IMPLICATIONS OF ROUNDING AND REBASING FOR EMPIRICAL ANALYSES USING CONSUMER PRICE INFLATION

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Abstract

Monthly CPI inflation rates can be spuriously choppy when constructed using the official CPI, rebased with 1982-84=100. The problem can be traced to rounding that occurs when only one digit after the decimal place is reported in rebased CPI data. This paper compares three CPI measures to illustrate how rounding and rebasing introduce distortions that affect variance properties, alter lag specification in autoregressive models, and "flip" results of unit root tests. To reduce distortions, the paper recommends using either original release data or the CPI rebased with 1967=100.

Keywords: Inflation uncertainty, inflation variance

JEL: E3, C8.

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1 Motivation

The question of whether economic relationships may depend on the current inflation regime has been reignited with the recent coupling of strong real growth and low inflation. In particular, researcher interest in asking whether economic behavior differs in low-inflation environments as compared to high-inflation environments has increased. Because current inflation rates have fallen to levels not seen since the 1960s, data from the 1960s and earlier may throw light onto economic relationships in low inflation environments. Consequently, having accurate inflation data prior to 1970 is important.

Standard practice followed by researchers may not lead to the choice of the most accurate data. Usually, analysts who want to examine inflation construct inflation measures using the level of a Consumer Price Index (CPI). However, monthly CPI inflation rates can be spuriously choppy when constructed using the official CPI, rebased with 1982-84=100. And under positive inflation, the spurious choppiness and related problems become more severe each time the Index is rebased to a more recent year. The problem can be traced to rounding and/or truncation of significant digits that occurs when only one digit after the decimal place is reported. The problem exists because the general level of the CPI increases considerably over time. Thus, for small index levels, significance is lost when only one digit after the decimal is reported.[1]

This practice of rounding can have serious implications for empirical studies. For instance, using data since 1955, augmented Dickey-Fuller tests reject the null hypothesis that inflation contains a unit root when inflation is constructed using the offical CPI, but do not reject the unit-root null

[1]The Bureau of Labor Statistics (BLS) recently cited this problem when explaining their recent change of decision to not rebase the Consumer Price Index to 1993-1995=100. As reported in the December 1997, *CPI Detailed Report*: "The Bureau of Labor Statistics (BLS) previously indicated that it would change the reference base for both the Consumer Price Index for All Urban Consumers (CPI-U) and the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W) from the present 1982-84=100 base to a 1993-1995=100 base, effective with the release of the January 199 index in February 1999. BLS also planned to discontinue the alternative, or 1967=100 base, in 1999, as well. ... BLS has decided not to implement this rebasing plan and will maintain the reference base of 1982-84=100 used for most items. In addition, the 1967=100 reference base will continue to be the alternate base for the All Items indexes. This decision is based, in part, on the fact that historical data have less precision after rebasing. Rebasing is simply an arithmetic transformation that does not substantively impact the index. Because the rebased index values are smaller, however, the loss of precision due to rounding is more serious in historical data. In addition, retaining the old index reference bases will spare users the inconvenience associated with conversion."

for measures of CPI inflation that are less distorted by rounding. King and Watson (1994) noted that rounding can imply exaggerated standard deviations early in the sample relative to late in the sample. In fact, this paper shows that results of empirical investigations into the relationship between the level and variance of inflation may be affected by rounding distortions.

The next section of the paper discusses the data and explains how rounding and rebasing the level of the CPI can lead to spurious chopiness in Consumer Price Inflation. Section 3 compares properties of price inflation calculated using each of three CPI measures: two CPI series published by the Bureau of Labor Statistics (BLS) —the official CPI with 1982-84=100 and an alternate base-year CPI with 1967=100—and a series based on original-release data that may provide additional precision for early-dated observations. Section 5 concludes that distortions can be reduced through use of either original release data or the CPI rebased with 1967=100 rather than the official CPI rebased with 1982-84=100.

2 The Data

One observation in the CPI is, for all intents and purposes, a meaningless number. Unlike an unemployment rate or an interest rate, it has no intrinsic value. It is merely an index number and only has value in its relationship to other observations in the index.

In order to maintain the index at a level relatively close to 100, the BLS occasionally rebases the index. Intuitively, rebasing implies setting a chosen observation, or combination of observations (often referred to as the *base* observation) to a given number (typically 100) and rescaling the entire series in terms of the new base observation. For example, consider the problem of rebasing designed to set the value of an index to 100 in month t. If the current value of the index for month t is 256, then by dividing all observations by 2.56, the month t observation becomes 100. This does not change the relationship between the observations, it merely rescales the index to a different level and expresses the index relative to a different base month. Thus, changing the base month in and of itself presents no methodological problems.

The data examined in this paper are different versions of the same raw data.[2] One series, the CPI rebased with 1982-84=100 (henceforth CPI82), is currently the official version of the CPI. This

[2] Rounding of rebased data generally distorts movements of upward trending indexes. Although this paper is focussing on non-seasonally adjusted CPI data, the same issues are relevant for seasonally adjusted data and other indexes, such as the popular "core" CPI.

is the non-seasonally adjusted version of the CPI that most researchers currently use. A second series, the CPI rebased with 1967=100 (henceforth CPI67), is the alternative base series made available by BLS. Because this series is a constant multiple of the first series, the rate of change in the two series is the same over moderate horizons. The top two panels of Figure 1 show the natural logarithms of these two series. The two log series are parallel, reflecting that the rates of change of the series are the same over multiple periods. The levels of the series differ by the log of the rebasing multiplier.

