter? Because one of the original motivations for this project came from research on the forecast efficiency of the Survey of Professional Forecasters [see Keane and Runkle (1990) and Croushore (1993)], whose forecasters make their forecasts in the middle of each quarter.

time. For example, if you want to know what the data looked like on August 15, 1968, just pull down the data set from our web site and look at the vintage for August 1968, and you will find the relevant data—a time series for each variable from the first quarter of 1947 to the second quarter of 1968.[4] See Table III.1 for a list of the variables included in the data set and the Internet address where the data can be found.

A few notes about some of the variables are worth mentioning here, though more complete details can be found in the documentation files on our web page.[5] First, even though the interest-rate variables are never revised, they're included for completeness. The other variables are revised to some degree over time, though some, like the CPI, are revised only through changes in seasonal adjustment factors or changes in the base year. Note that the data set includes the chain-weighted GDP price index in vintages beginning with February 1996 but doesn't include a price-level measure before that. However, for vintages prior to February 1996, a price level can be constructed by taking the ratio of nominal GNP/GDP to real GNP/GDP. The data set is mostly complete, but some data are missing for the money stock, monetary base, and reserves variables; we're in the process of adding some of the missing data from obscure sources.

Though the project of collecting these data seems simple, it turned out that finding old data was not easy. Further, since the critical element for economic research is the timing of the data (was it released during the second week of February or the third?), we were very careful to

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[4] More precisely, there are two data sets at each date, one containing quarterly variables, such as real GDP, and another containing monthly variables, such as the unemployment rate.

[5] From links on the web page, you can download the data, read documentation about the data, and find out when new data will become available. We plan to add new vintages shortly after the 15th day of the middle month of each quarter.

include in each vintage only the observations we knew were available at the time. In many cases

data were revised, but the publications that detailed the revisions did not always say when the

revisions were made available. So it took a substantial amount of effort to figure out exactly

what observations should have been, or should not have been, included in each vintage. A

comprehensive set of notes about the data set is available on our web site to help researchers

understand our conventions for including or excluding particular observations. Also, some of the

data have been collected in real time since this project began in 1991, though the scope of the

project has expanded since that time.

After entering all the data into a set of database worksheets, we ran a number of editing

checks to try to ensure the quality of the data.[6] In some cases this was easy. For example, we

tested a large sample of vintages to make sure that the sum of the components of real output

added up to total real output. In other cases, where there was no adding-up constraint, we plotted

growth rates of the variables to ensure that they looked sensible. This helped tremendously in

finding typographical errors in the data set.

IV. DATA REVISIONS

We know that the economic data are revised, but are such revisions large enough to worry

about? For example, when one compares forecasts from a new model estimated on today's data

with forecasts from a model estimated on old data, how different are the data sets and the

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[6] Most of the data entry was done over the last six years by a small army of undergraduate students working as interns. From Princeton University: Michael Hodge, Ron Patrick, Adam Stark, Jason Harvey, Jake Erhard, Keith Wilbur, and Andrew Stern. From the University of Pennsylvania: Peter High, Lisa Forman, and Bill Wong. However, from 1997 to 1998 the lion's share of the work was done by Bill Wong, who hammered the data set into shape under the supervision of one of the authors, Tom Stark. Our thanks to all these wonderful students who produced a high-quality product! Research assistants at the Philadelphia Fed continue to collect new data.

resulting forecasts? To investigate this question, we'll look at a few selected variables: real

output, business fixed investment, and consumption spending on durable goods.[7]

First, to see how much the data vintage matters for fairly long horizons, we'll examine

revisions to five-year average growth rates.[8] We look at the annual average growth rate over

five-year periods in Table IV.1 for data from vintages (hereafter called "benchmark vintages")

dated November 1975, November 1980, November 1985, November 1991, November 1995, and

August 1999. These vintages were chosen because they were the last vintages prior to a

comprehensive revision of the national income and product accounts.

When the government made comprehensive revisions to the national income and product

account (NIPA) data following our benchmark vintage dates, they often made significant

changes, including modifying the definitions of variables and incorporating new source data.[9]

The base year was changed for real variables in January 1976 (from 1958 to 1972), in December

1985 (from 1972 to 1982), in late November 1991 (from 1982 to 1987), and in January 1996

(from 1987 to 1992). As a result, some of the differences across the benchmark vintages we look

at (1975 to 1980, 1985 to 1991, 1991 to 1995, and 1995 to 1999) incorporate base-year changes,

which affect real variables. Most importantly, since the base-year changes in 1976, 1985, and

1991 used the old fixed-weighted index methodology, the change of base year alters the timing of

substitution bias; this bias is large for dates further away from the base year.

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[7] See Croushore and Stark (1999b) for a similar analysis of the revisions to nominal output, real
consumption spending, and the price level.

[8] Patterson and Heravi (1991) examine cointegration between successive benchmark revisions in data
from the U.K., finding that cointegration sometimes exists.

[9] The construction of the NIPA data are explained in Ritter (2000).

There is a potentially significant change in one of our variables across the benchmark

vintages. The real output variable is GNP in vintages before February 1992 but GDP in vintages

from February 1992 on. Our data set is consistent with the "headline" variable (that is, the

variable that is listed in Tables 1.1 and 1.2 in the *Survey of Current Business* and is the focus of

the discussion about aggregate economic activity), but users need to be aware of this change,

since the differences between GNP and GDP are not random; they are persistent in sign. So

some of the differences across vintages in real output arise because of this definitional change.[10]

A major change in the methodology of the national income accounts arose in 1996, when

the government switched from fixed-weighted indexes to chain-weighted indexes, to eliminate

substitution bias. Under the fixed-weight methodology, such a change in the base year led to

significant changes in the growth rates of real variables, often with large changes for years in the

distant past. Under chain weighting, however, a change of base year has no impact on the growth

rates of real variables.

