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Monetary policy shocks: analyzing the quasi-narrative approach

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MONETARY POLICY SHOCKS: ANALYZING THE QUASI-NARRATIVE APPROACH

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This dissertation is dedicated to my family and friends.

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Abstract

This dissertation empirically identifies exogenous changes in monetary policy and estimates their effects on the economy. The framework is the Romer and Romer (2004) quasi-narrative approach to identifying exogenous changes in monetary policy. The first essay replicates the Romer-Romer (RR) "quasi-narrative" measure of shocks and updates them with Greenbook forecasts to 2003. A key result is the quasi-narrative approach is robust to updates and corrections for serial correlation. An alternative, independently formed measure of the intended funds rate from Thornton (2005) is compared to the RR measure. The measures are highly correlated and display slight differences concerning the timing of the changes in the intended funds rate.

The second essay examines the relative importance of three sources of monetary policy shocks in the quasi-narrative approach. The sources analyzed are changes in operating regimes, changes in chairmen, and the credit controls of 1980. It is found that the responses of monetary policy to forecasted increases in output and inflation were strongest during the NBR targeting period and during the term of Paul Volcker as chairman. The most important source analyzed is shown to be the changes in chairmen.

The third essay utilizes the quasi-narrative approach to create measures of monetary policy shocks from alternative real-time data. Three real-time data sources are constructed and explained. When jointly considered with the Greenbooks data used by RR, alternative real-time data is found to add significant information in the response of monetary policy. However, when compared to the RR results, the shocks produced from incorporating alternative data along with the Greenbook data produce only small and transitory differences in the responses of macroeconomic variables. Next, monetary policy shocks are constructed using only alternative real-time data that can be updated with a much shorter lag than is the case for shocks estimated using only Greenbook data. These new shocks are found to be highly correlated with the original RR measures. The shocks obtained from two specifications are shown to be reasonable substitutes for the RR measures, displaying only transitory, slight differences in the responses of output and prices.

Chapter 1
Introduction

In order to empirically estimate the effects of exogenous changes in monetary policy on the economy, identification of a measure of monetary policy shocks is critical. It is important to distinguish between the systematic responses of monetary policy and exogenous changes, or shocks. In setting its policy instrument, the central bank looks at many macroeconomic and financial variables. To empirically describe how the central bank sets its policy instrument, a reaction function (sometimes referred to as a policy equation) is often specified and estimated. The reaction function encompasses "…the systematic reaction of policy to economic conditions and unexpected shifts in monetary policy (policy shocks)" (Zha, p. 30).

For example, consider a function of the form $S_t = f(\Phi_t) + \mu_t$, where S_t represents the Federal Reserve's policy instrument, such as the federal funds rate or nonborrowed reserves. $f(\Phi_t)$ is the systematic response of monetary policy to the variables in the information set Φ_t used by policymakers in formulating monetary policy. Φ_t usually includes macroeconomic and financial variables. Bernanke (2004) notes that a forecast-based approach to implementing policy is widely used by central banks. This means that central bank forecasts of macroeconomic variables like output and prices are a key element of Φ_t. The residuals, μ_t, are interpreted as shocks to monetary policy, i.e. exogenous changes in monetary policy. These are changes to monetary policy that aren't systematic responses to the central bank's information set. However, it should be noted these shocks are unique to the specification of the policy equation as the residuals are unexplained changes based only on the information included in Φ_t. The focus of the empirical literature is on estimating the effects of exogenous changes in monetary policy; hence, a crucial element in estimating the effects of monetary policy on the economy is identifying exogenous monetary policy shocks.

There are many interpretations as to what causes exogenous changes in monetary policy. Christiano et. al (hereafter, CEE) (1998) point out three interpretations of monetary policy shocks. One

interpretation is that transitory changes in the weights given to macroeconomic variables in the policy equation could be a source of exogenous shocks. Transitory changes in the weights might result from transitory changes in policymaker's preferences for output and inflation, from political pressures, from transitory changes in the views of particular policymakers or in the way that the views of policymakers are aggregated in making a policy decision.

A second interpretation is that the Fed wants to avoid the social costs of disappointing the expectations of private agents. If there are shocks to agents' expectations about central bank policy, this may lead to unpredictable changes as the central bank varies policy to avoid disappointing private agents. A third interpretation by Bernanke and Mihov (1998) is that measurement error in preliminary data could be a source of shocks.

Several methods of identifying monetary policy shocks have been used in the literature. The first is a purely statistical approach often used in the vector autoregressions (VAR) literature in which assumptions about the contemporaneous reaction of monetary policymakers to economic variables or about the long-run effects of monetary policy are used to identify monetary policy shocks. A second method is the narrative approach introduced by Friedman and Schwartz (1963) and extended by Romer and Romer (hereafter, RR) (1989). In this approach, exogenous shocks to monetary policy are identified from a careful reading of the description of monetary policy decisions. A third method is dubbed the "quasi-narrative" approach developed by RR (2004), and it blends elements of the narrative and statistical approaches. The focus of this dissertation is on the quasi-narrative approach.

1.1 VAR Approach

The effects of monetary policy on the economy are often estimated using vector autoregressive (VAR) models developed by Sims (1980). The literature that uses VARs to identify monetary policy shocks and estimate their effects is voluminous and a brief explanation of VARs is needed to understand how monetary policy shocks are identified and their effects are estimated.

Consider a structural model

$$y_t = A_0 y_t + A_1 y_{t-1} + \ldots + A_q y_{t-q} + \mu_t$$

where y_t is a vector of economic variables, A_0 is a coefficient matrix of contemporaneous effects, A_i is the coefficient matrix for lagged values of *y* (with *q* as the maximum lag) and μ_t is the vector of structural shocks and has a variance-covariance matrix, Ω.

The elements of *y* include macroeconomic variables, such as output and inflation, and a monetary policy variable, such as the federal funds rate. The row corresponding to the policy variable can be thought of as a policy reaction function that describes responses in the policy variable due to prior and/or contemporaneous movements in the non-policy variables, prior movements in the policy variables, and exogenous policy shocks, μ_t.

A VAR model can be thought of as the reduced-form of a structural model. To get the reduced form model, the equation above is solved for y_t.

$$y_t = \left(I - A_0\right)^{-1} A_1 y_{t-1} + \ldots + \left(I - A_0\right)^{-1} A_q y_{t-q} + \left(I - A_0\right)^{-1} \mu_t$$

which can be rewritten as

$$y_t = \sum_{i=1}^{q} \pi_i y_{t-i} + \varepsilon_t$$

where $\pi_i = (I - A_0)^{-1} A_i$, $i = i, \ldots, q$, and $\varepsilon_t = (I - A_0)^{-1} \mu_t$ with variance-covariance matrix, Σ.

This is the basic VAR model where *y* is expressed in autoregressive form as a function of prior values of *y* and shocks to the variables in *y*. The reduced form coefficients (π_i) are non-linear combinations of the structural parameters and the elements of the variance-covariance matrix Σ are non-linear combinations of the structural parameters, for the contemporaneous relations among the variables and the structural variances. If at least some of the elements of A_0 are non-zero, the errors will be correlated across equations, and the element of ε_t corresponding to the monetary policy variable will not generally be the structural monetary policy shock.

In order to identify the monetary policy shocks and estimate their effects on economic activity, the structural shocks, μ_t, must be extracted from the residuals of the VAR. As can be seen, an estimate for the matrix of contemporaneous coefficients, A_0, is needed to obtain these shocks.

To get an estimate of the elements of A_0, often contemporaneous restrictions based on economic theory or on timing considerations for availability of information are imposed on Σ. Long-run restrictions on Σ based on economic theory or sign restrictions based on the theoretically-expected effects of policy actions are also sometimes used to obtain estimates of the element of A_0 and hence identify policy shocks.

VARs and methods of imposing restrictions have been used to extensively to estimate exogenous monetary policy shocks and their effects on macroeconomic activity. However, a central question arises as to whether the shocks identified from this statistical approach are accurate measures of the true monetary policy shocks experienced in the economy. As previously mentioned, in the VAR the row corresponding to the monetary policy variable can be interpreted as the policy equation of the central bank. The policy equation specifies the policy variable as a function of only lagged values of itself and other variables included in the model. There is no explicit consideration of central bank forecasts in the monetary policy equation.

Bernanke (2004) notes that, for central banks in general, and the Fed in particular, a forecast-based approach to implementing policy has become dominant. This in turn suggests that consideration of central bank forecasts is likely to be important in identifying monetary policy shocks. Only to the extent that past values of the VAR model variables are used in generating forecasts of future values of these variables are forecasts of economic activity even implicitly considered in generating typical VAR measures of the policy shocks. Since more information than lagged values of macro data are used by central banks in forecasting future economic activity, VARs only imperfectly account for the forecasts used by central bankers in formulating monetary policy.

Bernanke et al. (2005) also point out problems associated with VARs due to the small information sets typically used. Increasing the number of variables in a VAR is difficult as it decreases the degrees-of-freedom. VARs typically use between six or eight variables, but central banks use many more data series

when formulating monetary policy. They argue that "…to the extent that central banks and the private sector have information not reflected in the VAR analysis, the measurement of policy innovations is likely to be contaminated" (p. 388). Hence, the monetary policy shocks identified by typical VARs may not be accurate representations of exogenous changes because they do not fully account for the central bank's information set. Bernanke et al. (2005) propose a factor-augmented VAR (FAVAR) approach in which they extract common factors from larger datasets for use in the estimation. These factors summarize over one hundred data series used by the central bank and can be included in the VAR without severely limiting the degrees-of-freedom. However, including the factors in a VAR still does not take central bank forecasts into consideration. The factors extracted from the data series are based on only current and lagged values of data in the central bank's information set. Consequently, the FAVAR approach does not alleviate the problem of not accounting for forecasts in the information set.

The above discussion shows there are drawbacks to the VAR approach of identifying monetary policy shocks and their effects on the economy. Conventional VARs are usually constrained to using a small number of variables that do not fully represent the large amount of information central banks use in formulating policy; this may in turn produce inaccurate shock estimates. Further, as forecasts are important in formulating policy decisions, and VARs do not typically directly incorporate forecasts in the model, policy shocks derived from VARs may not be totally exogenous

1.2 Narrative Approach

Another way of identifying monetary policy shocks is through non-statistical methods. Romer and Romer (RR) (1989) followed Friedman and Schwartz (1963) in using the narrative approach to identify exogenous changes in monetary policy. They state the reason that purely statistical tests, such as VARs, "…probably have not played a crucial role in forming most economists' view about the real effects of monetary disturbances is that such procedures cannot persuasively identify the direction of causation" (pg. 121). Their goal in this paper was to identify disturbances in monetary policy which were not driven by developments in real economic activity based on a careful reading of documents pertaining to monetary policy decisions. While VARs are constrained by small information sets that only contained

lagged variables, analyzing the "Record of Policy Actions" and the minutes of the FOMC meetings to identify exogenous changes in monetary policy implicitly incorporates a great deal of information, including forecasts, used by the Federal Reserve in formulating policy decisions.

They identify monetary policy shocks in the post-World War II era as "…only episodes in which the Federal Reserve attempted to exert a contractionary influence on the economy in order to reduce inflation." (p. 134). They argue this narrow definition of monetary policy shocks helps reduce the bias in narrative identification as it only looks at times the Fed looked to induce a recession to depress inflation. This helps make their approach as systematic as possible and reduces the likelihood that any correlation between the monetary policy variable and output is due to reverse causality from output to monetary policy. RR identify six contractionary monetary policy shocks to reduce inflation. These occurred in October of 1947, September 1955, December 1968, April 1974, April 1978, and October 1979.

RR create a dummy variable equal to 1 in each of the six months in which a policy shock is identified and equal to 0 in all other months and regress output on twenty-four of its own lags and thirty-six lags of the monetary policy shock dummy. They also estimate the regression with the unemployment rate as the dependent variable and twenty-four lags of the unemployment rate and thirty-six lags of the monetary policy shock dummy as the independent variables. Using these regressions, RR estimate impulse response functions for output and unemployment for a unit shock to their dummy variable. They find highly significant effects of monetary policy on real economic activity. They also find that these effects were relatively large and persistent.

The narrative approach has been utilized to create other variables for analysis of monetary policy. Most notably, Boschen and Mills (1995) read Federal Reserve documents to construct an index that, for each period of time, identifies the intensities of monetary policymaker's preferences for inflation reduction or stimulation of output growth. The index takes on values of -2 (strong intent to reduce inflation), -1, 0, 1, 2 (strong intent to stimulate growth). They investigate the effects of their policy index and the RR shock dummy (as well as several other policy indexes) on money market indicators of monetary policy. The authors estimated a bivariate VAR that included a money market variable, such as

nonborrowed reserves or the federal funds rate, and a monetary policy index such as their index or the RR measure. The authors found that narrative indicators and RR dummies "…yield qualitatively similar conclusions about the impact of monetary policy on key money market variables" (p. 42). Their findings provide evidence that the narrative approach to monetary policy shocks produce responses in the money market consistent with economic theory.

The narrative approach is not without its critics. Hoover and Perez (1994a, 1994b) offered three very strong criticisms of the RR narrative approach and the statistical methods associated with it. Hoover and Perez (hereafter HP) first use an oil price shock dummy identified by Hamilton and perform Granger-causality tests with both the RR monetary policy dummy and the oil shock dummy in the same equation on output. They find the oil shock dummy Granger causes output but the RR monetary policy dummy does not.

Next, HP replace the monetary policy dummy with the oil shock dummy in the RR equation. After estimating the regression and computing the IRF's, HP find that the results using the oil shock dummy are as good or better than the results using the monetary policy dummy. If RR had wanted to prove the importance of oil price shocks, instead of monetary policy shocks, their methodology would have accomplished this.

HP construct a model for an economy in when the Fed express an intention to engage in contractionary policy when inflation is high enough. However, in this model, by construction the Fed cannot affect real output and has no way to effectively back up its intentions. They specify an intention index that equals 1 when the average inflation rate over the current and previous two years is greater than or equal to 9.5%. HP use this model to generate artificial series for output and the intention index. They apply RR's methodology to the artificial output series and a measure of monetary policy shocks consisting of four dates at which their intention index equaled 1. They find that a monetary policy shock appears to cause a decline in output even by construction though monetary policy cannot have an effect in the model. This illustrates that RR's methodology cannot differentiate between the cases in which monetary policy matters and when it does not.

RR (1994) defended their approach and stated that the Hoover and Perez arguments had little effect on their conclusions. RR extended their sample, added another monetary policy shock in December 1998 to the six they previously identified, and modified their regression of output on its own lags and lags of their monetary policy dummy to include a measure of oil price shocks. RR found that the significance of monetary policy was not affected when oil price shocks are considered.

Leeper (1997) also addressed the narrative and VAR approaches to monetary policy. He first found that the RR dummy variable for monetary policy shocks contains endogenous components since it can be predicted from past macroeconomic and financial market information. He next used single equation regressions to compute IRF's similar to RR but does this for six separate variables, whereas RR estimated these for only output and unemployment. He also extends the horizons to show responses for ten years after the shock. In response to a one unit contractionary shock in the RR dummy, a significant price puzzle is found at all horizons and the response of output is found to be permanently lower. These results are not in line with economy theory. It is also found that the long-term interest rate is permanently higher and significant at longer horizons relative to the short-term interest rate which rises temporarily before returning to its initial level. When treating the RR dummy as endogenous in the VAR, he finds the results are much improved in patterns but the responses of the variables are much smaller in magnitude. Leeper then estimates a VAR using a short-term interest rate as a policy variable in place of the RR dummy. He extracts the innovations to the short-term interest rate and constructs a dummy variable equal to 1 each time the innovation is positive and exceeds one standard deviation of the series. He uses this dummy to compute single equation IRF's for each of the six variables considered earlier to a unit shock in the new dummy variable. He finds the results are almost identical to those using the RR dummy. He points to this as further evidence that the RR dummy contains endogenous elements as the short-term interest rate is a measure widely agreed to contain endogenous responses.

The narrative approach has drawbacks in that it can often be characterized as subjective. Even though RR try to make it as systematic as possible, critics argue there may be bias in choosing the shocks and these shocks may still contain endogenous components. However, it does have the advantage of implicitly

incorporating a great deal of information looked at by the Federal Reserve in indentifying exogenous changes in monetary policy.

1.3 Quasi-Narrative Approach

A third approach to identifying monetary policy shocks was developed by Romer and Romer (2004). This approach is dubbed "quasi-narrative" because the process includes both a narrative component and a statistical component in identifying exogenous changes in monetary policy.

The narrative component of this approach comes from the construction of a measure of the intended federal funds rate (FFR). Although the emphasis on FFR in implementing monetary policy has varied over time, especially during the non-borrowed reserves targeting regime, the Federal Reserve has always implicitly or explicitly set a target for FFR. RR review FOMC documents, internal memos, and an internal email and construct a time series for the intended, or target, federal funds rate for each FOMC meeting. A narrative approach to constructing an intended funds rate is necessary since the target federal funds rate has only been explicitly announced by the FOMC since 1995. While data on the actual funds rate is available, use of the intended rate rather than the actual federal funds rate eliminates contemporaneous feedback to the actual funds rate from unexpected changes in reserve demand or from changes in factors that affect reserve supply that are outside the direct control of the Federal Reserve.

The quasi-narrative approach is not completely narrative because it adds a quantitative element to the estimation of monetary policy shocks. As mentioned earlier, central banks consider not only current and past economic conditions, but also take into account expected future economic activity in formulating monetary policy. Consequently, RR argue that, in constructing exogenous measures of monetary policy, it is important to account for changes in the policy instrument based on forecasts of future economic activity as well as feedback from current and past economic activity. Failure to do so will lead to biased estimates of exogenous changes in monetary policy and may laed to misestimates of the effect of monetary policy on economic activity.

The "Current Economic and Financial Conditions" document, commonly referred to as the Greenbook, contains past values and forecasts of important macroeconomic variables. It is produced

before every FOMC meeting by the staff of the Federal Reserve Board of Governors and presented to the FOMC before each meeting. In order to incorporate the use of forecasts into the process of obtaining monetary policy shocks, RR regress the change in the intended funds rate on Greenbook forecasts of inflation and output growth for the current and two future quarters, on the forecast of the unemployment rate for the current quarter, and on forecasts of inflation and output growth for the previous quarter. Changes in the forecasts of inflation and output growth at each quarterly horizon are also included in the regression, and, the level of the intended funds rate before the FOMC meeting is added to the equation. The equation is estimated using data for each FOMC meeting rather than using data at a monthly frequency. FOMC meetings are held at approximate 6 week intervals, so there will not be an FOMC meeting in every month.

The residuals from this equation constitute the RR quasi-narrative measure of monetary policy shocks The RR policy shocks reflect a variety of factors mentioned earlier including the evolution of the Fed's operating procedures, changes in policymakers' views on the economy over time, changes in Fed goals, political pressures, non-systematic interactions among policymakers, and information about future economic activity not included in the Greenbook. The quasi-narrative regression approach of RR to constructing exogenous monetary policy shocks is appealing for several reasons. It explicitly takes into account forecast information that policymakers respond to in formulating monetary policy. As mentioned earlier, VARs do not completely account for the forecast aspect of setting monetary policy and mainly look at past values of the variables included. The quasi-narrative shocks are much less prone to the criticism of subjectivity as the intended funds rate is the only narrative part of the approach. The shocks are determined by quantitative methods using FOMC data. The purely narrative approach examines Federal Reserve documents to explicitly identify monetary policy shocks and the intent of the Federal Reserve. This approach is much more sensitive to the criticism that it possibly contains bias in the identification

Prior to estimating the effects of exogenous monetary policy shocks on output and prices, RR convert the shocks to monthly values by setting the shock a particular month equal to the residual for a particular

FOMC meeting taking place during that month. If there are no meetings during the month, the shock is set to zero. If there is more than one FOMC meeting occurring during that month, the residuals for those meetings are added. These monthly shocks are used to compute the responses of macroeconomic variables. RR first compute IRF's from single equation regressions of output and prices on their own lags and lags of the monetary policy shock measure. They find that the single equation estimates of the effect of monetary policy shocks on output growth using their measure generate a significant transitory effect on the level of output. The response of prices to their shock measure is a significant long-lived effect, although this effect becomes negative and significant only after two years. RR also estimate a simple three variable VAR containing output, prices, and a monetary policy variable created by cumulating their measure of shocks. They find that the effects on output are larger compared to those of previous VAR studies, such as Sims (1992) and Bernanke and Mihov (1998). The responses of prices are also much larger at longer horizons compared to these previous studies and the responses become negative in a much quicker manner. However, the own effect of monetary policy is long-lived. They conclude that "the results indicate that the impacts of monetary policy on both output and inflation are large" (p. 1081).

The method in which RR construct their monetary policy shocks has been questioned. Ellison and Sargent (2009) argue that the quasi-narrative shock series is "…purged of information in the staff forecasts but there is no guarantee that it will be exogenous with respect to the FOMC forecast" (p. 16). They note that, in addition to the Greenbook forecasts, FOMC members generate their own forecasts and that these forecasts also influence the intended federal funds rate. Therefore, the RR policy equation that includes only the Greenbook forecasts and not the FOMC forecasts is misspecified as are the policy shocks generated from that equation.

Whether the misspecification is serious enough to affect the estimates of the effects of monetary policy on output and prices is an empirical question. Ideally one would like to include the FOMC forecasts, beginning in 1969, as explanatory variables in the policy equation, but this is not feasible since over the samples considered in this dissertation the FOMC forecasts were released to the public only twice a year. However, the spirit of the Ellison-Sargent critique that information about the future state of

the economy beyond that in the Greenbook influences monetary policymakers can be addressed by including other forecasts like those in the Survey of Professional Forecasters in the RR policy equation. This exercise, in fact, is an important part of this dissertation.

1.4 Structure of Dissertation

This dissertation contributes to the literature of identifying exogenous changes in monetary policy using the quasi-narrative approach in the following ways. This dissertation first replicates the RR results from the quasi-narrative approach over the RR original sample of Jan. 1969 – Dec. 1996 and then extends the sample using Greenbooks available through 2003. The results from the 2003 sample are compared to the original sample results. It is found that the results are robust across samples.

The criticisms of subjectivity that are a concern in the narrative approach are of lesser concern in the quasi-narrative approach since subjective elements affect the determination of the interned federal funds rate only before the Fed began announcing a formal target for the federal funds rate. However, subjectivity in the determination of the intended funds rate before the announcement of formal targets is addressed by comparing an independently formulated narrative measure to that of RR. It is found that the correlation between the two measures is high and the differences are relatively small.

This dissertation next investigates the relative importance of several sources of shocks in the quasi-narrative approach. Specifically, it analyzes the sensitivity of the quasi-narrative shocks and their effects on macroeconomic variables to three measurable factors. The first two factors are changes in monetary policy operating regimes and changes in the chairmen of the Board of Governors. In the context of the interpretation of shocks discussed by CEE, these two factors are sources of shocks because they may lead to shifts in the weights given to macroeconomic variables in the policy equation. The credit controls imposed by the Federal Reserve Board at the request of President Carter in 1980 are another measurable source of monetary policy shocks that can be investigated in the quasi-narrative framework. When the credit controls were implemented, the demand for credit throughout the economy fell sharply. The Fed responded to this by slashing its intended funds rate much more than the current and forecast state of the economy would have suggested; thus there are very large shocks during this time. It is shown that the

quasi-narrative shocks and their effects on macroeconomic variables are the most sensitive to changes in chairmen.

RR assume the only data the FOMC responds to when formulating policy are the Greenbooks. As mentioned earlier, typical VARs have the disadvantages of using a small number of variables that do not account for the large amount of data that the Federal Reserve uses and they do not explicitly incorporate forecasts of economic variables. These may lead to contaminated measures of monetary policy. While incorporating the Greenbook forecasts alleviates the second disadvantage, if policymakers respond systematically to information about the economy beyond what is in the Greenbooks, the quasi-narrative shocks are not completely exogenous and may still contain anticipatory movements. This dissertation constructs alternative real-time data sources and assesses their importance in explaining changes in the intended funds rate. It is found that alternative data provides significant information in explaining the variation of monetary policy. However, the sensitivity of the monetary policy shocks to this alternative data is not large. The monetary policy shocks obtained from considering alternative data along with the Greenbook data are highly correlated with the RR shocks that consider only the Greenbook data. The responses of macroeconomic variables to these new shocks display only slight, transitory significant differences.

The quasi-narrative approach to identifying shocks has several advantages to other methods as it explicitly incorporates forecasted data from the Greenbook and is not particularly sensitive to the addition of alternative data used by the Federal Reserve. However, since the Greenbooks are released with such a long lag, this approach cannot be used to empirically investigate the effects of monetary policy shocks in more recent time periods. This dissertation constructs new measures of monetary policy shocks using the quasi-narrative method. The new measures are constructed using alternative real-time data as proxies for the Greenbook forecasts that are released with a much shorter lag than the Greenbook data. These alternative shocks can be updated on a more timely basis. This dissertation finds two measures are reasonable substitutes for the original RR measures. The new measures created in this dissertation will

allow a researcher to investigate the effects of monetary policy shocks on macroeconomic variables in more recent time periods.

Chapter 2
Replication and Update of the Romer-Romer Measure

2.1 Introduction

This chapter first replicates the RR measure of monetary policy shocks for their original sample using the Greenbook data employed by RR. Following RR, the effects of these shocks on output and price are estimated using both single-equation and VAR techniques and are found to be identical to the RR results. Next, the dataset is extended to include information from Greenbooks through 2003 which have become available since the original RR measure was constructed. Evidence of first order serial correlation in the measure of shocks is found when the sample is extended to include Greenbooks through 2003.

Explanations for the presence of serial correlation include interest rate smoothing and omitted macro variables the FOMC responds to. Both explanations are considered when constructing monetary policy shocks. The equation is re-specified to include a lagged dependent variable in light of the interest rate smoothing explanation. The residuals from the 2003 sample are also corrected for serial correlation. This is done given that many of the omitted variables the FOMC may respond to are difficult to measure. New measures of monetary policy shocks are constructed for the original and extended sample when using the lagged dependent variable specification, as well as for the extended sample with and without a correction for serial correlation. These measures are compared to the original RR measure and the effects of the shocks on output and price are estimated using both single-equation and VAR techniques and are compared to the original results. It is found that extending the sample produces similar regression results, highly correlated shock measures, and similar macroeconomic effects when extending the sample to 2003.

The RR measure of the intended funds rate is compared to Thornton's independently formulated intended funds rate measure. The measures and their differences are analyzed. The results show that

Thornton's measure of the intended funds rate is very highly correlated to that of RR and the differences between the two measures are relatively minor.

This chapter shows that the RR "quasi-narrative" approach is robust to updates and alternative methods for dealing with serial correlation. There are no sustained significant differences among any of the responses of output and prices from the monetary policy shocks obtained from an extended sample to 2003. While there are differences in the measures of the RR and Thornton intended funds rates, the correlations are very high.

2.2 Dataset Construction

The "Current Economic and Financial Conditions" document (commonly referred to as the "Greenbook") is produced before every FOMC meeting by the staff of the Federal Reserve Board of Governors. This document contains past values and forecasts of important macroeconomic variables. These documents are presented to the FOMC before each meeting and are a source of information upon which monetary policy decisions are based. Greenbooks are kept confidential for five years until they are made available for public viewing. RR use values from the Greenbook for each FOMC meeting that occurred between 1969 and 1996.[1] To explain the layout of the Greenbook forecasts in the data that will be used for estimation, let $f_{x,y,z}^{GB[Qtr,Yr]}$ represent a Greenbook forecast from a particular quarter. In the superscript, *Qtr* and *Yr* represent the quarter and year of the forecast. In the subscript, *x* represents the meeting number in the quarter, *y* represents the quarter in which the meeting is taking place, and *z* represents the year of the meeting. For example, $f_{1,2,72}^{GB[4,72]}$ would represent a forecast for the fourth quarter of 1972 from the Greenbook that was prepared for the first FOMC meeting of the second quarter in 1972. An example of the data layout for the FOMC meetings of the first two quarters of 1969 is shown in Table 2.1. The RR dataset includes Greenbook values for real GNP / real GDP, the real GNP / GDP deflator, and the unemployment rate.

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[1] In June 2010, the Federal Reserve combined the Greenbook and Bluebook into one document titled "Report to the FOMC on Economic Conditions and Monetary Policy". It is referred to as the "Teal Book". However, this change is not currently applicable to this study as only Greenbooks are available to the public.

Table 2.1 – Greenbook Data Layout Example

Meeting Date	Previous Quarter	Current Quarter Forecast	One Quarter Ahead Forecast[2]	Change In the Previous Quarter's Forecast	Change In the Current Quarter's Forecast [3]
1-14-69	$f_{1,1,69}^{GB[Q4,68]}$	$f_{1,1,69}^{GB[Q1,69]}$	$f_{1,1,69}^{GB[Q2,69]}$	NA	NA
2-4-69	$f_{2,1,69}^{GB[Q4,68]}$	$f_{2,1,69}^{GB[Q1,69]}$	$f_{2,1,69}^{GB[Q2,69]}$	$f_{2,1,69}^{GB[Q4,68]}$ - $f_{1,1,69}^{GB[Q4,68]}$	$f_{2,1,69}^{GB[Q1,69]}$ - $f_{1,1,69}^{GB[Q1,69]}$
3-4-69	$f_{3,1,69}^{GB[Q4,68]}$	$f_{3,1,69}^{GB[Q1,69]}$	$f_{3,1,69}^{GB[Q2,69]}$	$f_{3,1,69}^{GB[Q4,68]}$ - $f_{2,1,69}^{GB[Q4,68]}$	$f_{3,1,69}^{GB[Q1,69]}$ - $f_{2,1,69}^{GB[Q1,69]}$
4-1-69[4]	$f_{4,1,69}^{GB[Q4,68]}$	$f_{4,1,69}^{GB[Q1,69]}$	$f_{4,1,69}^{GB[Q2,69]}$	$f_{4,1,69}^{GB[Q4,68]}$ - $f_{3,1,69}^{GB[Q4,68]}$	$f_{4,1,69}^{GB[Q1,69]}$ - $f_{3,2,69}^{GB[Q1,69]}$
4-29-69	$f_{1,2,69}^{GB[Q1,69]}$	$f_{1,2,69}^{GB[Q2,69]}$	$f_{1,2,69}^{GB[Q3,69]}$	$f_{1,2,69}^{GB[Q1,69]}$ - $f_{4,1,69}^{GB[Q1,69]}$	$f_{1,2,69}^{GB[Q2,69]}$ - $f_{4,1,69}^{GB[Q2,69]}$
5-27-69	$f_{2,2,69}^{GB[Q1,69]}$	$f_{2,2,69}^{GB[Q2,69]}$	$f_{2,2,69}^{GB[Q3,69]}$	$f_{2,2,69}^{GB[Q1,69]}$ - $f_{1,2,69}^{GB[Q1,69]}$	$f_{2,2,69}^{GB[Q2,69]}$ - $f_{1,2,69}^{GB[Q2,69]}$
6-24-69	$f_{3,2,69}^{GB[Q1,69]}$	$f_{3,2,69}^{GB[Q2,69]}$	$f_{3,2,69}^{GB[Q3,69]}$	$f_{3,2,69}^{GB[Q1,69]}$ - $f_{2,2,69}^{GB[Q1,69]}$	$f_{3,2,69}^{GB[Q2,69]}$ - $f_{2,2,69}^{GB[Q2,69]}$

2.3 Regression to Obtain Shocks

To obtain a measure of exogenous changes in monetary policy, RR utilize their narrative measure of the intended funds rate as the dependent variable in the following regression:

$$\Delta ff_m = \alpha + \beta\, ffb_m + \sum_{i=-1}^{2}\gamma_i \Delta\tilde{y}_{mi} + \sum_{i=-1}^{2}\delta_i(\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}) + \sum_{i=-1}^{2}\varphi_i\tilde{\pi}_{mi} + \sum_{i=-1}^{2}\theta_i(\tilde{\pi}_{mi} - \tilde{\pi}_{m-1,i}) + \rho\tilde{\mu}_{m0} + \varepsilon_m \quad (1),$$

where Δff_m is the change in the intended federal funds rate that occurred at meeting *m* and ffb_m is the level of the intended federal funds rate prior to the meeting. y is the log level of output, $\Delta\tilde{y}$ is the forecast of the rate of growth of output, and $\tilde{\pi}$ is the forecast of the inflation rate. Greenbook forecasts for the quarter before the FOMC meeting (i = -1), the quarter of the meeting (i=0), and one and two quarters

[2] The two quarter ahead forecast variable is not shown but is constructed in the same manner. It is included in all relevant analyses.

[3] The two quarter ahead change in the variable forecast is not shown, but is constructed in the same manner. It is included in all relevant analyses.

[4] Although April is the beginning of the second quarter, this particular meeting is treated as taking place in the first quarter in the RR dataset since the Greenbook was prepared in the first quarter. Subsequent similar cases are treated the same.

ahead (i = 1,2) are considered.[5] For the total unemployment rate ($\tilde{\mu}$), only the forecast for the quarter of the FOMC meeting is used.

The current quarter forecast for the unemployment rate is used as another measure of the current state of economy that is considered by the FOMC. Only the forecast of the current quarter unemployment rate is used by RR because Okun's Law predicts a strong relationship between the unemployment rate and output. Consequently, there is likely to be a high degree of co-linearity between the forecasts of the unemployment rate and the growth rate of output.

$(\Delta\tilde{y}_{m,i} - \Delta\tilde{y}_{m-1,i})$ and $(\tilde{\pi}_{m,i} - \tilde{\pi}_{m-1,i})$ are changes in the forecasts for output growth and inflation. These measures are included because a forecast for a particular quarter may change from one meeting to another, and the FOMC may respond to the change in the forecast as well as the forecast itself. The error term, ε_m , is the measure of exogenous policy shocks. Quarterly Greenbook forecasts of the annualized percentage change in real GNP/GDP, the annualized percentage change in the GNP/GDP deflator[6], and the level of the unemployment rate are used for Δy , π , and μ , respectively.

The original RR results are estimated at the frequency of FOMC meetings from 1969 – 1996. At the time of this writing, Greenbooks are available until 2003, and, accordingly, the original RR dataset has been updated to 2003 using the PDF Dataset from the Federal Reserve Bank of Philadelphia website. The RR equation is estimated over both samples. Table 2.2 presents a replication of the original RR results and the results for the extended sample.

The original and updated results are quite comparable. The individual coefficients are of comparable magnitude, and, with one exception, of the same sign, and the sum of the coefficients for a particular explanatory variable are also of similar magnitude.

[5] Data from the Greenbook are used for every observation. For the lagged forecast (i = -1), the value from the Greenbook is often actual real-time data rather than the forecast of the quarter before the one the FOMC meeting is taking place in. Investigation of the actual Greenbooks shows that there is often an indicator as to whether the previous quarter's value is a forecast or preliminary data; however, RR make no distinction as the data always come from the Greenbook.