Original-release data can be used to construct a third series, CPI0. The series of originally published data contains the original CPI reported by the BLS. For this paper, observations of original-release CPI were taken from back-issues of the *Survey of Current Business*. The bottom panel of Figure 1 shows the natural logarithms of original-release data. The series of original-release data has a number of breaks, each corresponding roughly to a time when the BLS introduced a newly rebased index. From 1971 through 1986, the original data and CPI67 have the same base month, so the observations are equivalent. From 1987 through the present, the original data and CPI82 have the same base month, so the observations are equivalent. The original-release data is not usually reported as a single series by the BLS because the BLS follows a standard practice of rebasing all prior observations each time a rebasing occurs whereas the plotted series shows the data as originally reported. With the introduction of a new base year, the BLS reports all subsequent observations using a different base year than the base year relevant for earlier observations. Between rebasings, the three series are parallel—again, reflecting that the rates of change of the series are the same over multiple periods.

Problems associated with rebasing can be traced to the BLS practice of reporting only one digit after the decimal place. As noted above, changing the base month in and of itself presents no methodological problems. However, because historical observations become smaller after rebasing, the practice of only reporting one digit after the decimal place implies a loss of precision in the index. A simple example illustrates how rounding after rebasing implies a loss of precision and distorts inflation measures. Table 1 applies a monthly inflation rate of 0.2 percent (slightly over 2.4 percent at an annual rate) to two indexes: one index has a value of 20.0 in month t and the second index equals 100.0 in the same month. The second and fifth columns, respectively, record subsequent monthly observations under a rounding policy that only records one digit after the decimal. The third and sixth columns report month-over-previous-month inflation rates expressed at an annual rate and calculated as $1200 \times log(CPI_t/CPI_{t-1})$. And, the fourth and seventh columns report inflation over the previous 12 months, calculated as $100 \times log(CPI_t/CPI_{t-12})$.[3] The problem is obvious. When rounding to the same number of digits for both indicies, an index with a smaller value will imply different month to month percentage changes than an index with a larger value. While neither index in the table records the "true" level of the index, the timing of price movements is particularly distorted for the lower index, which only records changes in the index every few observations. This lumping of price movements in the lower index is manifested in choppiness in the monthly inflation rate, and a larger variance of inflation.

Because the BLS rounds to one digit of significance after rebasing, early observations of the CPI have been implicitly rounded to a different degree of precision than the originally published data. As a result, the smaller the rebased index number, the greater the potential distortion in inflation rates. To be consistent, as early observations become smaller with rebasing, the BLS should have considered adding an additional digit of significance to these rebased index numbers. Because the BLS did not control for precision during rebasing, inflation rates calculated using rebased and rounded indexes will be less accurate for lower index values, i.e., for earlier observations.

The implications for inflation are visually easy to see. Rounding distorts the timing of inflation. Figure 2 plots the monthly rates of inflation of the CPI calculated using CPI82, CPI67, and CPI0, respectively, π_{82}, π_{67}, and π_0.[4] The more recent the last rebasing, the more choppy is inflation. For instance, in the 1950s and 1960s, π_{82} bounced between only four different general inflation rates–roughly -4 percent, 0 percent, 4 percent, and 8 percent. As explained in the above example, this chopiness, or volatility, occurs because rounded rebased data tends to either overstate or understate prive movements on a month-to-month basis. If one were not aware of the rounding, the logical interpretation of the 1982-84=100 rebased data is that monthly inflation rates in the 1950s and 1960s were particularly volatile and moved in large steps from month to month.

[3]The rounding problem would exist even if month-over-previous-month inflation was calculated as $100 \times ((CPI_t/CPI_{t-1})^{12} - 1)$ and if inflation over the previous 12 months was calculated as $100 \times ((CPI_t/CPI_{t-12}) - 1)$.

[4]As in the example, inflation rates are calculated according to $\pi_{i,t} = 1200 \times (log(CPIi_t/CPIi_{t-1})$ where i indexes the CPI measures, taking on values of 82, 67, and 0. At breaks in the CPI0 measure, inflation rates are calculated using CPI67.

3 Implications of Rounding for Empirical Analysis

This section examines the implications of rounding inherent in rebasing of the CPI for empirical analyses using inflation. Analysis is confined to samples starting in 1955 or later for several reasons. First, most empirical macroeconomic studies use only post-WWII (or post Korean War) data. Considering that we simply wish to highlight differences in the data, we thought it better to focus on data that is most commonly used for empirical research; years where the inflation process has been extensively examined. Second, because inflation data immediately following WWII is subject to violent gyrations, this period is excluded to preclude having observations from these few years driving the results. Third, the inflation rate in the 1990s is closer to that of the 1950s and 1960s than the 1970s or 1980s. Thus, in order to gain insight into the inflation process in the 1990s, there is renewed interest in studying other periods of low inflation, namely the mid 1950s through the late 1960s. Furthermore, these years turn out to be the years when the implications of rounding are more severe, *because* inflation was low during these years.

The first subsection examines differences between the three inflation series. The second subsection illustrates how rounding error distortions affect the time series properties of inflation. The third subsection investigates some of the implications of rounding and rebasing for variance properties of inflation.