As we look across the columns of Table IV.1, we can see how the five-year annual

average growth rate has changed across benchmark vintages. For real output, the vintage makes

a difference, especially when the base year is changed. Especially large changes show up in

moving from the 1985 to the 1991 benchmark vintage (reflecting the base-year shift of December

1985) and moving from the 1995 to the 1999 benchmark vintage (reflecting the move to chain

weighting in 1996). But those differences in real output growth are tiny compared with what we

see for various components of output. The growth rates for business fixed investment have

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[10] We could create a data set with all GNP data, but GNP data are no longer released at the same time
as the headline number (GDP); so the timing in all the data sets would change.

changed dramatically across vintages. For example, business investment grew 3.9 percent per

year in the first half of the 1950s, according to the 1975 benchmark vintage, but grew 5.0 percent

per year according to the 1980 vintage. Even more dramatic was the slowdown in the measured

growth rate in the first half of the 1990s, from 5.7 percent in the 1995 vintage to just 2.7 percent

in the 1999 vintage (thanks, in large part, to the switch to chain weighting and the impact that

had on investment in producers' durable equipment, especially for computers). Consumer

spending on durables is also quite volatile as measured across the benchmark vintages, especially

in the second half of the 1950s and again in the second half of the 1960s.

One way to examine how revisions affect the data is to plot differences in the data across

vintages for the same date. Figures IV.1 to IV.3 show plots of the differences between the log

levels of the variables, with the mean difference (over the common time period) subtracted,

because it reflects mainly base-year changes. Let $X(t,s)$ represent the level of a variable for time t

in vintage s. We plot, for each date t that is common to vintages a and b, the value of $Z_t \equiv \log$

$[X(t,a)/X(t,b)] - m \equiv \log [X(t,a)] - \log [X(t,b)] - m$, where m is the mean of $\log[X(\tau,a)/X(\tau,b)]$

over the largest sample of τ contained in both vintages, and where b is a later vintage than a.[11]

In the figures, the first column of plots compares the first benchmark vintage (a = 1975)

to each later benchmark vintage. So, the upper left plot is the second benchmark vintage (b =

1980) compared to the first; the plot below compares the third benchmark vintage (b = 1985) to

the first; and so on. The second column does the same for the second benchmark vintage (a =

1980), and so on, and the final column, which has just one entry, compares the fifth benchmark

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[11] Since we've removed the mean, we won't capture any mean shifts in variables, but those are
illustrated in Table IV.1.

vintage (a = 1995) to the sixth (b = 1999). The notation on each plot follows the convention Lz#, where L means the logarithm of the variable, z represents the variable (z=Y for real output, z=IB for business fixed investment, and z=CD for consumption of durables), and where # represents the benchmark vintage, with #=1 for the November 1975 vintage, #=2 for November 1980, #=3 for November 1985, #=4 for November 1991, #=5 for November 1995, and #=6 for August 1999.

If you look at plots on the main diagonal of the figures, you're comparing adjacent benchmark vintages. The plots below the main diagonal show comparisons across two or more benchmark vintages. Each plot shows dates along the horizontal axis from 1947Q1 to 1998Q3. The last data point plotted is 1975Q3 in column 1, 1980Q3 in column 2, 1985Q3 in column 3, 1991Q3 in column 4, and 1995Q3 in column 5. The vertical axis in each plot is listed at the top of each figure; these are demeaned log differences.

Three major features of the plots are apparent: (1) trends; (2) spikes; and (3) other deviations from a linear trend. First, the dominant feature of the plots is the presence of trends. A downward tilt means later data points were revised upward relative to earlier data, reflecting faster trend growth; similarly, an upward tilt means that later data points were revised downward relative to earlier data. Second, a spike in a plot means that data for a particular date or series of dates were revised significantly in one direction relative to other dates in the sample. The third source of difference in the plots is the presence of long-lived deviations from a linear trend (or, when no trend is evident, from zero), suggesting that there are low frequency differences between vintages. Taken together, the plots point to cross-vintage differences at many frequencies.[12]

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[12] See Croushore and Stark (1999b) for some spectral analysis of the revisions.

In Figure IV.1, the effects of substitution bias on real output growth rates are apparent by looking at the tilt in the plots. For example, in moving from benchmark vintage 3 to benchmark vintage 4, the log ratio series tilts upward, because the fixed-weight method with a change in base year from 1972 to 1982 greatly changes the relative pricing relationships between energy and other goods. Thus, the plot is tilted, as even data from long before were affected significantly. But moving from vintage 5 to vintage 6 reverses that effect, thanks to chain weighting. Notice also that the movement from GNP to GDP (from vintage 4 to vintage 5) didn't cause much effect.

In Figure IV.2, showing business fixed investment, the most striking result is the steepness of the plots in the bottom row. This represents a change in methodology when chain-weighting was introduced in 1996. As a result, changes to investment spending estimates were particularly pronounced, because of large changes in the price indexes for investment in technology (especially computers), and hence in the real value of investment.[13] In addition, the changes in the measurement of investment spending when benchmark revisions occur (columns 1, 3, 4, and 5) are remarkable, especially because they are nonlinear. They come from a variety of sources, including new data from censuses, changes in estimated prices, and changes in procedures for calculating values. This suggests that, in analyzing forecasts, one should be very careful about what vintage of the data one uses as "actual," since redefinitions, changes in methodology, and changes in relative prices seem to have dramatic effects on both the levels and the growth rates of business fixed investment.

