WORKING PAPER NO. 05-6
BENCHMARK REVISIONS AND THE U.S. PERSONAL SAVING RATE

Leonard Nakamura and Tom Stark
Federal Reserve Bank of Philadelphia

April 2005

FEDERAL RESERVE BANK OF PHILADELPHIA
Ten Independence Mall, Philadelphia, PA 19106-1574• (215) 574-6428• www.PhiladelphiaFed.org

Benchmark Revisions and the U.S. Personal Saving Rate

Leonard I. Nakamura and Tom Stark

Federal Reserve Bank of Philadelphia

 We thank Mike Dotsey for ideas and advice. We would like to thank John Chew and Will Olney for superb research assistance.

Benchmark Revisions and the U.S. Personal Saving Rate

Leonard I. Nakamura and Tom Stark

ABSTRACT

Initially published estimates of the personal saving rate from 1965 Q3 to 1999 Q2, which averaged 5.3 percent, have been revised up 2.8 percentage points to 8.1 percent, as we document. We show that much of the initial variations in personal saving rate across time was meaningless noise. Nominal disposable personal income has been revised upward an average of 8.4 percent: one dollar in twelve was originally missing! We use both conventional and real-time estimates of the personal saving rate to forecast real disposable income, gross domestic product, and personal consumption and show that the personal saving rate in real-time almost invariably makes forecasts worse. Thus while the personal saving rate may have some forecasting power once we know the true saving rate, as Campbell (1987) and Ireland(1995) have argued, as a practical matter it is useless to forecasters.

Correspondence to:

Leonard I. Nakamura, Research Department, Federal Reserve Bank of Philadelphia, 10 Independence Mall, Philadelphia, PA 19106, 215-574-3804 (office), 215-574-4364 (fax), leonard.nakamura@phil.frb.org (e-mail). Tom Stark, Research Department, Federal Reserve Bank of Philadelphia, 10 Independence Mall, Philadelphia, PA 19106, 215-574-6436 (office), 215-574-4364 (fax), tom.stark@phil.frb.org (e-mail).

Benchmark Revisions and the U.S. Personal Saving Rate

I. Introduction

Do we know what the current U.S. personal saving rate is, in practice? The personal saving rate is a small difference between two large aggregates – personal outlays and disposable personal income – that are initially measured largely independently and with considerable noise. Is the U.S. personal saving rate informative about future income or expenditure growth? If it is mean-reverting, for example, a low personal saving rate should imply that future income will rise faster than consumption. Moreover, if consumption obeys the permanent income hypothesis, then as Campbell (1987) has argued, a low personal saving rate implies that real labor income is expected to accelerate. However, the personal saving rate is difficult to measure. In this article, we argue that as a practical matter, noise in the U.S. personal saving rate makes it uninformative for forecasting purposes.

Economists have worried about how well personal saving is measured at least since Taubman (1968). Revisions to the U.S. personal saving rate have been large and positive in the past four decades. Initially published estimates of the personal saving rate from 1965 Q3 to 1999 Q2 have been revised upward from 5.3 percent to 8.1 percent, as we document. Most of these revisions are due to the benchmark revisions that follow economic censuses, with large revisions *decades* after the initial estimate. These result primarily from large upward revisions to both disposable personal income and personal outlays. Nominal disposable personal income has been revised as much as 14.8 percent and on average from 1965 Q3 to 1999 Q2, 8.4 percent.

Benchmark revisions substantially change the relative ranking of saving rates for individual quarters and five-year averages. For example, the early 1980s is now viewed as the period with the highest saving rates in the postwar period; yet at the time it appeared to have some of the lowest saving rates since the Korean War. As we shall show, the usefulness of the personal saving rate in predicting future movements in real income described by Ireland (1995) vanishes when real-time data is used.

We assume throughout (and believe) that the revised data bring us closer to the true state of affairs that economic agents confront. Thus, we do not argue that the tests of the permanent income hypothesis carried out by Campbell and Ireland are invalid; for evaluating the quantitative validity of a hypothesis about economic behavior, revised data are generally preferable. Rather, we argue that to test the practical value of an economic relationship for *forecasting* the n-step-ahead test based on real-time data should be preferred.

We briefly review our dataset and the process the U.S. Bureau of Economic Analysis (BEA) uses to revise national accounts data, and show that the major changes to the personal saving have occurred in benchmark revisions. We show how the personal saving rate and disposable income have changed over successive revisions, and discuss some of the sources of the revisions. Finally, we use both conventional and real-time estimates of the personal saving rate to forecast real disposable income, gross domestic product, and personal consumption. We show that adding the personal saving rate to univariate AR models in real-time almost invariably makes the forecasts worse.

II. Real-time data and revisions to the personal saving rate

The Federal Reserve Bank of Philadelphia maintains a real-time data set for macroeconomists that consists of vintage snapshots of data as they were reported in the middle of each quarter from 1965 Q3 to the present; it is documented in Croushore and Stark (2001) and on-line at http://www.phil.frb.org/econ/forecast/reaindex.html.

The personal saving rate is personal saving as a percentage of disposable (after-tax) personal income. Personal saving, in turn, is disposable personal income less personal outlays. Disposable personal income includes wages and salary income and benefits, proprietors' and rental income, dividend and interest income, and transfer payments such as social security benefits, less contributions to social insurance and taxes. As such, it represents the income of households, nonprofits, and noncorporate businesses. Some of these items are easily measured, such as social insurance benefits and contributions, but other benefits and transfers are subject to measurement and conceptual problems. Wages and proprietors' income are subject to underreporting in government records as a result of tax evasion. Benefits and transfers are subject to conceptual as well as measurement issues. And rental income and proprietors' income require measurement of deduction that are hard to define and measure well.

Capital gains on equity (other than from qualified equity stock options) and real estate are not included in personal income. Maki and Palumbo (2001) have shown that the decline in the saving rate in the 1990s can be largely attributed to a fall in the saving rate for the highest income quintile, whose wealth-to-income ratio rose at the same time, presumably as a result of capital gains. Thus personal income may be understated to the extent that the value of equity holdings appears as (uncounted) capital gains rather than

(counted) dividends, and to the extent that the rental return to property ownership omits the capital gains from rising house prices.[1]

Personal outlays are personal consumption expenditures (95 percent of personal outlays) plus transfers and nonmortgage interest payments.

The data revision process. The BEA revises the national income accounts as follows. Data on a given quarter's economic activity are first published in an *advance* estimate, late in the first month of the next quarter.[2] The data available at this time is recorded in the Philadelphia Fed's real-time data set as the vintage of that quarter. The *revised* estimate is published in the second month of a quarter followed a month later by a *final* estimate. These data are then generally left unchanged until the following summer, when the latest three years of national account data are revised.[3] A set of initial estimates thus undergoes three *summer* revisions. Thereafter, the estimates are only changed in what are called *benchmark* revisions, which now occur every four years. The average personal saving rate from 1965 Q3 to 1999 Q2 was 5.3 percent when first observed in the advance estimates (Figure 1); in the 2005Q1 vintage it averages 8.1 percent. Thus the personal saving rate over time has been revised systematically upward.

Where in the revision process did the upward revisions occur? In *benchmark* revisions. As Figure 2 shows, the pre-benchmark revisions – revisions that occur between the advance estimate and the last vintage before any benchmark revision -- have

[1] Rental income, including implied income from owner-occupied housing, in 2004 was $166 billion. This is a paltry 1.2 percent nominal return on net equity of housing (for households, nonprofits, and nonfarm, noncorporate businesses) of $13.7 trillion. Over the entire period from 1965 to 2004, according to latest vintage information, the average nominal return was 1.5 percent. By comparison, for the same period the return to the 12 month constant maturity Treasury 6.6 precent.