3.1 Differences between the three Inflation Series

Differences between the three inflation measures are nontrivial. Figure 3 gives a rough idea of the magnitude of the discrepancy between inflation calculated using rebased data, and inflation calculated using original-release data. This plot shows the differences between inflation rates based on the two rebased series and inflation based on the original-release data, i.e., $\pi_{67} - \pi_0$ and $\pi_{82} - \pi_0$. Three features are apparent. First, the difference between π_{67} and π_0 is exactly zero over years when both π_{67} and π_0 are calculated using 1967 base-year CPI values and the difference between π_{82} and π_0 is zero when both π_{82} and π_0 are calculated using 1982-84 base-year CPI values. Second, the differences are larger at the beginning of the sample than at the end of the sample, with the differences between π_{82} and π_0 larger than the differences between π_{67} and π_0 early in the sample. Third, while differences between π_{67} and π_0 in the first half of the sample reflect less precision in CPI67 than in CPI0, differences over the last decade actually reflect less precision in CPI0 (which is identical to CPI82 over this period) than in CPI67.

One approach to statistically measuring the difference between the three series is to examine pairwise correlations between the series. If the series are identical they will be perfectly correlated, and the pairwise correlation will equal one. Correlation coefficients less than one provide evidence of differences between the series.

Table 2 shows the pairwise correlations between the series for several samples. Several results are apparent. First, the pairwise correlation between π_0 and π_{67} are very close to one, and, with the exception of the 1985-94 sample, are closer to one than either the correlations between π_0 and π_{82} or the correlations between π_{67} and π_{82}.[5] Second, the correlation between π_{82} and π_0 and the correlation between π_{82} and π_{67} both equal 0.85 over 1955-64. While such a correlation coefficient usually signals considerable similarities between different economic variables, it is surprisingly low given that π_{82}, π_{67} and π_0 are supposed to be different versions of the *same* raw data. These results suggest that differences between the three inflation measures may be empirically nontrivial. The remainder of the section will investigate how rebasing and rounding can affect empirical analyses by comparing properties π_{67}, π_{82}, and π_0.

3.2 Time Series Properties

A large fraction of empirical macroeconomic analyses use atheoretic time series techniques. These models began attracting attention in the 1970s when Box-Jenkins forecasting equations were shown to out-perform econometric forecasting models (Kennedy (1998)). The Box and Jenkins (1970) technique suggested modeling the behavior of a variable using past behavior of that variable, i.e. using an ARIMA(p,d,q) model. The popularity of ARIMA models, and in particular, vector autoregressions, became increasingly popular with Sims' (1980) critique that traditional large-scale macroeconomic models contain incredible identification assumptions. Soon thereafter, increased attention was given to the order of differencing necessary to render a series stationary when Nelson and Plosser (1982) were unable to reject the presence of a unit root in a collection of common macroeconomic data series.

Consideration of the implications of rounding error is important for time series models with

[5] Since the 1985-94 exception is a period for which CPI0 and CPI82 are identical, inflation rates constructed using these series are perfectly correlated over this sample. Nevertheless, the correlation of 0.99 between π_0 and π_{67} is also very high over this sample.

inflation because rounding error distorts the time series properties of inflation. Rebasing may shift the timing of price movements and alter autocorrelations and related properties of inflation. Consequently, model selection criteria may recommend different lag lengths for autoregressive models depending on whether or not inflation rates are calculated using rebased index data. Additional dissimilarities may be evident in estimated autocorrelations, lags identified by significant autocorrelations, and unit root test results.

Table 3 provides the lag choice recommended by Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC) for inflation rates based on π_0, π_{67}, and π_{82}. In general, AIC lag recommendations for π_{82} differ considerably from AIC lag recommendations for π_0 and π_{67}. SIC lag recommendations also differ somewhat across alternative inflation specifications, although, for samples which exclude the 1965-74 interval, SIC lag recommendations do not depend on the measure of CPI inflation. This result is consistent with smaller rounding error distortions for more recent observations.

Rebasing affects more than just the choice of maximum lag. Table 4 shows that estimated autocorrelations and partial autocorrelations are also affected. The top half of the table presents estimates for an early 15-year sample and the bottom half of the table presents estimates for the last 15 years of the the data. For the early sample, autocorrelations for π_{82} are significantly different than those of π_0 or π_{67}. In particular, while the first order autocorrelation of π_{82} is relatively small and insignificantly different from zero, first order autocorrelations of π_0 and π_{67} are relatively large, positive, and significant. The low first order autocorrelation for π_{82} is likely due to excessive choppiness in this series caused by rounding error. Because CPI82 is the lowest and least precise of the three indices, as suggested in the discussion of Table 1, rounding error in CPI82 is more likely to result in choppiness in the monthly inflation rate π_{82} than in π_0 or π_{67}. In an otherwise positively autocorrelated series, such choppiness should reduce estimates of the first-order autocorrelation coefficient.

For the early sample, autocorrelations differ at more than just the first lag. Autocorrelations are positive and significant only at lags 2, 4, 6, 8, 9, and 12 for π_{82}. By contrast, autocorrelations are significant at lags 1 through 5, 8, 9, and 12 for both π_0 and π_{67}, although lags 6 and 15 are also significant for π_{67}. Over the later sample, when rounding error is less likely to be a problem, estimated autocorrelations are similar across the three inflation measures. Partial autocorrelations show similar properties with point estimates and significance of estimates less sensitive to the inflation measure in the later sample than in the early sample.