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[13] For more on these issues, see Landefeld and Parker (1995, 1997).

Figure IV.3 shows that real consumption on durables is strongly affected by some

revisions, but less so by others. As is the case with some of the other plots, chain weighting

leads to the opposite tilt direction of fixed weighting, because of distortions of relative prices

under fixed weighting. In the first column, the decline in durables from the benchmark revision

came about from the reclassification of some items from consumption to residential investment,

plus reclassification of a portion of autos from consumption to business investment (depending

on personal versus business ownership). In the fourth column, the declines in the growth rates of

durables arise because of changed depreciation assumptions, new source data, and quality

adjustments. And in the last column, it's mostly the change to chain weighting that affects the

pattern of revisions. Chain weighting reverses some of the earlier effects of fixed weighting, so

the lower left-hand plot is basically flat, though other plots have a substantial tilt to them.

Having documented that data revisions are potentially large for a variety of variables, we

now pose the question: do such revisions matter for forecasting?

V. AN EMPIRICAL FORECASTING EXAMPLE

To illustrate how the data vintage matters in forecasting, we run some simple empirical

exercises. We estimate and forecast real output growth with an ARIMA model and compare the

forecasts generated from models estimated on latest-available data (from our August 1999

vintage) to those generated from models estimated on our real-time data.[14] We proceed in the

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[14] See Croushore and Stark (1999a) for similar results with additional forecasting models, including
a univariate Bayesian model, and with the multivariate quarterly Bayesian vector error-correction
(QBVEC) model of Stark (1998). Similar results to those discussed in this paper obtain, though
Bayesian methods seem to reduce the impact of data revision on forecasts.

following manner: (1) estimate a model for real output growth using data for the second quarter of 1948 through the third quarter of 1965 that was known in November 1965; (2) forecast quarter-over-quarter real output growth for the fourth quarter of 1965 and the following three quarters to the third quarter of 1966, then form a four-quarter average growth-rate forecast over that time span; (3) repeat parts (1) and (2) in a rolling procedure, going forward one quarter each step, adding one more observation to the sample used for estimation; and (4) calculate the forecast errors for the four-quarter-average forecasts.[15] We follow this procedure once using the real-time data set (for which data revisions are possible as we roll forward each quarter using the next vintage associated with that quarter), and a second time using only the latest vintage available when this analysis was undertaken (vintage August 1999, which contains no data revisions as we roll forward each quarter).

Using an AR(4) model on the first-difference of log real output, we find that the two forecasts look somewhat different over time but not dramatically so (top panel of Figure V.1). Forecast errors appear similar (middle panel) but can be quite different at certain times (bottom panel), such as in 1976. A scatter plot shows a positive relationship between the two sets of forecasts, but there are differences between the forecasts (Figure V.2). Evidently, the vintage of the data matters even for such simple forecasts as these AR(4) forecasts. However, taking the August 1999 vintage as representing the actual value for the data, the root-mean-squared-forecast error (RMSE) is not very different when forecasts are based on real-time data (2.38) as opposed to final revised data from the August 1999 vintage (2.40). That's actually quite surprising

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[15] This procedure could also be carried out to examine forecasts one quarter ahead, two quarters ahead, three quarters ahead, or four quarters ahead, rather than the average of the four quarterly forecasts, with similar results.

because it says that having today's vintage gives no better forecast performance than having available just real-time data, when the goal is to forecast the data as they appear today; or it may simply mean that forecasting a variable such as real output growth using time-series methods isn't a very productive enterprise in the sense that the forecast errors associated with the AR(4) model are large relative to the revisions of the data.

An additional benefit of the real-time data set is that it can be used by a researcher to choose a different set of values to use as "actuals" in calculating forecast errors. In the results we've discussed so far, the latest vintage (August 1999) was used to represent the actuals, but alternative choices are sensible as well. One could argue that a forecaster shouldn't need to forecast changes in NIPA methodology, and thus that data from not long after the forecast was made should be used as actuals. Alternatively, one could argue that forecasters should be expected to forecast variables reasonably well until a comprehensive NIPA revision is made. We can easily use the real-time data set to calculate the forecast errors defined on these alternative actuals.

If we use as actuals the real-time values of real output growth one year after the end of the forecast period, we get an RMSE of 2.67 forecasting with real-time data as opposed to 2.70 forecasting with final revised data. If we use as actuals the data from the benchmark vintage just before the next comprehensive revision, we find an RMSE of 2.80 forecasting with real-time data as opposed to 2.85 forecasting with final revised data.[16] Somewhat larger differences (around

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[16] None of these differences in root mean square errors are large enough to be statistically significant, based on tests for comparing forecast accuracy, like those of Diebold and Mariano (1995).

14

0.2) between the forecasts using the alternative data sets occur if we compute the RMSEs over nonoverlapping five-year intervals, rather than over the entire period.

This exercise illustrates the idea that forecasts for selected sample periods may be substantially affected by data vintage, as Figures V.1 and V.2 show. We've done other experiments (not reported here) that show similar results with other forecasting models [see Croushore and Stark (1999a)].