[2] Until 1985, the BEA also published a "flash" GDP estimate 15 days before the end of a quarter, but this estimate only included aggregate nominal and real GDP, without any underlying detail (although some detail was circulated internally within the government), and did not include the personal saving rate.

[3] One change in the routine has been that wages and salaries, since 2002 Q3, are revised again 3 months after the final estimate.

been relatively unbiased and small, with the mean rise 0.06 percentage point and a mean squared revision of 1.13 percentage points.[4] By contrast, the revisions from advance estimates to the latest vintage (the data published in 2005 Q1) have a mean of 2.44 percentage points and a mean squared revision of 9.75 percentage points. The benchmark revisions thus account for very nearly all of the bias and the bulk of the mean squared revision.

The revisions in the first three years after the data are first published are primarily from regular sources whose availability is delayed. Systematic biases related to these data can be estimated and eliminated, and BEA apparently has done so. Benchmark revisions, on the other hand, incorporate two basic types of changes: statistical changes, based on newly available data, and definitional changes. Statistical changes include data from censuses, such as the economic census or the population census, and other sources of data that become available with a long lag or irregularly, such as IRS random audit data. Definitional changes include changes in data recognition (such as reclassification of government pension contributions as personal income) and changes in concept (such as including software as investment or introducing chain-weighted prices).

These steady upward shifts have applied to all periods. Let us look at all our data points beginning in 1965 Q3, averaged into five-year periods (Table 1). We take vintages from the first complete vintage after a benchmark revision.[5] What we see is that of the 26 changes that these groups underwent in benchmark revisions, 16 were positive and greater than 0.5 percentage point.

[4] This figure and accompanying data omit the advance estimates that occur just before a benchmark revision, which has had no opportunity to change. We also excluded the last advance estimate, for 2004 Q4, for the same reason from both this and the next figure.
[5] Complete data back to 1947 is occasionally not available until two or three quarters after a benchmark revision.

Why are revisions biased upward? Income is harder to measure than expenditure. Upward revisions to disposable personal income income have been very large. Disposable personal income has been revised as much as 14.8 percent; on average, from 1965 Q3 to 1999 Q2, the revision has been 8.4 percent (Figure 4). Over the same period, nominal GDP and personal outlays were revised up by less, nominal GDP by 6.5 percent, and personal outlays by 5.1 percent.

Among the immediately available data, the more complete and reliable data are on the demand or product side; this is the source of gross domestic product. Income side data are aggregated to gross domestic income (GDI), conceptually the same as GDP, but in practice differing by between 2.3 percent and -1.8 percent; GDP minus GDI is called the statistical discrepancy. Generally speaking, the statistical discrepancy is positive – since 1965 Q3 it has averaged of 0.7 percent, with 129 of 158 observations positive – suggesting that typically income is undercounted. The fact that GDP and not GDI is used as the primary yardstick expresses the general sense that it is the more reliable of the two aggregates. As statistical agencies uncover additional income and product, these revisions have been larger on the income side.

Over time, changes in the economy make new types of income and expenditures – such as stock equity options and Internet sales – more important. This leads to efforts to measure these new activities, raising income and expenditures. While uncovering new expenditures will typically simultaneously reveal new income, sometimes income will be revealed without as much expenditure. On net, saving will rise, and rise more for recent observations than in the more distant past. Put another way, revisions may be somewhat endogenous. If a part of income has been excluded, and it becomes more important, then

the measured saving rate will appear to be out of kilter, and efforts will likely be made to measure the excluded income.

To flesh out the benchmark revision proces, we have examined in detail the 6 benchmark revisions to the 1979 personal saving rate. Over their course, the 1979 personal saving rate was revised from 4.5 percent to 8.9 percent, a $85 billion increase. Here we discuss the two largest revisions that raised the 1979 personal saving rate (a more detailed narrative of the benchmark revisions is provided in Appendix A).

In the 1985 revision, the BEA incorporated the findings of a series of random audits by the IRS (the Taxpayer Compliance Measurement Program) to attempt a full-scale assessment of undermeasurement resulting from the underground economy. This is an example of a statistical revision. Wages and salaries and proprietors' income were increased by $16 billion and $60 billion respectively, and consumption expenditures by $30 billion. The rise in measured consumption came about because some of the proprietors whose income was previously uncounted were retailers and service providers, so that as their income was counted, so was their output. The net effect was a $46 billion increase in personal saving, with disposable income increasing $76 billion. In this case, the uncovering of unmeasured activity revealed much more additional income than consumption expenditure.

In 1999, the BEA made a definitional change, reclassifying government employee retirement contributions as personal income. Retirement funds can be treated as income when they are received by the beneficiaries or when they are accrued. Private retirement funds are treated as income when they are accrued, while social security is treated as income when it is received. When the accounts were first set up, government retirement

funds were dominated by the federal government, which did not need to set aside funds for retirement programs. As time passed, state and local employment came to dominate government employment, and it then became appropriate to treat government retirement programs in parallel with private pension programs. As contributions were larger than benefits, the net result was to raise saving by $30 billion. In this case, the rise of state and local employment led to a reclassification of government expenditure.

The appendix also documents two definitional revisions that raised disposable personal income and personal outlays without affecting saving. One was the 1985 classification of payments to medical vendors as government transfers to households and personal consumption expenditures rather than, as previously, government expenditures. The other was the 1990 reclassification of payments to government educational and medical institutions as personal consumption expenditures rather than as nontax payments to government (which are treated like a tax and deducted from disposable income). The effect of these two changes was to raise both disposable personal income and personal outlays by $49 billion.

Thus far, we have focused on rising levels of the saving rate. Another question is whether the benchmark revisions have tended to wash away differences between advance estimates of the saving rate. Consider a regression whose left-hand side variable is a given vintage (V) personal saving rate (PSR_V) and whose right-hand side variables are the original advance estimates of the personal saving rate ($PSR_{advance}$) and a constant:

$$PSR_V = \alpha + \beta\, PSR_{advance}. \qquad (1)$$

If the revision process raised all the PSRs by the same percentage points, then the coefficient on the advance PSR, β, would be 1, and the revisions would show up as an

increase in the constant term, α. On the other hand, if the revision process implies that initial differences tend to diminish, as they did for 1975 and 1980, we would expect β to be less than 1, and for α to be larger than the average increase in the PSR. In particular, the coefficient β is covariance over variance, and tells us how much of the initial variance is due to true underlying difference as known at a given later vintage.

Mankiw, Runkle, and Shapiro (1984) have argued that equation 1 should have α = 0 and β = 1 if the preliminary estimate of an economic measure is an optimal forecast of the final estimate of that measure. In this view, a low value of β implies that an economic decisionmaker would be better off at the time of the initial announcement using additional information to make an optimal forecast of the final estimate, as otherwise the decisionmaker would attribute too much information to the preliminary estimate.

We show the results of estimating equation 1 for overlapping 19-year periods in Table 2 (we choose 19 years because we can get two complete non-overlapping groups into our 39-year sample), taking five-year intervals for our analysis. The most telling results are the first series of regressions. For the period from 1965 Q3 to 1984 Q2, β is for all periods significantly different from 1, using a Newey-West robust standard errors. By the 1984 Q3 vintage, one quarter of initial differences had disappeared. Over successive vintages, the initial differences diminished in importance until they were on average only one-third of their initial amounts. Throughout the personal saving rate fails the Mankiw et al test. Moreover, all periods fail the Mankiw et al test after the initial vintage.

The β coefficients in our regression equation fall over time as more revisions occur. Is this time effect of revisions statistically significant? Consider a regression that has the

latest vintage saving rates on the left-hand side but allows the constant and the coefficient on the advance estimate to change as the amount of time available to revise the data increases. We call this revision time "Rtime" = number of quarters between the advance estimate of that observation and the latest vintage.