Results of unit root tests may depend on the measure of inflation used. For 1955-98, results of unit root tests differ according to whether inflation is measured using π_0, π_{67}, or π_{82}. Augmented Dickey-Fuller t-type tests were calculated using the same dependent variable observations and with the number of lagged differences in the Dickey-Fuller regressions chosen according to the AIC recommendation in Table 3.[6] For π_{82}, the calculated ADF t-statistic of -3.11 suggested rejecting the null hypothesis of a unit root, based on a 5 percent critical value of -2.89. By contrast, ADF t-statistics equal to -2.69 and -2.88 for π_0 and π_{67} respectively suggest not rejecting the null hypothesis of a unit root.

3.3 Variance Properties

An important macroeconomic question is whether higher inflation leads to more variable inflation. This question is regarded as important because, as argued by Friedman (1977), increased uncertainty leads to a less efficient allocation of resources and more variable inflation has been associated with increased uncertainty about future inflation. Investigations of the relationship between the level and variance of inflation are numerous and techniques used vary. Examples include Okun (1971), Gordon (1971), Taylor (1981), Holland (1984), Katsimbris (1985), Froyen and Waud (1987), Ball and Cecchetti (1990), Evans (1991), Brunner and Hess (1993), Kim (1993), Evans and Wachtel (1993), and Davis and Kanago (1998).

Consideration of the implications of rounding errors is important for studies involving the variance of inflation because rounding error distorts the variance of inflation. As illustrated by the example in section 2, the variance of the inflation rate of rebased and rounded data may be considerably higher than the variance of the inflation rate of the original data. Rebased index data lose the timing of many price movements, missing some price movements and overstating others. As a result, inflation rates calculated using rebased data tend to have a higher variance than inflation rates calculated using original data.

[6] Note that if AIC recommends p lags in an autoregressive model of inflation, then the appropriate number of lagged differences is $p-1$.

Moving average estimates of the variance at time t are constructed according to

$$Var_t(\pi_i) = \frac{1}{12}\sum_{j=0}^{11}(\pi_{i,t-j} - \bar{\pi}_{i,t})^2 \tag{1}$$

where

$$\bar{\pi}_{i,t} = \frac{1}{12}\sum_{j=0}^{11}\pi_{i,t-j}. \tag{2}$$

The top panel of Figure 4 shows the moving average estimates of the variance of π_{67}; The bottom panel shows the ratio of the variance of π_{82} to the variance of π_{67} and the ratio of the variance of π_0 to the variance of π_{67}. The ratio of the variance of π_0 to the variance of π_{67} is close to one, reflecting that the variances of π_{67} and π_0 track one-another relatively closely. However, the ratio of the variance of π_{82} to the variance of π_{67} suggests that the variance of π_{82} is about double that of π_{67} or π_0 from the late 1950s through the early 1970s. Consequently, whereas the variances of π_{67} and π_0 during the 1990s are in approximately the same range as they were during the 1950s and 1960s, the same is not true of the variance of π_{82}.

If, as suggested earlier, the variance of inflation in the 1960s was overstated by CPI82, then empirical investigations of the links between the level of and variance of inflation based on CPI82 may have understated the relationship. Rounding of early observations of CPI82 made inflation seem more volatile in the earlier low inflation periods of the 1950s and 1960s relative to the high inflation periods of the 1970s and early 1980s.

Table 5 shows the correlation between inflation and the variance of inflation for each of π_0, π_{67}, and π_{82} over several samples. Correlations between inflation and the variance of inflation differ across the three measures of inflation. And, over the full sample, as hypothesized, the correlation between inflation and the variance of inflation is lowest when inflation is calculated using CPI82.

An alternative approach to investigating the relationship between the level and variance of inflation is to define the variance of inflation as the variance of the residuals from an autoregressive (or other) model of inflation. Table 6 provides the results from a test of whether the variance of inflation residuals is a function of the level of inflation. Each cell in the table contains the significance level for a Breusch and Pagan (1979) test, modified as suggested by Koenker (1981). For a given sample, residuals for all three inflation measures are from an AR(p) model of inflation with p chosen as the maximum of the three AIC lag choices for that sample as reported in Table 3. This approach guarantees that differences in test significance across inflation measures is not due to differences in AR order. Results in the table are for a test that $\sigma_t^2 = h(\alpha \bar{\pi}_{t-1})$ where σ_t^2 is the variance of time t inflation residuals, $\bar{\pi}_{t-1} \equiv (1/12) \sum_{k=1}^{12} \pi_{t-k}$ is the inflation rate over the previous 12 months, and $h(.)$ is an unspecified function. A 12-month inflation measure was chosen to measure the level of inflation so that the rounding distortions would primarily affect inflation residuals and not the level of inflation. Under the null hypothesis, $\alpha = 0$, and the variance of inflation residuals is not a function of the level of inflation. For two samples, results differ across inflation measures. In particular, for 1955-1964 and 1955-1975, although there is insufficient evidence to reject the null hypothesis for π_0 and π_{67}, there is sufficient information to reject the null hypothesis at a 10 percent level of significance for π_{82}.

4 Conclusions

Rounding of data series can introduce serious distortions. A prominent example is the official Consumer Price Index, rebased with 1982-84=100. Because the general level of the CPI has increased considerably over time, rebasing of the CPI combined with rounding/truncation of observations to only one digit after the decimal place has reduced precision of early observations. The paper shows that rounding error in the official CPI introduces serious distortions into monthly CPI inflation rates in the 1950s and 1960s. The distortions are sufficiently large to flip the results of unit root tests and significance of first order autocorrelations. Distortions also implied understated correlations between the level and variance of inflation and reversed results of statistical tests to assess whether the variance of inflation residuals was a function of the level of inflation. Empirical results based on the alternative CPI with 1967=100 were similar to those based on original release data, suggesting that rounding error distortions were relatively small for the alternative CPI.