VI. CONCLUSIONS

This paper describes our real-time data set for macroeconomists, explains how the data were assembled, and shows the extent to which some data revisions are potentially large enough to matter for forecasting. Forecasts based on real-time data are certainly correlated positively with forecasts based on final data, but data revisions to real output may cause forecasts based on current-vintage data to be considerably different from forecasts based on real-time data over selected sample periods. To be fair, the results of our empirical exercise suggest that when evaluated over long periods, forecast-error statistics are not sensitive to the distinction between real-time and latest-available data, even though forecasts for isolated periods can diverge. We suspect, however, that this result may not generalize to other classes of models, and in particular, depends crucially on the persistence of the process of revisions, the persistence of the process describing the variable being modeled, and on the type of model. At a minimum, we believe further research is warranted and that our empirical findings sound a cautionary note for studies claiming that some new, improved forecasting method is superior to other methods, if the study presents only evidence based on current-vintage data rather than real-time data.

Our hope is that the real-time data set presented in this paper and available on our web site will serve as a standard for forecasters and others engaged in research that may be affected by data revisions.

TABLE III.1
BASIC INFORMATION ABOUT THE REAL-TIME DATA SET

Web site: http://www.phil.frb.org/econ/forecast/reaindex.html

Variables Included in the Data Set

Quarterly observations:
      Nominal GNP (vintages before 1992) or GDP (vintages in 1992 and after)
      Real GNP (vintages before 1992) or GDP (vintages in 1992 and after) and components:
            Consumption and its components:
                  Durables
                  Nondurables
                  Services
            Components of Investment:
                  Business Fixed Investment
                  Residential Investment
                  Change in Business Inventories (Change in Private Inventories after
                      vintage August 1999)
            Government Purchases (Government Consumption and Gross Investment,
                vintages in 1996 and after)
            Exports
            Imports
      Chain-Weighted GDP Price Index (vintages in 1996 and after)

Monthly observations:
(quarterly averages of these variables are also available in the quarterly data sets)
      Money supply measures:
            M1
            M2
      Reserve measures (data from Board of Governors):
            Total reserves
            Nonborrowed reserves
            Nonborrowed reserves plus extended credit
            Monetary base
      Civilian Unemployment Rate
      Consumer Price Index (seasonally adjusted)
      3-month T-bill Rate
      10-year T-bond Rate

Additional Variables Planned for 2000:
      Corporate Profits
      Import Price Index

Table IV.1
Average Growth Rates Over Five Years
For Benchmark Vintages
Annualized percentage points

Vintage Year:	'75	'80	'85	'91	'95	'99
Period						

Real Output

Period	'75	'80	'85	'91	'95	'99
49Q4 to 54Q4	5.2	5.1	5.1	5.5	5.5	5.3
54Q4 to 59Q4	2.9	3.0	3.0	2.7	2.7	3.2
59Q4 to 64Q4	4.1	4.0	4.0	3.9	4.0	4.2
64Q4 to 69Q4	4.3	4.0	4.1	4.0	4.0	4.4
69Q4 to 74Q4	2.1	2.2	2.5	2.1	2.3	2.6
74Q4 to 79Q4	NA	3.7	3.9	3.5	3.4	3.9
79Q4 to 84Q4	NA	NA	2.2	2.0	1.9	2.2
84Q4 to 89Q4	NA	NA	NA	3.2	3.0	3.2
89Q4 to 94Q4	NA	NA	NA	NA	2.3	1.9

Real Business Fixed Investment

Period	'75	'80	'85	'91	'95	'99
49Q4 to 54Q4	3.9	5.0	5.0	4.9	4.8	4.7
54Q4 to 59Q4	2.5	3.1	3.2	2.7	3.0	3.0
59Q4 to 64Q4	5.9	5.6	5.7	5.3	5.7	6.2
64Q4 to 69Q4	6.3	6.2	6.4	6.0	6.0	7.1
69Q4 to 74Q4	2.0	1.7	1.9	2.5	2.9	3.6
74Q4 to 79Q4	NA	3.9	5.8	5.2	5.7	6.5
79Q4 to 84Q4	NA	NA	4.6	2.4	2.4	3.5
84Q4 to 89Q4	NA	NA	NA	2.7	1.0	1.1
89Q4 to 94Q4	NA	NA	NA	NA	5.7	2.7

Real Consumption Spending on Durables

Period	'75	'80	'85	'91	'95	'99
49Q4 to 54Q4	4.1	3.8	3.6	3.9	4.3	3.8
54Q4 to 59Q4	3.0	2.0	2.0	2.0	1.7	2.4
59Q4 to 64Q4	6.3	5.2	5.4	4.7	4.5	6.0
64Q4 to 69Q4	7.8	7.0	7.2	6.7	6.4	7.3
69Q4 to 74Q4	1.7	2.6	2.7	2.6	2.0	2.8
74Q4 to 79Q4	NA	7.1	7.0	6.8	6.3	6.6
79Q4 to 84Q4	NA	NA	4.6	4.8	4.1	4.9
84Q4 to 89Q4	NA	NA	NA	4.9	4.7	5.0
89Q4 to 94Q4	NA	NA	NA	NA	4.9	3.2

Note: Each table entry shows the average annual growth rate of the variable over the five-year period shown in the first column, as recorded in the benchmark data vintage at the top of each column. Reading across columns within a given row illustrates the degree to which five-year annual average growth rates have been revised over time.