[6] GDP replaced GNP as the measure for output beginning with the Greenbook prepared for the December 17, 1991 FOMC meeting. This replacement was incorporated into the update.

Table 2.2 - Determinants of the Change in the Intended Federal Funds Rate

	Sample 1969:1 – 1996:12		Sample 1969:1 – 2003:12	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.171	0.141	0.076	0.107
Initial level of intended funds rate	-0.021	0.012	-0.017	0.010
Forecasted output growth, Quarters ahead:				
-1	0.007	0.010	0.006	0.009
0	0.003	0.019	0.008	0.016
1	0.010	0.032	0.019	0.025
2	0.022	0.032	0.013	0.025
Change in forecasted output growth since last meeting, Quarters ahead:				
-1	0.050	0.030	0.046	0.025
0	0.152	0.030	0.138	0.026
1	0.021	0.046	0.015	0.037
2	0.021	0.051	0.031	0.041
Forecasted inflation, Quarters ahead:				
-1	0.021	0.024	0.025	0.021
0	-0.044	0.029	-0.041	0.026
1	0.010	0.044	0.009	0.039
2	0.052	0.047	0.053	0.042
Change in forecasted inflation since last meeting, Quarters ahead:				
-1	0.057	0.045	0.055	0.039
0	0.003	0.048	-0.012	0.041
1	0.031	0.074	0.036	0.065
2	-0.062	0.081	-0.056	0.067
Forecasted unemployment rate (current quarter)	-0.048	0.021	-0.045	0.018
R^2	0.28		0.28	
S.E.E.	0.39		0.36	
D-W	1.84		1.80	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC meetings over the period 1969:1 – 2003:12 has 319 observations.

As expected, the sum of the coefficients on forecast output growth for both samples is positive; for the original sample it is 0.042 (t-statistic = 2.52) and for the extended sample the sum is 0.046 (t-statistic = 3.22). The sum of the coefficients on forecast inflation is positive for both samples - 0.039 (t-statistic = 2.25) for the original sample and 0.045 (t-statistic = 2.99) for the extended sample. The sum of the

coefficients on the change in forecast output growth is 0.244 (t-statistic = 3.96) for the original sample and 0.230 (t-statistic = 4.66) for the extended sample. For the change in forecast inflation, the sum of the coefficients is 0.030 (t-statistic = 0.32) for the original sample and 0.022 (t-statistic = 0.27) for the extended sample. The coefficient for the current unemployment rate is negative and significant for both samples: -0.048 (t-statistic = -2.30) for the original sample and -0.045 (t-statistic = -2.57) for the extended sample. For each explanatory variable, the sums of the coefficients are not significantly different over the two samples. The R^2s are similar across both samples, with approximately 30% of the variation of the change in the intended funds rate being explained. This implies substantial variation of the change in the intended funds rate is not explained by Greenbook forecasts, and the unexplained variation is defined as exogenous variation. As noted by RR, there are many sources of exogenous variation in the intended funds rate. Changes in the FOMC's operating procedures, such as nonborrowed reserve targeting instead of federal funds rate targeting, political pressures on the Federal Reserve, changes in policymakers' views on the economy, and any information not included in the Greenbook the FOMC may respond to are all examples of what could cause changes in the intended funds rate not explained by Greenbook forecasts.

When testing each group of variables for joint significance, the results differ between the samples. The forecast output variables have an F-statistic of 1.91 (p-value = 0.11) for the original sample and 3.59 (p-value = 0.01) for the extended sample. The forecast inflation variables have an F-statistic of 1.88 (p-value = 0.12) for the original sample and 3.08 (p-value = 0.02) for the extended sample. The forecast output and forecast inflation variables become jointly significant in the 2003 sample. The change in forecast output variables have an F-statistic of 10.98 (p-value = 0.00) for the original sample and 12.59 (p-value = 0.00) for the extended sample. The change in the forecast inflation variables have an F-statistic of 0.55 (p-value = 0.70) for the original sample and 0.70 (p-value = 0.59) for the extended sample. The change in forecast output variables are jointly significant in both samples while the change in forecast inflation variables are not significant in either.

2.3.1 Serial Correlation Detection

Table 2.2 illustrates the similarities in the estimation over the two samples. While the Durbin-Watson statistics are comparable between the original and extended samples, their relatively low levels warrant further investigation of serial correlation. If serial correlation is present, this indicates ε_m is correlated with past values of itself and there is persistence in the monetary policy shocks, i.e. there is "monetary policy inertia". Reasons for inertia in monetary policy will be discussed later in this section.

The presence of serial correlation presents concerns regarding the results and hypothesis tests of the RR equation. If serial correlation is indeed present in the residuals, the OLS estimates of the coefficients will still be consistent and unbiased; however, they will no longer be efficient. The standard errors of the coefficients will be incorrect and the hypothesis tests conducted based on these estimates may be misleading.

For both samples, the Durbin-Watson statistics of 1.84 and 1.80 are in between the lower and upper critical values for rejecting serial correlation, and the test is inconclusive.[7] Therefore, the residuals are tested for serial correlation using the Breusch-Godfrey (BG) test (Breusch 1979, Godfrey 1978). The BG test allows for tests of higher order serial correlation compared to the D-W test. Also, the BG test conditions the test of autocorrelation on the independent variables, as opposed to the Box-Pierce test, an alternative test for serial correlation. The BG test will have higher power when the null hypothesis of no serial correlation is false. To test for serial correlation, the BG test is performed by regressing the residuals from equation (1) on the explanatory variables from equation (1) and on lags of the residuals. One lag of residuals is included to test for first order serial correlation while two lags are added to test for second order, if necessary. The BG test can be performed for higher orders of serial correlation by adding additional lags of the residuals. The regression estimated is

$$\hat{\varepsilon}_m = \alpha + \beta\, ffb_m + \sum_{i=-1}^{2} \gamma_i \Delta\tilde{y}_{mi} + \sum_{i=-1}^{2} \delta_i (\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}) + \sum_{i=-1}^{2} \varphi_i \tilde{\pi}_{mi} + \sum_{i=-1}^{2} \theta_i (\tilde{\pi}_{mi} - \tilde{\pi}_{m-1,i}) + \rho\tilde{\mu}_{m0} + \eta\hat{\varepsilon}_{m-1} + \upsilon$$

[7] The critical values are from the table for Durbin-Watson critical values for extended samples from Clint Cummins at Stanford, http://www.stanford.edu/~clint/bench/dw05c.htm. These values are built from the work of N.E. Savin and K.J. White, "The Durbin-Watson Test for Serial Correlation with Extreme Sample Sizes or Many Regressors," *Econometrica 45*, 1977, p.1989-1996.

for first order serial correlation.

The null hypothesis of the BG test is no serial correlation, and if the η coefficients are not significantly different from zero, the null hypothesis is not rejected. The BG statistic is $(n - p) R^2$, where *n* is the number of observations and *p* is the number of lagged residuals added into the regression. This statistic follows a Chi-squared distribution with *p* degrees of freedom. Table 2.3 shows the results of the BG tests performed on both samples.

Testing the residuals for serial correlation in the original sample produces a coefficient on the lagged residuals that has a t-statistic of 1.33. The BG statistic is 2.01 with a p-value of 0.16. The BG test doesn't reject the null hypothesis of no first order serial correlation for the original sample. For the extended sample, the coefficient on the first lag of residuals has a t-statistic of 1.90 and a BG statistic of 3.92 with a p-value of 0.06. At the standard 5% level, the null hypothesis of no serial correlation can't be rejected, but it can be rejected at the 6% level.

Given the possibility of first order serial correlation in the 2003 sample results, equation (1) is estimated and Newey-West (NW) standard errors are computed (Newey-West 1987). The NW standard errors will be robust to both heteroskedasticity, and more importantly, serial correlation. These standard errors will allow valid hypothesis testing for significance of individual coefficients, the sums of coefficients, and the joint significance of groups of variables in the regression. The results are shown in Table 2.4.

The t-statistic for the sum of the coefficients on forecast output growth is 2.20 as compared to 3.22 without the NW correction. The sum of coefficients on forecasted inflation has a t-statistic of 2.75 as compared to 2.99 without the NW correction. The sum of the coefficients on the change in forecast output growth has a t-statistic of 4.50 as compared to 4.66 without the NW correction and the sum of coefficients on the change in forecasted inflation has a t-statistic of 0.29 compared to 0.32 without the NW correction.

The coefficient for the unemployment rate is very significant with a t-statistic of -3.06 compared to -2.57 without the NW correction.

Table 2.3 – Breusch-Godfrey Test for Serial Correlation

	Test for First Order **Sample** **1969:1 – 1996:12**		**Test for First Order** **Sample** **1969:1 – 2003:12**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.020	0.143	0.019	0.109
Initial level of intended funds rate	-0.003	0.013	-0.004	0.011
Forecasted output growth, Quarters ahead:				
-1	-0.001	0.010	-0.001	0.009
0	0.001	0.019	0.001	0.016
1	0.000	0.032	0.000	0.025
2	0.000	0.032	-0.001	0.025
Change in forecasted output growth since last meeting, Quarters ahead:				
-1	-0.002	0.030	-0.001	0.025
0	-0.009	0.031	-0.010	0.027
1	0.006	0.046	0.006	0.038
2	0.006	0.052	0.008	0.042
Forecasted inflation, Quarters ahead:				
-1	-0.002	0.024	-0.002	0.021
0	0.002	0.030	0.003	0.026
1	0.000	0.045	-0.001	0.040
2	0.003	0.049	0.005	0.043
Change in forecasted inflation since last meeting, Quarters ahead:				
-1	0.001	0.045	0.001	0.039
0	-0.003	0.049	-0.002	0.042
1	-0.021	0.076	-0.020	0.067
2	0.014	0.084	0.008	0.069
Forecasted unemployment rate (current quarter)	-0.002	0.021	-0.002	0.018
First Lag of Residuals	0.096	0.072	0.121	0.064
R^2	0.01		0.01	
S.E.E.	0.36		0.36	
D-W	1.98		1.98	

The tests for first order serial correlation in the original sample have 259 observations and 315 observations for the extended sample.

The significance of the sums of coefficients, as well as the significance of the coefficient on the unemployment rate, is not altered when using robust standard errors.

Table 2.4 - Determinants of the Change in the Intended Federal Funds Rate - Newey-West Standard Errors

	Sample 1969:1 –2003:12	
	Coefficient	**Standard Error**
Constant	0.076	0.096
Initial level of intended funds rate	-0.017	0.011
Forecasted output growth, Quarters ahead:		
-1	0.006	0.009
0	0.008	0.014
1	0.019	0.023
2	0.013	0.024
Change in forecasted output growth since last meeting, Quarters ahead:		
-1	0.046	0.030
0	0.138	0.036
1	0.015	0.035
2	0.031	0.038
Forecasted inflation, Quarters ahead:		
-1	0.025	0.024
0	-0.041	0.029
1	0.009	0.054
2	0.053	0.061
Change in forecasted inflation since last meeting, Quarters ahead:		
-1	0.055	0.043
0	-0.012	0.042
1	0.036	0.077
2	-0.056	0.066
Forecasted unemployment rate (current quarter)	-0.045	0.015
R^2	0.28	
S.E.E.	0.36	
D-W	1.80	

The sample of FOMC meetings over the period 1969:1 – 2003:12 has 319 observations.

When using robust errors, testing each group of variables for joint significance leads to the following results. The forecast output variables have an F- statistic of 2.12 (p-value = 0.08). These variables are now only jointly significant at the 10% level compared to having a p-value = 0.00 without the NW correction. The forecast inflation variables have an F-statistic of 3.92 (p-value = 0.00). These variables present a greater of degree of joint significance compared to not using the NW correction. The change in forecast output variables have an F-statistic of 7.22 (p-value = 0.00) compared to 12.59 (p-value = 0.00) without the NW correction. The change in the forecast inflation variables have an F-statistic of 0.69 (p-value =

0.60) compared to 0.70 (p-value = 0.59) without the NW correction. The change in forecast output variables are still jointly significant while the change in the forecast inflation variables are still not jointly significant. Using Newey-West standard errors when testing for joint significance does not alter the significance of the results compared to not using the NW correction. This is expected as the serial correlation coefficient is very low and the absence of serial correlation can only be rejected at the 6% level.

The presence of serial correlation presents other issues that must be investigated concerning the specification of the RR equation. Serial correlation implies the RR equation to obtain shocks may be mis-specified. There are two explanations in the literature for the presence of serial correlation in the policy rate equation. Many studies have often referred to one explanation as "interest rate smoothing". This explanation states that the FOMC only partially adjusts the target rate in response to economic information so that desired changes in the funds rate (i.e. changes in the target rate) are spread out over time. This is presumably done for a number of reasons including: reducing volatility in financial markets, reducing interest rate volatility, and helping control long-term interest rates through expectations. Consequently, many policy rules have been formulated to include past values of the policy instrument. The second explanation is that the inertia in policy behavior indicated by the serial correlation is due to the omission of other variables that can't be easily measured that exhibit persistent behavior. Rudebusch (2002) suggests that monetary policy inertia in quarterly estimated policy rules is merely an illusion caused by frequent persistent shocks the central bank must respond to. These persistent influences might be responses to financial crises, judgmental adjustments, or differences between actual and revised data. In this case, the serially correlated policy shock reflects determinants of FOMC behavior that can't be easily measured. These competing views and the fact that studies provide mixed evidence in support of each view (for a summary of this evidence, see Coibion-Gorodnichenko (2011)) confirm it is important to consider the implications of each explanation for the construction of policy shocks.

2.3.2 Lagged Dependent Variable (LDV) Specification

The interest smoothing explanation suggests that equation (1) should be re-specified to include a lagged value of the change in the intended target funds rate. This specification shows the FOMC changing policy based on forecasts of economic activity as well as responding to the change in the intended funds rate that took place at the previous meeting. To obtain the measures of monetary policy shocks, equation (1) becomes

$$\Delta ff_m = \alpha + \beta\, ffb_m + \sum_{i=-1}^{2}\gamma_i \Delta\tilde{y}_{mi} + \sum_{i=-1}^{2}\delta_i(\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}) + \sum_{i=-1}^{2}\varphi_i\tilde{\pi}_{mi} + \sum_{i=-1}^{2}\theta_i(\tilde{\pi}_{mi} - \tilde{\pi}_{m-1,i}) + \rho\tilde{\mu}_{m0} + \lambda\Delta ff_{m-1} + \varepsilon_m \quad (2),$$

where Δff_{m-1} is the previous meeting's change in the intended funds rate. While there is only evidence of serial correlation in the 2003 sample, equation (2) is estimated over the original and extended samples. If the specification is changed, the new specification should be valid over all samples. Table 2.5 reports the results for the lagged dependent variable specification for the original and 2003 samples.

All coefficient estimates in the LDV specification are similar in magnitude and have the same sign across samples. This is also true when comparing the LDV coefficients to those obtained from estimating equation (1). The coefficient on the previous meeting's change in the intended target funds rate is 0.15 (t-statistic = 2.48) in the original sample and 0.16 (t-statistic = 3.00) for the extended sample. The significance of the lagged dependent variable suggests the FOMC adjusts the intended funds rate in response to forecasts of economic activity and also to last meeting's change in the intended funds rate. The sum of the coefficients on forecast output growth for both samples is positive; for the original sample it is 0.032 (t-statistic = 1.89) and for the extended sample the sum is 0.036 (t-statistic = 2.45). The sum of the coefficients on forecast inflation is positive for both samples - 0.040 (t-statistic = 2.31) for the original sample and 0.045 (t-statistic = 3.02) for the extended sample. The sum of the coefficients on the change in forecast output growth is 0.253 (t-statistic = 4.15) for the original sample and 0.239 (t-statistic = 4.90) for the extended sample. For the change in forecast inflation, the sum of the coefficients is 0.022 (t-statistic = 0.23) for the original sample and 0.013 (t-statistic = 0.16) for the extended sample. The coefficient for the current unemployment rate is negative and significant for both samples: -0.039 (t-

statistic = -1.87) for the original sample and -0.037 (t-statistic = -2.12) for the extended sample. The response of the intended funds rate to unemployment is now only significant at the 10% level. The R^2's are the same across both samples.

Table 2.5 - Determinants of the Change in the Intended Federal Funds Rate – Lagged Dependent Variable

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.178	0.140	0.095	0.106
Initial level of intended funds rate	-0.026	0.012	-0.022	0.010
Forecasted output growth, Quarters ahead:				
-1	0.005	0.010	0.005	0.009
0	0.001	0.019	0.004	0.016
1	0.010	0.031	0.017	0.025
2	0.016	0.032	0.009	0.025
Change in forecasted output growth since last meeting, Quarters ahead:				
-1	0.044	0.030	0.039	0.025
0	0.136	0.030	0.123	0.026
1	0.032	0.046	0.028	0.037
2	0.041	0.051	0.049	0.041
Forecasted inflation, Quarters ahead:				
-1	0.016	0.024	0.019	0.021
0	-0.034	0.029	-0.030	0.026
1	0.007	0.043	0.005	0.039
2	0.050	0.047	0.051	0.041
Change in forecasted inflation since last meeting, Quarters ahead:				
-1	0.065	0.044	0.062	0.038
0	-0.004	0.048	-0.016	0.041
1	0.015	0.073	0.020	0.065
2	-0.055	0.080	-0.054	0.067
Forecasted unemployment rate (current quarter)	-0.039	0.021	-0.037	0.018
Previous meeting's change in intended target	0.145	0.058	0.157	0.052
R^2	0.30		0.30	
S.E.E.	0.39		0.36	
D-W	2.04		2.03	

The sample of FOMC meetings over the period 1969:1 – 1996:12 have 263 observations. The sample of FOMC meetings over the period1969:1 – 2003:12 have 319 observations.

When testing each group of variables for joint significance, the results differ between the samples. The forecast output variables have an F-statistic of 1.04 (p-value = 0.39) for the original sample and 2.78 (p-value = 0.10) for the extended sample. The forecast inflation variables have an F-statistic of 1.70 (p-

value = 0.15) for the original sample and 2.78 (p-value = 0.03) for the extended sample. The forecast inflation variables become jointly significant in the 2003 sample. The change in forecast output variables have an F-statistic of 9.61 (p-value = 0.00) for the original sample and 11.43 (p-value = 0.00) for the extended sample. The change in the forecast inflation variables have an F-statistic of 0.62 (p-value = 0.65) for the original sample and 0.84 (p-value = 0.50) for the extended sample. The change in forecast output variables are jointly significant in both samples while the change in the forecast inflation variables are not significant in either. These results are similar to the original RR specification.

Although the Durbin-Watson statistic is shown, the D-W statistic is not appropriate to test for serial correlation when a lagged dependent variable is used. The reason is that the estimated value of the serial correlation coefficient is biased towards 0. There is a greater likelihood of accepting the null hypothesis that the serial correlation coefficient is equal to zero even when it is not.

An alternative statistic is the Durbin h-statistic. The h-statistic is computed as $h = \hat{\rho}\sqrt{\frac{T}{1 - T\hat{V}(\hat{\alpha})}}$ where $\hat{\rho}$ is the estimated 1st order serial correlation coefficient computed from the OLS residuals, T = sample size, and $\hat{V}(\hat{\alpha})$ = estimated variance of OLS estimate of the coefficient on the lagged dependent variable. A standard normal distribution is used to test whether $\rho = 0$. For the 1996 (2003) sample, the h-statistic is -1.05 (-0.62) with a p-value of 0.29 (0.53). For both samples, the Durbin h-statistic indicates the null hypothesis of no serial correlation cannot be rejected. This indicates no serial correlation is present in the LDV specification for either sample.

Another alternative is to run the BG test, as done earlier, on the LDV specification residuals. Running the BG test on the original (extended) sample residuals gives a coefficient estimate of -0.244 (-0.215) on the first lag of residuals and a p-value of 0.10 (0.12). The actual BG statistics are 3.18 (2.94) with a p-value of 0.08 (0.09). The BG statistics thus indicate that the null hypothesis of no serial correlation can't be rejected at the 5% level, and the h-statistics also point to no serial correlation in the LDV model.

2.3.3 Prais-Winsten (PW) Correction for Serial Correlation

Rudebusch's explanation for serial correlation in the policy equation suggests that the central bank is often responding to economic shocks not captured by the output, inflation, and unemployment forecast variables. However, many of these omitted macro and financial variables that should be included in the specification are very difficult to measure. In light of the difficulty of measuring these variables, an alternative is to correct the residuals for serial correlation.

To correct for first order serial correlation in the extended sample, the Prais-Winsten (PW) method is used in the regression for the extended sample until 2003. The PW method is a generalized least squares procedure that corrects for serial correlation. This desirable feature of PW allows further analysis to be conducted using all exogenous measures of monetary policy. Using an alternative correction, such as the Cochrane-Orcutt method, will quasi-difference out the first observation eliminating one of the measures of monetary policy shocks.

Suppose a standard regression $y_t = \alpha + \beta x_t + \varepsilon_t$ with x_t a vector of exogenous variables has errors with first-order serial correlation, $\varepsilon_t = \rho\varepsilon_{t-1} + \mu_t$. The regression for the previous period is $y_{t-1} = \alpha + \beta x_{t-1} + \varepsilon_{t-1}$. The standard regression is transformed by subtracting ρ times the lagged regression from the current period regression giving

$$(y_t - \rho y_{t-1}) = \alpha(1-\rho) + \beta(x_t - \rho x_{t-1}) + (\varepsilon_t - \varepsilon_{t-1})$$

which is equal to

$\widetilde{y_t} = \alpha(1-\rho) + \beta\widetilde{x_t} + \mu_t$, where $\widetilde{y_t} = (y_t - \rho y_{t-1})$ and $\widetilde{x_t} = (x_t - \rho x_{t-1})$.

An OLS estimation of this regression provides residuals, μ_t, without serial correlation and becomes the new exogenous measure. The estimate of ρ is then separated from the coefficients for reporting purposes. The PW method allows for all observations to be kept as it makes the following transformation for the first observation:

$$(1-\rho)^{1/2}\, y_1 = \alpha(1-\rho)^{1/2} + \beta(1-\rho)^{1/2}x_1 + (1-\rho)^{1/2}\mu_1 .$$

Table 2.6 shows the results of the regression to obtain shocks when correcting for serial correlation.

Table 2.6 - Determinants of the Change in the Intended Federal Funds Rate with Serial Correlation Correction

	Sample 1969:1 –2003:12	
	Coefficient	**Standard Error**
Constant	0.087	0.122
Initial level of intended funds rate	-0.021	0.012
Forecasted output growth, Quarters ahead:		
-1	0.006	0.010
0	0.008	0.017
1	0.025	0.026
2	0.006	0.026
Change in forecasted output growth since last meeting, Quarters ahead:		
-1	0.044	0.025
0	0.122	0.026
1	0.011	0.037
2	0.046	0.041
Forecasted inflation, Quarters ahead:		
-1	0.022	0.022
0	-0.040	0.027
1	0.008	0.041
2	0.061	0.044
Change in forecasted inflation since last meeting, Quarters ahead:		
-1	0.052	0.038
0	-0.004	0.041
1	0.036	0.065
2	-0.078	0.067
Forecasted unemployment rate (current quarter)	-0.046	0.020
Rho	0.134	0.065
R^2	0.29	
S.E.E.	0.36	
D-W	1.97	

The sample of FOMC meetings over the period 1969:1 – 2003:12 has 319 observations.

The sum of the coefficients on forecast output growth is .046 (t-statistic = 2.86) and the sum of the coefficients on forecast inflation is .051 (t-statistic = 3.03). These groups are both jointly significant in the regression with forecast output growth variables and forecast inflation variables both having F-stats of 3.03 (p-value = 0.018). The sum of the coefficients on the change in forecast output growth is .22 (t-statistic = 4.50) and .006 (t-statistic = 0.08) for the change in forecast inflation. The change in forecast

output growth variables are jointly significant in the regression (F-stat = 12.59, p-value = 0.00) while the change in forecast inflation variables are not (F-stat = 0.70, p-value = 0.59). The coefficient for the current unemployment rate is negative and significant at -.046 (t-statistic = -2.33). The PW correction provides similar results to the standard OLS results for the 2003 sample.

2.4 Description of Monetary Policy shocks

Figure 2.1 illustrates the measures of monetary policy shocks obtained from the RR method utilizing the Greenbook forecasts and the shocks obtained from the LDV specification for the original sample. It then illustrates the monetary policy shocks from the RR method extending the sample to 2003 for the original specification, the LDV specification, and the residuals that include a correction for serial correlation. The residuals have been converted to a monthly measure. These residuals are converted because the methods to estimate the effects of these shocks on output and prices, to be explained in more detail later, are conducted using monthly data. To obtain a monthly measure of the policy shock, the residual at each meeting is set as the shock for the month of the meeting. If there are no meetings in a month, the shock is set to zero. If there are two meetings in a particular month, the residuals from the two meetings are added to generate the shock value for that month.[8]

Figure 2.1 shows the estimates of the shocks are very similar across samples and methods. The increased volatility during the Federal Reserve's period of nonborrowed reserve targeting is illustrated by the large shocks that occur in all three series between the meetings of August 15, 1978 and August 18, 1981.

As noted earlier, the residuals from the OLS, LDV, and PW regressions are taken as the measures of exogenous monetary policy shocks. For the 1969:1-1996:12 period of overlap among the three series, they are all highly correlated as shown in Table 2.7 which displays the overall correlations among the shock measures. There is almost perfect correlation among all shock measures. This is expected since the coefficient estimates are unbiased and the magnitude of the serial correlation coefficient is very small.

[8] This only occurs four times in the data and there are never more than two meetings in a month.

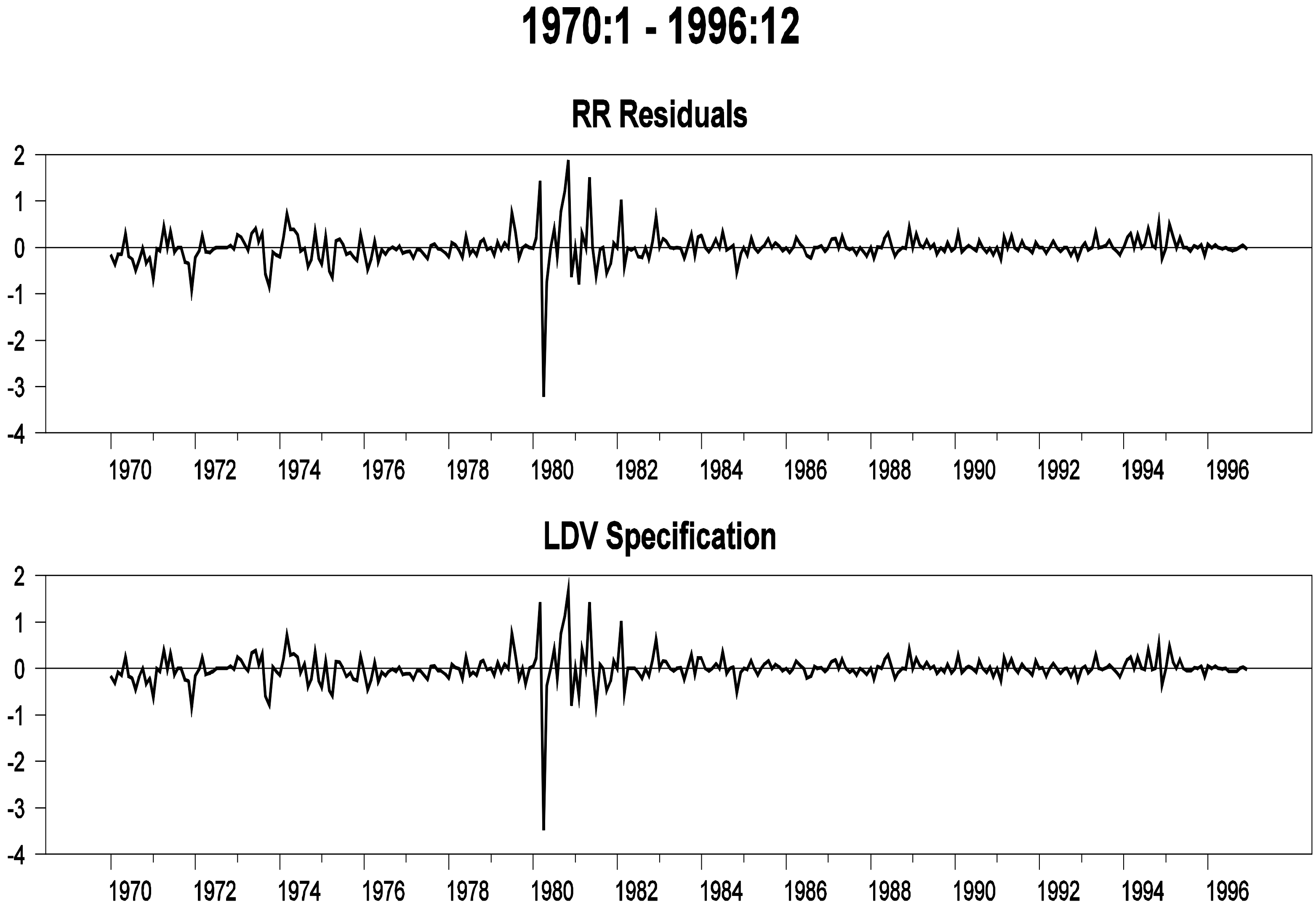


Figure 2.1 - Monthly Residuals

(fig. 2.1 cont'd)

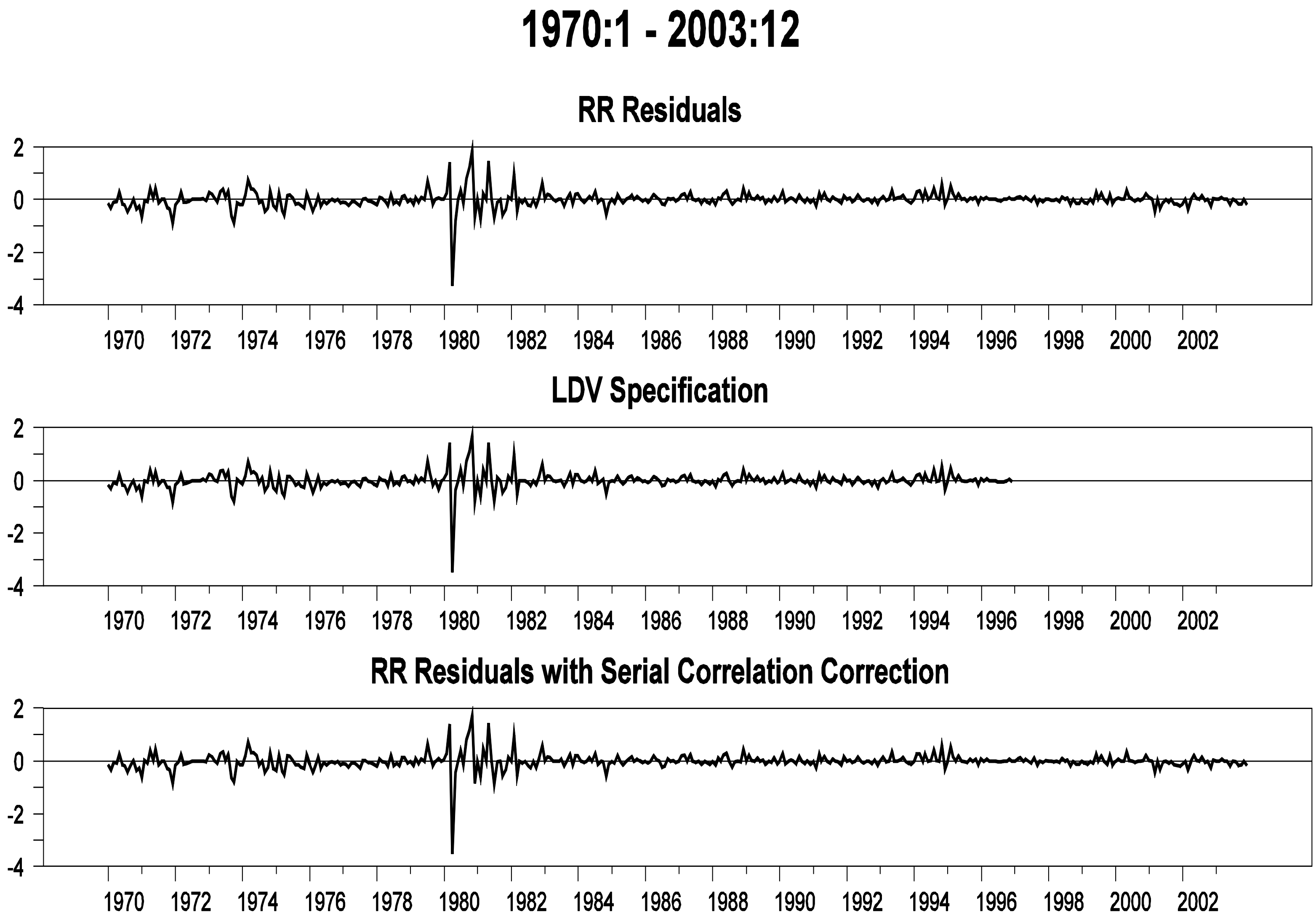

1970:1 - 2003:12
RR Residuals
LDV Specification
RR Residuals with Serial Correlation Correction
2
0
-2
-4
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002

Table 2.7 – Correlations Among Shock Measures

	RR	RR – 1996 LDV Specification	RR - 2003	RR – 2003 LDV Specification	RR – 2003 S.C. Correction
RR	1.00				
RR – 1996 LDV Specification	0.99	1.00			
RR - 2003	0.99	0.99	1.00		
RR – 2003 LDV Specification	0.98	0.99	0.99	1.00	
RR – 2003 S.C. Correction	0.99	0.99	0.99	0.99	1.00

2.5 The Effects of Monetary Policy on Output and Price

Following RR, the residuals from equation (1) are interpreted as measures of changes in monetary policy that are free of endogenous and anticipatory movements. The effects of shocks to monetary policy on the levels of output and price are estimated by computing cumulative impulse response functions (IRFs) from the following regressions which are estimated using monthly data:

$$\Delta y_t = \alpha_0 + \sum_{k=1}^{11} a_k D_{kt} + \sum_{i=1}^{24} b_i \Delta y_{t-i} + \sum_{j=1}^{36} c_j S_{t-j} + e_t \qquad (2)$$

$$\Delta p_t = \alpha_0 + \sum_{k=1}^{11} a_k D_{kt} + \sum_{i=1}^{24} b_i \Delta p_{t-i} + \sum_{j=1}^{48} c_j S_{t-j} + e_t \qquad (3)$$

where Δy is output growth (measured by the change in the log of non-seasonally adjusted industrial production[9]), Δp is the inflation rate (measured by the change in the log of the non-seasonally adjusted producer price index for finished goods), D is a monthly dummy, and S is the RR monetary policy shock measure. The specification of the equations is the same as that used by RR. Note that twenty-four lags of the dependent variable are included in each equation, but thirty-six lags of the policy shock are included in the output growth equation whereas forty-eight lags of the policy shock are included in the inflation equation. RR state "there appear to be longer lags in the impact of policy on prices" (p. 1073) and hence

[9] For the original sample, the change in the log of the non-seasonally adjusted index from the original RR data is used for direct comparison purposes. Since the writing of that paper, the index has been revised and analysis for updated samples utilizes the latest index available on the Federal Reserve Board of Governors website.

use longer lags in the price equation. These equations are estimated over the original RR 1970:1-1996:12 sample and over the 1970:1-2003:12 extended sample.