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Table 1: Effect of Index Rounding on Inflation Rates

Month	Index 1			Index 2		
t	Level	Inflation $t-1$ to t % AR	Inflation $t-12$ to t % AR	Level	Inflation $t-1$ to t % AR	Inflation $t-12$ to t % AR
1	20.0			100.0		
2	20.0	0.0		100.2	2.4	
3	20.1	6.0		100.4	2.4	
4	20.1	0.0		100.6	2.4	
5	20.2	6.0		100.8	2.4	
6	20.2	0.0		101.0	2.4	
7	20.2	0.0		101.2	2.4	
8	20.3	5.9		101.4	2.4	
9	20.3	0.0		101.6	2.4	
10	20.4	5.9		101.8	2.4	
11	20.4	0.0		102.0	2.4	
12	20.4	0.0		102.2	2.4	
13	20.5	5.9	2.5	102.4	2.3	2.4
14	20.5	0.0	2.5	102.6	2.3	2.4
15	20.6	5.8	2.5	102.8	2.3	2.4
16	20.6	0.0	2.5	103.0	2.3	2.4
17	20.6	0.0	2.0	103.2	2.3	2.4
18	20.7	5.8	2.4	103.5	3.5	2.4
19	20.7	0.0	2.4	103.7	2.3	2.4
20	20.8	5.8	2.4	103.9	2.3	2.4
21	20.8	0.0	2.4	104.1	2.3	2.4
22	20.9	5.8	2.4	104.3	2.3	2.4
23	20.9	0.0	2.4	104.5	2.3	2.4
24	20.9	0.0	2.4	104.7	2.3	2.4
Mean		2.3	2.4		2.4	2.4
Variance		5.01	0.02		0.06	0.00

Table 2

Correlation between Inflation Measures

Sample	Correlation between π_0 and π_{67}	π_0 and π_{82}	π_{67} and π_{82}
1955:1-1964:12	.96	.85	.85
1965:1-1974:12	.99	.94	.95
1975:1-1984:12	1.00	.99	.99
1985:1-1994:12	.99	1.00	.99
1955:1-1974:12	.99	.93	.93
1975:1-1994:12	1.00	.99	.99
1955:1-1998:12	.99	.97	.97

Table 3

Lag Choice Recommended by Akaike and Schwarz Criteria

	Akaike Information Criteria		
Sample	π_0	π_{67}	π_{82}
1955:1-1964:12	2	2	2
1965:1-1974:12	6	6	7
1975:1-1984:12	18	18	23
1985:1-1994:12	7	7	7
1955:1-1974:12	19	19	14
1975:1-1994:12	9	9	11
1955:1-1998:12	24	23	22
	Schwarz Information Criteria		
Sample	π_0	π_{67}	π_{82}
1955:1-1964:12	1	1	1
1965:1-1974:12	6	6	2
1975:1-1984:12	1	1	1
1985:1-1994:12	1	1	1
1955:1-1974:12	6	6	4
1975:1-1994:12	1	1	1
1955:1-1998:12	8	9	9

Table 4: Autocorrelations and Partial Autocorrelations

Lag (Months)	Autocorrelations π_0	π_{67}	π_{82}	Partial Autocorrelations π_0	π_{67}	π_{82}
1955:1 - 1969:12						
1	**0.36**	**0.28**	0.06	**0.36**	**0.28**	0.06
2	**0.33**	**0.32**	**0.32**	**0.22**	**0.26**	**0.32**
3	**0.21**	**0.18**	0.12	0.05	0.05	0.09
4	**0.30**	**0.25**	**0.20**	**0.18**	0.13	0.11
5	**0.23**	**0.21**	0.07	0.06	0.09	-0.00
6	0.19	**0.20**	**0.17**	0.00	0.05	0.08
7	0.18	0.15	0.05	0.05	0.02	-0.00
8	**0.28**	**0.24**	**0.24**	**0.16**	0.14	**0.16**
9	**0.27**	**0.28**	**0.24**	0.10	**0.16**	**0.23**
10	0.21	0.18	0.13	-0.00	-0.03	0.00
11	0.17	0.15	0.07	-0.01	-0.02	-0.10
12	**0.29**	**0.25**	**0.24**	**0.17**	**0.16**	0.14
13	0.11	0.11	0.12	-0.15	-0.08	0.08
14	0.05	0.02	-0.02	-0.13	**-0.19**	**-0.20**
15	0.17	**0.22**	0.18	**0.18**	**0.23**	0.10
16	0.14	0.07	0.05	-0.03	-0.06	0.06
17	0.14	0.14	0.09	-0.05	-0.08	-0.09
18	0.06	0.05	0.07	-0.02	-0.01	-0.04
1984:1 - 1998:12						
1	**0.40**	**0.41**	**0.39**	**0.40**	**0.41**	**0.39**
2	0.10	0.10	0.09	-0.08	-0.08	-0.07
3	0.00	-0.01	0.00	-0.01	-0.02	-0.01
4	0.03	0.03	0.02	0.05	0.06	0.04
5	0.15	0.15	0.15	0.14	0.14	**0.16**
6	0.10	0.12	0.10	-0.03	0.00	-0.02
7	**0.28**	**0.28**	**0.29**	**0.30**	**0.28**	**0.31**
8	**0.20**	**0.20**	**0.20**	-0.02	-0.01	-0.02
9	0.05	0.05	0.05	-0.05	-0.05	-0.04
10	0.01	0.00	0.00	0.02	0.01	-0.00
11	0.04	0.04	0.03	0.05	0.06	0.06
12	**0.25**	**0.26**	**0.25**	**0.19**	**0.20**	**0.18**
13	0.04	0.03	0.04	**-0.21**	**-0.25**	**-0.21**
14	-0.03	-0.03	-0.03	-0.04	-0.01	-0.04
15	0.01	0.01	0.02	0.02	0.02	0.03
16	0.11	0.10	0.11	0.13	0.12	0.14
17	0.17	0.18	0.16	0.03	0.07	0.01
18	0.08	0.09	0.08	0.02	-0.00	0.04