We run the regression $PSR_{2005q1V} = a_0 + a_1\ Rtime + (b_0 + b_1\ Rtime)\ PSR_{advance}$.

$$PSR_{2005Q1V\,int\,age} = \underset{(.616)}{.168} + \underset{(.015)}{.076}Rtime + (\underset{(.208)}{.89368} - \underset{(.00202)}{.00731}Rtime)PSR_{AE}$$

The standard errors, in parentheses under the coefficients, are Newey-West HAC robust standard errors. The equation shows that the coefficient on the advance estimate falls by .029 annually, suggesting that over the roughly 20 years that the median observation has been revised, more than half of its initial cross-sectional variation has proved to be measurement error.

Will the future be like the past? Because the nature of the benchmark revision process is highly idiosyncratic, we cannot rely on this. Our conclusion from this regression analysis is that in the past, large differences between personal saving rates have proved to be mostly the consequence of measurement error. It is possible that a large part of the current difference between the high saving rates in the early 1980s and the current low saving rate will also prove to be the result of measurement error. What is clear is that these data are measured with considerable noise, and there is little reason to believe that our measures have become more stable than in the past.

Is the personal saving rate useful in forecasting in real time?

We now address the question of whether the personal saving rate is too noisy in practice to be useful in forecasting in real time. If saving rates are low, should we expect that future income will rise relative to consumption as saving rates mean-revert? John

Campbell(1987) has argued that a low saving rate should be a signal of expected future growth in labor income. In a bivariate vector autoregression of saving and real labor income growth, lags of the saving rate should have a negative sum, according to this theory, so that increases in the saving rate forecast declines in real labor income. Campbell's regressions, covering 1953 to 1985, confirmed that high savings rates did forecast slower real labor income growth. Campbell's empirical work was revisited by Peter Ireland (1995). The coefficients on saving had a negative sign as Campbell's hypothesis predicts, and the personal saving rate improved forecasts relative to the forecasts of a pure autoregression.

We wish to revisit these findings in real-time, to see whether, if forecasters had used the personal saving rate to forecast future income growth, their forecasts would have improved. To do this, we estimate our model and make our out-of-sample forecasts using real-time data. To compute forecast errors, we use two tests. First, we compute forecast errors based on real-time data, which is the test a business economist might wish to pass. Second, we compute forecast errors based latest available vintage data. If, as we suppose, the latest vintage data has the closer relationship to other economic variables (such as unemployment, inflation, or interest rates) then in forecasting these other economic variables a decisionmaker might prefer this latter test.

Our data is not the same as Ireland's: we have real-time data on real disposable income not real labor income. Labor income, a constructed variable that excludes dividend income, interest income, and the capital share of proprietor's income, is not a variable published as such by BEA. To check to see whether this substitution creates a large difference, we replicate Ireland's analysis using the same sample period, vintage,

and lag length, substituting disposable personal income for labor income, in Table 3. This is to show that the essential features of the estimation are not disturbed by the inclusion of some of the capital income measures that Campbell and Ireland have excluded.. As Ireland did, we use 6 lags. We find that at forecast horizons of 1, 2 and 4 quarters that forecast accuracy increases when we forecast real disposable income in the VAR but not as much as Ireland's forecasts of real labor income.[6] At an 8 quarter forecast horizon, we do not show forecast improvement. We take this as evidence that disposable personal income is a reasonable but noisier stand-in for labor income.

We now proceed to our main forecast comparisons for disposable income in Tables 4 and 5. We use our entire dataset. The underlying data used for the estimations go back to 1953 Q1, and our first forecast begins with 1970 Q1. The test used is the ratio of the root-mean-square error (RMSE) of the out-of-sample bivariate VAR forecast to the RMSE of the out-of-sample univariate AR forecast. This is performed forecasting one, two, four, and 8 quarters ahead, with tests taken separately at each horizon. In Table 4, we show the regression results using Ireland's choice of lag lengths, 6 lags. In Table 5, we use the Schwarz criterion, which has good asymptotic properties, to choose the lag length.

Table 4 shows that if we use Ireland's choice of lag lengths, with latest vintage data (LV), the Campbell hypothesis offers forecast improvement at one and four quarter ahead forecast intervals. Over the entire period, at a one-quarter horizon, the out-of-sample forecast for real disposable personal income that uses the latest vintage bivariate vector autoregression has a RMSE ratio of .976, suggesting some modest value for the saving rate in forecasting. If we use real-time data, however, this result disappears. Whether we

[6] Ireland gave ratios of MSE, so we have taken square roots.

use latest vintage data as our test of forecast accuracy (RTLV), or real-time data (RT, defined a first-published data), the saving rate worsens our forecasts.

We also divide up our sample at 1981 Q4, the period at which latest vintage data for the personal saving rate begin their long-term decline. If this long-term decline is an artifact of imperfections of our measure of personal saving, then this may be a useful breakpoint. We find at a one-quarter horizon there is some value to using the saving rate in the first part of the sample, 1970 to 1981, even using real-time data. However, from 1982 forward, while the conventional data suggest a (small) value to including the saving rate (ratio of RMSE of .97), this completely disappears for real-time data.

If we use the Schwarz criterion to choose lag length, even latest vintage data does not show the personal saving rate as offering a forecast advantage over the entire period. However, over the first 12 years, the Schwarz criterion regressions show similar results to the 6 lag length regressions. In all cases, real time data results in poor forecasting performance. Similar results (not shown) are found when we forecast real GNP/GDP.

Let us turn now to whether the data match the theory qualitatively in sample. Real-time data has negative sum-of-coefficients for the saving rate for most of the history, again suggesting that the permanent income hypothesis is correct (Figure 5). However, the sum has become progressively less negative, and has actually been near zero, and occasionally positive, since 1998. This suggests either that the empirical validity of this aspect of the permanent income hypothesis has weakened over this period, or that the data on saving have become sufficiently noisy that the hypothesis cannot be verified. For forecasting real GNP/GDP we find a similar decline in the negative sum-of-coefficients.

Consumption. If the personal saving rate is mean-reverting, then a low saving rate implies that either consumption must slow or income must rise. Empirically, whether the impact is on consumption or income could depend on the relative variability of temporary consumption and income. A concern that some policymakers have had is that consumption growth will slow as the low saving rate is corrected upward.[7] What we find is that there is no empirical evidence for this effect, either in conventional data or the real-time data. The four real consumption measures we test are real personal consumption expenditures, and the three major components of PCE (durables, nondurables, and services). The real measures (in annualized percent changes) are each forecasted with the personal saving rate using a bivariate vector autoregression using the SIC to choose lag length contrasted with the univariate forecast using the SIC.

We find, with all consumption variables, that adding the saving rate to the VARs worsens the forecast (Table 6). The real-time data sum-of-coefficients has been typically positive for aggregate real PCE and for durable goods PCE (Figure 6). This suggests that periods when consumers stock up on durable goods are followed by periods when durable goods consumption slows. This is consistent with the volatility of the durable goods series. However, even this effect vanishes beginning around 1998.

We have argued that measures of personal saving are subject to substantial measurement error. In the past, large variations in personal saving across time have typically been revised away. The contention that the low personal saving rate implies that in the future consumption must rise more slowly than income may be wrong:

[7] For example, the U.S. Federal Open Market Committee minutes for September 21, 2004 stated, "Members perceived several possible sources of downside risk to household spending. In particular, households might hold back on spending in an attempt to increase their saving, which had fallen to a very low level relative to income."

benchmark revisions might well result in the current low rate being revised upward substantially. Taken together, our results show that one should be careful about drawing inferences based upon the latest observations of the U.S. personal saving rate.

Appendix:

Revision narrative for 1979 disposable personal income and personal saving:

1979 disposable personal income was reported as $1624.3 billion (1980 Q4 vintage) before the first benchmark revision; most recently it was $1793.5 billion (2005 Q1). Benchmark revisions to disposable personal income increased it by $169.2 billion.