Tables 2.8 – 2.112 show the results of these regressions when each shock measure is used. Table 2.8 presents results for the original sample RR residuals. Table 2.9 shows results when the RR specification sample is extended to 2003. Tables 2.10 and 2.11 show the results when a lagged dependent variable is used to obtain the monetary policy shocks for the original and extended samples, respectively. Table 2.12 shows the results when the shocks obtained from the RR specification in the extended sample are corrected for serial correlation. All display similar regression statistics, coefficients, and standard errors.

Through a method of recursive substitution, RR obtain cumulative impulse response functions that provide estimates of the effect of a sustained one percentage point increase in the shock measure on output and price for 48 months. Looking at equation (2), RR compute the individual IRF's as follows: Rewrite equation (2) as

$$\left(y_t - y_{t-1}\right) = b_1\left(y_{t-1} - y_{t-2}\right) + b_2\left(y_{t-2} - y_{t-3}\right) + \dots + b_{24}\left(y_{t-24} - y_{t-25}\right) + c_1 S_{t-1} + c_2 S_{t-2} + \dots + c_{36} S_{t-36} + e_t$$

Rearranging the equation and collecting terms shows

$$y_t = \left(1+b_1\right) y_{t-1} + \left(b_2 - b_1\right) y_{t-2} + \left(b_3 - b_2\right) y_{t-3} + \dots + \left(b_{24} - b_{23}\right) y_{t-24} - b_{24} y_{t-25} + c_1 S_{t-1} + c_2 S_{t-2} + \dots + c_{36} S_{t-36} + e_t$$

If we lag this equation one period, we obtain

$$y_{t-1} = \left(1+b_1\right) y_{t-2} + \left(b_2 - b_1\right) y_{t-3} + \left(b_3 - b_2\right) y_{t-4} + \dots + \left(b_{24} - b_{23}\right) y_{t-25} - b_{24} y_{t-26} + c_1 S_{t-2} + c_2 S_{t-3} + \dots + c_{36} S_{t-37} + e_{t-1}.$$

This is substituted into the previous equation to give

$$\begin{aligned} y_t &= \left(1+b_1\right)\left\{\left(1+b_1\right) y_{t-2} + \left(b_2 - b_1\right) y_{t-3} + \left(b_3 - b_2\right) y_{t-4} + \dots + \left(b_{24} - b_{23}\right) y_{t-25} - b_{24} y_{t-26} + c_1 S_{t-2} + c_2 S_{t-3} + \dots + c_{36} S_{t-37} + e_{t-1}\right\} + \\ &\left(b_2 - b_1\right) y_{t-2} + \left(b_3 - b_2\right) y_{t-3} + \dots + \left(b_{24} - b_{23}\right) y_{t-24} - y_{t-25} + c_1 S_{t-1} + c_2 S_{t-2} + \dots + c_{36} S_{t-36} + e_t. \end{aligned}$$

Collecting terms shows that

$$\begin{aligned} y_t &= \left(1+b_1\right)^2 y_{t-2} + \left(1+b_1\right)\left(b_2 - b_1\right) y_{t-3} - \left(1+b_1\right) b_2 y_{t-4} + \dots + \left(1+b_1\right) b_{24} y_{t-25} - \left(1+b_1\right) b_{24} y_{t-26} + \\ &\left(1+b_1\right) c_1 S_{t-2} + \left(1+b_2\right) c_1 S_{t-3} + \dots + \left(1+b_2\right) c_{36} S_{t-37} + \left(1+b_2\right) e_{t-1} + \\ &\left(b_2 - b_1\right) y_{t-2} - b_2 y_{t-3} + \dots + b_{24} y_{t-24} - b_{24} y_{t-25} + c_1 S_{t-1} + c_2 S_{t-2} + \dots + c_{36} S_{t-36} + e_t \end{aligned}$$

and this can be simplified to

Table 2.8

The Impact of RR Shocks On Industrial Production

	Shock			Change In Industrial Production	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0038	0.0018	1	0.0627	0.0637
2	0.0026	0.0018	2	-0.0128	0.0633
3	-0.0038	0.0018	3	0.1072	0.0628
4	-0.0012	0.0018	4	0.0484	0.0630
5	-0.0039	0.0018	5	0.0284	0.0629
6	-0.0001	0.0018	6	-0.0054	0.0628
7	-0.0008	0.0019	7	0.0179	0.0627
8	-0.0029	0.0019	8	0.0075	0.0626
9	-0.0021	0.0019	9	0.0396	0.0622
10	-0.0047	0.0018	10	-0.0426	0.0609
11	-0.0025	0.0019	11	0.0709	0.0593
12	-0.0035	0.0019	12	0.2867	0.0602
13	-0.0021	0.0019	13	0.0227	0.0608
14	-0.0007	0.0018	14	-0.1964	0.0604
15	-0.0003	0.0019	15	-0.1511	0.0610
16	0.0019	0.0018	16	-0.1282	0.0623
17	-0.0009	0.0018	17	0.0777	0.0635
18	-0.0024	0.0018	18	0.0853	0.0632
19	-0.0023	0.0019	19	0.0557	0.0632
20	-0.0007	0.0019	20	0.0805	0.0629
21	-0.0011	0.0019	21	-0.0604	0.0631
22	-0.0032	0.0018	22	-0.0171	0.0630
23	0.0015	0.0019	23	-0.0675	0.0630
24	0.0000	0.0019	24	0.0863	0.0631
25	-0.0001	0.0019			
26	0.0000	0.0019			
27	-0.0007	0.0019			
28	0.0038	0.0019			
29	0.0013	0.0019			
30	0.0035	0.0019			
31	0.0018	0.0019			
32	0.0009	0.0018			
33	0.0014	0.0018			
34	0.0047	0.0018			
35	0.0011	0.0018			
36	0.0024	0.0018			

R^2 = 0.86 S.E.E. = 0.009 D.W. = 2.02
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

The Impact of RR Shocks On the Producer Price Index

	Shock			Change In Producer Price Index	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0006	0.0009	1	0.1916	0.0645
2	0.0001	0.0009	2	0.0024	0.0652
3	-0.0005	0.0009	3	-0.0378	0.0655
4	0.0010	0.0009	4	-0.0984	0.0655
5	0.0014	0.0009	5	0.0089	0.0656
6	-0.0006	0.0009	6	0.1073	0.0654
7	0.0001	0.0009	7	-0.0563	0.0653
8	0.0005	0.0009	8	0.0499	0.0652
9	-0.0013	0.0009	9	0.0743	0.0654
10	0.0009	0.0009	10	-0.0494	0.0653
11	-0.0016	0.0009	11	0.0873	0.0653
12	-0.0003	0.0009	12	0.1268	0.0653
13	0.0001	0.0009	13	-0.0707	0.0646
14	-0.0002	0.0009	14	-0.0201	0.0642
15	0.0010	0.0009	15	-0.0185	0.0639
16	-0.0004	0.0009	16	-0.0176	0.0634
17	0.0003	0.0009	17	0.0562	0.0632
18	-0.0012	0.0009	18	0.0287	0.0633
19	0.0005	0.0009	19	0.0091	0.0623
20	-0.0020	0.0009	20	0.0928	0.0625
21	0.0002	0.0009	21	0.0042	0.0627
22	-0.0001	0.0009	22	-0.0037	0.0626
23	-0.0013	0.0009	23	-0.0572	0.0622
24	-0.0019	0.0009	24	0.0451	0.0610
25	-0.0024	0.0009			
26	-0.0025	0.0010			
27	-0.0017	0.0010			
28	-0.0002	0.0010			
29	-0.0022	0.0010			
30	-0.0033	0.0010			
31	-0.0031	0.0010			
32	-0.0006	0.0010			
33	-0.0013	0.0010			
34	-0.0010	0.0010			
35	-0.0015	0.0010			
36	-0.0033	0.0010			
37	-0.0019	0.0010			
38	-0.0016	0.0010			
39	0.0001	0.0010			
40	-0.0017	0.0010			
41	-0.0007	0.0010			
42	-0.0029	0.0010			
43	-0.0013	0.0010			
44	-0.0003	0.0009			
45	-0.0015	0.0009			
46	0.0001	0.0009			
47	-0.0015	0.0009			
48	-0.0008	0.0009			

R^2 = 0.57 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 2.9

The Impact of RR Shocks On Industrial Production

	Shock			Change In Industrial Production	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0042	0.0017	1	0.0340	0.0544
2	0.0022	0.0017	2	0.0451	0.0541
3	-0.0040	0.0017	3	0.1183	0.0534
4	-0.0005	0.0017	4	0.0084	0.0537
5	-0.0037	0.0017	5	0.0554	0.0537
6	0.0002	0.0017	6	-0.0527	0.0538
7	-0.0004	0.0017	7	0.0364	0.0535
8	-0.0028	0.0017	8	-0.0021	0.0533
9	-0.0021	0.0017	9	0.0547	0.0535
10	-0.0039	0.0017	10	-0.0518	0.0529
11	-0.0025	0.0017	11	0.0428	0.0514
12	-0.0032	0.0017	12	0.3285	0.0518
13	-0.0013	0.0017	13	0.0000	0.0517
14	-0.0009	0.0017	14	-0.1899	0.0515
15	-0.0003	0.0017	15	-0.1308	0.0522
16	0.0016	0.0017	16	-0.1089	0.0528
17	-0.0005	0.0017	17	0.0843	0.0531
18	-0.0023	0.0017	18	0.0788	0.0531
19	-0.0021	0.0017	19	0.0574	0.0531
20	0.0001	0.0017	20	0.0392	0.0528
21	-0.0010	0.0017	21	-0.0573	0.0528
22	-0.0029	0.0017	22	-0.0502	0.0527
23	0.0020	0.0017	23	-0.0545	0.0527
24	-0.0001	0.0017	24	0.1215	0.0531
25	0.0001	0.0017			
26	0.0003	0.0017			
27	-0.0012	0.0017			
28	0.0036	0.0017			
29	0.0012	0.0017			
30	0.0033	0.0017			
31	0.0019	0.0017			
32	0.0005	0.0017			
33	0.0013	0.0016			
34	0.0054	0.0017			
35	0.0009	0.0017			
36	0.0028	0.0017			

$R^2 = 0.86$ S.E.E. = 0.009 D.W. = 2.00
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

The Impact of RR Shocks On the Producer Price Index

	Shock			Change In Producer Price Index	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0007	0.0009	1	0.1967	0.0555
2	0.0006	0.0009	2	-0.0578	0.0565
3	-0.0006	0.0009	3	0.0284	0.0567
4	0.0007	0.0009	4	-0.0286	0.0566
5	0.0019	0.0009	5	0.0411	0.0565
6	-0.0006	0.0009	6	0.0588	0.0564
7	0.0001	0.0009	7	0.0607	0.0560
8	0.0009	0.0009	8	0.0134	0.0560
9	-0.0015	0.0009	9	0.0712	0.0571
10	0.0004	0.0009	10	-0.0444	0.0574
11	-0.0018	0.0009	11	0.1518	0.0574
12	-0.0007	0.0009	12	0.1200	0.0581
13	0.0002	0.0009	13	-0.1040	0.0578
14	-0.0001	0.0009	14	0.0336	0.0575
15	0.0006	0.0009	15	-0.1131	0.0576
16	-0.0005	0.0009	16	-0.0410	0.0577
17	0.0001	0.0009	17	0.0569	0.0576
18	-0.0012	0.0009	18	0.0796	0.0577
19	0.0002	0.0009	19	-0.0674	0.0570
20	-0.0014	0.0009	20	0.0110	0.0573
21	0.0005	0.0009	21	0.0793	0.0573
22	-0.0006	0.0009	22	-0.0240	0.0575
23	-0.0012	0.0009	23	-0.0758	0.0573
24	-0.0019	0.0009	24	0.0629	0.0561
25	-0.0014	0.0009			
26	-0.0027	0.0009			
27	-0.0011	0.0009			
28	-0.0003	0.0009			
29	-0.0018	0.0009			
30	-0.0022	0.0009			
31	-0.0024	0.0010			
32	0.0001	0.0010			
33	-0.0007	0.0010			
34	0.0001	0.0010			
35	-0.0013	0.0010			
36	-0.0028	0.0010			
37	-0.0008	0.0010			
38	-0.0008	0.0010			
39	0.0001	0.0010			
40	-0.0014	0.0009			
41	-0.0001	0.0010			
42	-0.0027	0.0009			
43	-0.0008	0.0009			
44	0.0000	0.0001			
45	-0.0015	0.0009			
46	-0.0004	0.0009			
47	-0.0008	0.0009			
48	-0.0008	0.0009			

$R^2 = 0.49$ S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 2.10

The Impact of RR LDV Shocks On Industrial Production

	Shock			Change In Industrial Production	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0036	0.0018	1	0.0616	0.0638
2	0.0024	0.0018	2	-0.0160	0.0634
3	-0.0037	0.0018	3	0.1033	0.0630
4	-0.0017	0.0018	4	0.0414	0.0631
5	-0.0038	0.0018	5	0.0236	0.0631
6	-0.0001	0.0019	6	-0.0082	0.0630
7	-0.0014	0.0018	7	0.0128	0.0627
8	-0.0033	0.0019	8	0.0047	0.0626
9	-0.0027	0.0019	9	0.0324	0.0622
10	-0.0048	0.0018	10	-0.0380	0.0608
11	-0.0033	0.0019	11	0.0696	0.0592
12	-0.0038	0.0019	12	0.2884	0.0603
13	-0.0027	0.0019	13	0.0254	0.0609
14	-0.0009	0.0019	14	-0.1970	0.0604
15	-0.0008	0.0019	15	-0.1493	0.0611
16	0.0017	0.0019	16	-0.1200	0.0624
17	-0.0002	0.0019	17	0.0781	0.0638
18	-0.0024	0.0019	18	0.0871	0.0634
19	-0.0020	0.0019	19	0.0522	0.0634
20	-0.0014	0.0019	20	0.0889	0.0632
21	-0.0014	0.0019	21	-0.0597	0.0635
22	-0.0033	0.0019	22	-0.0197	0.0633
23	0.0015	0.0019	23	-0.0679	0.0633
24	0.0003	0.0019	24	0.0809	0.0634
25	0.0001	0.0019			
26	0.0002	0.0019			
27	-0.0007	0.0019			
28	0.0039	0.0019			
29	0.0015	0.0019			
30	0.0037	0.0019			
31	0.0020	0.0019			
32	0.0013	0.0018			
33	0.0012	0.0018			
34	0.0047	0.0018			
35	0.0015	0.0018			
36	0.0019	0.0018			

R^2 = 0.86   S.E.E. = 0.009   D.W. = 2.01
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

The Impact of RR LDV Shocks On the Producer Price Index

	Shock			Change In Producer Price Index	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0007	0.0009	1	0.1947	0.0646
2	0.0000	0.0009	2	0.0118	0.0652
3	-0.0006	0.0009	3	-0.0388	0.0654
4	0.0010	0.0009	4	-0.0910	0.0654
5	0.0016	0.0009	5	0.0154	0.0655
6	-0.0005	0.0009	6	0.1134	0.0652
7	-0.0001	0.0009	7	-0.0510	0.0653
8	0.0004	0.0009	8	0.0480	0.0652
9	-0.0013	0.0009	9	0.0824	0.0652
10	0.0006	0.0009	10	-0.0450	0.0653
11	-0.0015	0.0009	11	0.0970	0.0654
12	-0.0005	0.0009	12	0.1254	0.0654
13	-0.0001	0.0009	13	-0.0715	0.0649
14	-0.0004	0.0009	14	-0.0185	0.0644
15	0.0009	0.0009	15	-0.0128	0.0641
16	-0.0003	0.0009	16	-0.0229	0.0635
17	0.0003	0.0009	17	0.0553	0.0633
18	-0.0010	0.0009	18	0.0252	0.0634
19	0.0001	0.0009	19	0.0081	0.0623
20	-0.0020	0.0009	20	0.0880	0.0626
21	0.0001	0.0009	21	-0.0049	0.0628
22	0.0000	0.0009	22	-0.0070	0.0626
23	-0.0013	0.0009	23	-0.0670	0.0622
24	-0.0019	0.0009	24	0.0443	0.0609
25	-0.0024	0.0009			
26	-0.0027	0.0009			
27	-0.0020	0.0010			
28	-0.0001	0.0010			
29	-0.0018	0.0010			
30	-0.0033	0.0010			
31	-0.0029	0.0010			
32	-0.0008	0.0010			
33	-0.0011	0.0010			
34	-0.0009	0.0010			
35	-0.0011	0.0010			
36	-0.0033	0.0010			
37	-0.0018	0.0010			
38	-0.0015	0.0010			
39	-0.0001	0.0010			
40	-0.0014	0.0010			
41	-0.0004	0.0010			
42	-0.0027	0.0010			
43	-0.0015	0.0010			
44	-0.0003	0.0009			
45	-0.0014	0.0009			
46	0.0001	0.0009			
47	-0.0015	0.0009			
48	-0.0008	0.0009			

R^2 = 0.56   S.E.E. = 0.005   D.W. = 2.00
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 2.11

The Impact of RR LDV Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0040	0.0017	1	0.0294	0.0545
2	0.0018	0.0017	2	0.0424	0.0541
3	-0.0038	0.0017	3	0.1164	0.0535
4	-0.0012	0.0017	4	0.0010	0.0538
5	-0.0036	0.0017	5	0.0534	0.0538
6	0.0002	0.0017	6	-0.0567	0.0538
7	-0.0012	0.0017	7	0.0333	0.0535
8	-0.0033	0.0017	8	-0.0038	0.0532
9	-0.0030	0.0017	9	0.0520	0.0534
10	-0.0040	0.0017	10	-0.0442	0.0529
11	-0.0034	0.0017	11	0.0419	0.0512
12	-0.0036	0.0017	12	0.3315	0.0517
13	-0.0019	0.0017	13	0.0020	0.0517
14	-0.0011	0.0017	14	-0.1851	0.0515
15	-0.0009	0.0017	15	-0.1297	0.0520
16	0.0013	0.0017	16	-0.1017	0.0527
17	0.0003	0.0017	17	0.0876	0.0531
18	-0.0023	0.0017	18	0.0800	0.0532
19	-0.0019	0.0017	19	0.0583	0.0532
20	-0.0006	0.0017	20	0.0461	0.0529
21	-0.0013	0.0017	21	-0.0530	0.0530
22	-0.0027	0.0017	22	-0.0527	0.0529
23	0.0022	0.0017	23	-0.0548	0.0529
24	0.0004	0.0017	24	0.1224	0.0534
25	0.0004	0.0017			
26	0.0006	0.0017			
27	-0.0009	0.0017			
28	0.0037	0.0017			
29	0.0015	0.0017			
30	0.0037	0.0017			
31	0.0023	0.0017			
32	0.0011	0.0017			
33	0.0011	0.0017			
34	0.0056	0.0017			
35	0.0017	0.0017			
36	0.0024	0.0017			

R^2 = 0.86 S.E.E. = 0.009 D.W. = 2.00
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

The Impact of RR LDV Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0008	0.0009	1	0.1925	0.0555
2	0.0005	0.0009	2	-0.0538	0.0564
3	-0.0007	0.0009	3	0.0178	0.0565
4	0.0006	0.0009	4	-0.0272	0.0564
5	0.0021	0.0009	5	0.0393	0.0563
6	-0.0006	0.0009	6	0.0589	0.0561
7	0.0000	0.0009	7	0.0580	0.0558
8	0.0007	0.0009	8	0.0095	0.0557
9	-0.0015	0.0009	9	0.0712	0.0568
10	0.0001	0.0009	10	-0.0445	0.0572
11	-0.0018	0.0009	11	0.1541	0.0572
12	-0.0009	0.0009	12	0.1158	0.0579
13	-0.0001	0.0009	13	-0.1071	0.0577
14	-0.0002	0.0009	14	0.0345	0.0573
15	0.0005	0.0009	15	-0.1070	0.0575
16	-0.0004	0.0009	16	-0.0495	0.0574
17	0.0001	0.0009	17	0.0577	0.0573
18	-0.0010	0.0009	18	0.0771	0.0574
19	-0.0002	0.0009	19	-0.0632	0.0567
20	-0.0016	0.0009	20	0.0071	0.0570
21	0.0005	0.0009	21	0.0748	0.0571
22	-0.0005	0.0009	22	-0.0249	0.0572
23	-0.0014	0.0009	23	-0.0799	0.0570
24	-0.0019	0.0009	24	0.0680	0.0558
25	-0.0017	0.0009			
26	-0.0029	0.0009			
27	-0.0016	0.0009			
28	-0.0004	0.0009			
29	-0.0017	0.0009			
30	-0.0025	0.0009			
31	-0.0024	0.0010			
32	-0.0004	0.0010			
33	-0.0007	0.0010			
34	-0.0001	0.0010			
35	-0.0011	0.0010			
36	-0.0031	0.0009			
37	-0.0010	0.0010			
38	-0.0010	0.0010			
39	-0.0004	0.0010			
40	-0.0014	0.0009			
41	0.0000	0.0009			
42	-0.0028	0.0009			
43	-0.0013	0.0009			
44	-0.0002	0.0009			
45	-0.0016	0.0009			
46	-0.0005	0.0009			
47	-0.0010	0.0009			
48	-0.0009	0.0009			

R^2 = 0.50 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 2.12

The Impact of RR Adjusted Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0044	0.0017	1	0.0318	0.0545
2	0.0022	0.0017	2	0.0436	0.0541
3	-0.0037	0.0017	3	0.1200	0.0534
4	-0.0009	0.0017	4	0.0098	0.0538
5	-0.0041	0.0017	5	0.0564	0.0538
6	0.0001	0.0017	6	-0.0553	0.0538
7	-0.0007	0.0017	7	0.0347	0.0535
8	-0.0027	0.0017	8	-0.0067	0.0533
9	-0.0023	0.0017	9	0.0528	0.0535
10	-0.0040	0.0017	10	-0.0491	0.0529
11	-0.0030	0.0017	11	0.0453	0.0513
12	-0.0033	0.0017	12	0.3317	0.0518
13	-0.0018	0.0017	13	0.0016	0.0518
14	-0.0010	0.0017	14	-0.1880	0.0515
15	-0.0006	0.0017	15	-0.1325	0.0522
16	0.0014	0.0017	16	-0.1112	0.0529
17	0.0000	0.0017	17	0.0845	0.0531
18	-0.0022	0.0017	18	0.0763	0.0531
19	-0.0021	0.0017	19	0.0566	0.0531
20	-0.0002	0.0017	20	0.0405	0.0528
21	-0.0011	0.0017	21	-0.0591	0.0528
22	-0.0028	0.0017	22	-0.0550	0.0527
23	0.0019	0.0017	23	-0.0577	0.0527
24	0.0000	0.0017	24	0.1166	0.0532
25	0.0005	0.0017			
26	0.0002	0.0017			
27	-0.0013	0.0017			
28	0.0034	0.0017			
29	0.0013	0.0017			
30	0.0035	0.0017			
31	0.0021	0.0017			
32	0.0006	0.0017			
33	0.0011	0.0017			
34	0.0055	0.0017			
35	0.0015	0.0017			
36	0.0026	0.0017			

R^2 = 0.86 S.E.E. = 0.009 D.W. = 2.00
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

The Impact of RR Adjusted Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0008	0.0009	1	0.1934	0.0555
2	0.0007	0.0009	2	-0.0605	0.0564
3	-0.0006	0.0009	3	0.0201	0.0566
4	0.0006	0.0009	4	-0.0278	0.0565
5	0.0022	0.0009	5	0.0388	0.0564
6	-0.0006	0.0009	6	0.0590	0.0562
7	0.0000	0.0009	7	0.0589	0.0559
8	0.0009	0.0009	8	0.0153	0.0557
9	-0.0015	0.0009	9	0.0709	0.0568
10	0.0002	0.0009	10	-0.0437	0.0572
11	-0.0019	0.0009	11	0.1530	0.0572
12	-0.0008	0.0009	12	0.1161	0.0579
13	-0.0001	0.0009	13	-0.1088	0.0576
14	-0.0001	0.0009	14	0.0328	0.0572
15	0.0005	0.0009	15	-0.1126	0.0574
16	-0.0005	0.0009	16	-0.0486	0.0574
17	0.0000	0.0009	17	0.0574	0.0572
18	-0.0010	0.0009	18	0.0747	0.0573
19	-0.0001	0.0009	19	-0.0653	0.0567
20	-0.0016	0.0009	20	0.0095	0.0569
21	0.0005	0.0009	21	0.0794	0.0570
22	-0.0005	0.0009	22	-0.0237	0.0571
23	-0.0013	0.0009	23	-0.0752	0.0570
24	-0.0019	0.0009	24	0.0688	0.0558
25	-0.0017	0.0009			
26	-0.0029	0.0009			
27	-0.0014	0.0009			
28	-0.0004	0.0009			
29	-0.0019	0.0010			
30	-0.0023	0.0010			
31	-0.0026	0.0010			
32	-0.0002	0.0010			
33	-0.0007	0.0010			
34	0.0001	0.0010			
35	-0.0012	0.0010			
36	-0.0030	0.0010			
37	-0.0009	0.0010			
38	-0.0010	0.0010			
39	-0.0001	0.0010			
40	-0.0014	0.0010			
41	0.0000	0.0010			
42	-0.0028	0.0009			
43	-0.0012	0.0009			
44	0.0000	0.0009			
45	-0.0016	0.0009			
46	-0.0005	0.0009			
47	-0.0009	0.0009			
48	-0.0010	0.0009			

R^2 = 0.50 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

$$y_t = c_1 S_{t-1} + \left[c_1 (1+b_1) + c_2 \right] S_{t-2} + \ldots + c_{36} S_{t-36} + (1+b_1) c_2 S_{t-3} + \ldots + (1+b_1) c_{36} S_{t-37} +$$
$$(1+b_1)^2 y_{t-2} + (1+b_1)(b_2 - b_1) y_{t-3} - (1+b_1) b_2 y_{t-4} + \ldots + (1+b_1) b_{24} y_{t-25} - (1+b_1) b_{24} y_{t-26} +$$
$$(1+b_1) e_{t-1} + (b_2 - b_1) y_{t-2} - b_2 y_{t-3} + \ldots + b_{24} y_{t-24} - b_{24} y_{t-25} + e_t.$$

If this recursive substitution is continued, the entire IRF will eventually be obtained. Looking at the equation shows that a one percentage point increase in the shock measure S_t will change the level of output by c_1 one month after the shock. The cumulative effect on output two months after the shock would be $c_1(1 + b_1) + c_2$. This process is continued until the entire IRF is derived.

Alternatively, the same results can be generated using polynomial division and summation to obtain a cumulative impulse response function. In this chapter, both the price and output cumulative impulse response functions are obtained using polynomial division. [10]

Let x represent either output or price. To obtain a cumulative impulse response function from a single equation, the equation[11]

$$\Delta x_t = \sum_{i=1}^{24} b_i \Delta x_{t-i} + \sum_{j=1}^{48} c_j S_{t-j}$$

is expanded show all terms while extracting the lag polynomial, L,

$$\Delta x_t = b_1 \Delta x_t L + b_2 \Delta x_t L^2 + \ldots + b_{24} \Delta x_t L^{24} + c_1 S_t L + c_2 S_t L^2 + \ldots + c_{48} S_t L^{48}.$$

This simplifies to the following equation:

$$\left(1 - b_1 L - b_2 L^2 - \ldots - b_{24} L^{24}\right) \Delta x_t = \left(c_1 L + c_2 L^2 + \ldots + c_{48} L^{48}\right) S_t.$$

Rearranging terms shows that the effect of S_t on the change in output or price is given by:

$$\Delta x_t = \left(\frac{c_1 L + c_2 L^2 + \ldots + c_{48} L^{48}}{1 - b_1 L - b_2 L^2 - \ldots - b_{24} L^{24}} \right) S_t.$$

If the term inside the brackets is expanded by polynomial division, the relationship between Δx_t and the shock measure is shown as

[10] The method of adding forty-eight lags to the shock variable is shown. The procedure is the same when adding thirty-six lags, as in the output equation.

[11] The constant and monthly dummy variables are not relevant to the analysis and hence are not shown.

$$\Delta x_t = (c_1 L + (c_2 + c_1)L^2 + [c_1 b_1^2 + c_1 b_2 + c_2 b_1 + c_2] + L^3 + \cdots)S_t.$$

The effect of a 1% increase in S_t will be zero in the month of the shock. The effect on Δx_t the month after the shock is c_1. The cumulative effect on Δx_t two months after the shock is $c_1 + (c_2 + c_1 b_1)$. This is the same result obtained as the method of recursive substitution used by RR. The response in each month is calculated through forty-eight months.

Confidence interval bands are obtained in a similar manner to RR. Coefficients are randomly drawn from a multivariate normal distribution with a variance-covariance matrix of the coefficients from the regression. Five hundred responses to a 1% increase in the shock measure are computed at each horizon in the IRF, and the standard deviation across these responses is used as the standard error of the IRF. The standard error is added to and subtracted from the response at each month to obtain upper and lower confidence interval (CI) bands, respectively.

Figure 2.2 first illustrates the output and price IRF's for equations that use the original replicated residuals and the original sample residuals from the lagged dependent variable specification. It then shows the results using the residuals from the RR specification from the 2003 sample, the residuals from the 2003 lagged dependent variable specification, and the residuals from the 2003 sample adjusted for serial correlation.

The point estimates are the solid lines and the dotted lines represent one standard deviation confidence intervals. For all responses, output falls significantly with a lag, but returns over time to its initial value. For the original and extended sample residuals with no serial correlation correction, the maximum effect occurs 27 months after the shock. The lagged dependent variable specification produces maximum responses in output that occur 24 months after the shock for the original sample and after 27 months for the extended sample. The CI bands span zero 47 months and 37 months after the shock for the original and extended samples, respectively. The PW adjusted residuals from the extended sample produce a maximum effect 24 months after the shock. For the original sample replication, the CI bands began to span the origin 40 months after the shock. For the extended sample, this occurs 37 months after

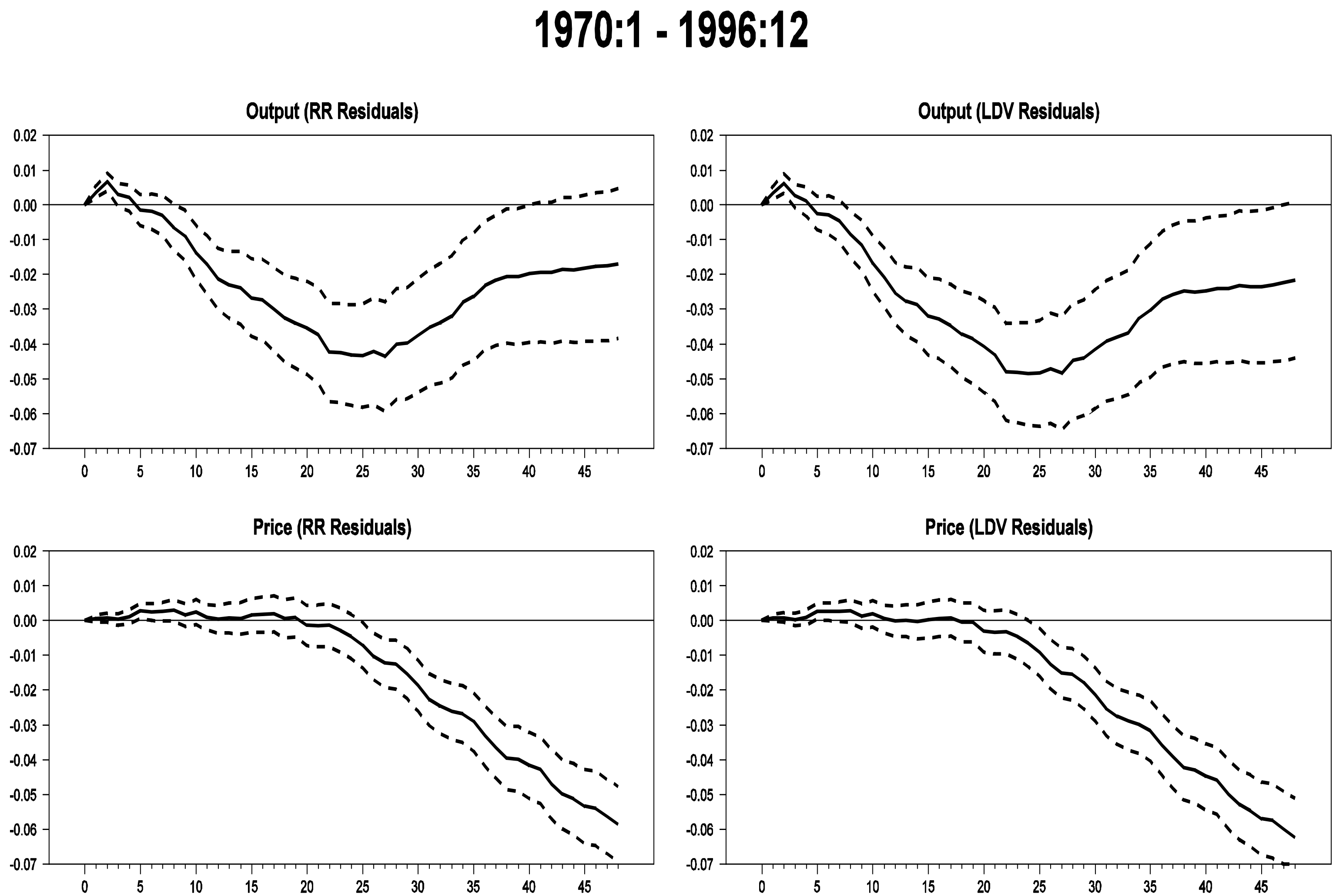
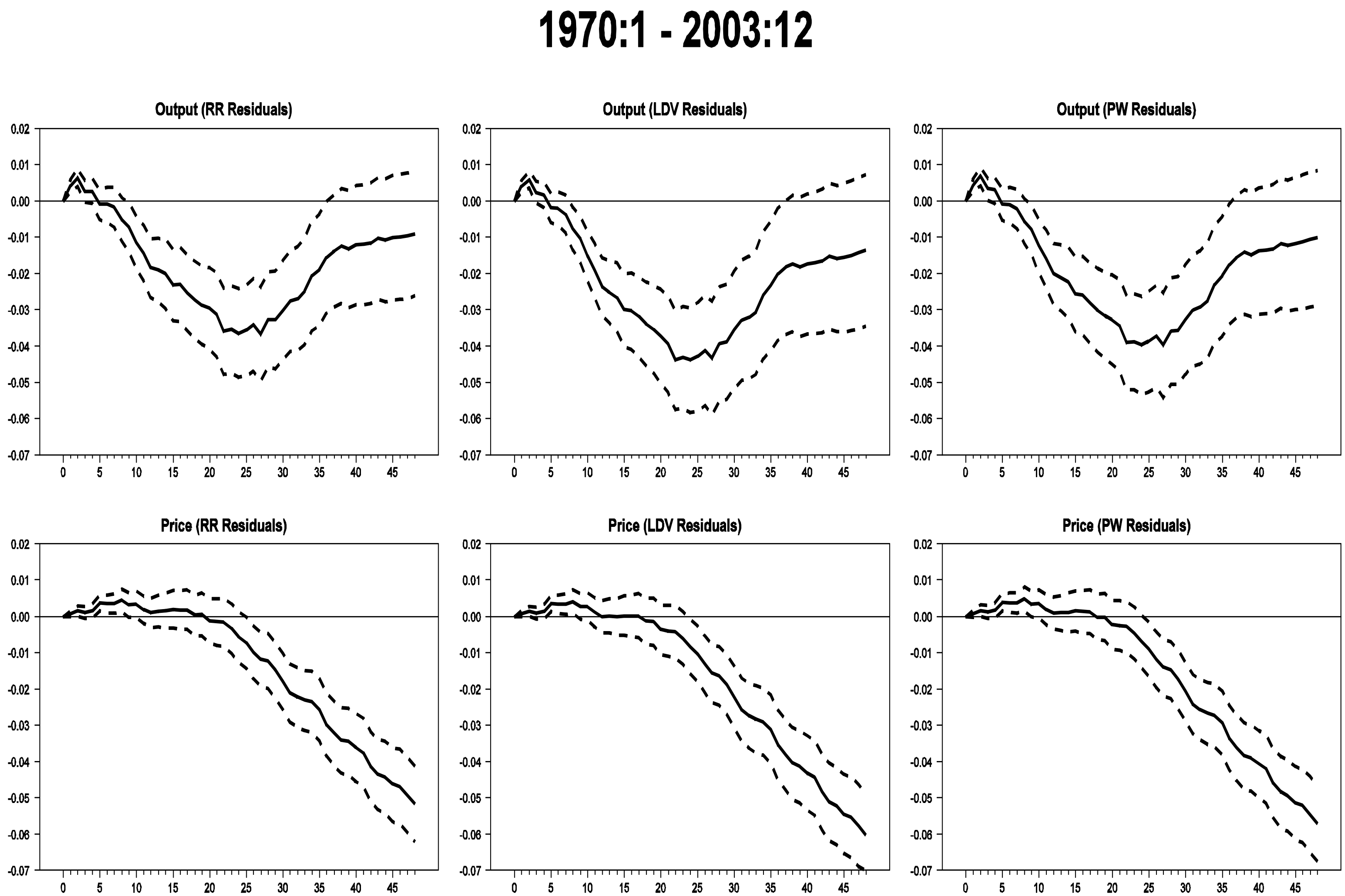


Figure 2.2 - Single EquationImpulse Response Functions

(fig. 2.2 cont'd)


1970:1 - 2003:12
Output (RR Residuals)
Output (LDV Residuals)
Output (PW Residuals)
Price (RR Residuals)
Price (LDV Residuals)
Price (PW Residuals)
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
0
5
10
15
20
25
30
35
40
45

the shock for the residuals with no serial correlation correction, the PW adjusted residuals, and the LDV specification residuals. A contractionary monetary policy shock generates a significantly lower price level in the long-run, although a significantly negative effect emerges only with a very long lag of a little over two years. All responses in prices become significant 25 months after the shock, with the exception of the extended sample lagged dependent variable specification. This response becomes significant 24 months after the shock. The maximum responses of output and price are similar across both samples and methods. The maximum effects are compared in Table 2.13.