Figure IV.1
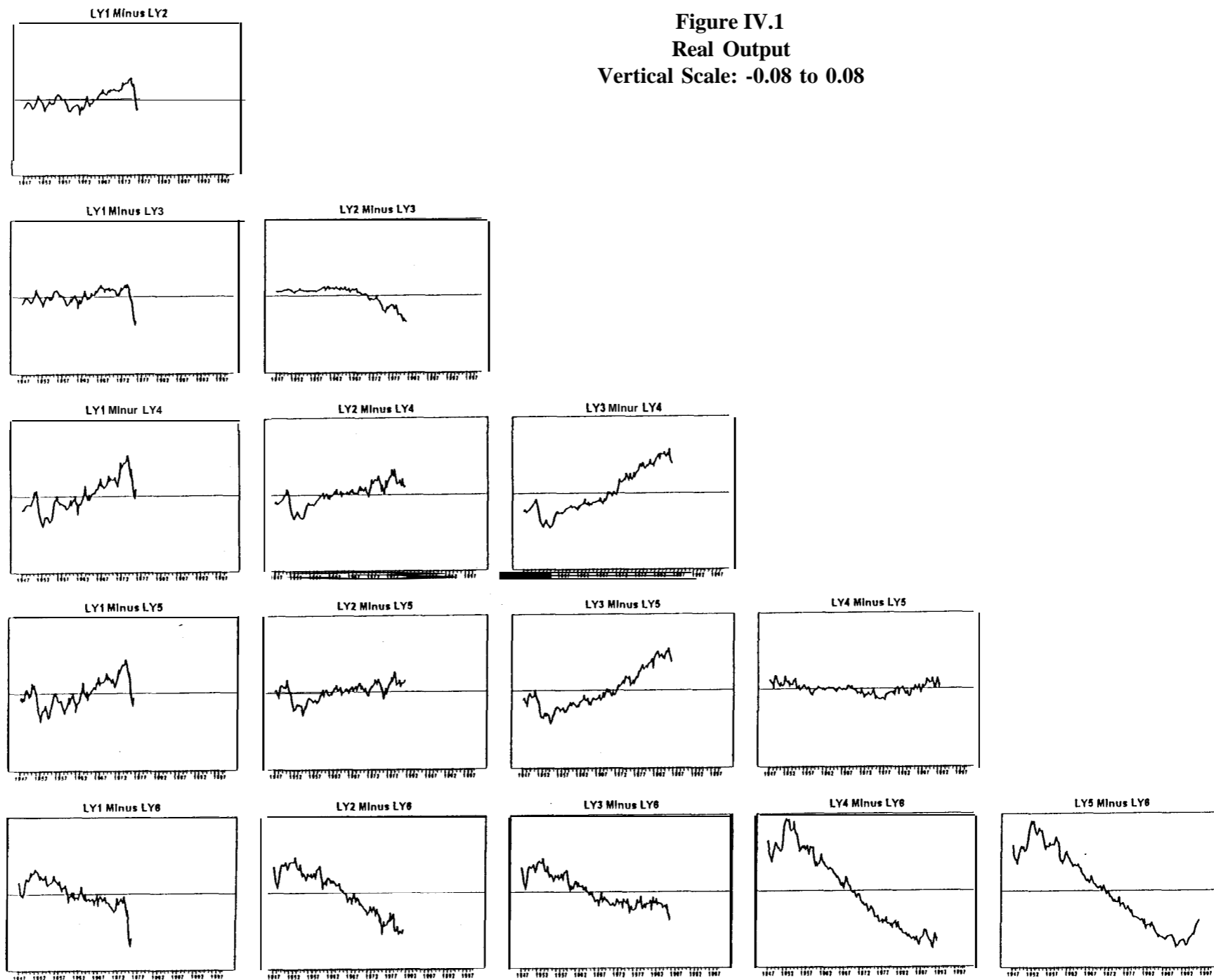Real Output
Vertical Scale: -0.08 to 0.08

LIB1 Minus LIB2

Figure IV.2
Real Business Fixed Investment
Vertical Scale: -0.25 to 0.15

Notes: See notes for Figure IV.1

LIB1 Minus LIB3　　　　**LIB2 Minus LIB3**

LIB1 Minus LIB4　　　**LIB2 Minur LIB4**　　　**LIB3 Minus LIB4**

LIB1 Minus LIB5　　　**LIB2 Minur LIB5**　　　**LIB3 Minus LIB5**　　　**LIB4 Minus LIB5**