1979 personal saving was reported as $73.8 billion in the 1980 Q4 vintage; most recently as $159.1 billion in the 2005 Q1 vintage. Benchmark revisions to saving were $85.3 billion. The 1979 personal saving rate rose from 4.5 in the 1980 Q4 vintage to 8.9 percent in the 2005 Q1 vintage.

In the 1980 revision, 1979 disposable income was increased by $17 billion, outlays by $5, and saving by $12. The increase in disposable income was primarily due to increases in interest income ($16 billion), based on new statistical information from the IRS and the economic censuses, partially offset by an increase in interest payments ($4 billion) that raised outlays.

In the 1985 revision, 1979 disposable income was increased by $88 billion, outlays by $56 billion and saving by $32 billion. Three main factors affected the revision. First, the BEA incorporated the findings of a series of random audits by the IRS (the Taxpayer Compliance Measurement Program) to attempt a full-scale assessment of undermeasurement resulting from the underground economy. Wages and salaries and proprietors' income were increased by $16 billion and $60 billion respectively, and consumption expenditures by $30 billion. Second, expanded measures of costs incurred in providing rental housing and new measures of the rents themselves reduced rental income by $25 billion. Third, $24 billion in medicare payments which had been considered government expenditures were reclassified as transfer payments and as consumption expenditures. This reclassification was due to recognition that these expenditures were increasingly controlled by the medicare patients, in that the medicare patients were determining from whom they received the services. This reclassification raised disposable income and outlays without affecting saving.

In the 1991 revision, 1979 disposable income was increased by $24 billion, outlays by $18 billion, and saving by $5 billion. The largest change was due to a change in the treatment of payments to government educational and medical institutions, such as tuition payments at state universities. These had been treated as nontax payments (part of tax and nontax payments) to government, with the outlays of the institutions treated as government expenditures. They were redefined as consumption expenditures sold by government enterprises. This raised disposable income (since taxes fell) and personal consumption expenditures.

In the 1995 revision, 1979 disposable income was increased by $23 billion, outlays by $10 billion, and saving by $13 billion. Rental income was increased by $18 billion, essentially undoing the 1984 revision, as a result of a lowered rate of depreciation of rental property. Consumption expenditures were affected by many factors, but one important one was an increase in the proportion of restaurant meals that were considered personal rather than business.

In the 1999 revision, 1979 disposable income was increased by $33 billion, outlays by $3 billion, and saving by $30 billion. The major change was a revision in the treatment of government retirement programs, which had been treated like social security and were now to be treated like private pension programs. Social security payments by employees and employers are considered to be like an indirect business tax, and excluded from personal income. Social security benefits are considered to be transfer payments, like welfare and medicare payments, and are included in personal income. Private pension benefits, on the other hand, are considered part of personal income, as if they were deposited in the employees' bank or brokerage accounts. No income is recorded when the benefits are paid out; benefit payments are treated like withdrawals from bank or brokerage accounts. When the federal government accounted for the bulk of government retirement programs, it was appropriate to treat these like social security, in the sense that the federal government did not have to set aside monies to fund the programs. But when state and local government employment came to surpass federal employment it was deemed reasonable to consider them like private pensions. The net effect of the change was to raise personal income by $30 billion, as contributions were substantially larger than benefits. Another factor raising personal income is that the interest payments and dividends to government retirement trust funds were added to interest and dividend income.

In the 2004 revision, disposable income fell by $15 billion, personal outlays fell by $8 billion, and saving fell by $7 billion. Employer contributions to social insurance were included in compensation, but also included in the subtracted portion, contributions to social insurance, thus having no net impact on personal income. The major revision was a reduction in interest income of $16 billion; this was due to a definitional change in the calculation of banking services which was offset by a reduction in PCE of banking services.

Implications of extrapolation of revision estimates. Consider, for example, nonfarm proprietors' income. BEA's fundamental source for this is IRS tax data, which it supplements with input-output tables. Unfortunately, there is a very large discrepancy between what is reported to the IRS and the BEA's best guess of such income. Adding together 2002 IRS adjusted gross income (AGI) for proprietors, estate and trusts, and partnerships, BEA arrives at $310 billion (Survey of Current Business, 2004, p.). When BEA adjusts its concept of proprietors' income to the IRS definition, it finds $705 billion. What BEA finds is an "AGI gap" of $395 billion. Of this, $309 billion is due to BEA's estimate of tax misreporting, primarily based on evidence from the 1970s, with the rest being unexplained. acts of extrapolation.

Appendix Table 1. Four Major Benchmark Revisions to 1979 personal saving and disposable income			
	Revision to		
Year	Saving	Disposable income	Major revisions
1985	$58	$88	$88 Misreporting of taxable income $28 Wages and salaries: generally corrections due to underreporting of wages and salaries as discovered in the taxpayer compliance measurement program of the IRS from 1973 to 1979. (1980 and 1984 revisions) $60 Proprietors income, TCMP $30 PCE TCMP
1985	0	$24	$24 medical vendor payments: medicare reclassified as income (transfer payments) and PCE as more choice permitted to consumers (1984 revision)
1991	0	$25	$25 tax reduced: payments to public educational and medical institutions had been considered nontax payments, and became considered PCE. So DPI was revised up along with PCE (1990 revision)
1999	30	$30	2. $30 (net) government retirement programs considered as income and not transfers as state and local expenditures come to outweigh federal (1999 revision)

Appendix Table 2. Benchmark revisions to 1979 U.S. personal income, by category, various years
in billions of dollars

Sources of and disposition of personal income	Benchmark revision date						total
	1980	1985	1991	1995	1999	2003	
personal income	19.6	90.2	-0.9	22.7	25.7	-19.3	138
wages and salary	8.5	16	3.3	0.5	-0.1	0.2	28.4
other labor income	-4.1	4.1	1.6	0	38.3	-0.2	39.7
employer contributions to SI*	0	0	0	0	0	82.6	82.6
proprietors' income	0.8	60.3	-10.1	3.2	-1.3	-3.6	49.3
rental income	3.6	-24.9	2.8	18.5	-2.6	-0.5	-3.1
interest income	17.5	11.9	1.7	0.4	9.9	-16.2	25.2
dividend income	-4.1	-0.5	2.3	0.1	6.9	0	4.7
transfers received by households	-2.6	23.7	-2.4	0	-36.5	1.1	-16.7
less contributions to SI	-0.1	0.4	0	0	-10.8	82.5	72
less taxes	2.1	2.7	-24.5	0	-6.9	-4.6	-31.2
disposable personal income	17.4	87.6	23.7	22.7	32.5	-14.7	169.2
personal outlays	5	55.8	18.3	9.9	2.9	-8	83.9
personal consumption expend	1.1	55.9	16.9	9.8	2.8	-4.1	82.4
interest paid	4.1	-0.2	1	0	0	-8.3	-3.4
transfers to government	0	0	0	0	0	4.3	4.3
transfers to ROW**	-0.1	0	0.4	0	0.2	0	0.5
personal saving	12.4	31.9	5.2	12.9	29.6	-6.7	85.3

*SI= Social Insurance **ROW= rest of world

Appendix table 3. 1979 Annual Personal Saving: Major sources of revision from 1980 to 2005				
	1980	2005	Revisions	Major Sources of Revision
1.Wage & Salary Disbursements	1227.6	1256.0	28.4	statistical (IRS audits, input-output tables)
2. Employer contributions to social insurance		82.6	82.6	offset by (9)
3. Other Labor Income	122.7	162.4	39.7	definitional: govt retirement payments
4. Proprietors Income	130.8	180.1	49.3	statistical
5. Rental Income	26.9	23.8	-3.1	
6. Interest Income	192.1	217.3	25.2	statistical
7. Dividends	52.7	57.4	4.7	
8. Transfer payments to persons	252	235.3	-16.7	
9. less Contributions for social insurance	80.7	152.7	72	definitional: offsets (2)
10. Personal Income	1924.4	2062.2	138.1	
11. less Tax & nontax payments	299.9	268.7	-31.2	definitional: redefine payments for public education and medicine (offset by 14)
12. Disposable Personal Income	1624.3	1793.5	169.2	
13. Personal Outlays	1550.5	1634.4	83.9	
14. Personal Consumption Expenditures	1509.3	1592.2	82.4	definitional: redefine payments for public education and medicine (offset by 11) stat: household expenditure at restaurants, etc.
15. Interest paid	39.6	36.2	-3.4	
16. Transfer payments to government		4.3	4.3	
17. Transfer payments to rest of the world	1.1	1.6	0.5	
18. Personal Saving	73.8	159.1	85.3	

REFERENCES

Bureau of Economic Analysis, U.S. Department of Commerce, *Survey of Current Business*, various issues, 1965 to 2005.