Table 2.13 - Comparison of Maximum Effects – Single Equation IRF's

Method for Obtaining Residuals	Method Sample Period	Maximum Effect on Output	Maximum Effect on Prices
Original RR	1969 - 1996	-4.3%	-5.9%
	1996 - 2003	-3.7%	-5.2%
RR with Lagged Dependent Variable Specification	1969 - 1996	-4.9%	-6.2%
	1969 - 2003	-4.4%	-6.0%
Serial Correlation Correction	1969 - 2003	-4.0%	-5.7%

The LDV specification for the original sample produces larger maximum responses than the RR replication. The maximum effect on output is 0.6 percentage points larger than the original RR sample and the maximum effect on prices is 0.3 percentage points larger. Compared to the RR results for the original sample, the maximum effects of the shock on output and prices become somewhat smaller when extending the sample to 2003 for the methods with and without a serial correlation correction. Looking at the original method for the extended sample shows that the maximum response of output is 0.6 percentage points smaller and the maximum response of prices is 0.7 percentage points smaller when compared to the original sample RR results. When using the PW correction, the maximum effects on output and prices are 0.3 percentage points and 0.2 percentage points smaller, respectively. However, the

LDV specification for the extended sample produces maximum responses 0.1 percentage points larger than the original results for both output and prices. The extended sample LDV specification also produces larger maximum effects than the original method for the extended sample. The maximum effect on output is 0.7 percentage points larger while the maximum response of prices is 0.8 percentage points larger. The PW method produces responses in output and prices that are 0.3 percentage points and 0.5 percentage points larger, respectively, than the original RR method in the extended sample. The LDV specification produces the largest effects on output and prices for all samples.

Figure 2.3 shows comparisons among the point estimates and CI bands for all specifications. It first plots the original RR point estimates with the CI bands obtained from the original sample lagged dependent variable specification. The point estimates from the original sample lagged dependent variable specification are then plotted with the original RR CI bands. Next, Figure 2.3 the RR original sample point estimates with the CI bands obtained from the RR extended sample with no serial correlation correction. It then plots the 2003 sample point estimates with the original sample RR CI bands. Figure 2.3 then plots the original RR point estimates with the CI bands obtained from the extended sample lagged dependent variable specification. The point estimates from the extended sample lagged dependent variable specification are plotted with the original RR CI bands. Figure 2.3 then plots the RR original sample point estimates with the CI bands obtained from the RR 2003 sample with a correction for serial correlation. It then plots the serial correlation correction for the 2003 sample point estimates with the original sample RR CI bands. Figure 2.3 next plots the RR extended sample point estimates with the CI bands obtained from the extended sample lagged dependent variable specification. The point estimates from the extended sample lagged dependent variable specification are plotted with the extended sample RR CI bands. Figure 2.3 continues by plotting the RR extended sample point estimates with the CI bands obtained from the RR 2003 sample with a correction for serial correlation. It then plots the serial correlation correction specification for the 2003 sample point estimates with the extended sample RR CI bands. Finally, Figure 2.3 plots the serial correlation correction point estimates with the CI bands obtained from the RR extended sample lagged dependent variable specification. It then plots the extended

sample lagged dependent variable specification point estimates with the serial correlation correction CI bands. If point estimates lie outside the CI bands, the responses are interpreted as significantly different.

Figure 2.3 shows there are no significant differences among any of the responses across samples or methods. It is worth noting that the responses of output from the 2003 sample are somewhat weaker than those from the original sample but still lie within the original sample CI bands.

2.6 Vector Autoregression Analysis

RR further explore the effects on output and prices by estimating a monthly three variable VAR that includes a cumulated measure of their monetary policy shocks as the measure of monetary policy. Since VAR's are often estimated to examine the effects of monetary policy on macroeconomic variables, including the new measure of shocks in a VAR as a measure of monetary policy allows for a more direct comparison with earlier studies. Many standard VARs use the federal funds rate in levels as the measure of monetary policy. However, the measures of monetary policy shocks from equation (1) are changes in the intended funds rate not explained by the Greenbook forecasts. Therefore, the shocks are cumulated to obtain a measure in levels that can be included in the VAR.

The VAR used is based on Christiano et. al (1996) and uses a standard Choleski decomposition for identification of structural shocks in the VAR. The ordering is as follows: output, price level, monetary policy measure. This assumes monetary policy responds contemporaneously to output and prices but has only a lagged effect on these variables. This implies that the FOMC will change monetary policy contemporaneously due to a change in output or prices but this change will take time to have an effect. This Choleski identification assumes that monetary policy affects the economy with a lag. Following RR, output is represented by the log of the index of industrial production and the price level is represented by the log of the producer price index. This VAR is replicated for the original sample monetary policy shocks and is extended for the 2003 sample as well. Each shock measure is cumulated to enter the VAR in levels as the measure of monetary policy. Each VAR contains thirty-six lags of all variables as well as a deterministic constant and seasonal monthly dummy variables.

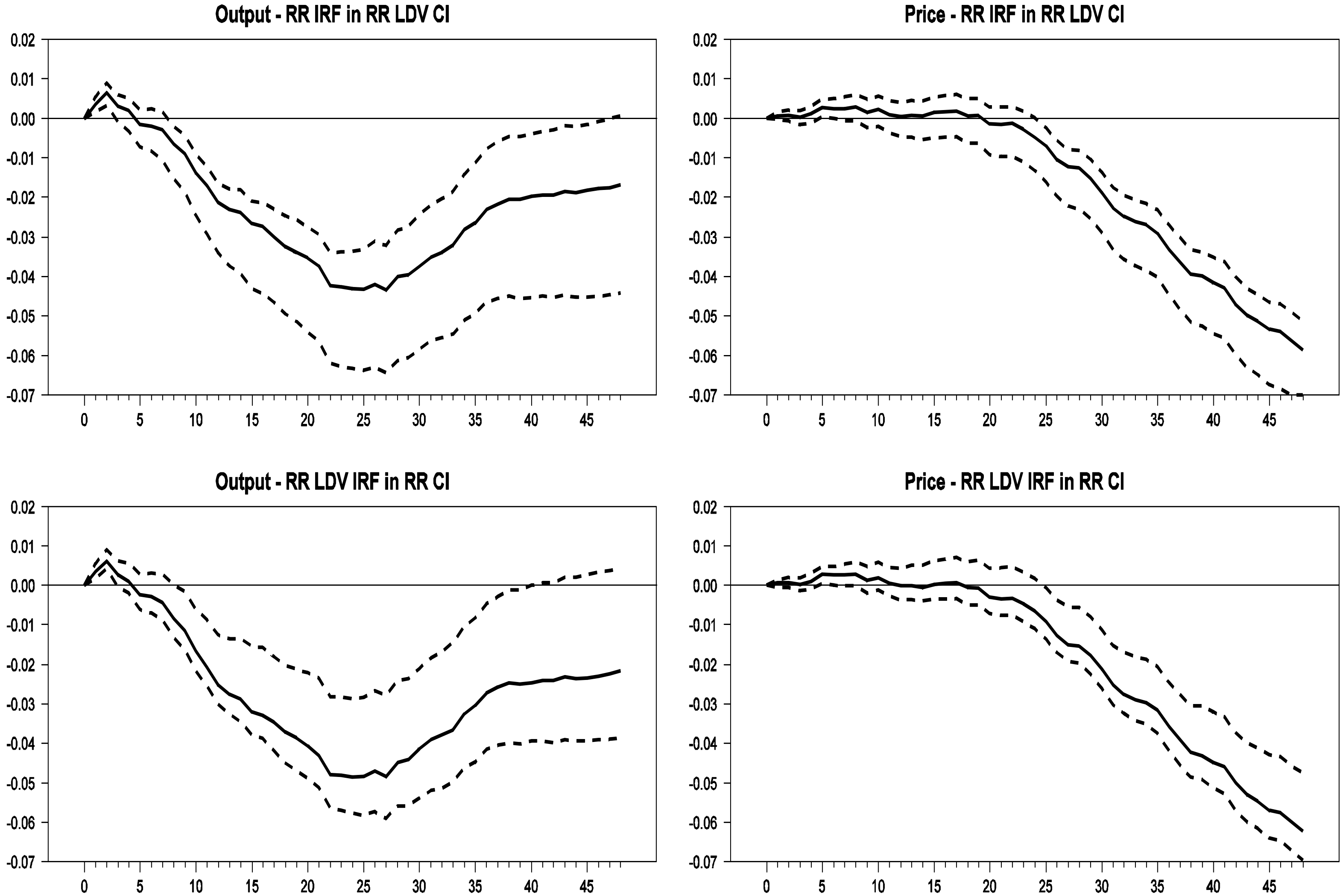
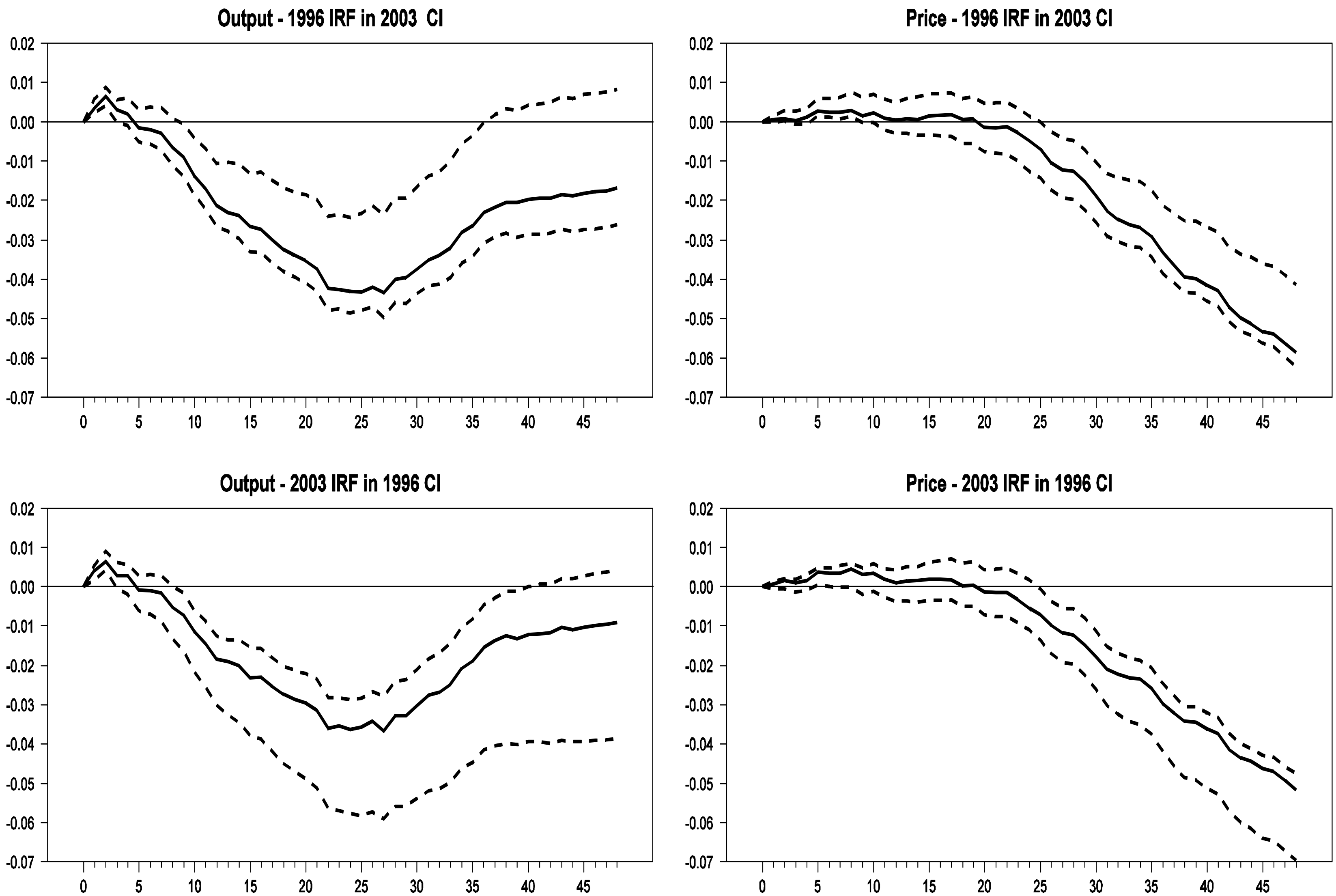


Figure 2.3 – Comparisons of Single Equation Impulse Response Functions - a

(fig. 2.3 cont'd) b



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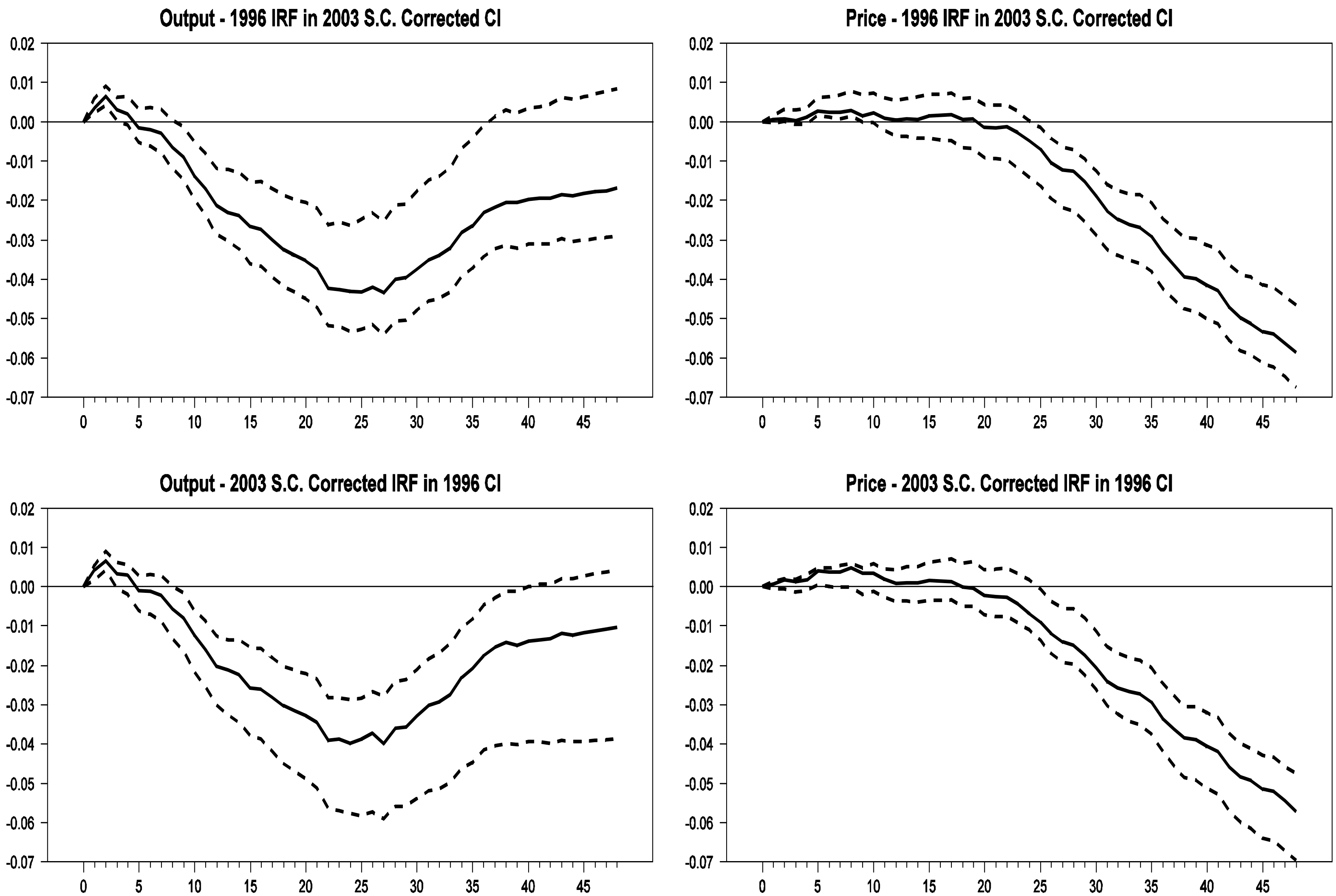

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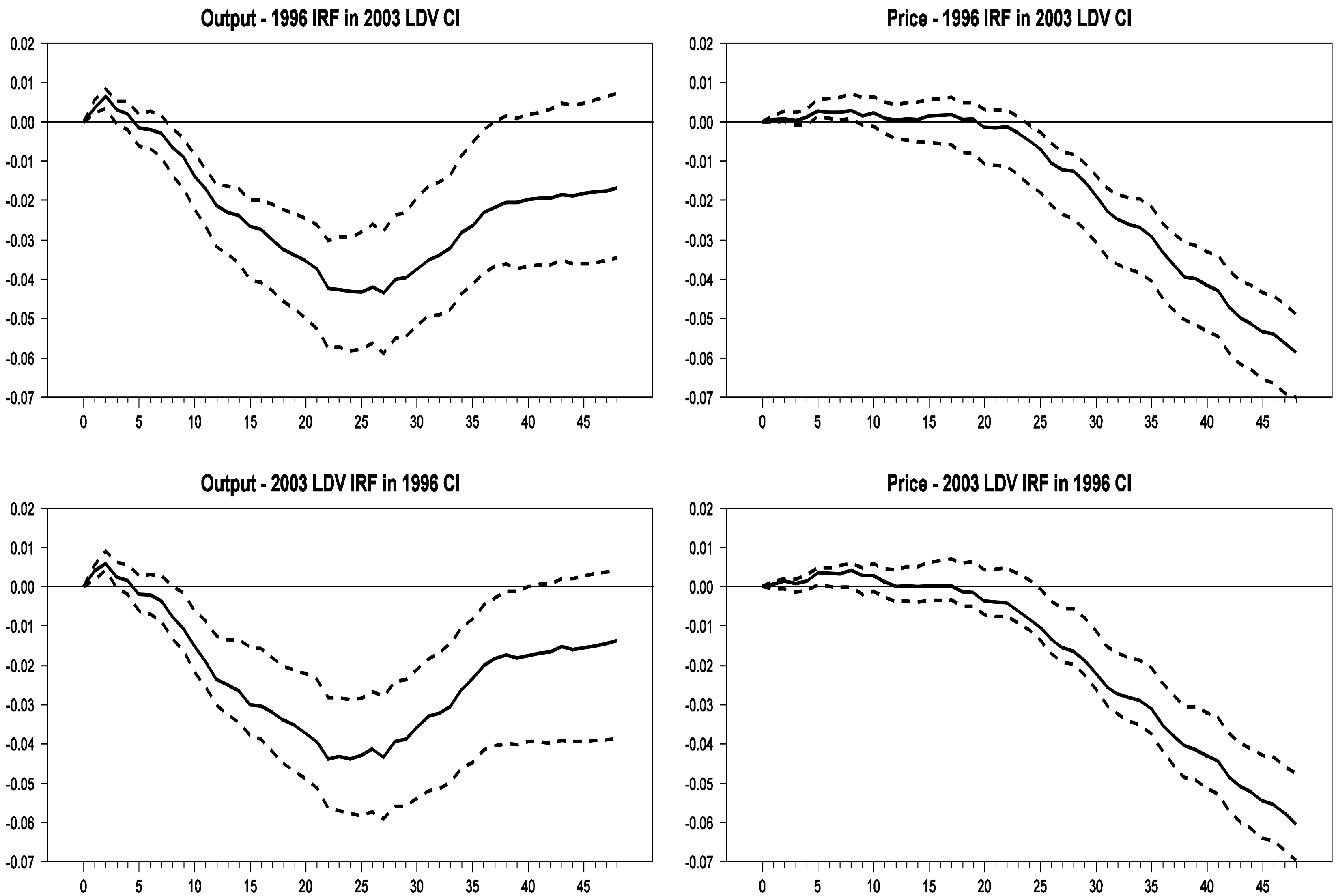

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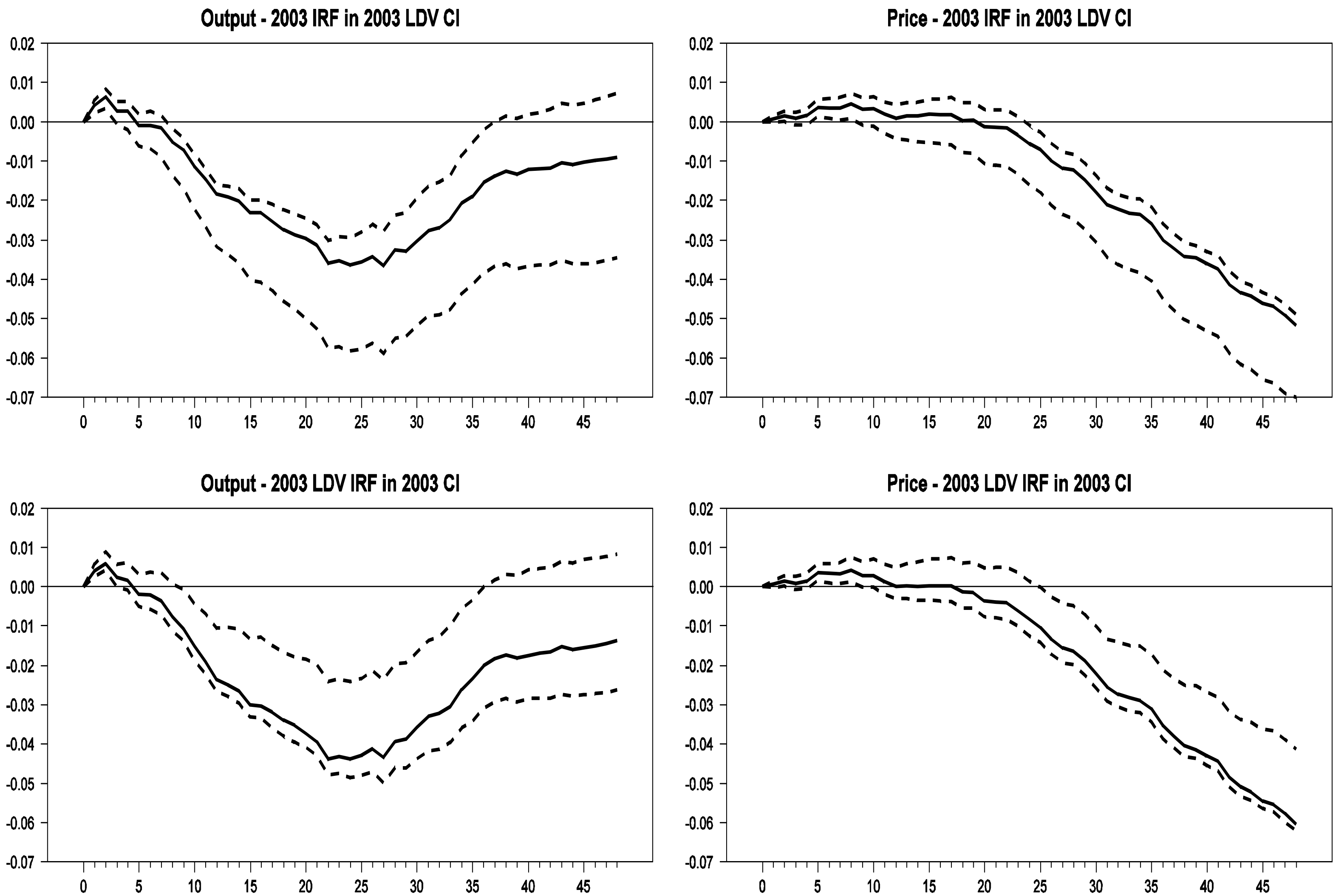

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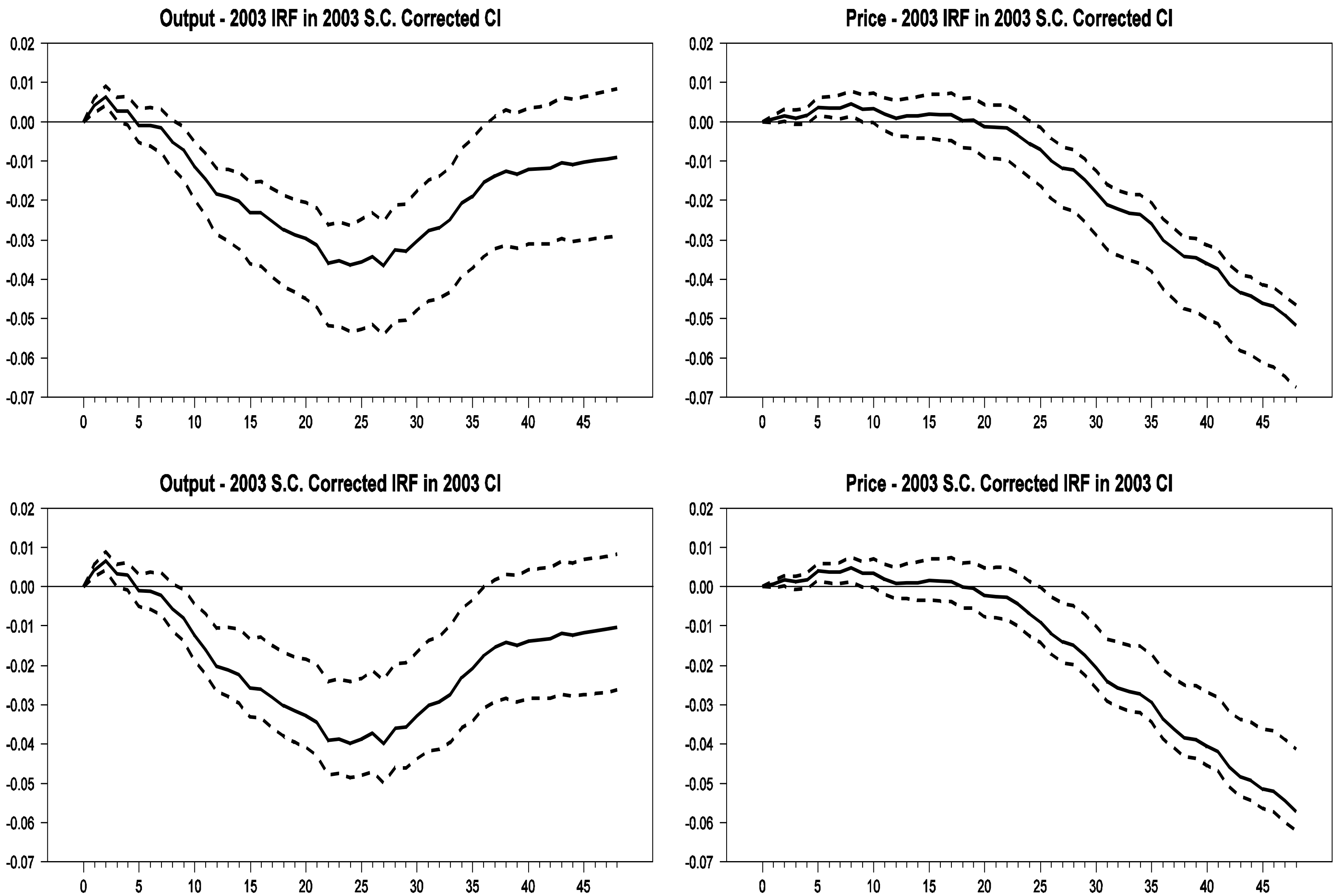

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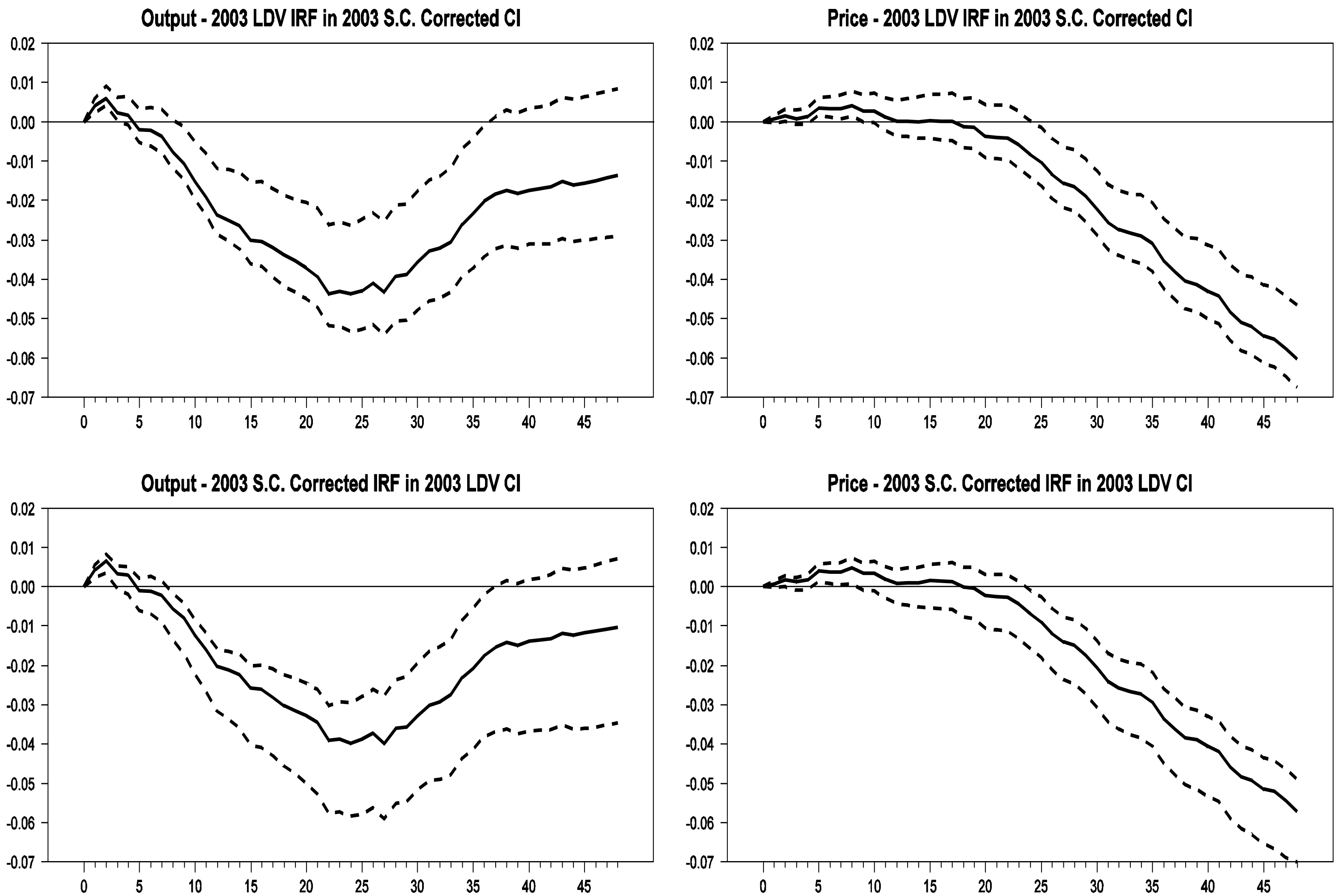


Figure 2.4 illustrates the output, price, and monetary policy measure IRF's for the original replicated residuals and the residuals obtained from the lagged dependent variable specification for the original sample. It then plots the IRF's obtained from the unadjusted residuals from the 2003 sample, the extended sample lagged dependent variable specification, and the residuals from the 2003 sample corrected for serial correlation.