Boldface entries are significantly different from zero at 5 percent.

Table 5

Correlation between Level and Variance of Inflation

Sample	π_0	π_{67}	π_{82}
1955:1-1964:12	.25	.27	.16
1965:1-1974:12	.65	.64	.51
1975:1-1984:12	-.23	-.23	-.19
1985:1-1994:12	.07	.10	.08
1955:1-1974:12	.51	.49	.35
1975:1-1994:12	.04	.05	.10
1955:1-1998:12	.31	.30	.25

Table 6

A test of whether the Variance of AR Inflation residuals

is a function of the Level of Inflation

Sample	π_0	π_{67}	π_{82}
1955:1-1964:12	.195	.232	**.078**
1965:1-1974:12	.174	.244	.145
1975:1-1984:12	.127	.127	.113
1985:1-1994:12	.331	.308	.385
1955:1-1974:12	.125	.140	**.092**
1975:1-1994:12	**.009**	**.010**	**.002**
1955:1-1998:12	**.005**	**.010**	**.007**

This table contains significance levels for a test of the hypothesis that the variance of residuals from an AR model of inflation are a function of the level of inflation. For each sample, the AR order was chosen to be the same for all three inflation measures and equal to the maximum of the AIC lag choices over the three inflation measures for the same sample, as reported in Table 3. Under the null hypothesis, the variance of inflation residuals is not a function of the level of inflation. Boldface entries reject the null hypothesis at a 10 percent level of significance.

Figure 1: The Consumer Price Index

(natural logarithm of index)