Campbell, John Y. "Does Saving Anticipate Declining Labor Income? An Alternative Test of the Personal Income Hypothesis," *Econometrica* 55, November 1987, 1249-73.

Croushore, Dean and Tom Stark, "A Real-Time Data Set for Macroeconomists: Does the Data Vintage Matter" *Review of Economics and Statistics* 85, August 2003, 605-617.

Croushore, Dean and Tom Stark, "A Real-Time Data Set for Macroeconomists" *Journal of Econometrics* 105, November 2001, 111-130.

Hall, Robert E., "Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence," *Journal of Political Economy* 86, December 1978, 971-987.

Ireland, Peter N., "Using the Permanent Income Hypothesis for Forecasting," *Federal Reserve Bank of Richmond Economic Quarterly* 81, Winter 1995, 49-63.

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

Taubman, Paul, "Personal Saving: A Time Series Analysis of Three Measures of the Same Conceptual Series," *Review of Economics and Statistics* 50, February 1968, 125-129.

Table 1. Personal Saving Rate, 5 Year Averages, After Benchmark Revisions (percent)

Five-year periods	Advance Estimate	Vintage						
		76Q1	81Q1	86Q1	93Q1	97Q2	00Q2	04Q1
65 Q3 to 70 Q2	6.30	6.57	7.21*	7.15	7.20	7.83*	8.55*	8.58
70 Q3 to 75 Q2	7.32	7.53	8.08*	8.71*	8.40	8.94*	10.09*	10.10
75 Q3 to 80 Q2	5.59		5.98	7.20*	7.10	7.68*	9.27*	9.14
80 Q3 to 85 Q2	5.49			6.52	7.98*	8.48*	10.25*	10.37
85 Q3 to 90 Q2	4.33				4.76	5.67*	7.80*	7.45
90 Q3 to 95 Q2	4.34					5.14	7.41*	6.32
95 Q3 to 00 Q2	2.69							3.53

*More than 0.5 percentage points larger than in the previous benchmark revision.

Source: BEA, Federal Reserve Bank of Philadelphia Real-Time Data Set for Macroeconomists

Table 2. Regression coefficients for:
Vintage Saving Rate = Constant + β * Advance Estimate Saving Rate
(Standard errors in parentheses are Newey-West HAC standard errors, lag truncation=3)

		Vintage				
		1984 Q3	1989Q3	1994Q3	1999Q3	2004Q3
1965 Q3 to 1984 Q2	constant in percent	2.48* (0.52)	3.51* (0.67)	5.10* (0.68)	5.60* (0.75)	7.45* (0.75)
	AE coeff	0.723** (0.077)	0.637** (.100)	0.414** (0.098)	0.418** (0.108)	0.331** (0.109)
1970 Q3 to 1989 Q2	constant in percent		0.99 (0.87)	3.21* (0.83)	3.74* (0.78)	6.17* (0.66)
	AE coeff		1.005 (0.130)	0.704** (0.121)	0.701** (0.116)	0.564** (0.102)
1975 Q3 to 1994 Q2	constant in percent			1.88 (0.88)	2.30* (0.92)	4.12* (1.05)
	AE coeff			0.87 (0.163)	0.89 (0.169)	0.881 (0.203)
1980 Q3 to 1999 Q2	constant in percent				-0.11 (0.49)	2.97* (0.71)
	AE coeff				1.217 (0.131)	0.960 (0.184)
1985 Q3 to 2004 Q2	constant in percent					2.30* (0.57)
	AE coeff					0.764*** (0.143)

*greater than 0, p value < .01
**less than 1, p value < .01
***less than 1, p value = .052

Table 3. Comparing Ireland's forecasts of real labor income with our forecasts of real disposable income
Forecasting real disposable income using the saving rate with latest vintage and real-time data, using 6 lags
Data from 1959 Q1 to 1994 Q3
Forecast period: 1970 Q1 to 1994 Q3
Forecast variable real, quarterly percent changes at annual rates (log difference x 400)

Forecast period	Forecast horizon			
Forecast period: 1970 Q1 to 1994 Q3	1 Quarter Ahead	2 Quarters Ahead	4 Quarters Ahead	8 Quarters Ahead
Forecast variable: Real labor income (Ireland, 1995)				
LV	.97	.93	.87	.94
Forecast variable: Real disposable income				
LV	.974	.982	.956	1.065
RTLV	1.047	1.072	1.094	1.158
RT	1.050	1.068	1.078	1.113

Each entry is the ratio of out-of-sample RMSE of the VAR model (with lags of the personal saving rate) to the RMSE of the univariate AR model, 6 lags.

LV indicates that the latest vintage of data (2005Q1) was used to estimate and forecast the model and to compute the forecast errors. RTLV indicates that real-time data were used to estimate and forecast the model, but the latest vintage of data was used to compute forecast errors. RT indicates that real-time data were used to estimate and forecast the model and to evaluate forecast errors.

Table 4. Forecasting real disposable income using the saving rate with latest vintage and real-time data, using 6 lags (Ireland) Data from 1953Q1 to 2004Q4 Forecast period: 1970 Q1 to 2004 Q4 Forecast variable real, quarterly percent changes at annual rates (log difference x 400)				
Forecast variable	Forecast horizon			
Disposable Income	1 Quarter Ahead	2 Quarters Ahead	4 Quarters Ahead	8 Quarters Ahead
Forecast period: 1970 Q1 to 2004 Q4				
LV	.976	1.001	.965	1.043
RTLV	.996	1.056	1.109	1.167
RT	1.016	1.077	1.094	1.091
Forecast period: 1970 Q1 to 1981 Q4				
LV	.979	.990	.933	1.005
RTLV	.982	1.047	1.132	1.202
RT	1.008	1.061	1.080	1.099
Forecast period: 1982 Q1 to 2004 Q4				
LV	.972	1.015	.999	1.076
RTLV	1.014	1.070	1.079	1.130
RT	1.026	1.104	1.119	1.081

Each entry is the ratio of out-of-sample RMSE of the VAR model (with lags of the personal saving rate) to the RMSE of the univariate AR model, 6 lags.

Table 5. Forecasting real disposable income using the saving rate with latest vintage and real-time data., using SIC to choose lag length Data from 1953Q1 to 2004Q4 Forecast period: 1970 Q1 to 2004 Q4 Forecast variable real, quarterly percent changes at annual rates (log difference x 400)				
Forecast variable	Forecast horizon			
Disposable Income	1 Quarter Ahead	2 Quarters Ahead	4 Quarters Ahead	8 Quarters Ahead
Forecast period: 1970 Q1 to 2004 Q4				
LV	1.011	1.068	1.126	1.304
RTLV	1.045	1.165	1.292	1.474
RT	1.061	1.181	1.290	1.407
Forecast period: 1970 Q1 to 1981 Q4				
LV	.957	.964	.938	1.042
RTLV	1.012	1.095	1.204	1.278
RT	1.011	1.095	1.167	1.203
Forecast period: 1982 Q1 to 2004 Q4				
LV	1.068	1.187	1.290	1.510
RTLV	1.084	1.256	1.383	1.654
RT	1.123	1.302	1.458	1.638

Each entry is the ratio of out-of-sample RMSE of the VAR model (with lags of the personal saving rate) to the RMSE of the univariate AR model, lag length chosen by SIC, generally equal to 1.