The point estimates are the solid lines and the dotted lines represent one standard deviation confidence intervals. The responses display similar patterns to the single equation IRF's; however, the magnitudes of the responses are somewhat smaller. In the VARs, output falls significantly with a lag, but returns over time to its initial value. For the original sample, the maximum effect occurs 24 months after the shock. The residuals from the original sample using the LDV specification produce a maximum effect on output 23 months after the shock. Both the uncorrected residuals and residuals corrected for serial correlation from the extended sample produce a maximum effect 22 months after the shock. The residuals from the LDV extended sample specification produce a maximum effect after 23 months. For the original sample RR residuals, the CI bands began to span the origin 34 months after the shock. The original sample LDV specification output CI bands span the origin 33 months after the shock. For the extended sample to 2003, the output CI bands span the origin 34 months after the shock for the responses from the residual measures with no serial correlation correction, the residuals with the PW correction, and the residuals from the LDV specification. Once again, a contractionary monetary policy shock generates a significantly lower price level in the long-run. All responses in prices become significant in less that two years after the shock. The responses from the original sample and extended sample residuals with no adjustment for serial correlation become significant 18 months after the shock. For the residuals corrected for serial correlation, the response in prices become significant 17 months after the shock. The responses from the original sample and extended sample residuals from the LDV specification both become significant 11 months after the shock. Extending the sample appears to reduce the maximum effect on output and prices. The maximum effects are compared in Table 2.14.

1970:1 - 1996:12

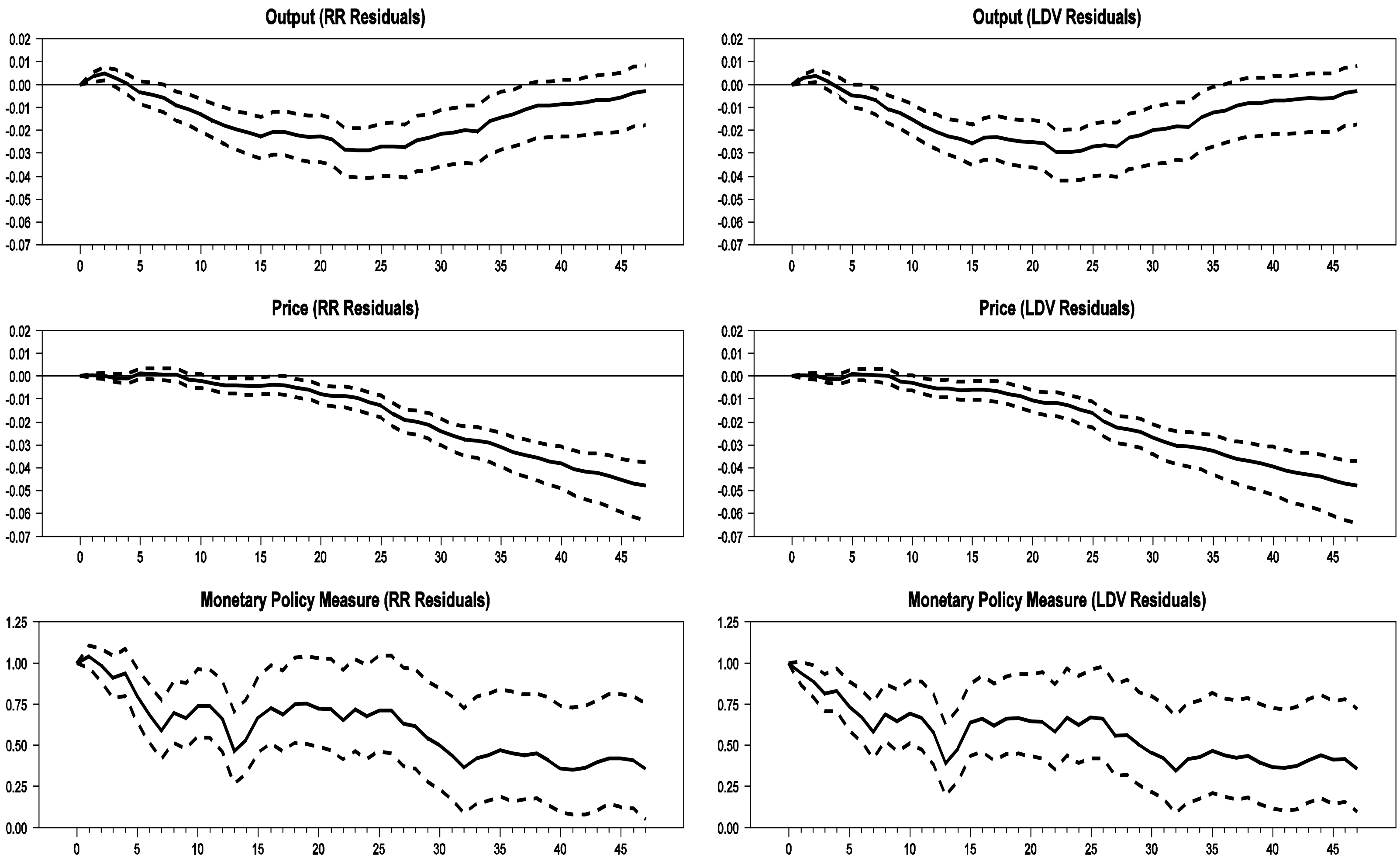


Figure 2.4 – VAR Impulse Response Functions

(fig. 2.4 cont'd)

1970:1 - 2003:12

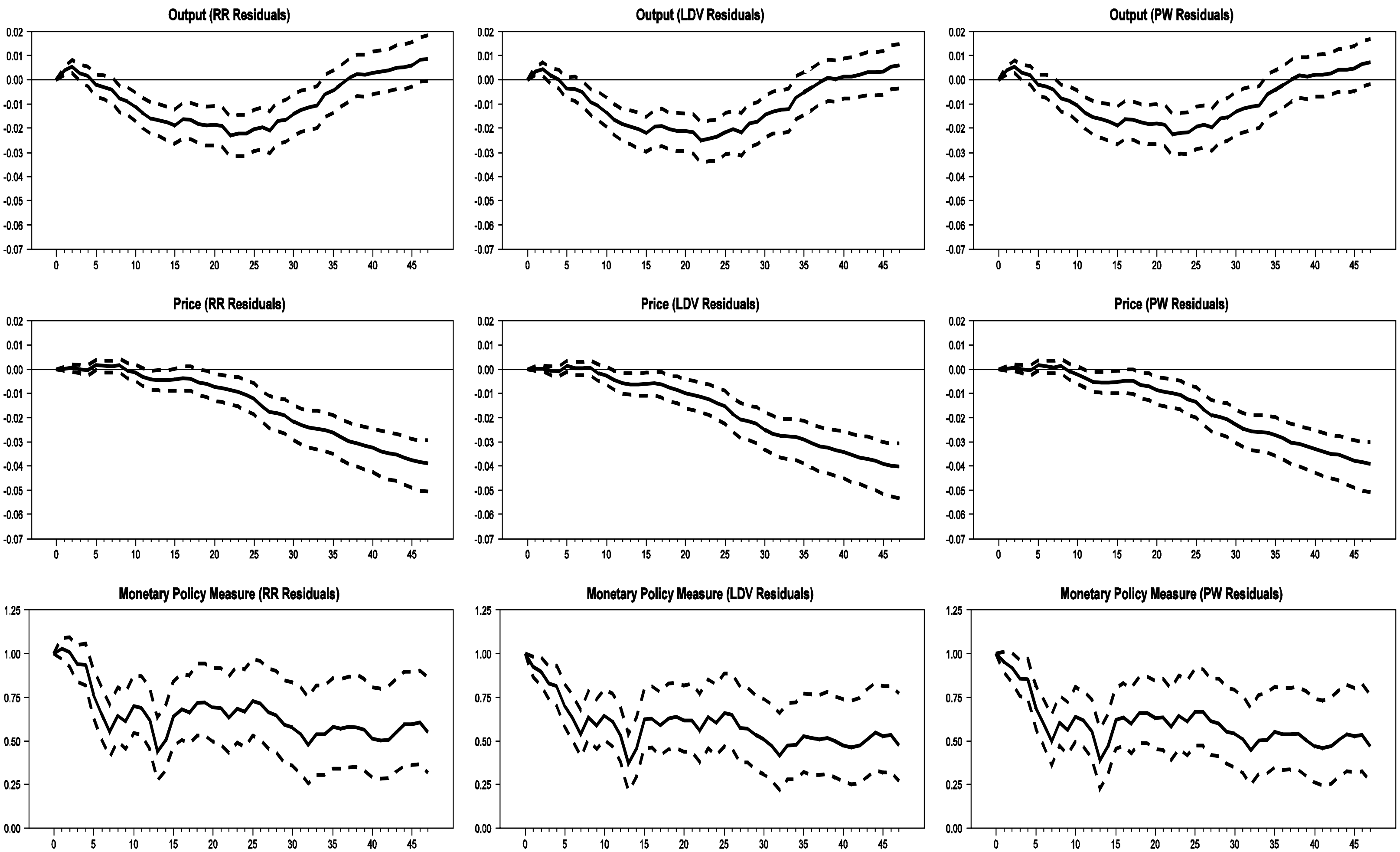


Table 2.14 - Comparison of Maximum Effects - VAR

Method for Obtaining Residuals	Method Sample Period	Maximum Effect on Output	Maximum Effect on Prices
Original RR	1969 - 1996	-2.9%	-4.8%
	1996 - 2003	-2.3%	-3.9%
RR with Lagged DependentVariable Specification	1969 - 1996	-3.0%	-4.8%
	1969 - 2003	-2.5%	-4.0%
Serial Correlation Correction	1969 - 2003	-2.2%	-3.9%

The VARs produce much smaller maximum effects on output and prices than do the single equation estimates. For the original sample with the RR specification residuals, the maximum effect on output is 1.4 percentage points smaller than from the single-equation IRF's while it is 1.1 percentage points smaller for prices. For the original sample lagged dependent variable specification, the maximum effect on output is 1.9 percentage points smaller than from the single-equation IRF's while it is 1.4 percentage points smaller for prices. Extending the sample produces a 1.4 percentage point smaller maximum effect on output for the VAR and 1.2 percentage point smaller effect for prices than for the RR specification residuals. When the lagged dependent variable specification is extended to 2003, the maximum response in output is 1.9 percentage points smaller in the VAR while the maximum response of prices is 2.0 percentage points smaller. Adjusting the extended sample residuals for serial correlation produces a 1.8 percentage point decrease in the maximum effect on output and a 1.8 percentage smaller maximum effect on price.

Comparison among the VAR results shows the LDV specification for the original sample produces a 0.1 percentage point larger maximum response in output and the same maximum effect on prices, as compared to the original sample RR results. Extending the sample weakens the maximum responses compared to the original sample RR results. The LDV specification for the extended sample produces a maximum effect on output 0.4 percentage points smaller and a maximum effect on prices 0.8 percentage

points smaller than the original RR sample results. The original RR shocks with no correction for serial correlation produce a maximum effect on output that is 0.6 percentage points smaller and a maximum effect on prices that is 0.9 percentage points smaller than the original results.. The RR shocks with a the PW adjustment produce a maximum effect on output that is 0.7 percentage points smaller and a maximum effect on prices that is 0.9 percentage points smaller than the original. Among the responses from the 2003 sample residuals, the LDV specification produces the largest maximum responses in both output and prices.

Figure 2.4 also shows that the own effects of a monetary policy shock are always positive and the CI bands never span zero for all samples. This implies a long lived effect of monetary policy on itself, but the magnitude of the monetary policy shock diminishes over time as the Fed responds to lower output and prices by reducing the target rate. In the single equation regressions to obtain IRF's, RR's policy measure was assumed to be exogenous and the initial one percentage point increase was sustained at the new level over the entire horizon. In the VARs, the measure of monetary policy was assumed to be jointly determined and was ordered last in a Choleski decomposition used to identify policy shocks. Consequently, the magnitude of the policy shock used in the single-equation estimates is larger after the first period than for the VAR policy shock. In the VARs, the magnitude of the shock is less than 1% after the first period, which leads to smaller effects than with the single-equation estimates.

Figure 2.5 shows comparisons among the point estimates and CI bands for all specifications. Figure 2.5 shows comparisons among the point estimates and CI bands for all specifications. It first plots the original RR point estimates with the CI bands obtained from the original sample lagged dependent variable specification. The point estimates from the original sample lagged dependent variable specification are then plotted with the original RR CI bands. Next, Figure 2.5 the RR original sample point estimates with the CI bands obtained from the RR extended sample with no serial correlation correction. It then plots the 2003 sample point estimates with the original sample RR CI bands. Figure 2.5 then plots the original RR point estimates with the CI bands obtained from the extended sample lagged dependent variable specification. The point estimates from the extended sample lagged dependent

variable specification are plotted with the original RR CI bands. Figure 2.5 then plots the RR original sample point estimates with the CI bands obtained from the RR 2003 sample with a correction for serial correlation. It then plots the serial correlation correction for the 2003 sample point estimates with the original sample RR CI bands. Figure 2.5 next plots the RR extended sample point estimates with the CI bands obtained from the extended sample lagged dependent variable specification. The point estimates from the extended sample lagged dependent variable specification are plotted with the extended sample RR CI bands. Figure 2.5 continues by plotting the RR extended sample point estimates with the CI bands obtained from the RR 2003 sample with a correction for serial correlation. It then plots the serial correlation correction specification for the 2003 sample point estimates with the extended sample RR CI bands. Finally, Figure 2.5 plots the serial correlation correction point estimates with the CI bands obtained from the RR extended sample lagged dependent variable specification. It then plots the extended sample lagged dependent variable specification point estimates with the serial correlation correction CI bands. If point estimates lie outside the CI bands, the responses are interpreted as significantly different.

Figure 2.5 shows at longer horizons, the response of output from the 1996 sample lies somewhat below the CI bands from the methods for extended samples. The responses of output from the 2003 sample methods lie slightly above the 1996 upper CI band. This implies a significantly weaker response in output at longer horizons when the sample is extended to 2003, but the magnitude of the difference is small. However, there are no significant differences in the responses of prices. Figure 2.5 also illustrates there are no significant differences among the 2003 sample methods as all point estimates are within all CI bands. The figures also illustrate there are no significant differences in the own effects of monetary policy for any of the samples or methods.

2.7 Comparison with An Alternative Measure of the Intended Federal Funds Rate

As noted earlier, the first step in the RR process of estimating monetary policy shocks is the specification of the intended or target fed funds rate. Beginning in 1995 when the Fed began to explicitly state its target federal funds rate, RR used the target rate stipulated by the FOMC, but, prior to 1995, RR

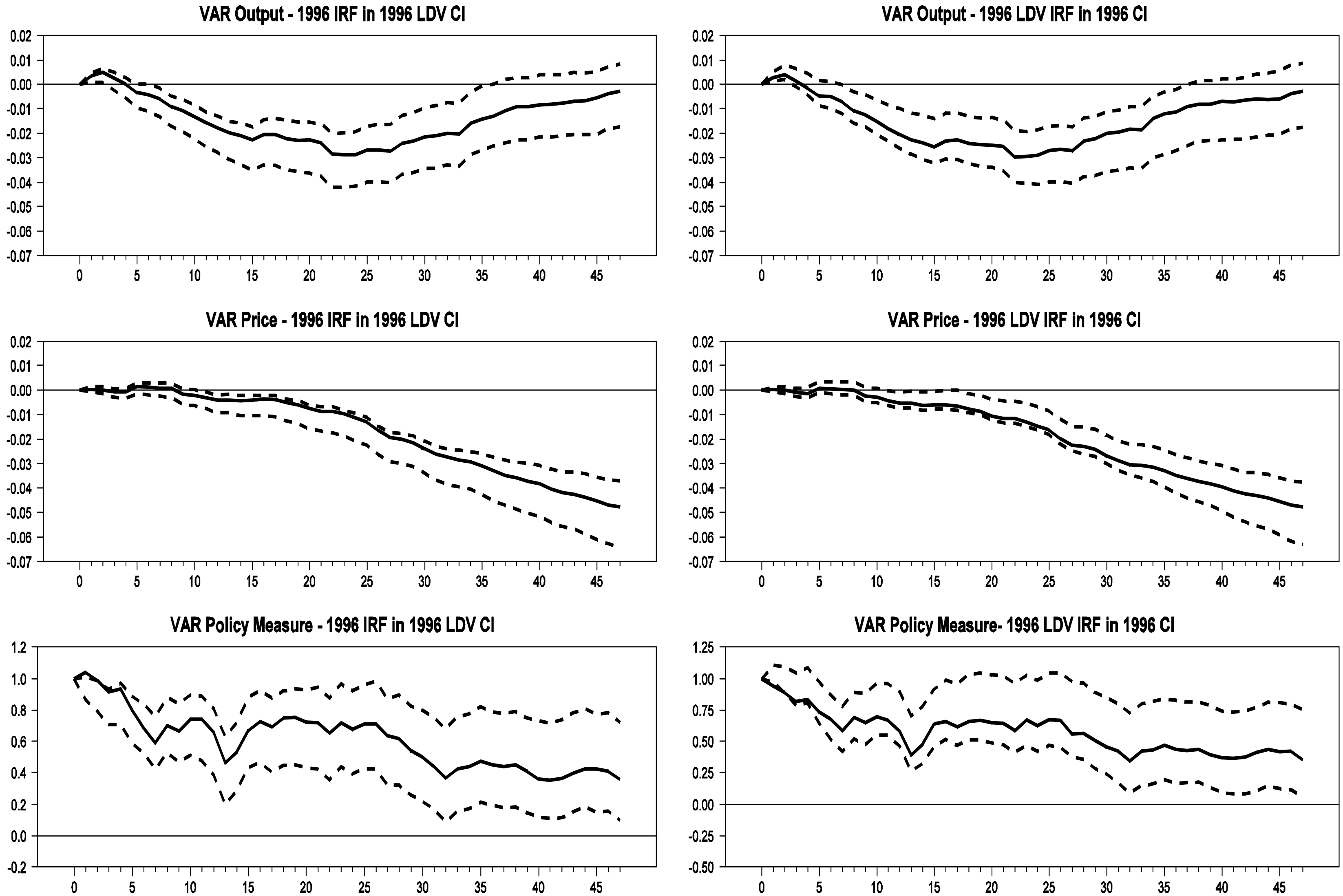
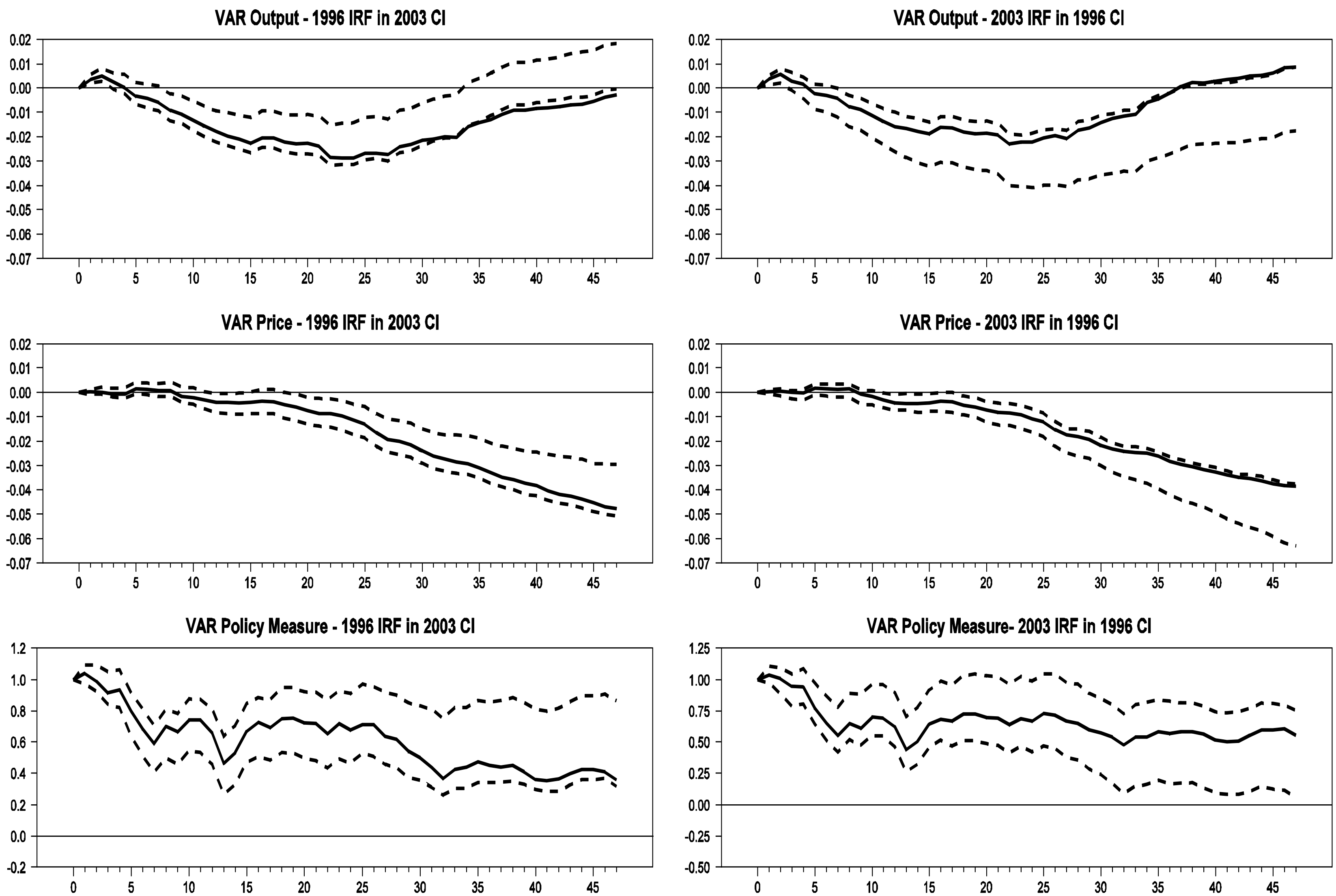


Figure 2.5 – Comparisons of VAR Impulse Response Functions – a

(fig. 2.5 cont'd.) b



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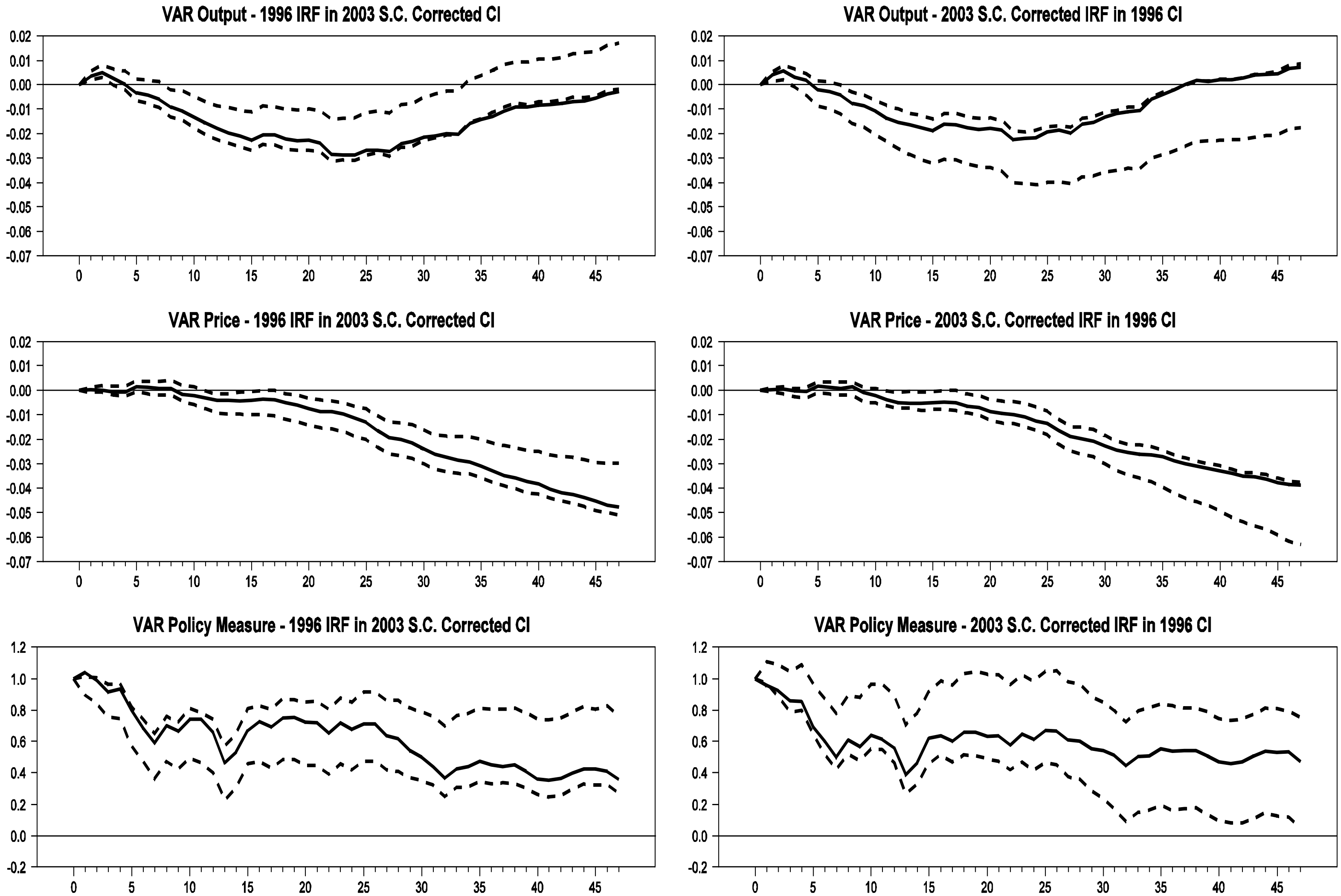

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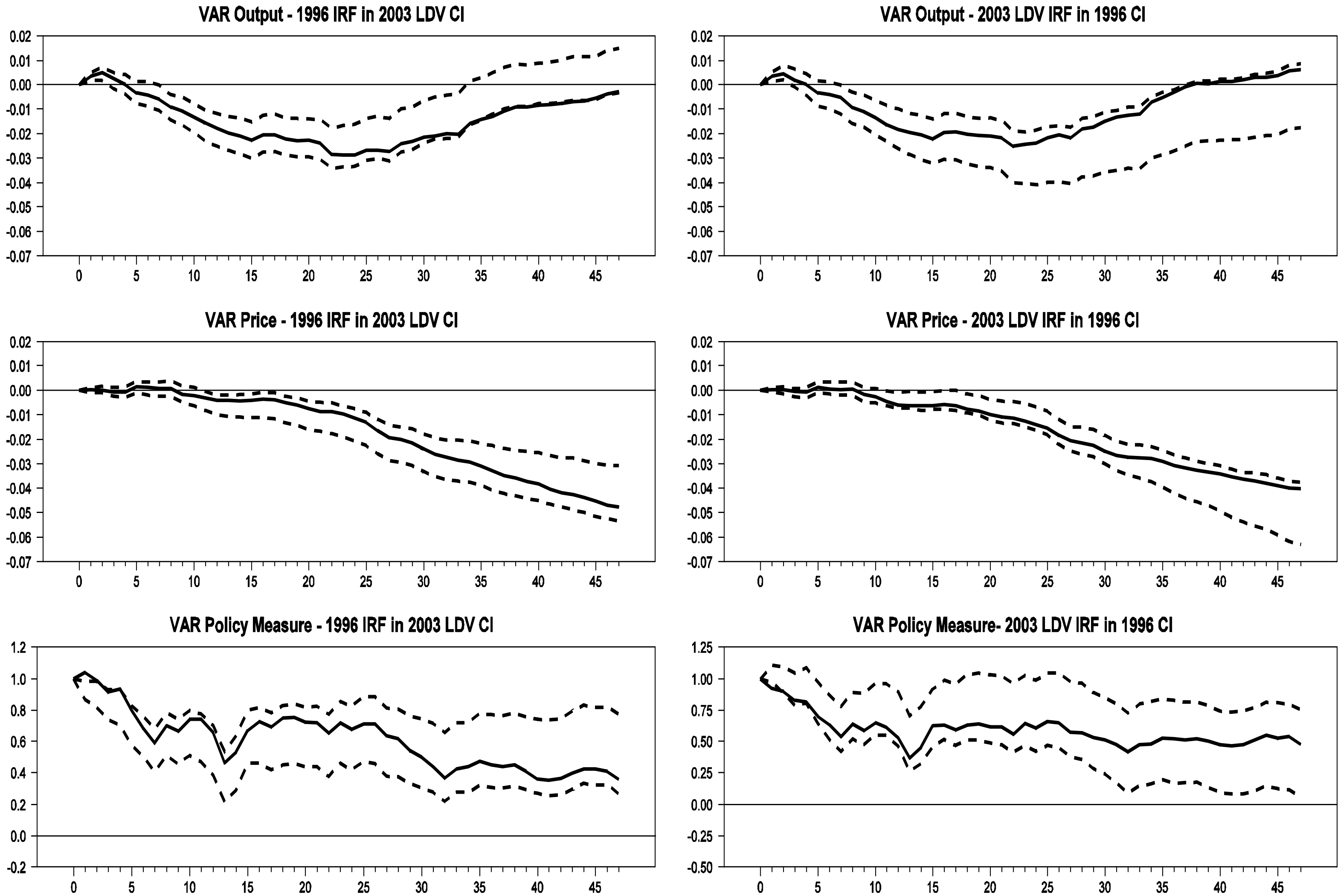

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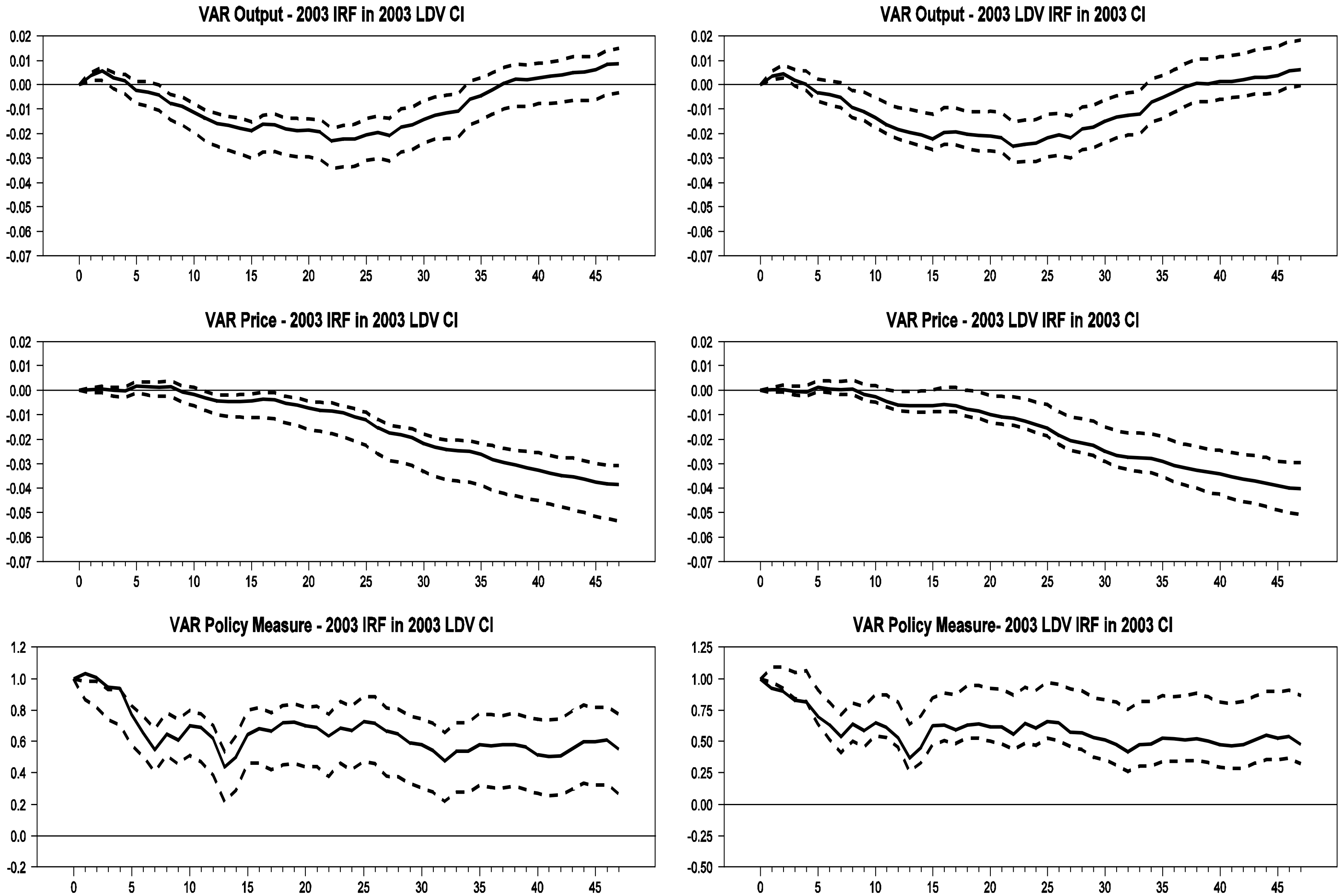