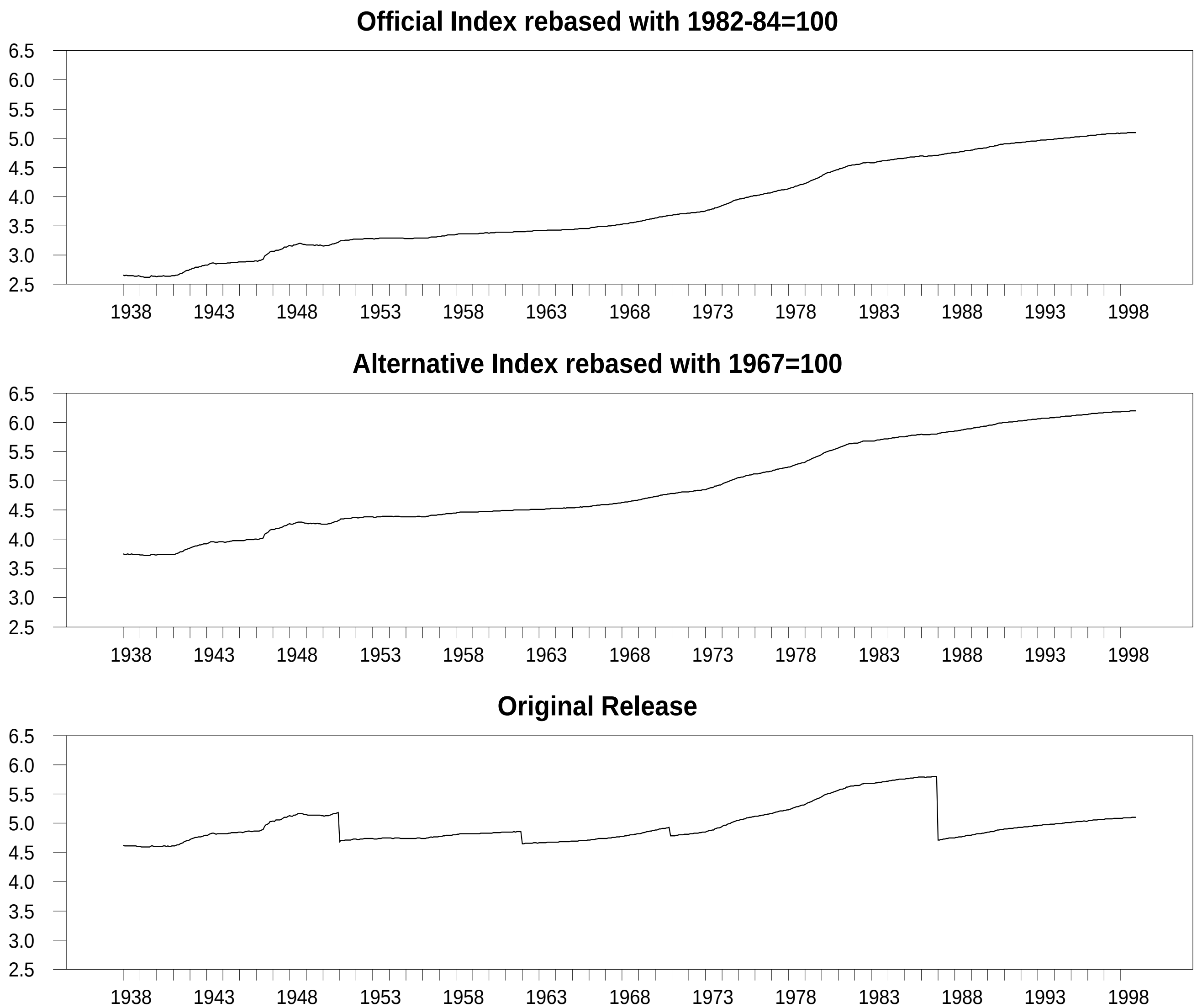


Figure 2: Monthly CPI Inflation

(annual percent)

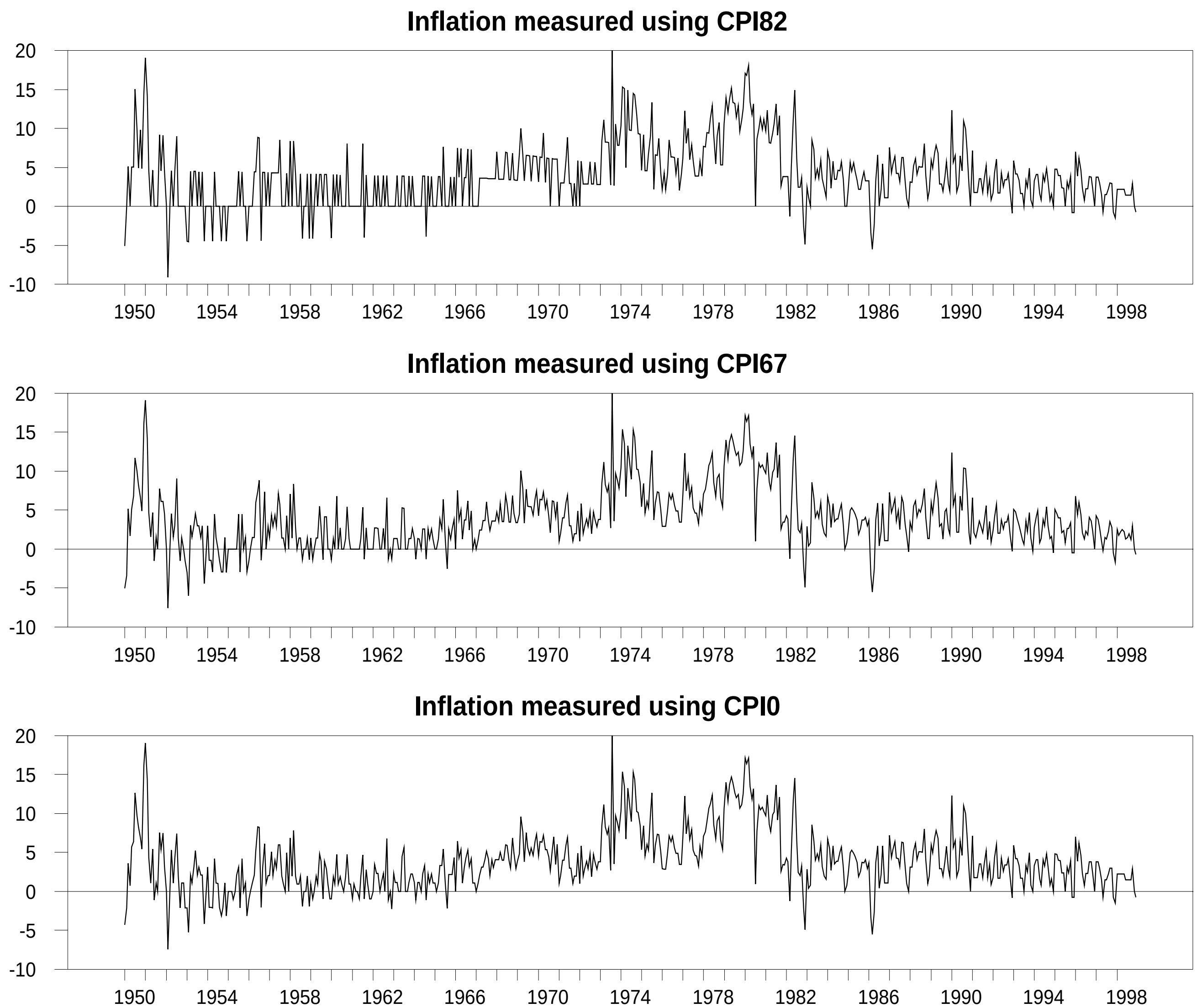


Figure 3: Differences Between Inflation Measures

(annual percent)