Table 6 Forecasting real output and consumption using the saving rate with latest vintage and real-time data., using SIC to choose lag length
Data from 1953Q1 to 2004Q4
Forecast period: 1970 Q1 to 2004 Q4
Forecast variable real, quarterly percent changes at annual rates (log difference x 400)

Forecast variable	Forecast horizon			
	1 Quarter Ahead	2 Quarters Ahead	4 Quarters Ahead	8 Quarters Ahead
GNP/GDP				
LV	1.021	1.033	1.063	1.097
RTLV	1.032	1.066	1.110	1.166
RT	1.058	1.083	1.114	1.156
PCE				
LV	1.037	1.065	1.078	1.061
RTLV	1.033	1.039	1.043	1.059
RT	1.028	1.042	1.037	1.043
PCE:Durables				
LV	1.030	1.046	1.066	1.042
RTLV	1.006	1.011	1.013	1.019
RT	1.007	1.008	1.004	1.012
PCE:Nondurables				
LV	1.023	1.036	1.048	1.054
RTLV	1.029	1.046	1.078	1.105
RT	1.024	1.047	1.084	1.101
PCE:Services				
LV	1.004	1.005	1.005	0.995
RTLV	1.043	1.063	1.079	1.089
RT	1.038	1.045	1.083	1.071

Each entry is the ratios of out-of-sample RMSE of the VAR model (with lags of the personal saving rate) to the RMSE of univariate AR model, lag length chosen by SIC, generally equal to 1.

Figure 1. Measured Personal Saving Rates

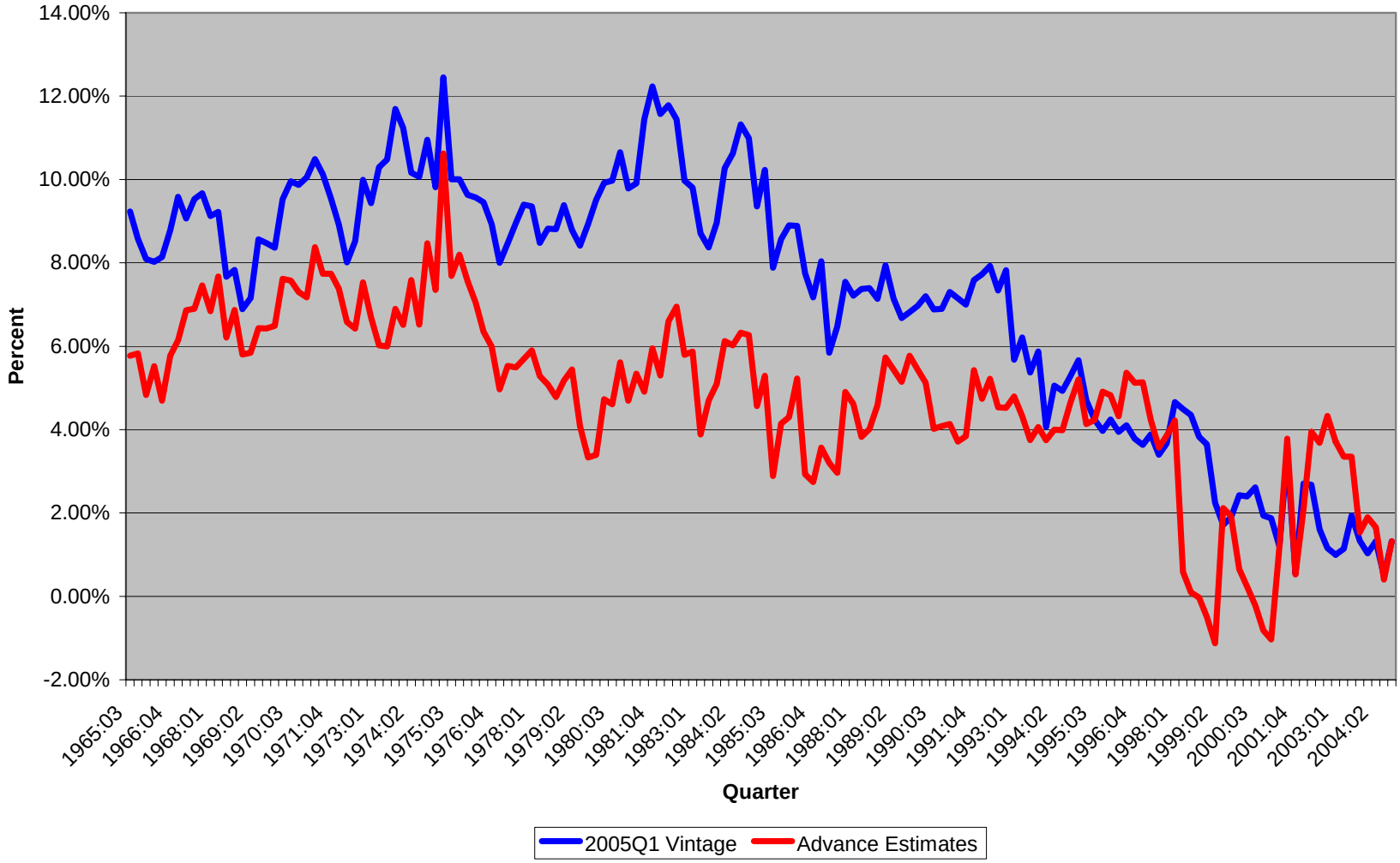


Figure 2
Histogram of Revisions to the Personal Saving Rate
Last-Before-Benchmark Minus Advance Estimates