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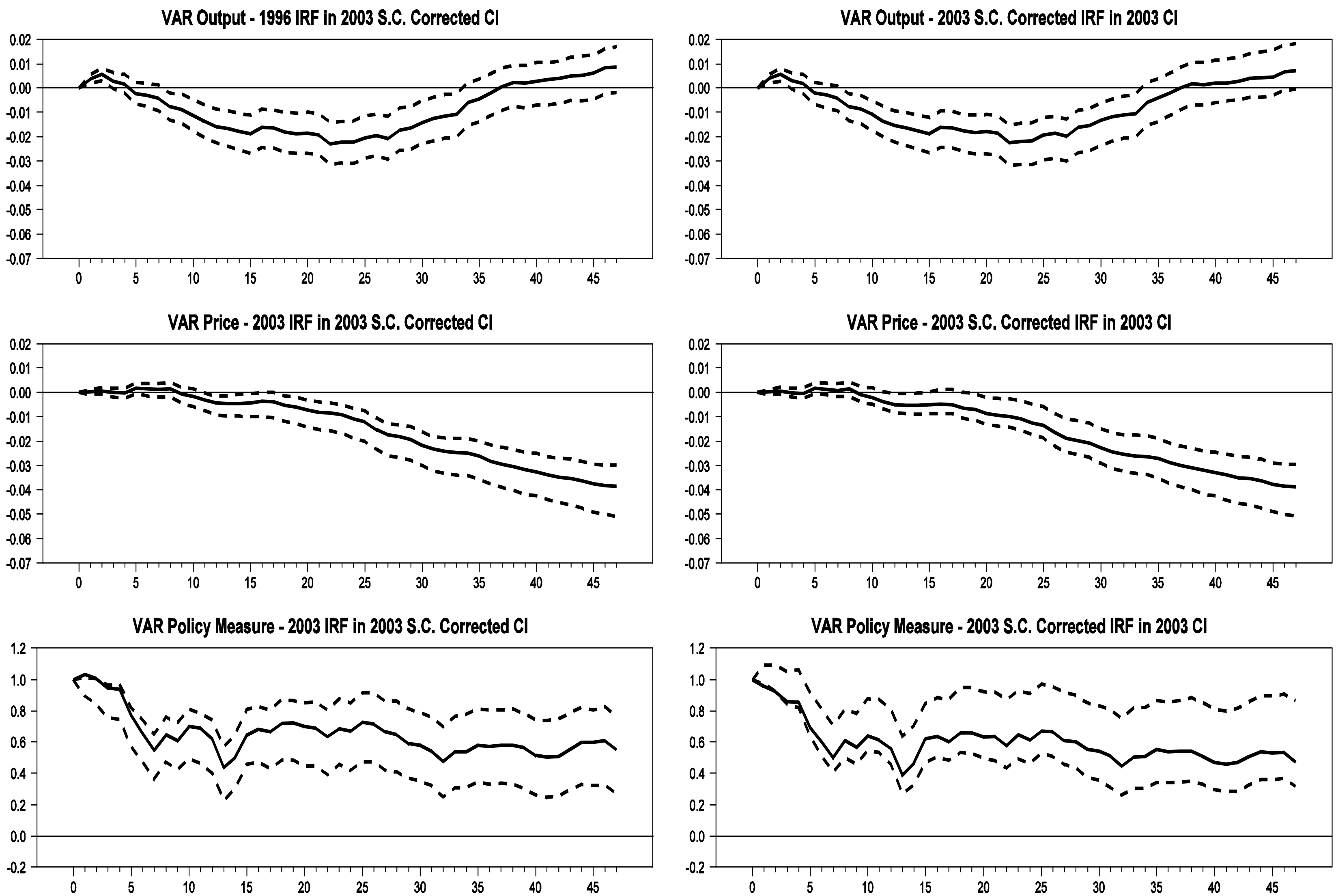

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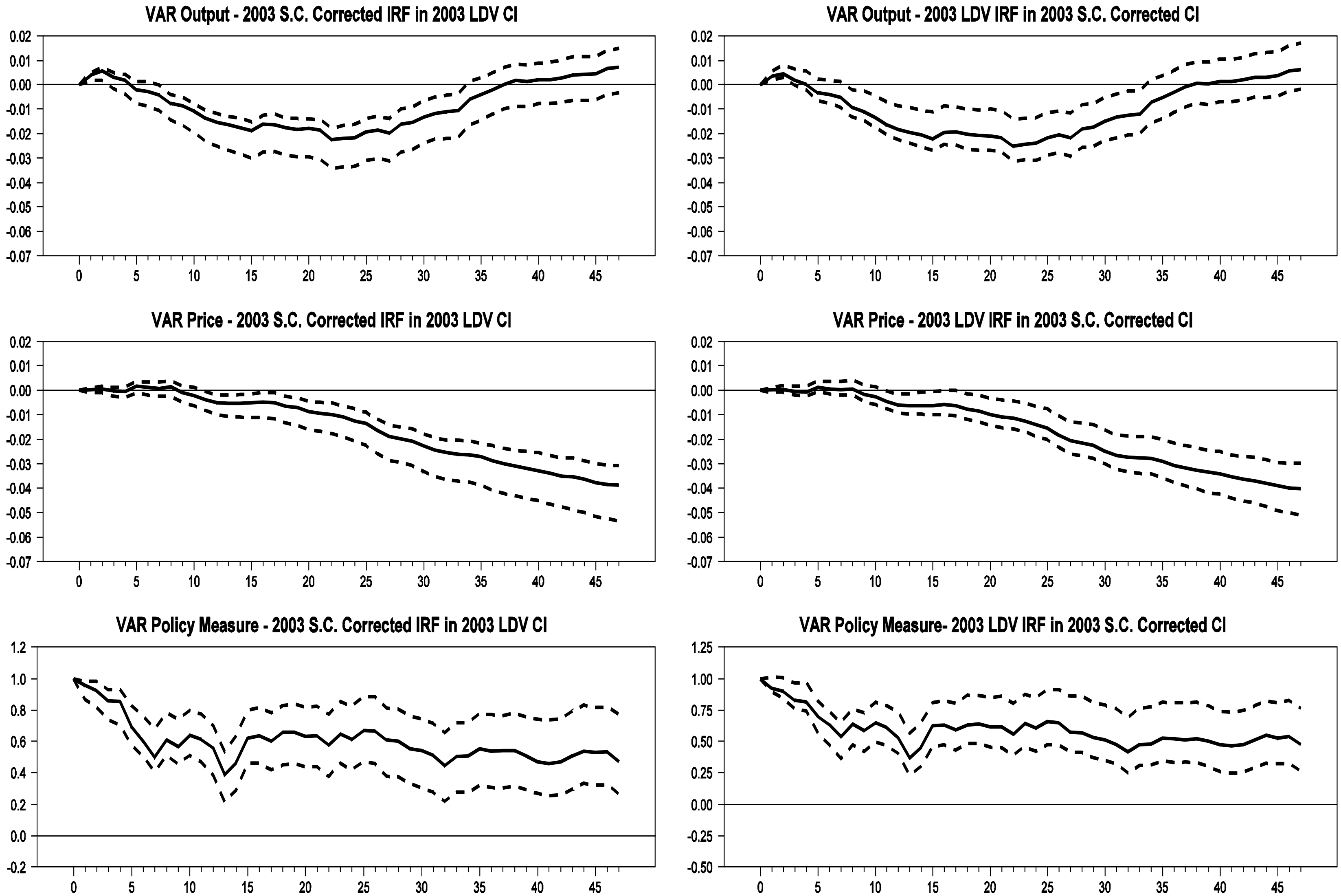


inferred the intended funds rate from a reading of Federal Reserve documents, a process that requires considerable judgment and interpretation. Consequently, it is possible that an alternate reading of the Fed documents might yield a somewhat different measure of the intended funds rate before 1995. Unfortunately, no one provides such an alternative over the entire period from 1969-1993, However, Thornton (2005) provides a daily measure of the target federal funds rate as well as information about the changes in the target that occurred at each FOMC meeting during the period from Sept. 27, 1982 to Dec. 31, 1993. Thornton uses verbatim transcripts of FOMC meetings, the Bluebook, the *Report of Open Market Operations and Money Market Conditions,* and data obtained from the New York Fed trading desk concerning open market operations to construct a daily narrative measure. Thornton's measure and the RR measure can thus be compared for a sub-sample of the 1969-1996 period. For the period of Sept. 27, 1982 to Dec. 31, 1993, the correlation between the RR target rate and the Thornton target rate prior to each FOMC meeting is 0.9996.[12] The correlation between the changes in the target rates at the FOMC meetings is 0.91. Figures 2.6 and 2.7 show various comparisons between the RR and Thornton measures.

Figure 2.6 plots the two measures of the change in the intended funds rate with the dashed lines being Thornton's measure while the solid lines are the measure of RR. Figure 2.7 plots the difference between the two measures of the change in the intended funds rate when the RR measure is subtracted from the Thornton measure. Between observations 15 and 20, the figure displays larger differences than the rest of the sample. These occur during the 10/2/1984, 11/07/1984, and 12/18/1984 FOMC meetings, where the differences are -0.375, -0.250, and -0.375, respectively. Thornton believes no change in the intended funds rate was associated with the 10/2/1984 meeting while RR report a 0.375 percentage point drop. At the 11/07/1984 and 12/18/1984 meetings, Thornton finds somewhat smaller drops in the intended funds rate than RR. In the November meeting Thornton shows a drop of 0.5 percentage points while RR find a

[12] After an email inquiry to Thornton about the appropriateness of the change he reported for the Oct. 5th, 1982 meeting, Thornton adjusted this change and the results reported above reflect this change.

stronger decrease of 0.75 percentage points. In the December meeting, Thornton finds a drop of 0.25 percentage points while RR find a large drop of 0.625 percentage points. The other large difference comes at the 68th observation of the sample during the 2/6/91 meeting. RR find a drop of 0.5 percentage points in the intended funds rate while Thornton finds no change. Thornton believes there was a drop prior to this meeting and the change was an intermeeting change associated with a conference call five days prior to the meeting. As Figure 2.6 and 2.7 show, there are some differences among the measures overall. However, the two measures are still highly correlated.

Figure 2.8 plots the two measures of the level of the intended funds rate prior to the meeting with the dashed lines being Thornton's measure while the solid lines are the measure of RR. The two measures are almost identical. Figure 2.9 plots the difference between the two. A large difference occurs at the 22nd observation at the 5/21/1985 meeting. Thornton concludes that there was no change associated with this meeting as the intended funds rate was decided to be set to 7.75% on May 17 to take effect on May 20, 1985. RR associate this 0.375 percentage point drop with the 5/25/1985 FOMC meeting. The other large difference once again comes from the 68th observation, the 2/6/1991 FOMC meeting. RR associate a 0.5 percentage point drop in the new intended funds rate of 6.25% with this meeting while Thornton does not.

These previous two occurrences and the later observations in Figure 2.9 point out the necessity for understanding the difference between the change in intended funds rate and the level of the intended funds rate prior to the meeting variables. For the final observations, Figure 2.7 shows many differences between the RR and Thornton change in the intended funds rate measures. However, Figure 2.9 shows no difference for the level of the intended funds rate prior to the meeting. This illustrates the fact that the level of the intended funds rate prior to the meeting is not a cumulated measure of the change in the intended funds rate. These data are constructed at a frequency of FOMC meetings; however, many changes in the intended funds rate take place between meetings. Closer inspection of the data shows that between observations 71 and 91, there were no differences in the level of the funds rate prior to the meeting in Figure 2.9 but six differences in the change in intended funds rate in Figure 2.8. This occurs because Thornton showed only one FOMC meeting having a change in the target intended funds rate. The

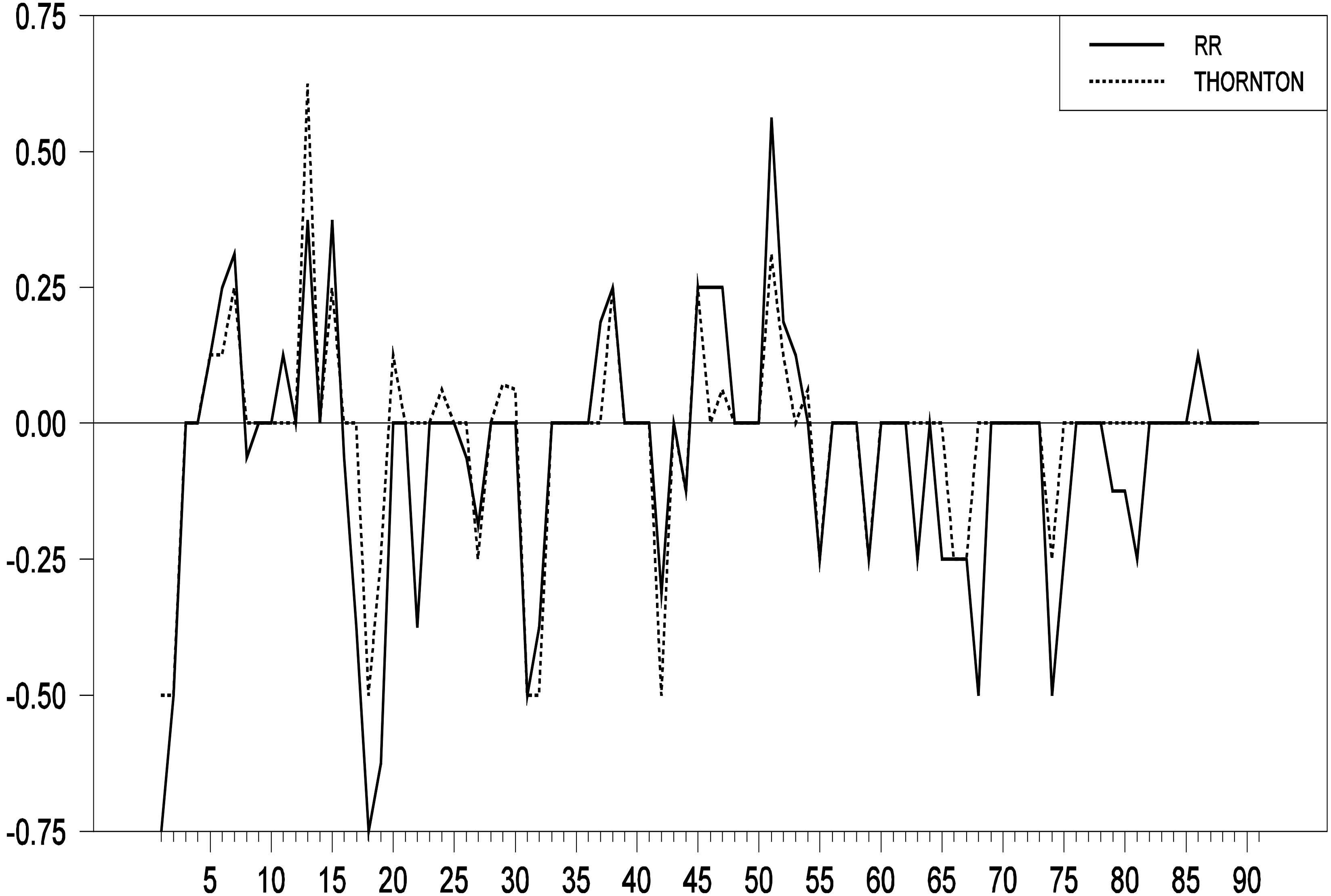


Figure 2.6 – Comparison of RR and Thornton Change in Intended Funds Rate

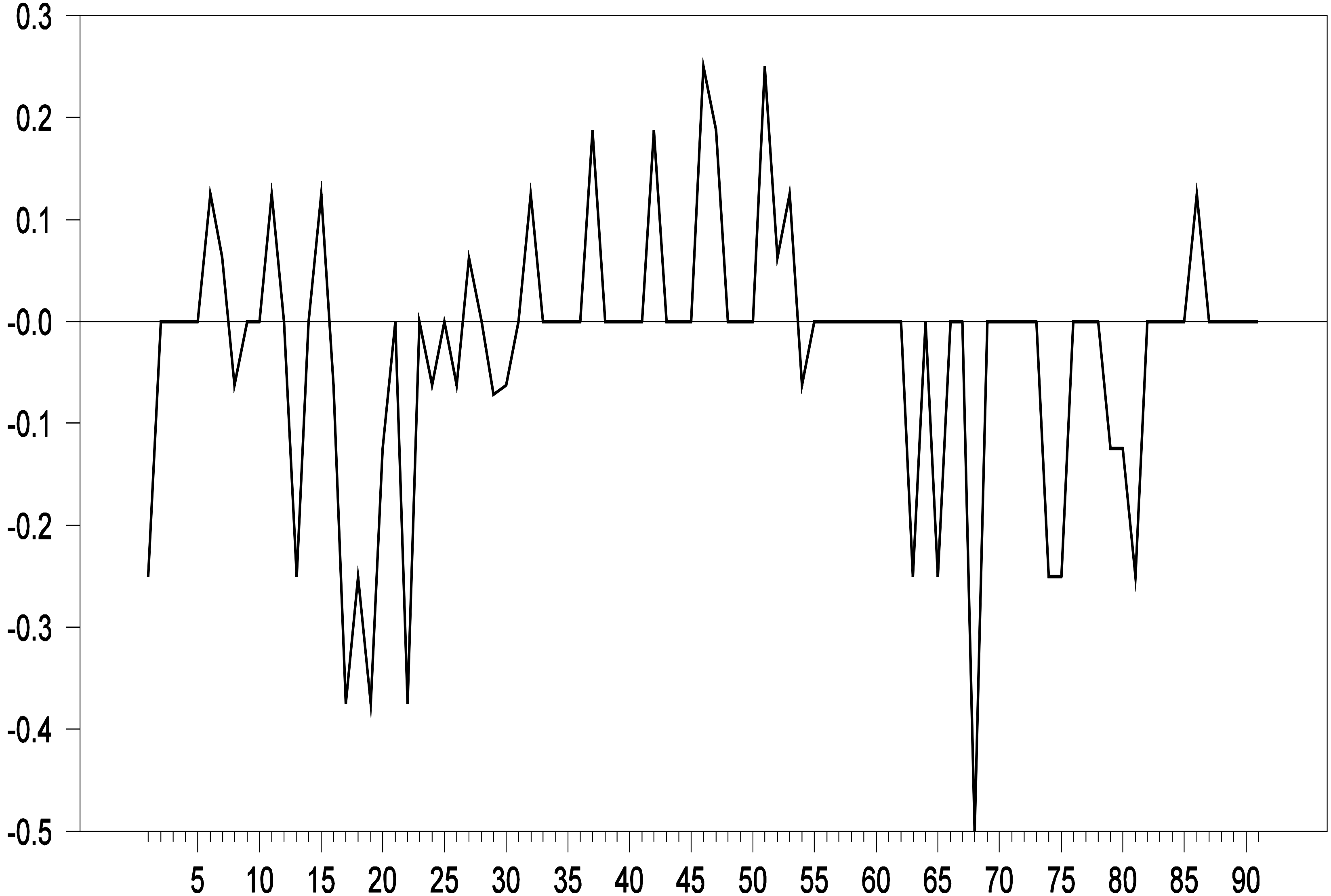


Figure 2.7 – Difference Between RR and Thornton Change in Intended Funds Rate

Figure 2.8 – Comparison of RR and Thornton Level of the Intended Funds Rate Prior to Meeting

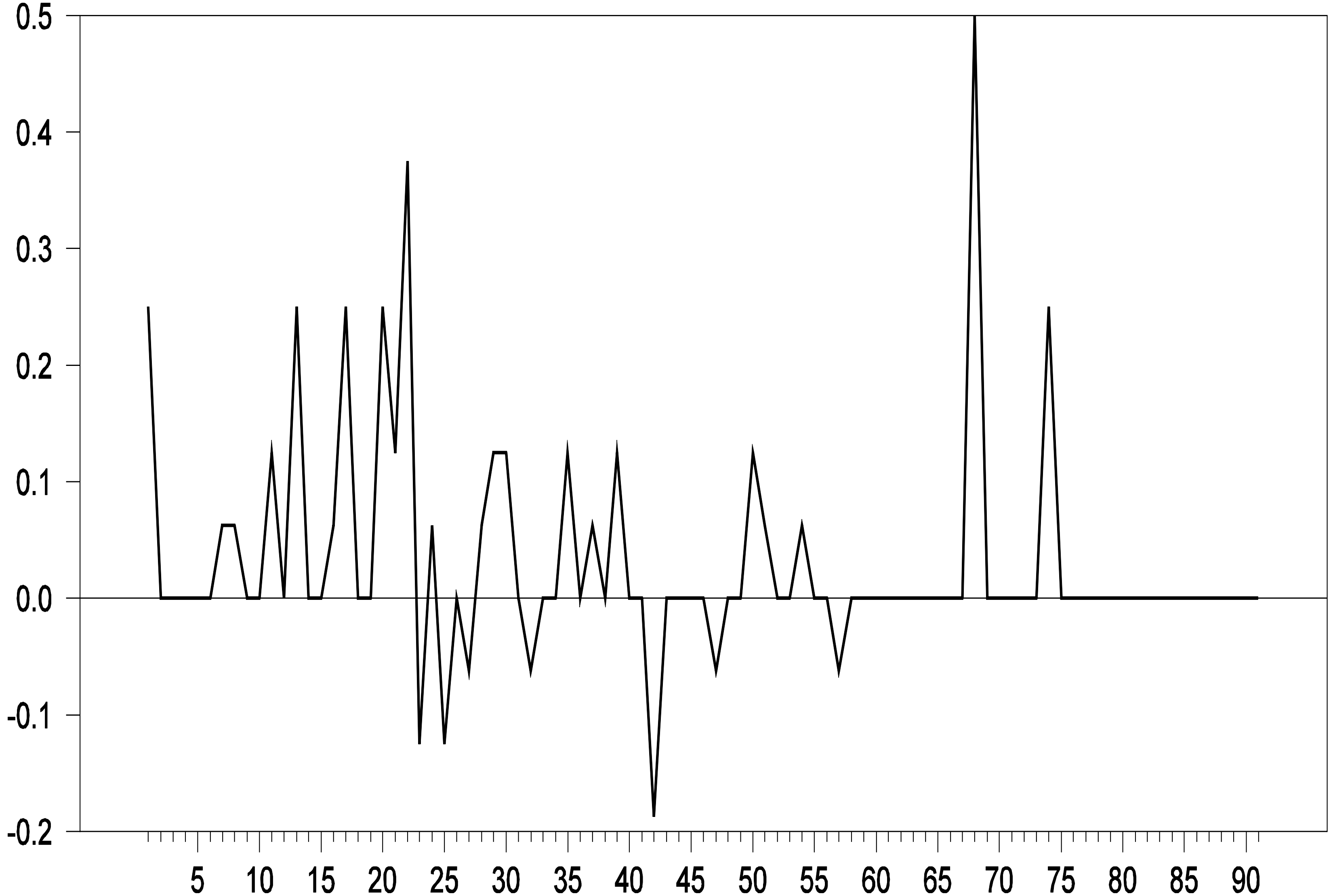


Figure 2.9 – Difference Between RR and Thornton Level of the Intended Funds Rate Prior to Meeting

rest of the changes were intermeeting changes. On the other hand, RR associated many changes in the intended funds rate with particular FOMC meetings. So while the level of the prior intended rate was the same at each meeting, Thornton observed that none of these meetings produced changes.

It appears that an independently formulated measure of the level of the intended funds rate after each meeting is very highly correlated with the RR measure, and changes in the intended funds rate measures are also highly correlated. There are some differences between the two measures, however.-Most of these come from differences in opinion as to whether particular changes should be associated with particular FOMC meetings or if they should be intermeeting changes. RR often place a change as associated with an FOMC meeting, while Thornton does not.

Although any narrative measure of the intended funds rate is subject to degrees of subjectivity, the above analysis shows that differences between the RR measure and an alternative independently formulated measure by Thornton are relatively small. Both the levels and changes in the intended funds rates are highly correlated.

2.8 Conclusions

This chapter has replicated and updated the RR quasi-narrative measure of monetary policy shocks. After updating RR's Greenbook, the RR regression is estimated for a sample extended to the end of 2003. The end point was dictated by the availability of Greenbook data. The coefficient estimates were similar to those obtained for the original RR sample, but the Breusch-Godfrey test provided evidence of first order serial correlation when the sample is extended to 2003. Estimation was done with Newey-West standard errors and was compared to ordinary least squares estimates but no differences in the significance of the variables was found.

There are two possible explanations for evidence of serial correlation found in the RR specification. The first is that the FOMC engages in "interest rate smoothing" to reduce volatility in both the financial markets and interest rates. Consequently, the RR specification was modified to include the lagged change in the intended funds rate. The coefficient on the lagged dependent variable was positive and significant. The magnitudes and signs of the other coefficients were similar to the original RR specification in both

samples. The significance of the sums of coefficients and the joint significance of the coefficient groups were not altered. The second explanation for the serial correlation is that the FOMC is responding to frequent shocks in other macroeconomic and financial variables that are very difficult to measure and hence that were omitted from the RR specification. Consequently, the residuals were corrected for serial correlation using the PW method. Once again, the magnitudes and signs of the coefficients were similar to the original RR specification with no serial correlation correction in the extended sample. The significance of the sums of coefficients and the joint significance of the coefficient groups were not altered. The residuals from the extended sample without a correction for serial correlation, the residuals with the PW correction, and those from the LDV specification all displayed similar patterns and are very highly correlated with the original RR measure.

RR's original IRF's for output and prices from single equation regressions were exactly replicated for the original sample. The IRF's from single equation regressions were also computed for both samples using residuals from the lagged dependent variable specification. The residuals with and without a serial correlation correct from the 2003 sample were used to compute IRF's. Although extending the sample to 2003 produced somewhat weaker effects of monetary policy on output, the results were not significantly different from the original RR estimates. There were no significant differences in the response of prices among any of the methods and the maximum response in prices was similar across all samples and methods. When only looking at responses from residuals from 2003 samples, there were no significant differences among the lagged dependent variable specification, or the extended samples with and without a serial correlation correction.

RR's original residuals were cumulated and IRF's for output and price from a three-variable VAR were exactly replicated for the original sample. The residuals from the lagged dependent variable specification for both samples, the extended sample to 2003, and the extended sample with a serial correlation correction were cumulated and IRF's are estimated from VAR's. The maximum responses for output and prices were much lower compared to the single equation estimates. Each measure that was obtained from extending the sample to 2003 produces smaller responses in output at longer horizons than

the original RR results. This shows the updated residuals produced significantly weaker effects on output; however, the magnitude of this difference is very small. Extending the sample to 2003 also resulted in smaller maximum effects of prices compared to the original RR results. However, these results were not significantly different. All responses have similar shapes and times to significance.

Since there are subjective elements in specifying the intended funds rate before 1995, an alternative independently formulated intended funds rate measure by Thornton for the period October 1982 – December 1993 was compared to that of RR. The correlations for the RR and Thornton series for the changes in the intended funds rate at FOMC meetings and the levels of the intended funds rate prior to the meetings was extremely high for this period. Many of the differences in the intended funds rate for the two series were due to the fact that some changes were not associated with FOMC meetings in Thornton's data while they were associated with meetings in RR's data.

Chapter 3
Alternative Specifications of the Romer-Romer Policy Equation

3.1 Introduction

The RR policy shocks in their quasi-narrative approach represent changes in monetary policy that are exogenous to Greenbook forecasts. As noted by RR, these shocks can come from a variety of sources. Some of these include changes in operating procedures, changes in the chairman in power, changes in policymakers' views on monetary policy's effects on the economy, preferences of policymakers towards Federal Reserve goals, information about the economy not included in the Greenbook, and political and private sector pressure on policymakers. This chapter analyzes the effects of measurable factors like changes in operating procedures, changes in chairmen, and the imposition of credit controls by Federal Reserve at the request of President Carter, on the RR monetary policy shocks and the effects of these shocks on output and prices. Because it is difficult to quantify the degree of political and private sector pressure, these sources of exogenous shocks are not directly analyzed.

Several operating regimes were employed by the Federal Reserve during the FOMC meetings from 1969 – 2003. The regimes that the FOMC employed over this sample include federal funds rate (FFR) targeting, nonborrowed reserves (NBR) targeting, borrowed reserves (BR) targeting, and FFR targeting again. Each operating regime differs as to which operating instrument is targeted by the Federal Reserve to conduct monetary policy. However, as will be discussed momentarily, even in the NBR and BR operating regimes, there was still a significant concern for the level of the FFR. Changes in operating regimes used by the FOMC over this time are a source monetary policy shocks, as each allowed differing degrees of variability in the intended funds rate in response to Greenbook forecasts. The importance of this source on the policy shock measure is investigated.

For the sample considered here, FFR targeting was first used for FOMC meetings held between January 1969 and September 1979. During this period, the Federal Reserve set intermediate targets for

growth rates in monetary aggregates. It then typically specified a relatively narrow target range for the FFR it believed to be consistent with achieving the monetary targets. The mid-point of this range was generally interpreted as the “intended” funds rate. If there are no shocks to the money or reserves markets, achieving both an interest rate target and a monetary target is compatible. However, if there are shocks to the money or reserves markets, then simultaneous achievement of both targets is generally not feasible. When conflicts emerged between achieving the money growth target or the FFR target, the trading desk at the Federal Reserve of New York gave precedence to the federal funds rate (Mishkin, 2009). The Fed was often reluctant to change its federal funds rate target during this time period leading to procyclical monetary policy. When increases in incomes led to increases in money demand, the Fed would increase total reserves in the banking system to maintain the target level of the funds rate. This led to increases in the money supply and imparted an inflationary bias to monetary policy. Because there are frequent shocks to the money and reserves markets, the Fed almost never hit its money target.

As the inflation rate increased towards double digits in the late 1970’s and the Fed’s concern for reducing inflation grew, it was clear that FFR targeting was not producing desired economic outcomes. In October 1979, as a signal of its resolve to slow money growth and reduce the inflation rate, the Federal Reserve adopted a new operating procedure in which there was less emphasis on limiting fluctuations in FFR and more emphasis on controlling the supply of NBR (hence the term NBR operating regime). Under this regime, the Fed still set an intermediate monetary target but now estimated the amount of nonborrowed reserves necessary to achieve this. The changing demands for reserves in the banking system were no longer met with accommodating changes in the supply of reserves to maintain a steady funds rate. However, a target range for the FFR that the Fed thought was consistent with its NBR and money targets was still set, but this range was wider than under FFR targeting. The target range was adjusted more frequently and more variation in the FFR was allowed in this regime than in the FFR targeting regime. However, not only was there more variation in the FFR during this regime, the variability of money growth increased substantially as well. The increased volatility in money growth during this time is often attributed to the large business cycle fluctuations as well as the many financial

innovations (such as new categories of deposits being added to monetary aggregates and the advent of ATM's) and financial deregulation that caused instability in the relationship between NBR and the money supply. Many argue that the Fed had no real desire to target NBR but stated this in order to alleviate political pressure. It is argued that the high interest rates needed to fight inflation during this time would not have been politically acceptable on their own so the Fed adopted an operating procedure where targeting FFR was not emphasized.

Targeting NBR was not achieving the desired growth rates of the monetary aggregates. Even though inflation drastically fell during NBR targeting, the NBR regime produced the undesirable feature of increasing volatility in interest rates and the money supply. With improved inflation performance, the desire to reduce volatility most likely played a key role in ending NBR targeting in October 1982. The Fed moved towards BR targeting in which the Fed still had an intermediate target for money growth and would try to achieve the level of BR consistent with that. However, BR targeting also led to the Fed neutralizing changes in the federal funds rate. For example, suppose the Fed has specified a target for BR and the demand by firms for bank loans increased. Reserve demand would then rise as banks sought funds to make additional loans. The increase in reserve demand would raise FFR and, given the value of the discount rate, banks would borrow more from the Fed. BR would rise about the target level. To maintain the BR target, the Fed would conduct open market purchases to increase the amount of NBR available. This would reduce the FFR and borrowed reserves would in turn fall back to the target level. Increasing NBR while keeping BR constant would increase the total amount of reserves which counteracted the initial increase in the funds rate. Thus, the BR targeting regime was in essence a move back to FFR targeting. Some argue the Fed did not want to state it was going back to the operating procedures that led to the high inflation of the 1970's or admit that adopting NBR targeting was a cover for the high interest rates to decrease inflation. So the Fed effectively disguised interest rate targeting as BR targeting (Baye and Jansen, 1994).

In the 1990's the Fed explicitly returned to FFR targeting. As of this writing, the Federal Reserve has no explicit intermediate target for monetary aggregates or longer term interest rates. The M1monetary

target of the Fed was dropped in February 1987 as the Fed shifted its focus to the M2 monetary aggregate. However, in July 1993, the M2 target was dropped as well.

There has been considerable debate as to when, and in some cases if, the FOMC engaged in BR targeting in the mid-to-late 1980's. Meulendyke (1998) states BR targeting was used by the Fed from 1982 until late 1987. Thornton (2006) states others suggest the switch from BR to FFR targeting continued much later, perhaps as late as 1992. However, Thornton also concludes from FOMC transcripts that the Federal Reserve simply engaged in FFR targeting by another name and even began targeting the funds rate prior to its decision to stop NBR targeting in October 1982.

This ambiguity about when BR targeting ends and whether there is any significant difference between BR targeting and FFR targeting leads to estimating the RR equation allowing for a differential response to Greenbook forecasts during only NBR targeting meetings. Achieving a NBR target caused the Federal Reserve to set the intended funds rate differently than if it were targeting the FFR. Allowing a different response during NBR targeting meetings controls for the regime changes and the effects of this source on the policy shocks can be investigated.

To account for the possibility that different chairmen may have different views of how monetary policy affects the economy and of how policymakers should respond to economic information and for the possibility that different management styles might affect group decisions and that different chairmen might respond differently to political pressure, the response of the FOMC to Greenbook forecasts is allowed to vary during the terms of different chairmen.

The entire sample of FOMC meetings available covers the time period from January 1969 until December 2003. William McChesney Martin was chairman for only fifteen FOMC meetings in this sample; from January 1969 – January 1970. Arthur Burns was chairman for meetings from February 1970 until February 1978. G. William Miller was chairman for FOMC meetings from March 1978 until July 1979; once again this only accounts for fifteen observations across the entire sample. Paul Volcker was chairman for meetings from August 1979 until July 1987. And Alan Greenspan was chairman for FOMC meetings from August 1987 until the end of the sample in 1996 and the extended sample to 2003. Miller

and Martin together combine for only thirty observations out of 263 (319) observations in the 1996 (2003) sample. Since the shortness of the terms of Martin and Mill means that the RR equation can't be estimated over samples corresponding to their terms, their terms are combined with that of Burns into a pre-Volcker term.

The RR equation to obtain policy shocks is estimated separately over pre-Volcker FOMC meetings, the meetings chaired by Volcker, and the meetings chaired by Greenspan. The residuals from these equations are combined to form a monetary policy shock series for the 1969 – 1996 and 1969 – 2003 samples. The shocks are compared to those from the RR equation estimated over the full samples that end in 1996 and 2003. The effects of the shocks from the separate chairmen regime regressions on output and prices are compared with the output and price effects of the original RR shocks for both samples.

In early 1980, the inflation rate in the United States reached double digits. With the Democratic primaries approaching, the Carter administration began an anti-inflation program that consisted of resubmitting the federal budget to reduce the deficit as well as selective credit controls. The administration saw credit controls as a way to control inflation while curtailing increasing interest rates as well as limiting the effects on the housing market. The Carter administration also hoped these credit controls would be accepted by the public and give the president an advantage in the upcoming election. Paul Volcker, the chairman of the Federal Reserve, spoke out publicly against credit controls on in February of 1980 during the semi-annual report on monetary policy. However, Volcker had been involved in discussion regarding the revised budget. Carter had accepted Volcker's suggestions to reduce the budget deficit and Volcker felt compelled to comply with the credit controls (Hetzel, 1996).