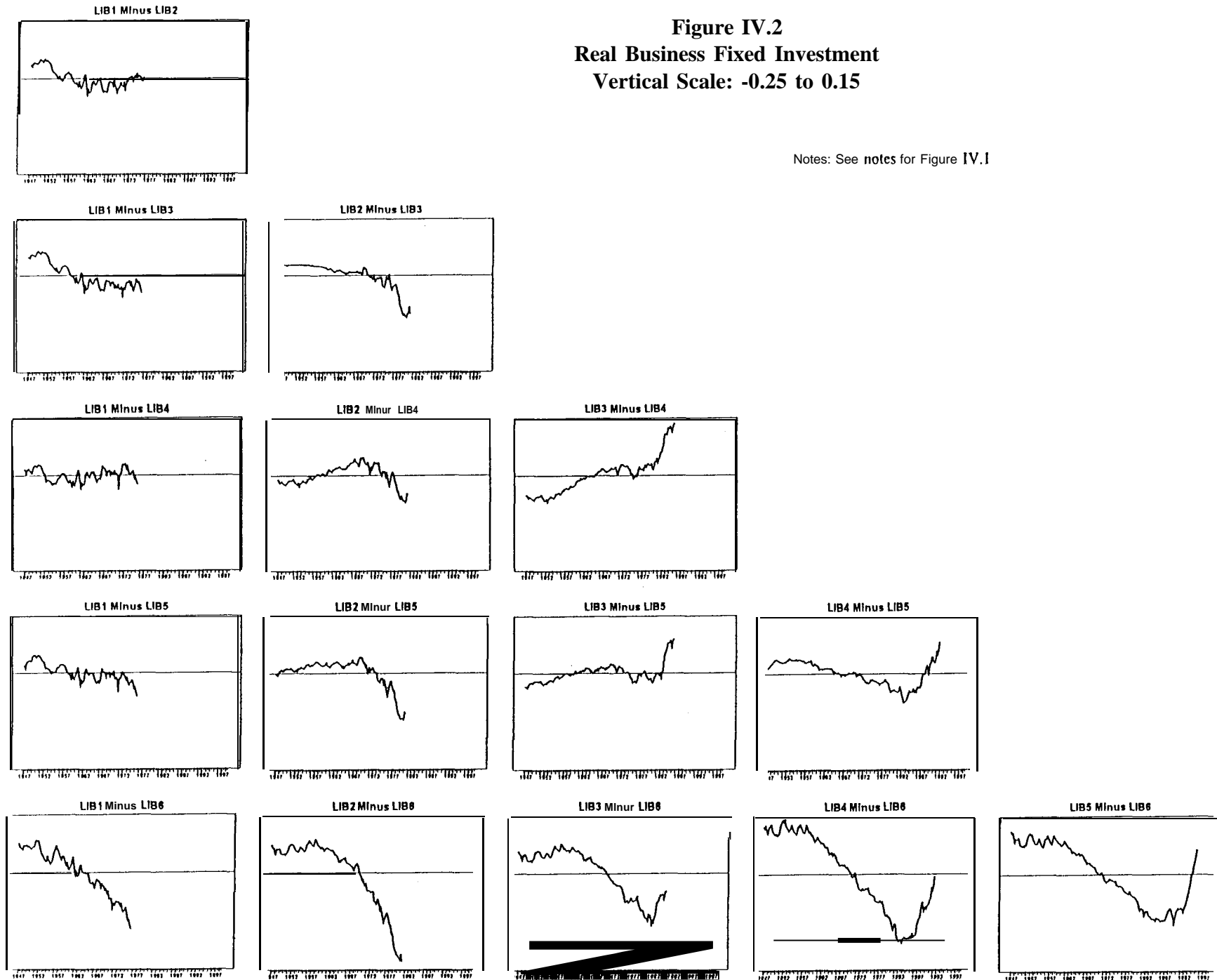**LIB1 Minus LIB6**　　**LIB2 Minus LIB6**　　**LIB3 Minur LIB6**　　**LIB4 Minus LIB6**　　**LIB5 Minus LIB6**

Figure IV.3
Real Consumption Spending on Durable Goods
Vertical Scale: -0.20 to 0.20

Notes: See notes for Figure IV. I.

Figure V.l

A Comparison of Two Real **GDP** Forecasts From a Rolling AR(4) Model
One-Year-Ahead, Four-Quarter Growth Rates

Legend: —— Real Time — — Latest Available

Y-axis: 9, 8, 7, 6, 5, 4, 3, 2, 1
X-axis: 1950, 1961, 1964, 1967, 197l, 1973, 1976, 1979, 1982, 1985, 1988, 1991, 1994, 1997, 2000

A Comparison of Two Forecast Errors From a Rolling AR(4) Model
Actual Minus Predicted

Legend: —— Real Time — — Latest Available

Y-axis: 6, 4, 2, 0, -2, -4, -6, -8
X-axis: 1958, 1961, 1964, 1967, 1970, 1973, 1976, 1979, 1982, 1985, 1968, 1991, 1994, 1997, 2000