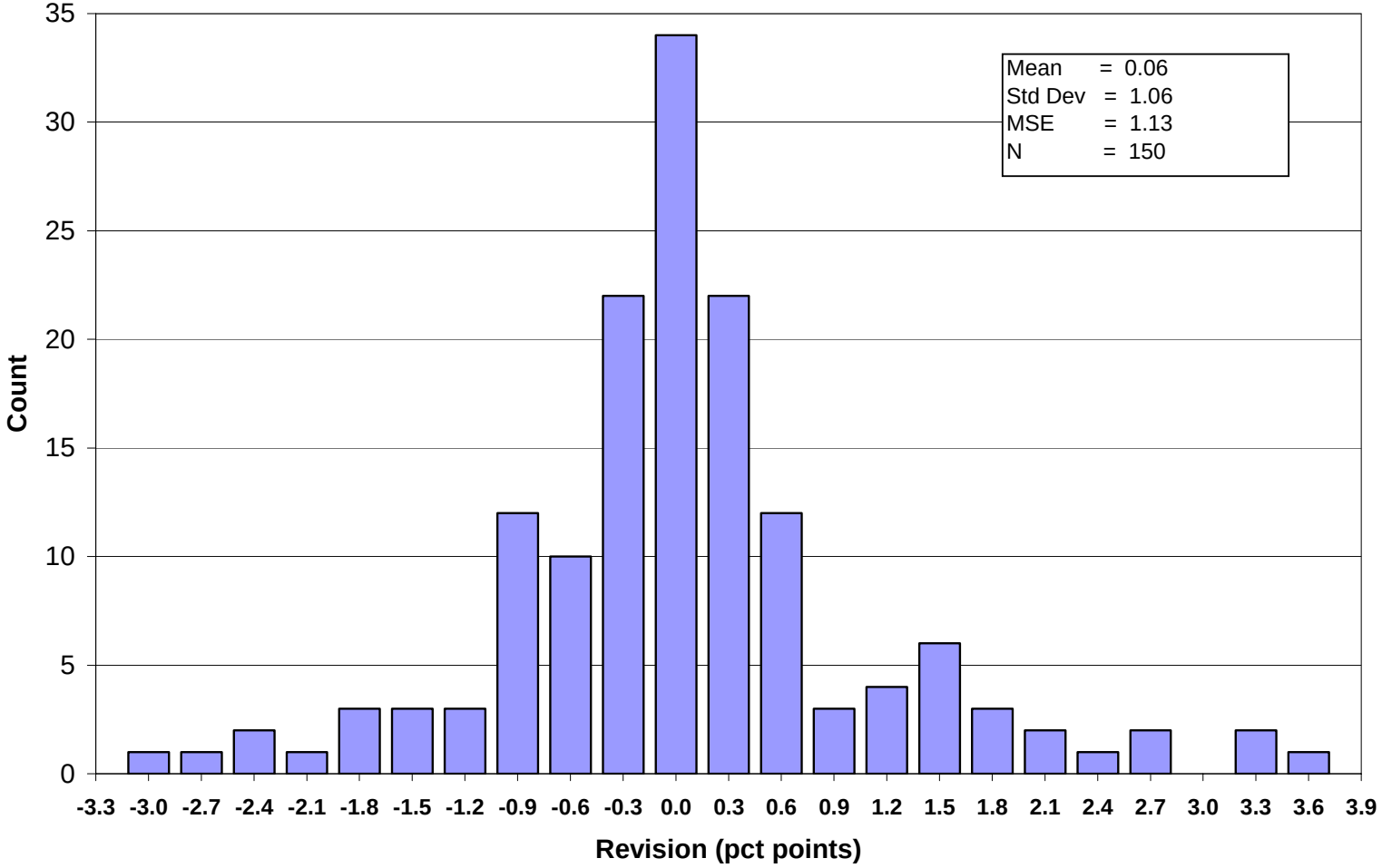


Figure 3
Histogram of Revisions to the Personal Saving Rate
Latest-Available Minus Advance Estimates