On March 14, 1980 President Carter signed Executive Order 12011 invoking the Credit Control Act of 1969 which gave the Board of Governors power to impose restraints on "any or all extensions of credit". The Board's Credit Restraint Program consisted of six restrictive measures. These included a voluntary credit restraint program for banks and finance companies, an increased deposit requirement of 15 percent on increases in certain consumer credit, an increase in the marginal reserve requirements on managed liabilities of large banks and a deposit requirement of 10 percent on managed liabilities of non-

member banks, a surcharge on discount window borrowings, and the imposition of special deposit requirements on additional assets held by money market mutual funds.

These credit controls were followed by an immediate drop in lending by financial institutions and many consumers stopped using credit cards. Demand for credit from business also fell. As lending fell, deposits and the demand for reserves in the banking system decreased. As a result, the intended funds rate measure in the RR dataset fell dramatically.

To investigate the effects of the credit controls on the policy equation and monetary policy shocks, a dummy variable is created for the three FOMC meetings during which the credit controls were in place. This dummy was added to the RR policy equation to obtain shocks and is found to have a negative and significant coefficient for both samples. Monetary policy shocks are obtained from this regression and the effects on output and prices are investigated and compared to RR.

3.2 Regimes Specification

The degree of emphasis on controlling the federal funds rate differed across regimes. The most volatility in the intended funds rate measure occurred during the period of nonborrowed reserves (NBR) targeting from October 1979 until October 1982. This is also the time period in which the monetary policy shocks from RR displayed the most volatility. This can partly be explained by the fact that during NBR targeting, the Federal Reserve tolerated much greater movement in the federal funds rate compared to other regimes, as the nominal funds rate was not as tightly controlled.

The RR equation to obtain shocks is

$$\Delta ff_m = \alpha + \beta ffb_m + \sum_{i=-1}^{2} \gamma_i \, \Delta\tilde{y}_{mi} + \sum_{i=-1}^{2} \delta_i \left(\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}\right) + \sum_{i=-1}^{2} \varphi_i \, \Delta\tilde{\pi}_{mi} + \sum_{i=-1}^{2} \theta_i \left(\Delta\tilde{\pi}_{mi} - \Delta\tilde{\pi}_{m-1,i}\right) + \rho\tilde{\mu}_{mi} + \varepsilon_m. \quad (1)$$

which assumes the FOMC responds to Greenbook forecasts in the same manner during all regimes. To investigate how significant of a source the NBR targeting period is on the quasi-narrative shocks, equation 1 is re-specified to allow a differential response to Greenbook forecasts between NBR targeting meetings and the rest of sample. A dummy variable, D_{NBR}, is constructed equaling 1 if the FOMC meeting

was targeting NBR and 0 otherwise. The RR regression is modified to include interactions for every variable with the NBR dummy as follows:

$$\Delta ff_m = \alpha + \beta ffb_m + \sum_{i=-1}^{2} \gamma_i \Delta\tilde{y}_{mi} + \sum_{i=-1}^{2} \delta_i \left(\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}\right) + \sum_{i=-1}^{2} \varphi_i \Delta\tilde{\pi}_{mi} + \sum_{i=-1}^{2} \theta_i \left(\Delta\tilde{\pi}_{mi} - \Delta\tilde{\pi}_{m-1,i}\right) + \rho\tilde{\mu}_{mi} + D_{NBR} + \beta D_{NBR} ffb_m + \sum_{i=-1}^{2} \gamma_i D_{NBR}\Delta\tilde{y}_{mi} + \sum_{i=-1}^{2} \delta_i D_{NBR}\left(\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}\right) + \sum_{i=-1}^{2} \varphi_i D_{NBR}\Delta\tilde{\pi}_{mi} + \sum_{i=-1}^{2} \theta_i D_{NBR}\left(\Delta\tilde{\pi}_{mi} - \Delta\tilde{\pi}_{m-1,i}\right) + \rho D_{NBR}\tilde{\mu}_{mi} + \varepsilon_m, \qquad (2)$$

To compare the responses of the NBR targeting regime to those of the rest of the FOMC meetings, equation 2 is estimated over both samples. As stated earlier, the FOMC tolerated greater fluctuations in the in the intended funds rate during the NBR targeting regime. This would imply for a given change in Greenbook forecasts, the change in the intended funds rate should be larger compared to all other FOMC meetings and the estimated coefficients for equation 2 should be larger in absolute value during the NBR targeting meetings. Since more volatility over the NBR targeting regime is allowed in this specification, the monetary policy shocks during this time period should be smaller than those of RR.

The results for the 1996 sample are shown in Table 3.1 and the results for the 2003 sample are shown in Table 3.2. The coefficients and standard errors of the interacted variables are under the NBR Targeting FOMC Meetings columns and the remaining coefficients and standard errors for the rest of the meetings are under the All Other FOMC Meetings columns.

Looking at the responses in the intended funds rate for the NBR targeting meetings shows that the responses appear to be much stronger during this time period. However, there are only 26 meetings during which NBR targeting is followed. Estimating nineteen coefficients over this time period allows for only seven degrees of freedom and the results should be interpreted with caution.

It is important to examine if the interaction terms are all jointly significant in the regression for each of the samples. If the variables are found to be different from zero, this provides evidence of that the response in the intended funds rate did differ during the NBR targeting period as compared to the rest of the FOMC meetings.

Table 3.1 - Determinants of the Change in the Intended Federal Funds Rate – Regimes

	NBR Targeting	FOMC Meetings	All Other	FOMC Meetings Until 1996:12
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Constant	17.885	2.987	0.125	0.122
Initial level of intended funds rate	-0.402	0.051	-0.015	0.011
Forecasted output growth, Quarters ahead:				
-1	-0.006	0.068	0.013	0.008
0	0.471	0.132	0.006	0.015
1	-0.126	0.154	0.005	0.025
2	0.795	0.224	0.002	0.025
Change in forecasted output growth since last meeting, Quarters ahead:				
-1	0.064	0.095	0.010	0.026
0	-0.532	0.141	0.092	0.024
1	-0.007	0.255	0.017	0.037
2	-0.310	0.148	0.033	0.043
Forecasted inflation, Quarters ahead:				
-1	0.077	0.187	0.006	0.019
0	-0.087	0.149	0.001	0.024
1	-0.368	0.135	-0.067	0.037
2	0.583	0.159	0.078	0.039
Change in forecasted inflation since last meeting, Quarters ahead:				
-1	-0.066	0.113	0.041	0.037
0	0.159	0.159	-0.003	0.042
1	0.708	0.209	0.103	0.059
2	-1.712	0.519	-0.019	0.063
Forecasted unemployment rate (current quarter)	-1.724	0.270	-0.027	0.016
R^2	0.65			
S.E.E.	0.29			
D-W	1.73			

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations.

Evidence of first order serial correlation is found in regressions for both samples. Tests of joint significance in the presence of serial correlation will not be reliable and serial correlation was corrected for in the same three ways as in Chapter 2. The regressions for both samples were first estimated and Newey-West (NW) standard errors with one lag were computed. Next, a lagged dependent variable (LDV) was added to equation 2 to account for interest rate smoothing. Finally, the regressions were run using the Prais-Winsten (PW) correction for serial correlation described in the previous chapter.

Table 3.2 - Determinants of the Change in the Intended Federal Funds Rate – Regimes

	NBR Targeting	**FOMC Meetings**	**All Other**	**FOMC Meetings Until 2003:12**
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Constant	17.991	2.773	0.018	0.090
Initial level of intended funds rate	-0.409	0.047	-0.009	0.009
Forecasted output growth, Quarters ahead:				
-1	-0.004	0.063	0.012	0.007
0	0.465	0.123	0.012	0.013
1	-0.129	0.143	0.008	0.020
2	0.798	0.208	0.000	0.019
Change in forecasted output growth since last meeting, Quarters ahead:				
-1	0.062	0.087	0.011	0.021
0	-0.522	0.130	0.082	0.021
1	-0.011	0.236	0.021	0.030
2	-0.313	0.136	0.037	0.034
Forecasted inflation, Quarters ahead:				
-1	0.079	0.174	0.005	0.017
0	-0.089	0.138	0.003	0.021
1	-0.372	0.125	-0.063	0.032
2	0.583	0.147	0.078	0.034
Change in forecasted inflation since last meeting, Quarters ahead:				
-1	-0.069	0.104	0.043	0.032
0	0.173	0.147	-0.017	0.035
1	0.695	0.193	0.117	0.052
2	-1.704	0.481	-0.026	0.052
Forecasted unemployment rate (current quarter)	-1.727	0.251	-0.024	0.014
R^2	0.63			
S.E.E.	0.27			
D-W	1.69			

The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations.

The tests of joint significance for the 1996 (2003) sample show that the interaction coefficients are significantly different from zero. For the regression incorporating NW standard errors, the F-statistic is 38.77 (44.03) with a p-value = 0.00 (0.00). The regression with a LDV gives an F-statistic of 12.67 (15.03) with a p-value = 0.00 (0.00). The regression with the PW correction for serial correlation shows an F-statistic of 14.01 (17.85) with a p-value = 0.00 (0.00). In all the regressions, the response of monetary policy during the NBR targeting regime was significantly different from all other FOMC meetings.

3.2.1 Description of Monetary Policy Shocks

For the Regimes specification, equation 2 was estimated over the 1996 and 2003 samples. Each regression allowed for a different response to the Greenbook forecasts during NBR targeting meetings and produced a set of residuals that represented exogenous changes in monetary policy not explained by information in the Greenbooks. To construct measures of monetary policy shocks for both 1996 and 2003 samples, the residuals are converted to a monthly series as in Chapter 2. These monthly series are used to estimate the effects on output and prices.

All monetary policy shocks are obtained from the original OLS regressions and have not been corrected for serial correlation. Chapter 2 showed that when the quasi-narrative monetary policy shocks were corrected for serial correlation by either adding a LDV or using the PW method, there were no significant differences compared to the OLS results for the responses of output and prices in either the single equation or VAR methods.

Figure 3.1 shows the monthly monetary policy shocks from the original RR regressions and those obtained from the Regimes regressions for both samples. Figure 3.1 shows that the magnitudes of the Regimes specification shocks are much smaller during the NBR targeting regime compared to the original RR residuals. This is to be expected as Tables 3.1 and 3.2 showed that the Fed adjusted the intended funds rate in response to Greenbook forecasts more during the NBR targeting period than during FFR targeting. This indicates that the unexplained variation in the change in the intended target funds rate is smaller during NBR targeting. Consequently, the residuals would be smaller during this period, compared to the original RR results and this is what is found.

For the Regimes residuals, the smallest shock occurs in the same month as RR and is -1.63 in both samples. These are not as small as those obtained in the RR regressions which were -3.22 in the original 1996 sample and -3.26 in the 2003 sample. The maximum shocks are equal to 0.94 in the 1996 and 2003 samples. These are much smaller than the RR maximum shocks of 1.87 for both the original and extended sample results. The correlations between the RR residuals and the Regimes specification residuals are 0.70 for the 1996 sample and 0.71 for the 2003 sample.

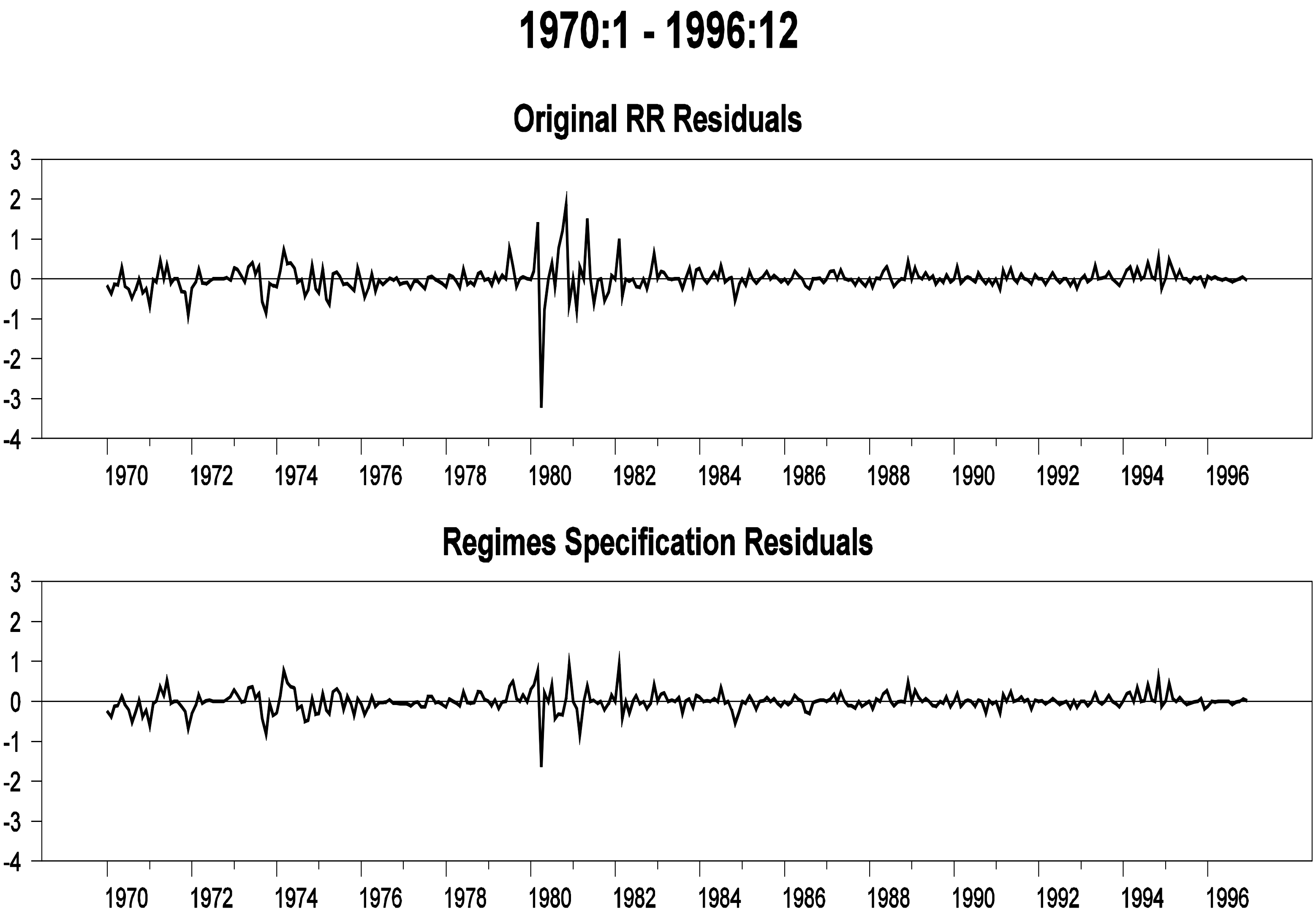
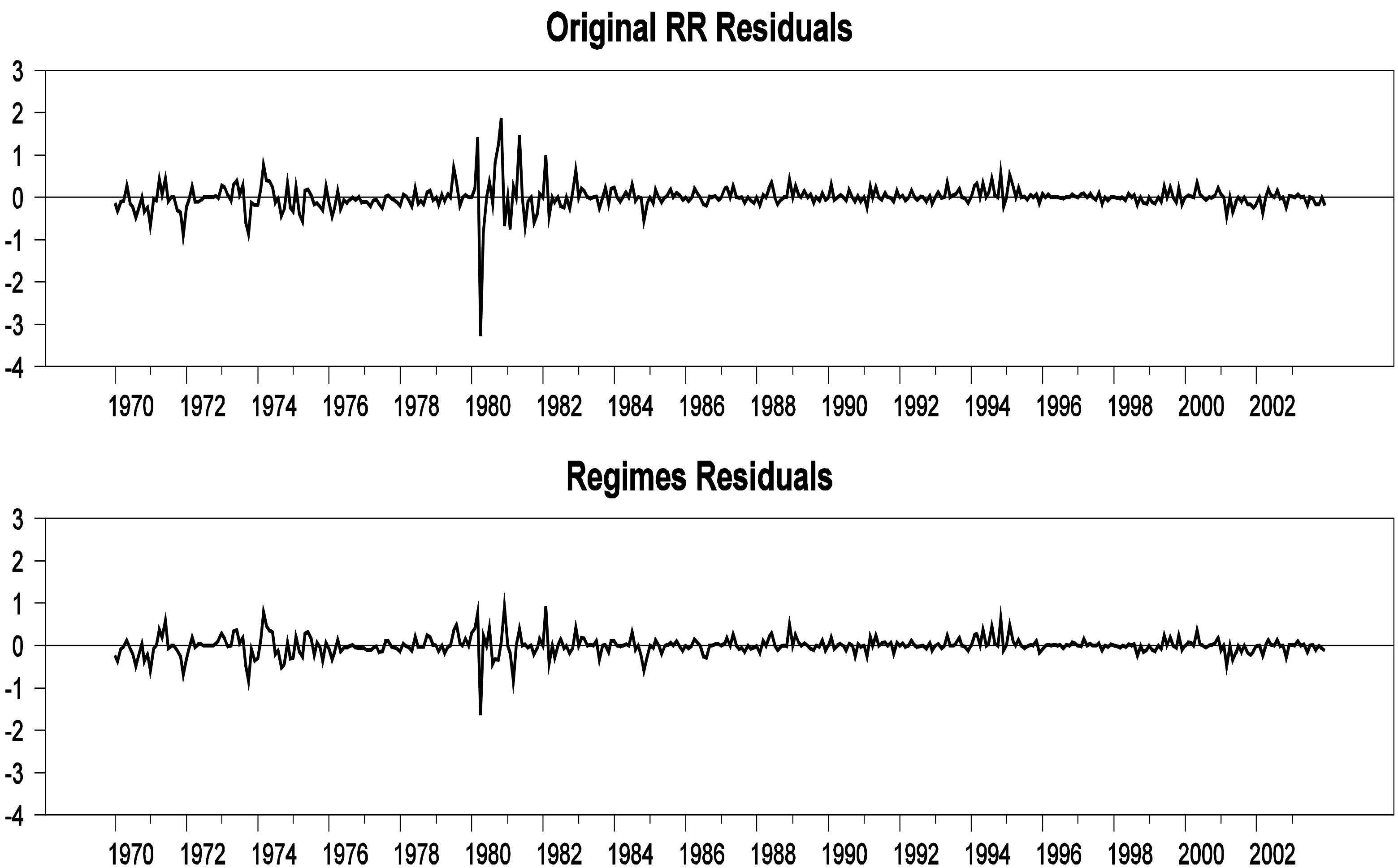


Figure 3.1 – Monthly Residuals

(fig. 3.1 cont'd.)

1970:1 - 2003:12



Allowing for a different response in the intended funds rate across the NBR targeting regime produces measures of policy shocks that are much smaller in magnitude in that regime than what is found when a uniform response across the entire sample is estimated.

3.2.2 Effects of Monetary Policy on Output and Prices

Chapter 2 explained the methods of computing impulse response functions from single equations and a three variable VAR. The residuals obtained from the Regimes specification regressions are interpreted as measures of changes in monetary policy at each FOMC meeting. The effects of shocks to monetary policy on the levels of output and prices are first estimated by computing cumulative impulse response functions (IRFs) and confidence interval bands from single equations. The coefficient estimates for the single equation regressions for output and prices are shown in the Appendix.

Figure 3.2 illustrates the output and price IRF's for a one percentage point increase in the Regimes specification shock measure for both samples. The point estimates are the solid lines and the dotted lines represent one standard deviation confidence intervals. Figure 3.3 plots the point estimates obtained from the Regimes specification residuals from the 1996 sample with the RR CI bands for 1996 sample. It also plots the Regimes responses for the 2003 sample with the RR CI bands from the 2003 sample. If the point estimates from the Regimes specifications are outside the RR CI bands, the responses are interpreted as significantly different.

In Figure 3.2 the response of output becomes negative three months after the shock in the 1996 sample. The response returns in the direction of the origin and becomes insignificant in the final month. In the 2003 sample, there is a shorter-lived significant transitory effect on output. The maximum effect on output for the 2003 sample is smaller than in the 1996 sample, but both display similar patterns.

The responses of the price level show significant price puzzles at very early horizons. The response does not become negative until twenty-four months after the shock in the original sample and twenty-five months after the shock in the extended sample. The response becomes significant twenty-eight months after the shock in the 1996 sample and thirty-two months in the 2003 sample.

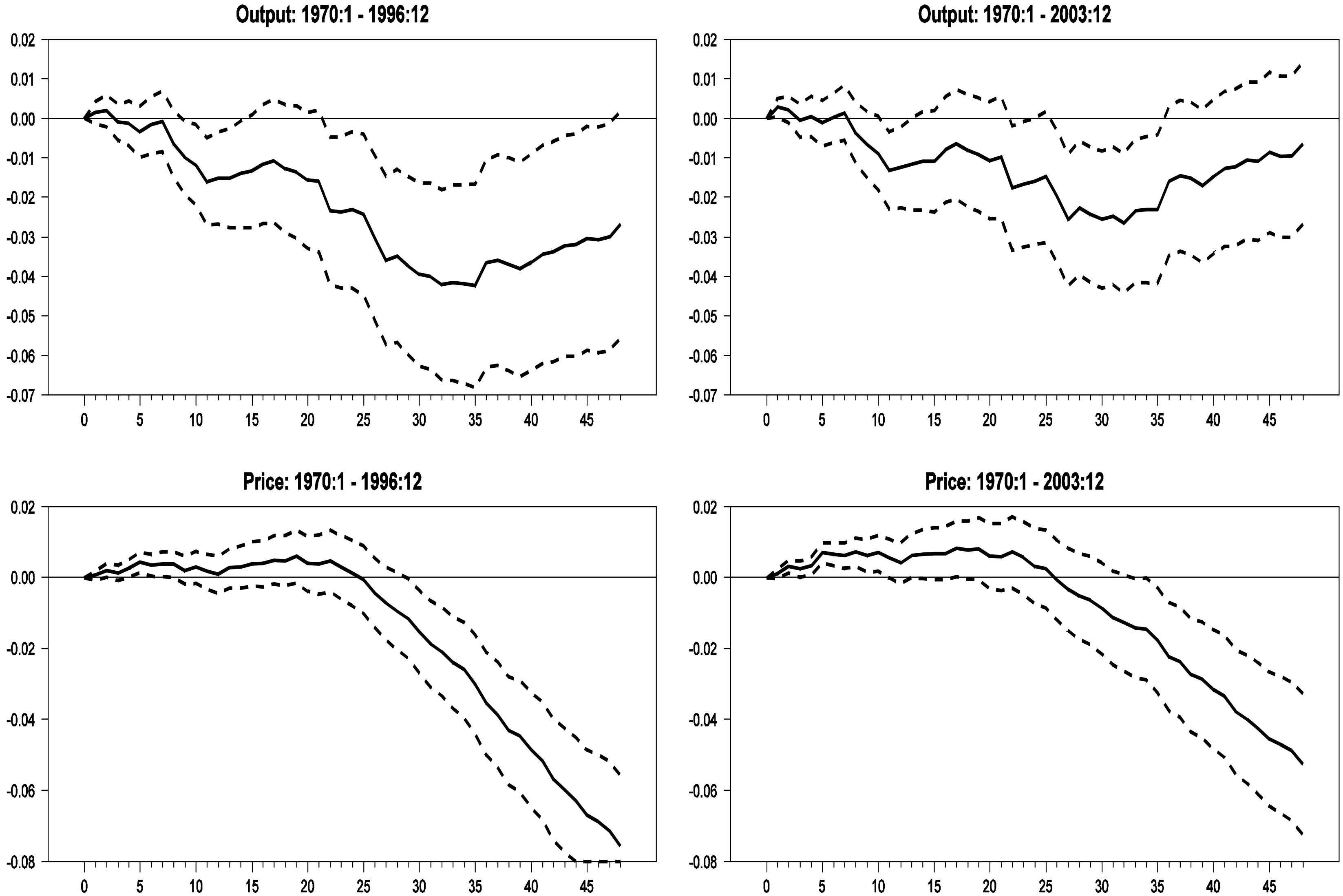


Figure 3.2 – Single Equation Impulse Response Functions: Regimes Specification

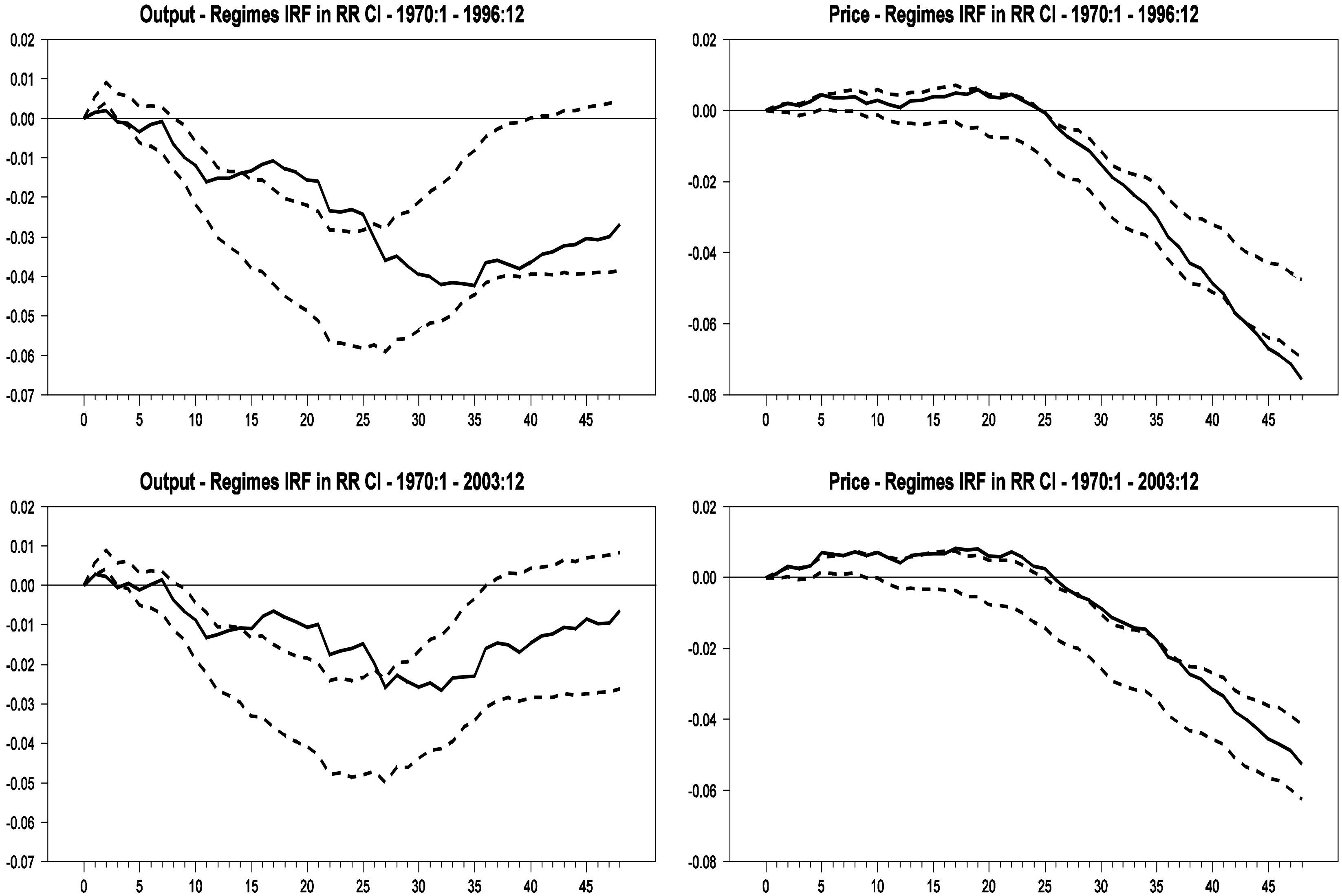


Figure 3.3 – Comparison of Romer-Romer and Regimes Specification Single Equation IRF’s

In Figure 3.3, the point estimates for output are above the upper RR CI band at intermediate horizons in both samples. The responses of output are transitorily weaker than those of RR. The responses are not significantly different at early and longer horizons. For the 1996 sample, the response of prices begins to lie below the lower RR CI band approximately forty months after the shock. When the example it extended to 2003, the response of prices lies slightly above the upper RR CI band at intermediate horizons. But in both samples, the departures from the RR CIs are quantitatively small and the results are generally not significantly different.

3.2.3 Vector Autoregression Analysis

As in Chapter 2, the effects on output and prices are further explored by estimating a monthly three variable VAR that includes a cumulated measure of monetary policy shocks as the monetary policy measure. Once again, the VAR uses a standard Choleski decomposition for identification of structural shocks and orders the variables as follows: output, price level, monetary policy measure. This ordering assumes that output and prices will respond to monetary policy with a lag but that monetary policy responds contemporaneously to movements in output and price. Each VAR contains thirty-six lags of all variables as well as a deterministic constant and seasonal monthly dummy variables. The VAR and IRF's are estimated for the 1996 and 2003 samples.

Figure 3.4 illustrates the output, price, and monetary policy measure IRF's for the cumulated residuals obtained from the Regimes specification. Figure 3.5 plots the point estimates obtained from the Regimes specification residuals from the 1996 sample with the RR CI bands for 1996 sample and the Regimes specification responses for the 2003 sample with the RR CI bands from the 2003 sample.

Figure 3.4 shows for the 1996 sample, the response of output follows the same pattern as the response from the single equation IRF. The significance varies at early and intermediate horizons before the point estimates return to the origin and the response becomes insignificant at longer horizons. In the 2003 sample, the point estimates are close to the origin until approximately thirty-five months after the shock

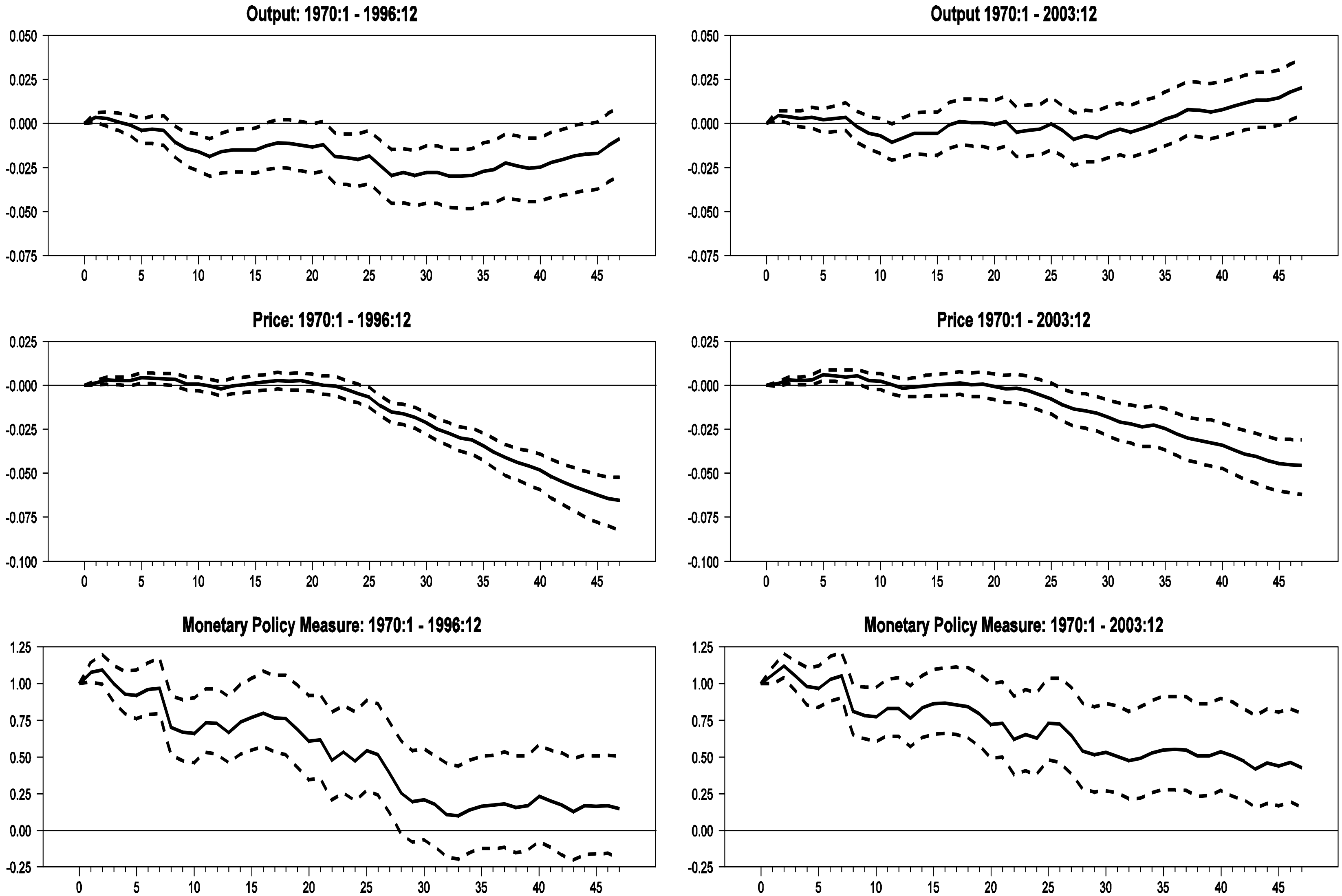


Figure 3.4 - VAR Impulse Response Functions: Regimes Specification

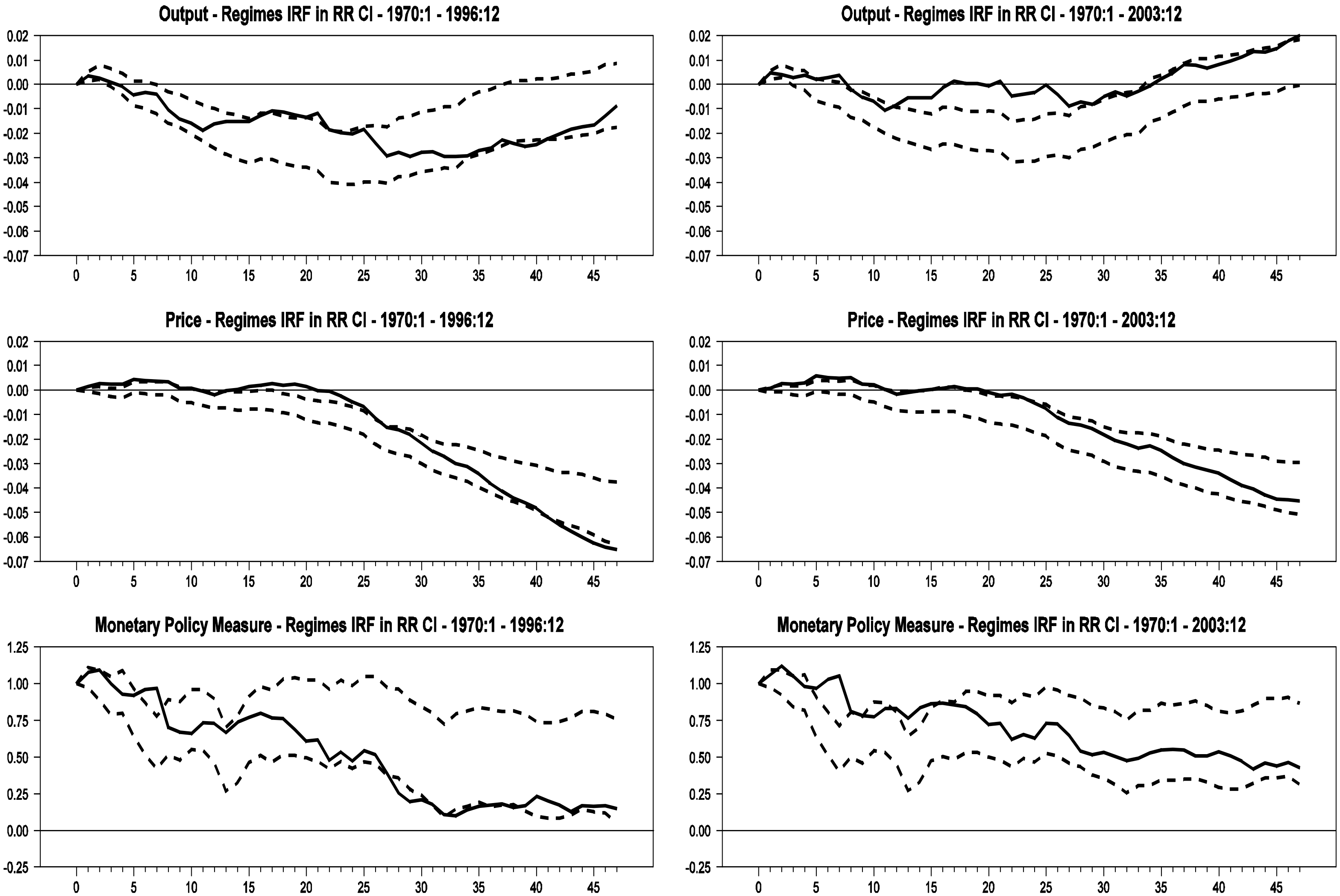


Figure 3.5 – Comparison of Romer-Romer and Regimes Specifications VAR IRF's

when they become positive. The entire response is insignificant until final two months when the lower RR CI band increases above the origin.