Difference Between Errors
Real Time Minus Latest Available

Y-axis: 2, 1, 0, -1, -2, -3
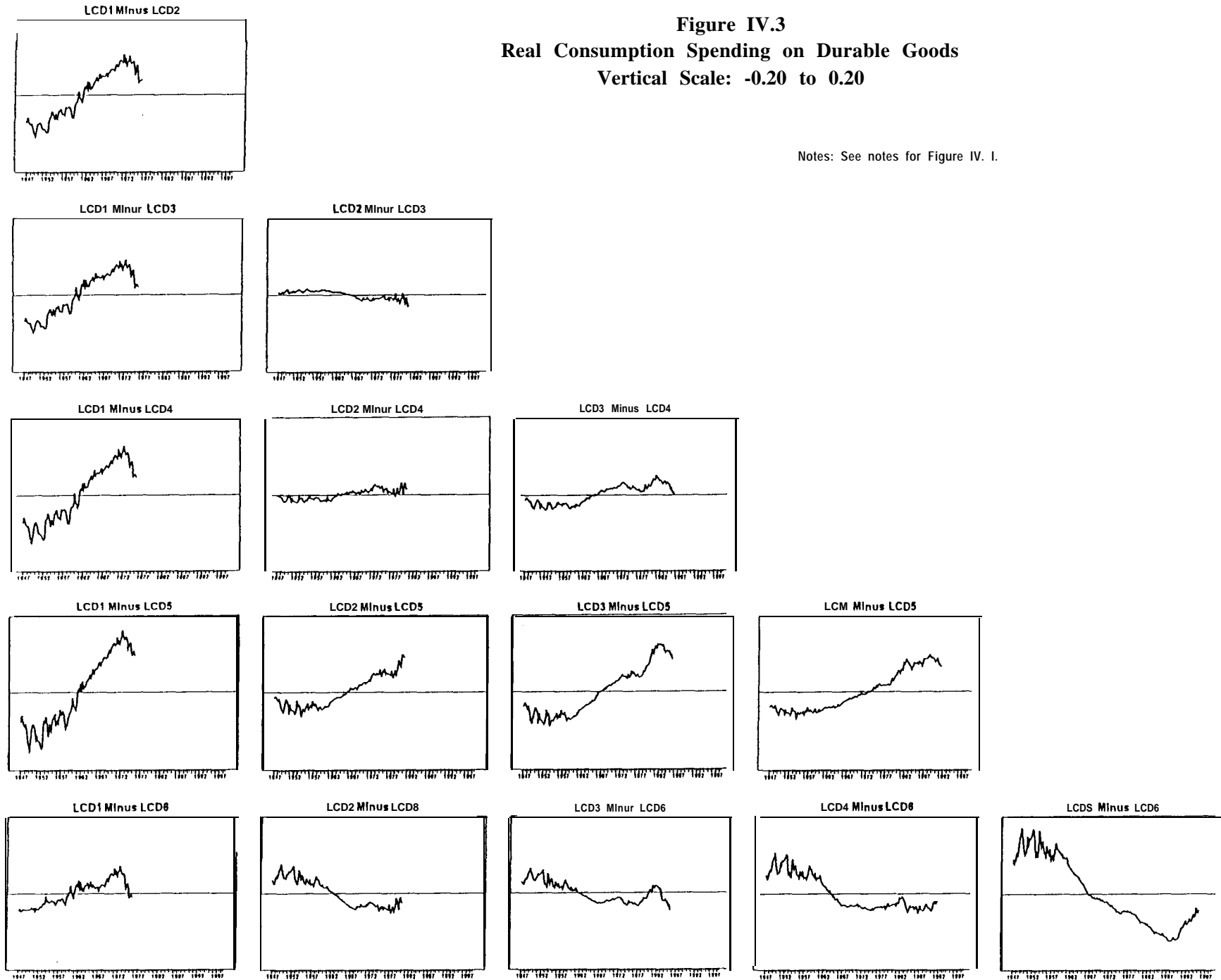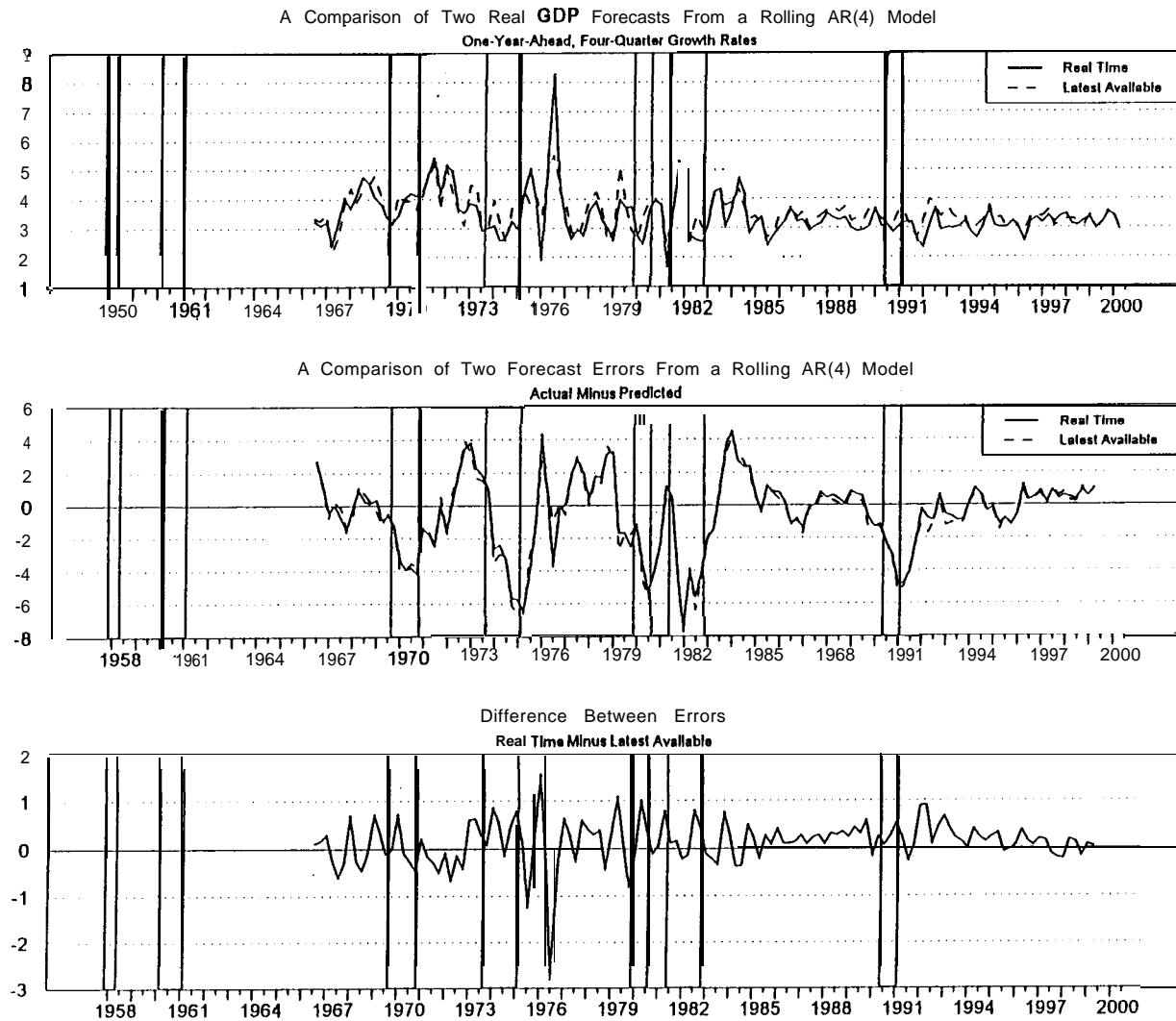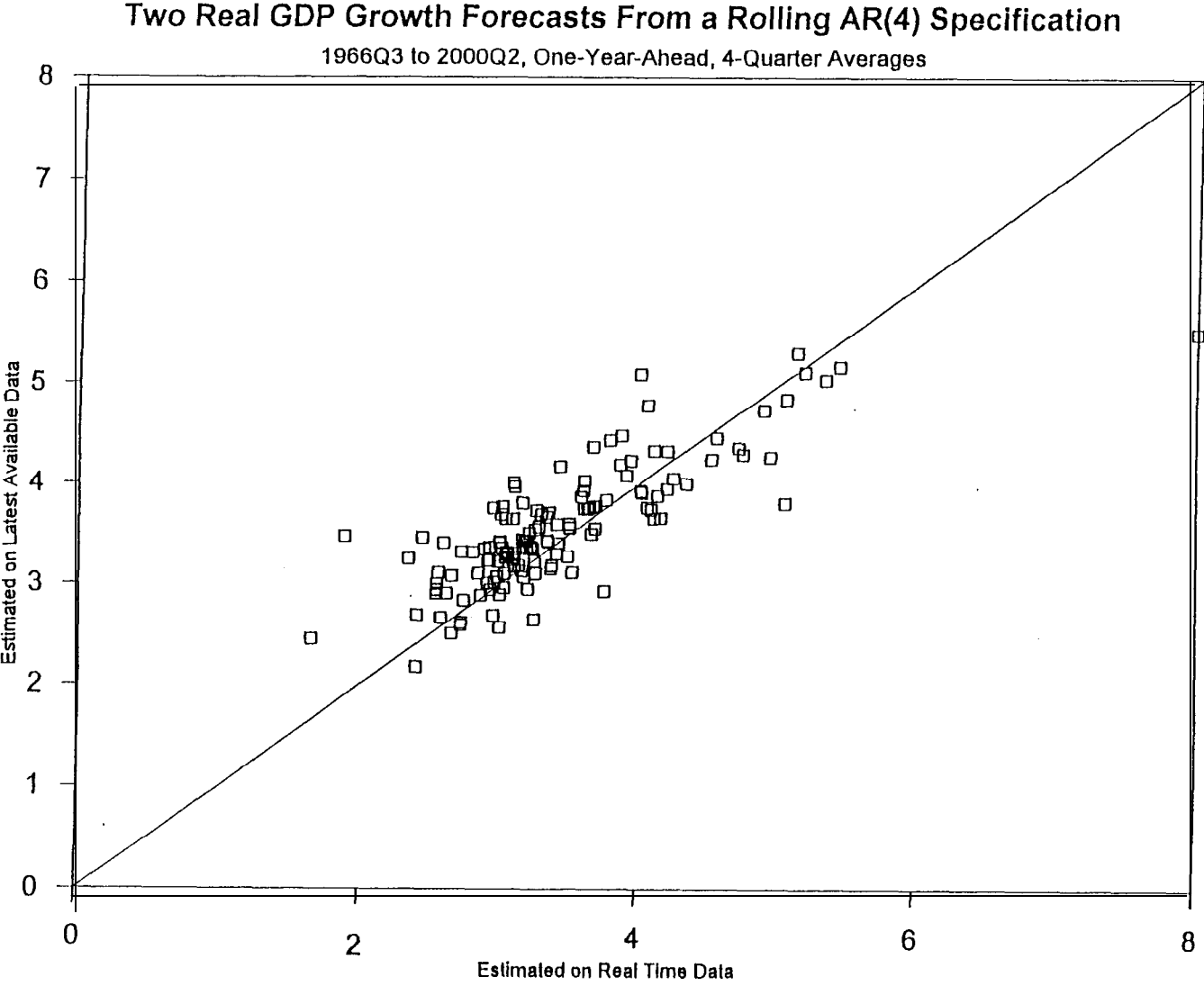X-axis: 1958, 1961, 1964, 1967, 1970, 1973, 1976, 1979, 1982, 1985, 1988, 1991, 1994, 1997, 2000

Notes: These 3 plots compare forecasts **made** using an AR(4) model in a rolling fashion, adding an additional quarterly data point each period to generate a forecast for the average annual growth rate of real output over the next year. The top plot shows the forecasted growth rates, one from generating forecasts using the real-time data set and the other from generating forecasts using lalest available data (vintage August 1999). The middle plot compares the forecast errors from the two different forecasts. The bottom plot shows the difference between the forecast errors, illustrating how much the use of real-time data matters. The lalest available vintage (August 1999) is used as "actual" in calculating forecast errors.

Figure V.2

Two Real GDP Growth Forecasts From a Rolling AR(4) Specification

1966Q3 to 2000Q2, One-Year-Ahead, 4-Quarter Averages

Notes: This scatter plot shows the forecasts from Figure V.1 along a 45-degree line so that the differences in forecasts based on the alternative data sets are readily apparent.

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