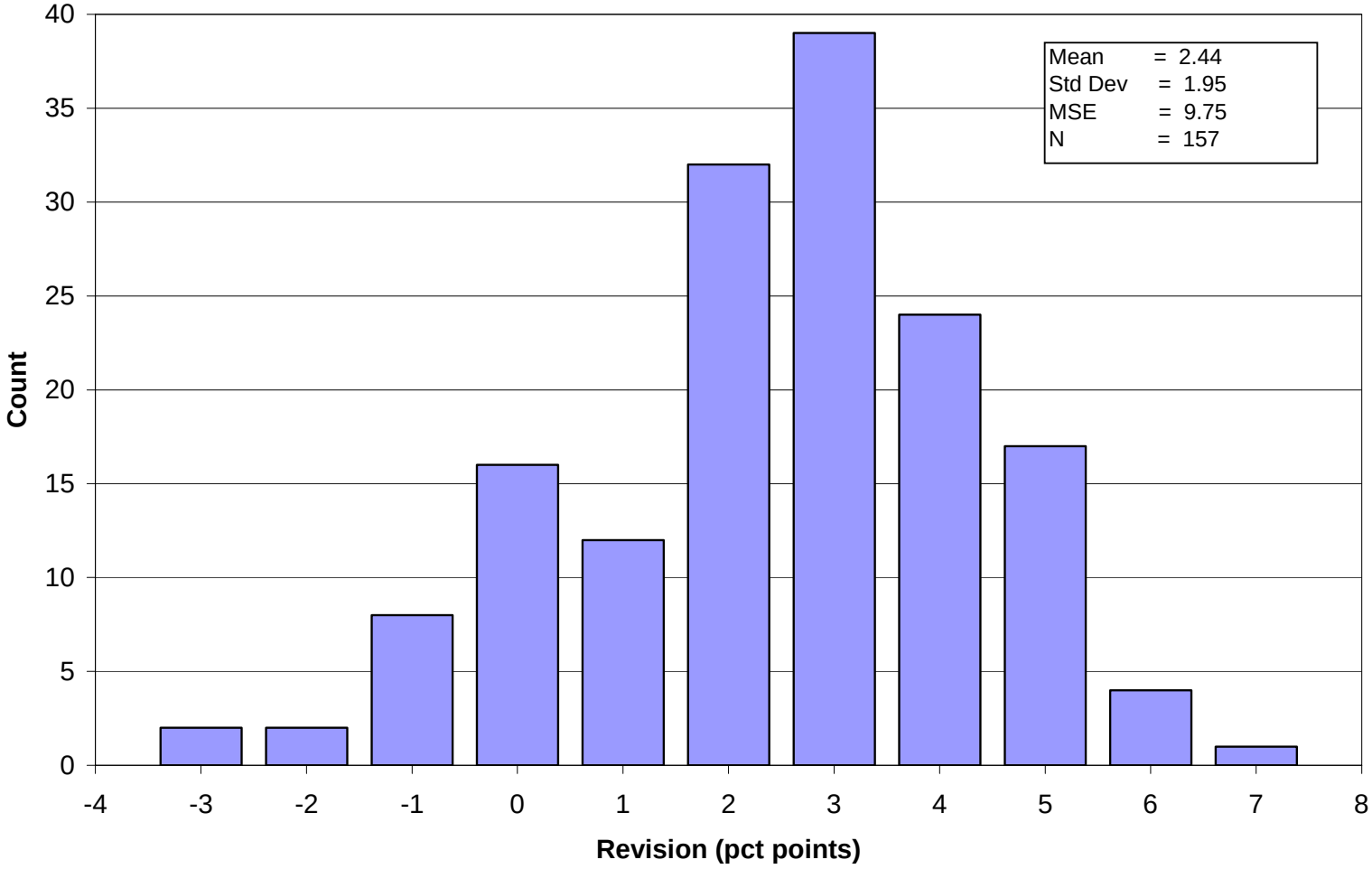


Figure 4
Revisions to Nominal Income and Output

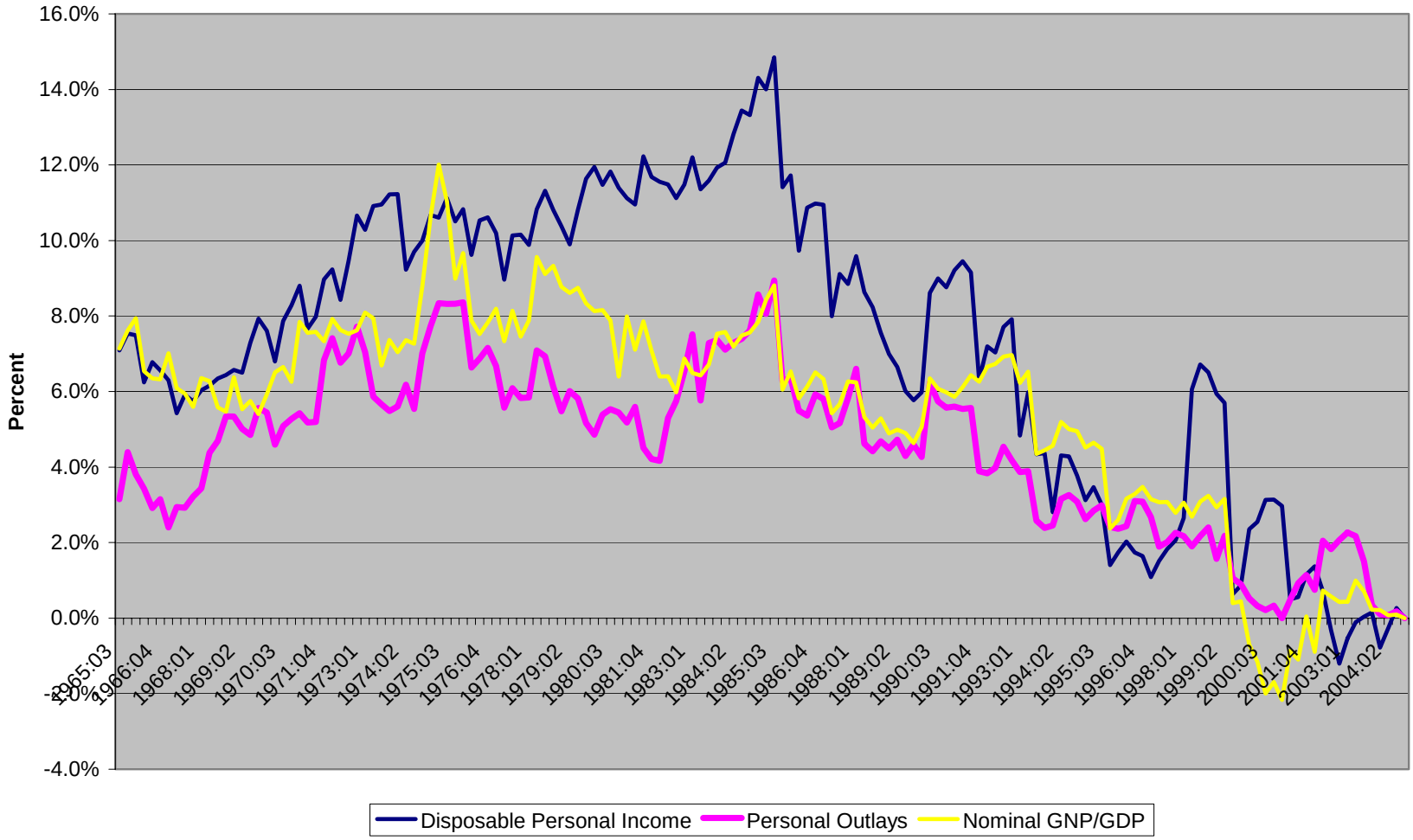
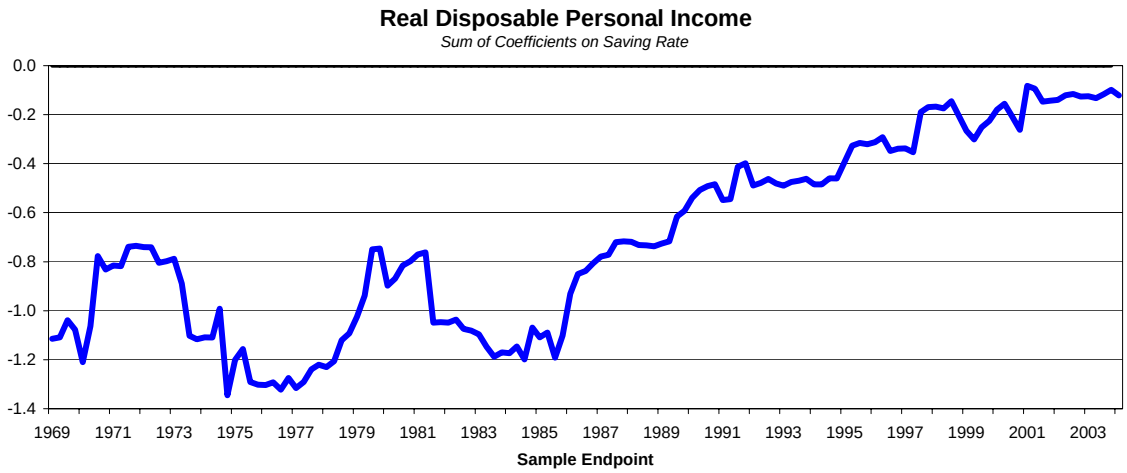
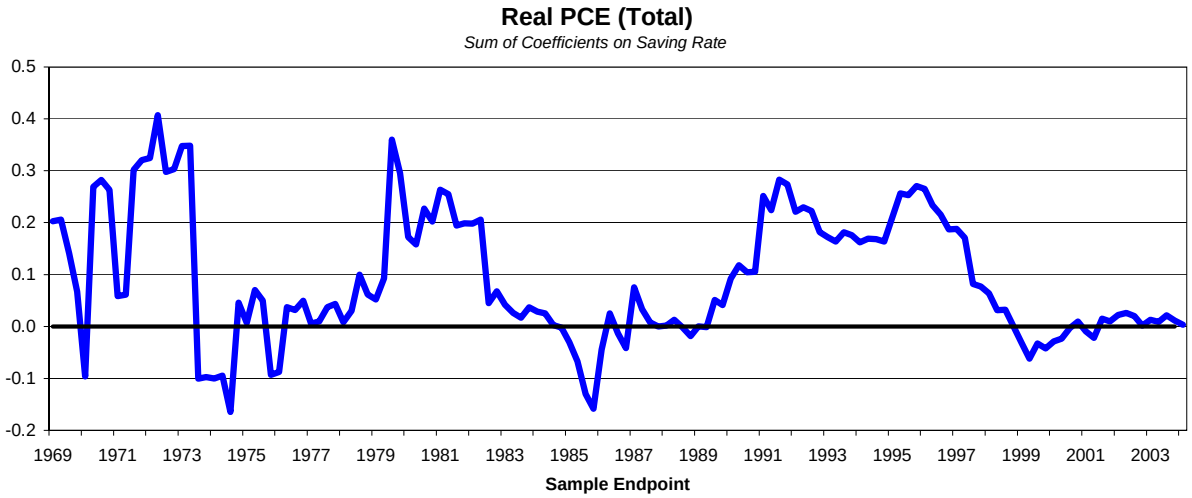


Figure 5



For Figures 5 and 6, VAR based on real-time data, lag length chosen by the SIC.

Figure 6


Real PCE (Total)
Sum of Coefficients on Saving Rate
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003
Sample Endpoint

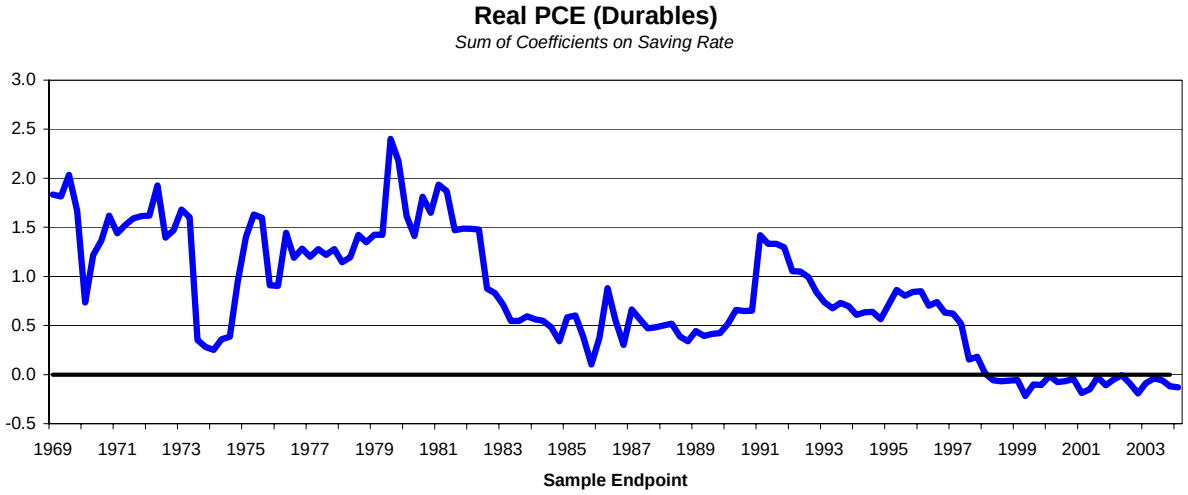

Real PCE (Durables)
Sum of Coefficients on Saving Rate
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003
Sample Endpoint

Figure 6 (continued)