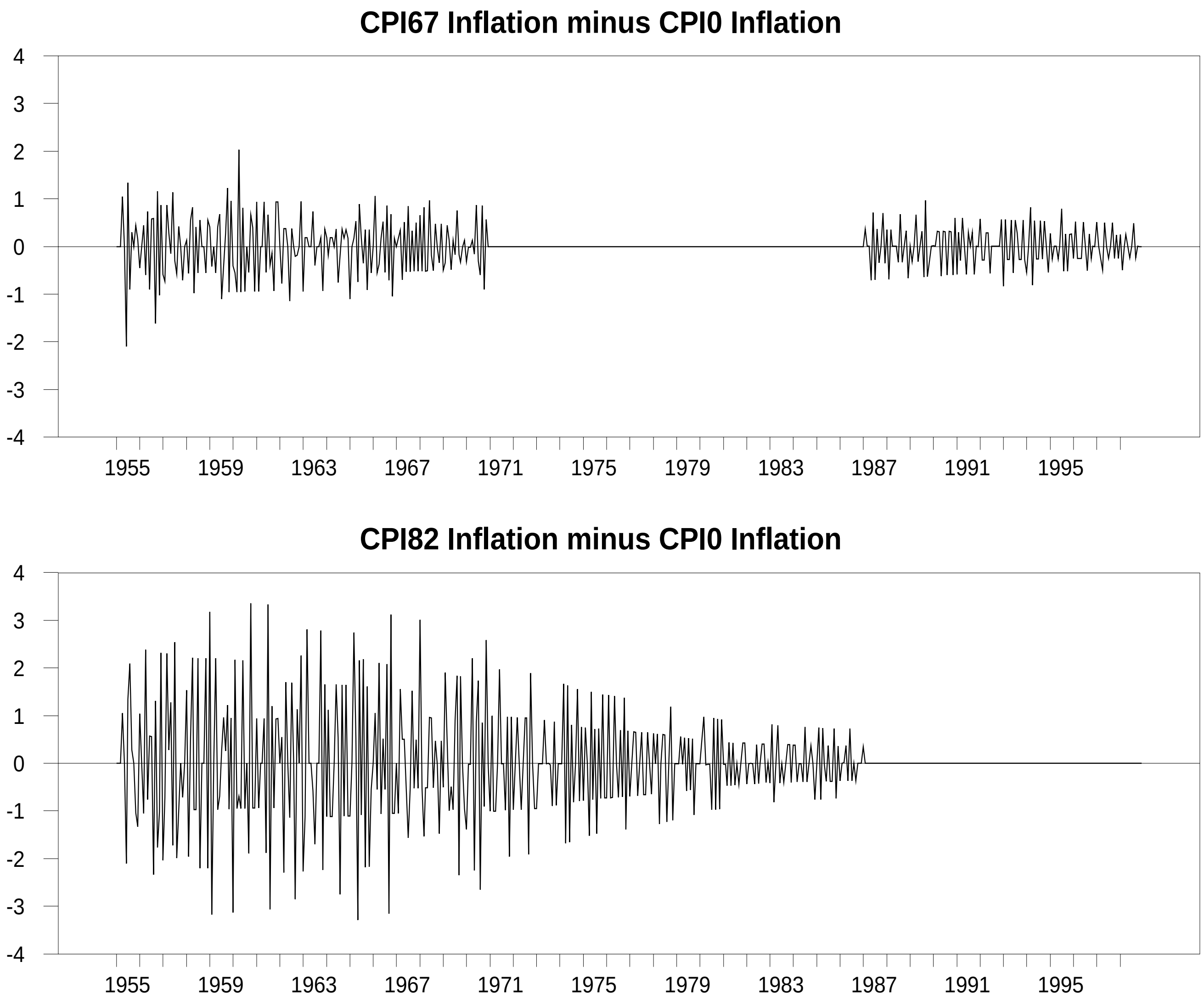
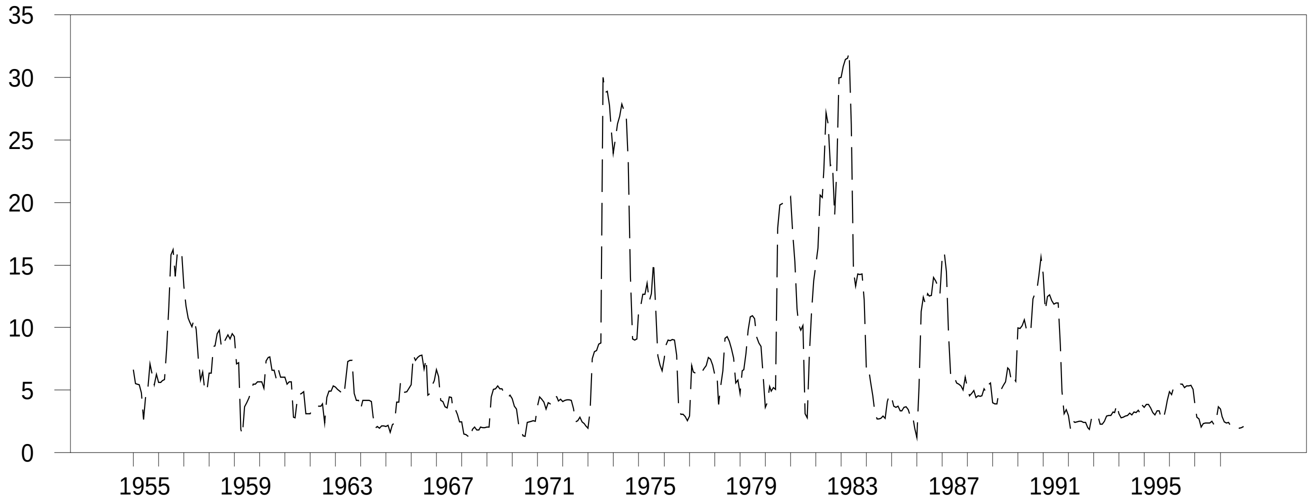


Figure 4: Estimates of the Variance of Inflation

Variance of Inflation measured using CPI67



Ratio of Variances