The responses of prices become permanently negative twenty-one months after the shock in the 1996 sample and twenty months after the shock in the 2003 sample. The responses become significant twenty-five months after the shock and twenty-six months after the shock for the 1996 and 2003 samples, respectively. There are significant price puzzles at early horizons for both samples.

The own effect of monetary policy becomes insignificant twenty-seven months after the shock in the 1996 sample. In the 2003 sample, the response of monetary policy is significantly positive at all horizons.

For the 1996 sample, Figure 3.5 shows the Regimes point estimates for output are above the upper RR CI band for a short period of time at intermediate horizons. There are no significant differences at all other horizons. For the 2003 sample, the significantly weaker response at intermediate horizons is larger and more pronounced, although still transitory as there are no significant differences at later horizons.

In the 1996 sample, the Regimes price response is significantly weaker at early horizons. For the final six months, the response then begins to lie below the lower RR CI band. For the 2003 responses, the weaker responses are slight and transitory at early horizons. There are no significant differences at intermediate and longer horizons.

In both samples, the own effects of monetary policy display slight transitory differences at early horizons. At later horizons in the 1996 sample, the response of monetary policy is transitorily weaker at later horizons. In the 2003 sample, there are no significant differences in intermediate or later horizons.

Allowing the response to Greenbook forecasts to differ across the NBR targeting regime provides suggestive evidence that the largest responses in monetary policy came during the NBR targeting regime of the FOMC. The tests of joint significance show the response of monetary policy was significantly different during the NBR targeting meetings compared to all other FOMC meetings in the sample. The monetary policy shocks created are highly correlated with those of RR, but the magnitudes of the largest observations decrease. The responses of output are generally significant for a shorter period of time, with the exception of the 1996 single equation IRF. The IRFs display significantly transitorily weaker effects

than those of RR at intermediate horizons. Compared to RR, the responses of prices are significantly weaker at early horizons, but these differences are small and transitory. While changes in operating regimes are a source of shocks in the quasi-narrative approach, controlling for them does not produce large or permanent differences in the results.

3.3 Chairmen

Romer and Romer state possible sources of their new measure of monetary policy shocks include, among others, the Federal Reserve's tastes and goals, politics, and things such as the personalities and views of the meeting participants. In their view, different chairmen of the Board of Governors may lead to differences in the way the intended funds rate is changed at each meeting. This view is supported by Clarida et. al (2000) who estimate monetary policy rules over a pre-Volcker sample and a Volcker-Greenspan sample. They find that in response to an increase in inflation during the pre-Volcker meetings, the FOMC raised the nominal funds rate by less than the increase in inflation. Consequently, the real interest rate fell. During a sample of FOMC meetings chaired by Volcker and then Greenspan, the Federal Reserve raised the nominal interest rate by more than the amount of inflation leading to a rise in the real interest rate.

While the Greenbook forecasts are presented at each FOMC meeting, different chairmen may have different preferences as to which variables they put the most weight on and have personalities that do or do not get other meeting participants to go along with the chair's views. Indeed, Hakes (1990) specifies a reaction function in which the independent variable is a dummy variable for tight or easy monetary policy with the dependent variables being output, price, unemployment, and the balance of trade. He first estimates the reaction function using OLS and then estimates it again as a probit probability model. The reaction function is estimated separately over the chairmanships of Martin, Burns, and Volcker. Hakes also performs tests of structural change on both the OLS and probit models for each pair of chairmanships. He finds that the objectives of the Martin and Volcker period were very similar with strong responses to inflation. However, he finds that the Burns era was "statistically distinct from both the Martin and Volcker periods" (p. 328).

Different chairmen may also respond differently to political pressures and set policy according to those pressures. Froyen and Waud (2002) estimate a policy rule using real-time data from Greenbooks, as well as including the SAFER index from Havrilesky (1995) to proxy for political signals, over different sample periods based on chairmanship. They find that there were significant responses to the SAFER index during the Burns chairmanship as well as the part of the Volcker chairmanship during the "monetarist period". No significant response to political pressure during the Greenspan era was found.

To further analyze the differences among chairmen, the responses of monetary policy in the RR policy equation are investigated before, during, and after Volcker's term. Chow tests are conducted on adjacent samples of FOMC meetings presided over by different chairmen to investigate if the responses in the intended funds rate differed during the Volcker term compared to FOMC meetings before and after his chairmanship. To conduct the Chow test, a dummy variable, $D_{Volcker}$, is constructed equaling 1 if the FOMC meeting was chaired by Volcker and 0 otherwise. To run the tests, the RR regression is modified to include interactions for every variable with the Volcker dummy as follows:

$$\Delta ff_m = \alpha + \beta ffb_m + \sum_{i=-1}^{2}\gamma_i\,\Delta\tilde{y}_{mi} + \sum_{i=-1}^{2}\delta_i\left(\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}\right) + \sum_{i=-1}^{2}\varphi_i\,\Delta\tilde{\pi}_{mi} + \sum_{i=-1}^{2}\theta_i\left(\Delta\tilde{\pi}_{mi} - \Delta\tilde{\pi}_{m-1,i}\right) + \rho\tilde{\mu}_{mi} + D_{Volcker} + \beta D_{Volcker} ffb_m + \sum_{i=-1}^{2}\gamma_i\,D_{NVolcker}\Delta\tilde{y}_{mi} + \sum_{i=-1}^{2}\delta_i\,D_{Volcker}\left(\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}\right) + \sum_{i=-1}^{2}\varphi_i\,D_{Volcker}\Delta\tilde{\pi}_{mi} + \sum_{i=-1}^{2}\theta_i\,D_{Volcker}\left(\Delta\tilde{\pi}_{mi} - \Delta\tilde{\pi}_{m-1,i}\right) + \rho D_{Volcker}\tilde{\mu}_{mi} + \varepsilon_m, \quad (3)$$

To compare the coefficients from the pre-Volcker and Volcker FOMC meetings, a Chow test was computed over a sample of 187 meetings from January 1969 – July 1987. To compare Volcker FOMC meetings to the Greenspan sample meetings until 1996, a Chow test was computed over a sample of 141 meetings beginning in August 1979 and ending in December 1996. To compare Volcker meetings to the extended sample of Greenspan FOMC meetings until 2003, a Chow test was computed over a sample of 197 meetings beginning in August 1979 and ending in December 2003.

Finally, to test if there were significant differences between the sample of Greenspan meetings ending in 1996 and those ending in 2003, the regression a chow test was computed over 132 meetings beginning in August 1987 and ending in December 2003. This was done by constructing a dummy variable, $D_{G03,}$

equaling 1 if the Greenspan meeting occurred after December 1996 and zero otherwise. This dummy variable was then interacted with each term and added to the original RR equation.

F-tests were conducted on the entire group of interacted variables to test for significant differences in the responses between the Volcker and pre-Volcker meetings, the Volcker and Greenspan FOMC meetings, as well as within the Greenspan-1996 and Greenspan – 2003 meetings.

The results for the Chow tests are shown in Table 3.3.

Table 3.3 – Chow Tests

	F-statistic	p-Value
Pre-Volcker vs. Volcker	3.03	0.00
Volcker vs. Greenspan - 1996	0.91	0.58
Volcker vs. Greenspan - 2003	2.04	0.01
Greenspan - 1996 vs. Greenspan - 2003	0.91	0.57

The Chow tests show there were significant differences in the responses of the FOMC between the pre-Volcker and Volcker terms with an F-statistic of 3.03 (p-value = 0.00). The responses did not differ between Volcker and Greenspan when only looking at the sample of meetings until 1996. However, adding more FOMC meetings chaired by Greenspan until the end of 2003 produces a significant difference between the Volcker and Greenspan meetings with an F-statistic of 2.04 (0.01). In comparing the Greenspan sample of meetings, there is no significant difference in the responses during Greenspan's time as chair. The F-statistic is 0.91 with a p-value = 0.57.

The RR policy equation assumes that the response to Greenbook forecasts does not differ across chairmen. To assess the importance of the source of changes in chairmen on the RR monetary policy shocks, a different response to Greenbook forecasts is allowed during each chairman's term. Equation 1 is estimated separately over samples of FOMC meetings in which different chairmen presided. The equation is estimated over a sample of 121 FOMC meetings from January 1969 – July 1979. The small number of meetings in the sample in which Miller and Martin were chair leads to the first sample combining the terms of Miller, Burns, and Martin into a pre-Volcker period. The equation was next estimated over a sample of 66 FOMC meetings from August 1979 – July 1987 when Volcker was chairman. The next

samples are 76 meetings from August 1987 until December 1996 and 132 meetings from August 1987 until December 2003. In both these samples, Alan Greenspan was chairman of all FOMC meetings.

In an OLS regression of equation 1 over the pre-Volcker meetings, a D-W statistic of 1.06 provided strong evidence of serial correlation. Breusch-Godfrey tests for first order and second serial correlation were computed. The test for first order serial correlation produced BG statistic of 32.76 (p-value = 0.00) and the t-statistic on the first lag of residuals is 6.13 (p-value = 0.00). The BG statistic in the test for second order serial correlation is 33.46 (p-value = 0.00) and the t-statistic on the second lag of residuals is -0.38 (p-value = 0.71). The test for second order serial correlation produces a very significant BG statistic but the coefficient on the second lag of residuals is insignificant. Consequently, only first order serial correlation is considered. To correct the standard errors in the presence of serial correlation, the regression over the sample of pre-Volcker meetings was estimated separately and Newey-West standard errors with one lag were computed. The other methods of correcting for serial correlation from Chapter 2 were including a lagged dependent variable and using the Prais-Winsten correction. However, since the focus will be on the OLS estimates to generate monetary policy shocks, the LDV and Prais-Winsten corrections were estimated but are not shown. As mentioned earlier the monetary policy shocks are constructed from the OLS residuals as adding a LDV or using the PW method to correct for serial correlation produced no significant differences from the OLS results for the responses of output and prices.

The regressions over the Volcker meetings, the shorter Greenspan sample, and the longer Greenspan sample produce D-W statistics of 2.21, 2.11, and 2.20, respectively. While this provides evidence there is no positive first order serial correlation, the high D-W statistics point to the possibility of negative serial correlation in the residuals. To test for negative serial correlation, a common method is to subtract the D-W statistic from 4 and if the result is below the lower critical value, there is evidence the residuals have negative serial correlation. The results from this produce test statistics of 1.79, 1.89, and 1.80. Each of these values falls in the indeterminate range between the upper and lower critical values. To test for negative serial correlation, the BG test is run over each of the samples.

Over the sample of Volcker meetings, the BG statistic is 1.10 with a p-value of 0.29. The coefficient on the first lag of residuals is -0.167 with a t-statistic of -0.85. Over the shorter sample of Greenspan meetings, the BG statistic is 1.01 with a p-value of 0.32. The coefficient on the first lag of residuals is -0.135 with a t-statistic of -0.86. Over the shorter sample of Greenspan meetings until 2003, the BG statistic is 0.67 with a p-value of 0.41. The coefficient on the first lag of residuals is -0.080 with a t-statistic of -0.75. The BG tests produce no evidence of first order negative serial correlation in any of the regressions and the original OLS standard errors are reported for each of these samples. Results from each regression are shown in Table 3.4.

Over the Volcker, Greenspan - 1996, and Greenspan - 2003 samples, approximately 50% of the variation in the funds rate is explained. In the pre-Volcker regression approximately 40% of the variation is explained. Each regression produces a higher R^2 than the original RR regressions estimated over the full samples. The sample of Volcker meetings has the highest standard error of estimate of 0.63. This is not surprising as the Volcker sample includes the period of NBR targeting.

Each of the regressions produces negative coefficients on the current quarter forecasted unemployment rate. Over the sample of pre-Volcker meetings, the coefficient on the unemployment rate is -0.093 and is significant with a t-statistic of -2.16 (p-value = 0.02). Over the sample of meetings when Volcker was chair, the response to unemployment was negative equaling -0.087 but insignificant with a p-value = 0.38. The response in the intended funds rate to the current quarter unemployment rate over the shorter sample of Greenspan - 1996 meetings is negative and significant. The coefficient on the unemployment rate is -0.196 with a p-value = 0.01. Over the longer sample of Greenspan meetings until 2003, the coefficient on the unemployment rate is still negative and significant. The response of the funds rate to the unemployment rate is -0.073 with a p-value = 0.05. The Volcker meetings are the only sample in which the response to unemployment is insignificant.

Table 3.4 - Determinants of the Change in the Intended Federal Funds Rate - Chairmen

	Pre-Volcker	FOMC Meetings	Volcker	FOMC Meetings	Greenspan	FOMC Meetings Until 1996:12	Greenspan	FOMC Meetings Until 2003:12
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.173	0.313	-0.308	0.778	1.015	0.494	0.043	0.217
Initial level of intended funds rate	-0.026	0.030	-0.148	0.049	-0.114	0.041	-0.060	0.025
Forecasted output growth, <u>Quarters ahead</u>:								
-1	0.011	0.008	0.019	0.044	0.027	0.017	0.017	0.011
0	0.007	0.015	-0.032	0.078	0.027	0.024	0.050	0.016
1	0.014	0.024	0.316	0.161	0.040	0.038	0.044	0.020
2	0.033	0.027	-0.036	0.144	0.015	0.053	-0.014	0.020
Change in forecasted output growth since last meeting, <u>Quarters ahead</u>:								
-1	0.031	0.030	0.071	0.090	-0.015	0.035	-0.019	0.023
0	0.068	0.025	0.237	0.102	0.056	0.031	0.033	0.023
1	-0.023	0.034	-0.193	0.180	0.011	0.048	0.031	0.029
2	0.043	0.053	0.073	0.179	0.001	0.069	0.027	0.034
Forecasted inflation, <u>Quarters ahead</u>:								
-1	0.016	0.017	0.111	0.111	0.051	0.033	0.006	0.021
0	0.021	0.026	0.035	0.105	0.043	0.038	0.034	0.027
1	-0.067	0.053	0.161	0.157	0.090	0.058	0.069	0.044
2	0.092	0.046	0.042	0.184	0.010	0.068	0.063	0.045
Change in forecasted inflation since last meeting, <u>Quarters ahead</u>:								
-1	0.076	0.043	0.005	0.129	-0.006	0.044	-0.006	0.032
0	0.011	0.041	-0.073	0.145	-0.076	0.053	-0.078	0.035
1	0.140	0.052	-0.091	0.236	-0.113	0.093	-0.012	0.067
2	-0.011	0.070	-0.426	0.314	0.138	0.107	0.058	0.061
Forecasted unemployment rate (current quarter)	-0.093	0.043	-0.087	0.097	-0.196	0.073	-0.073	0.037
R^2	0.39		0.51		0.53		0.54	
S.E.E.	0.25		0.63		0.17		0.15	
D-W	1.06		2.21		2.20		2.11	
N	121		66		76		132	

Tables 3.5 and 3.6 summarize the results from Table 3.4. Table 3.5 shows the sums of coefficients, and the corresponding t-statistics and p-values, for each group of forecast variables for each regression.

Table 3.6 shows the F-statistics and p-values for the tests of joint significance for each group of forecast variables for each regression.

Table 3.5 - Sums of Coefficients – Chairmen

	Pre-Volcker	**FOMC Meetings**		**Volcker**	**FOMC Meetings**		**Greenspan**	**FOMC Meetings Until 1996:12**		**Greenspan**	**FOMC Meetings Until 2003:12**	
	Sums of Coefficients	**t-statistic**	**p-value**	**Sums of Coefficients**	**t-statistic**	**p-value**	**Sums of Coefficients**	**t-statistic**	**p-value**	**Sums of Coefficients**	**t-statistic**	**p-value**
Forecasted output growth	0.066	3.38	0.00	0.267	2.99	0.00	0.109	2.23	0.03	0.097	4.56	0.00
Change in forecasted output growth since last meeting	0.120	1.86	0.06	0.188	0.74	0.46	0.053	0.78	0.44	0.072	1.85	0.07
Forecasted inflation	0.062	1.94	0.05	0.348	3.40	0.00	0.194	2.53	0.01	0.172	3.20	0.00
Change in forecasted inflation since last meeting	0.215	2.29	0.02	-0.585	-1.65	0.11	-0.057	-0.48	0.64	-0.038	-0.42	0.68

The sample of meetings prior to Volcker becoming chairman produce sums of coefficients that are positive and significant. The sum of coefficients on forecasted output growth is equal to 0.066 (t-statistic = 3.38). The sums of coefficients on forecasted inflation is 0.062 (t-statistic = 1.94). The sum of coefficients on the change in forecasted output growth variables are positive and significant at the 10% level. The sum of coefficients on the change in forecasted inflation is 0.215 (t-statistic = 2.29).

The sample of meetings when Volcker was chairman produces the largest sums of coefficients for each group of variables, with the exception of the change in forecasted inflation variables. However, this sum is still the largest in absolute value. The sum of coefficients on forecasted output growth is 0.267 (t-statistic = 2.99) and the sum of coefficients on forecasted inflation is 0.348 (t-statistic = 3.40). The sum of coefficients on the change in forecasted output variables is positive but insignificant. The sum of coefficients on the change in forecasted inflation variables is negative but insignificant.

The sums of coefficients on forecasted output growth and forecasted inflation in the Greenspan -1996 sample are positive and significant, though the magnitudes are not as large as the Volcker sample. The sum of coefficients on forecasted output growth is 0.109 (t-statistic = 2.23) and the sum of coefficients on forecasted inflation is 0.194 (t-statistic = 2.53). The sum of coefficients on the change in forecasted output growth are positive but insignificant. The sum of coefficients on the change in forecasted inflation are negative but insignificant. When extending the sample of Greenspan meetings to 2003, the results are similar. The sum of coefficients on forecasted output and forecasted inflation are smaller than the 1996 sample but have higher t-statistics. The sum of coefficients on forecasted output is 0.097 (t-statistic = 4.56) and the sum of coefficients on forecasted inflation is 0.172 (t-statistic = 3.20). The sum of coefficients on the change in forecasted output variables is 0.072 and is now significant at the 7% level with a t-statistic of 1.85 (p-value = 0.07). The sum of coefficients for the change in forecasted inflation is still negative and insignificant.

Table 3.6 - Joint Significance of Coefficients – Chairmen

	Pre-Volcker	**FOMC Meetings**	**Volcker**	**FOMC Meetings**	**Greenspan**	**FOMC Meetings Until 1996:12**	**Greenspan**	**FOMC Meetings Until 2003:12**
	F-statistic	**p-value**	**F-statistic**	**p-value**	**F-statistic**	**p-value**	**F-statistic**	**p-value**
Forecasted output growth	3.37	0.01	2.72	0.04	3.20	0.02	11.53	0.00
Change in forecasted output growth since last meeting	2.09	0.08	2.46	0.06	1.03	0.40	2.25	0.07
Forecasted inflation	2.60	0.03	3.31	0.02	1.87	0.13	2.61	0.04
Change in forecasted inflation since last meeting	2.95	0.02	0.74	0.57	0.86	0.49	1.59	0.18

In the pre-Volcker FOMC meetings, the forecasted output variables are jointly significant in the regression with an F-statistic of 3.37 (p-value = 0.01). The forecasted inflation variables are jointly significant with a p-value = 0.03. The change in forecasted output variables are jointly significant at the 8% level. The change in forecasted inflation variables are jointly significant at the 2% level with an F-statistic of 2.95 (p-value = 0.02).

In the Volcker sample of FOMC meetings, only the change in forecasted inflation variables are jointly insignificant. The forecasted output growth variables and the change in forecasted output variables are jointly significant with an F-statistics of 2.72 (p-value = 0.04) and 2.46 (p-value = 0.06), respectively. In the Volcker sample, the forecasted inflation variables have the highest F-statistic compared to the other samples with an F-statistic of 3.31 (p-value = 0.02).

In the Greenspan 1969 - 1996 sample, only the forecasted output variables are jointly significant with an F-statistic of 3.23 (p-value = 0.02). In the extended Greenspan sample, the change in forecasted output and forecasted inflation variables are significant. The forecasted output variables are still jointly significant with an F-statistic of 11.53 (0.00). The forecasted inflation variable become jointly significant with an F-statistic of 2.61 and a p-value = 0.04.

These results suggest that monetary policy during the Volcker term was quite different from the other terms. The estimated negative response of the intended funds rate to an increase in the forecasted unemployment rate was insignificant during the Volcker period, but the negative response was significant during FOMC meetings under the other chairmen. An increase in forecasted output growth or forecasted inflation elicited a very strong contractionary response in monetary policy. While the responses to increases in forecasted output and inflation were positive and significant during the terms of other Chairmen, the magnitudes of the responses were not as large. During the Volcker period, the FOMC responded to Greenbook forecasts of output growth and inflation differently from the FOMC meetings before or after his term.

While the responses to the change in forecasted output growth were insignificant in the Volcker and Greenspan-1996 samples, these responses were significant at the 6% level during pre-Volcker meetings and at the 7% level during the Greenspan – 2003 meetings. The only significant response to changes in forecasted inflation occurred during the pre-Volcker meetings. The FOMC responded strongly to changes in forecasted value during pre-Volcker meetings compared to those meetings chaired by Volcker or Greenspan.

3.3.1 Description of Monetary Policy Shocks

For the Chairmen specification, the OLS regressions estimated over four sample periods (pre-Volcker FOMC meetings, Volcker meetings, Greenspan FOMC meetings until 1996, and Greenspan meetings until 2003) are used to construct measures of monetary policy for both 1996 and 2003 samples. The residuals from each regression are converted to a monthly series. These monthly series are used to estimate the effects on output and prices. For the 1996 sample, the residuals from the pre-Volcker, Volcker, and Greenspan - 1996 samples were combined. For the 2003 sample, the residuals from the pre-Volcker, Volcker, and Greenspan - 2003 samples were combined.

Figure 3.6 shows the monthly monetary policy shocks from the original RR regressions and those obtained from the Chairmen regressions for both samples. The RR and Chairmen residuals have similar patterns over both samples. The Chairmen residuals also display similar volatility during the NBR targeting regime and Volcker's time as chairman. However, the results differ in terms of the maximum and minimum values for both samples. The original RR residuals for the 1996 and 2003 samples have a maximum value of 1.87 and a minimum value of -3.26. Controlling for the chairman by this specification produces a maximum shock of 1.69 and a minimum shock of -2.06 for both samples.

Although there are differences in the maximum values, the shock measures are highly correlated. The RR and Chairmen residuals have an overall correlation of 0.84 for both samples.

3.3.2 The Effects of Monetary Policy on Output and Price

The residuals obtained from the Chairmen specification are interpreted as measures of changes in monetary policy at each FOMC meeting. The effects of shocks to monetary policy on the levels of output and price are estimated by computing cumulative IRFs from single equations. The coefficient estimates for the single equation regressions for output and prices are shown in the Appendix.

Single equation IRF's are obtained and confidence interval bands are obtained in the same manner as before.

Figure 3.7 illustrates the output and price IRF's for a one percentage point increase in the shock measure for equations that use Chairmen specification residuals for the original and extended samples.

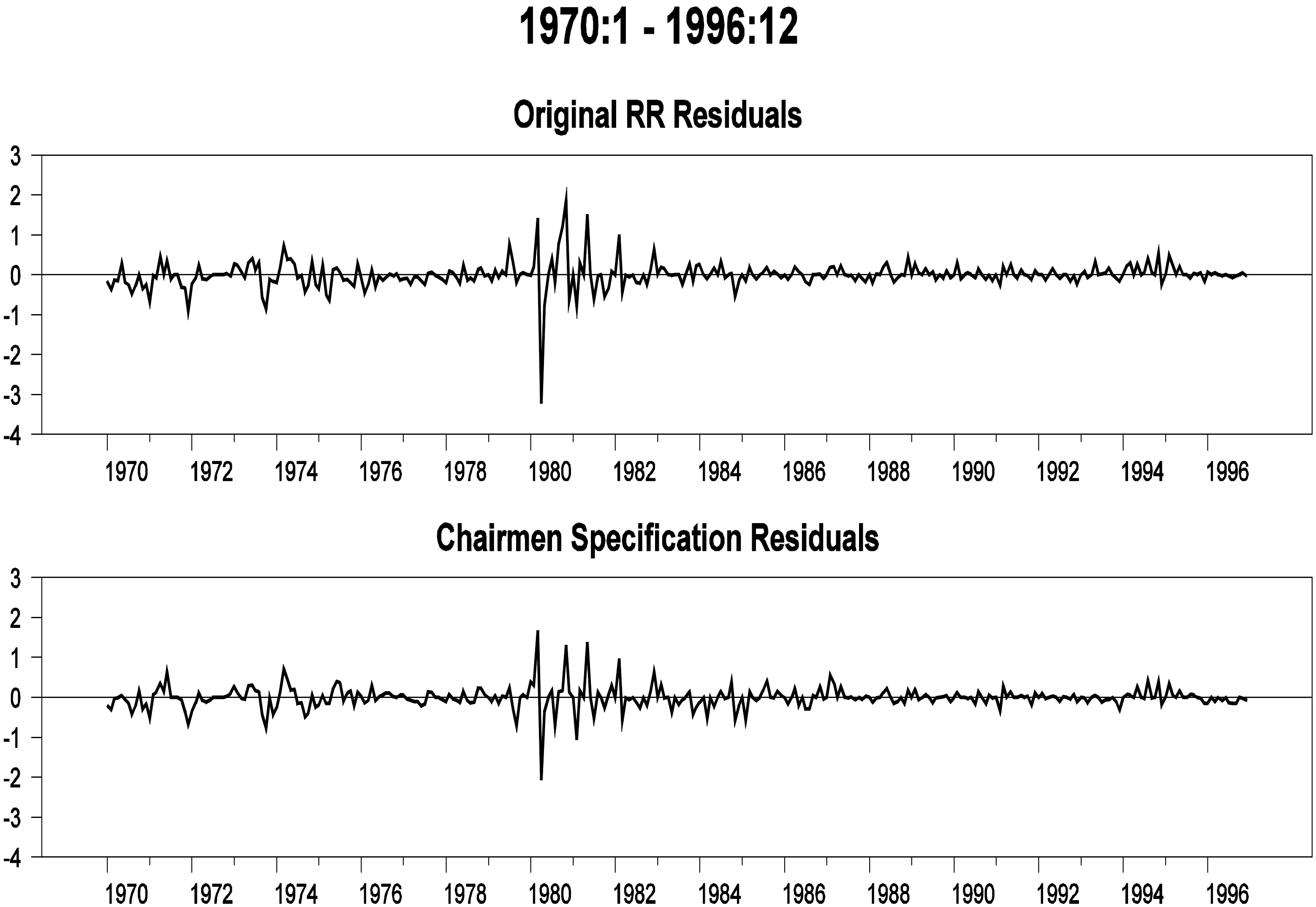
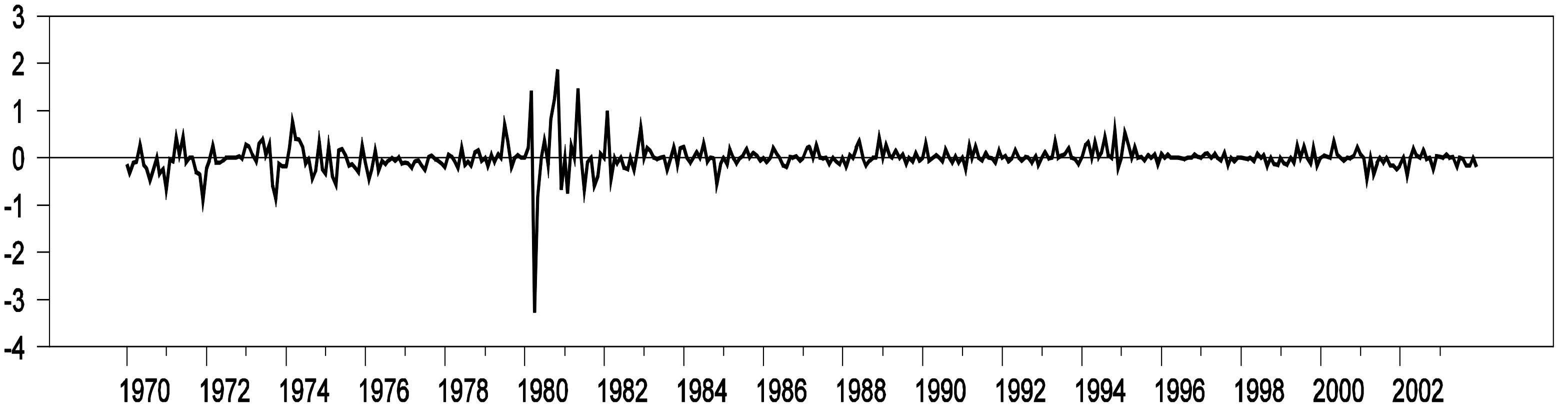


Figure 3.6 – Monthly Residuals

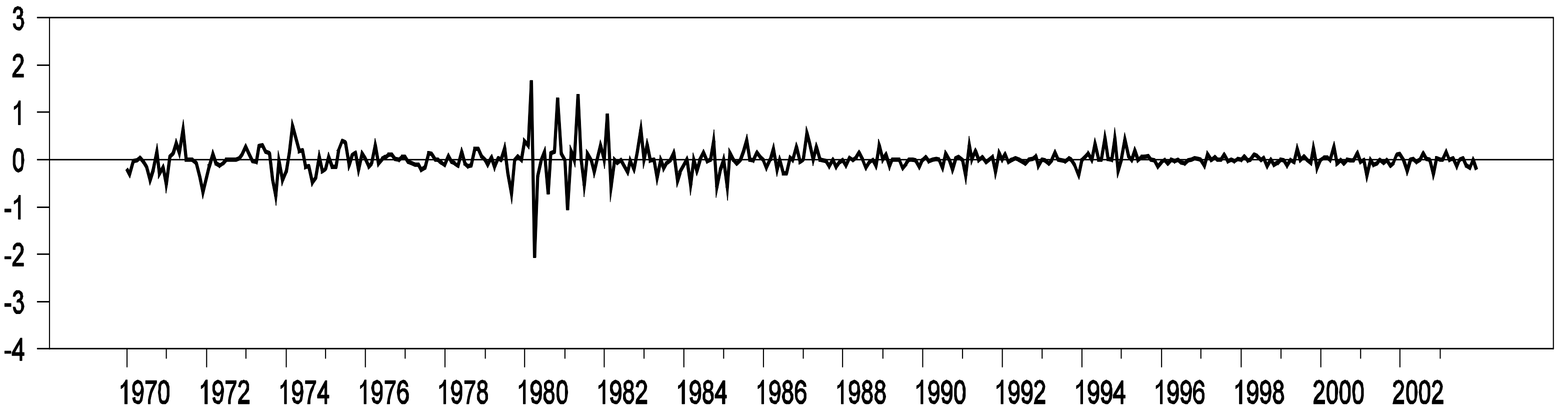
(fig. 3.6 cont'd.)

1970:1 - 2003:12

Original RR Residuals



Chairmen Specification Residuals



The point estimates are the solid lines and the dotted lines represent one standard deviation confidence intervals. Figure 3.8 shows the point estimates obtained from the Chairmen residuals along with the CI band obtained from the RR specification for the 1996 and 2003 samples.

Figure 3.7 shows that for the original sample, the negative response in output becomes slightly significant eleven months after the shock and is significant for nine months. However, for the 2003 sample, the entire response in output is insignificant.

The response of the price level becomes negative three months after the shock in the 1996 and 2003 samples. However, the CI bands are exceptionally wide and the entire response of prices to a monetary policy shock is insignificant in both samples. There is no significantly negative response to a contractionary monetary policy shock.

Allowing the response in the intended federal funds rate to differ among the terms of different chairmen produces measures of monetary policy that give almost completely insignificant effects on output and prices.

The Chairmen specification shocks produce significantly weaker responses in output for both samples. The point estimates lay completely above the RR CI bands at intermediate and longer horizons. The point estimates for prices for the Chairmen specification first lie very slightly below the lower RR CI band at early horizons and then above the RR CI bands at longer horizons for the 1996 sample. However, the Chairmen response in prices from the 2003 sample is almost completely contained in the RR CI bands with the exception of the final four months where it is slightly above the upper RR confidence interval band.

3.3.3 Vector Autoregression Analysis

The effects on output and price are further explored by estimating the monthly three variable VAR that includes a cumulated measure of monetary policy shocks as the monetary policy measure. The VAR and responses are estimated for the 1996 and 2003 samples. Figure 3.9 illustrates the output, price, and monetary policy measure IRF's for the cumulated residuals obtained from the Chairmen specification. Figure 3.10 plots the point estimates obtained from the Chairmen residuals from the 1996 sample with the

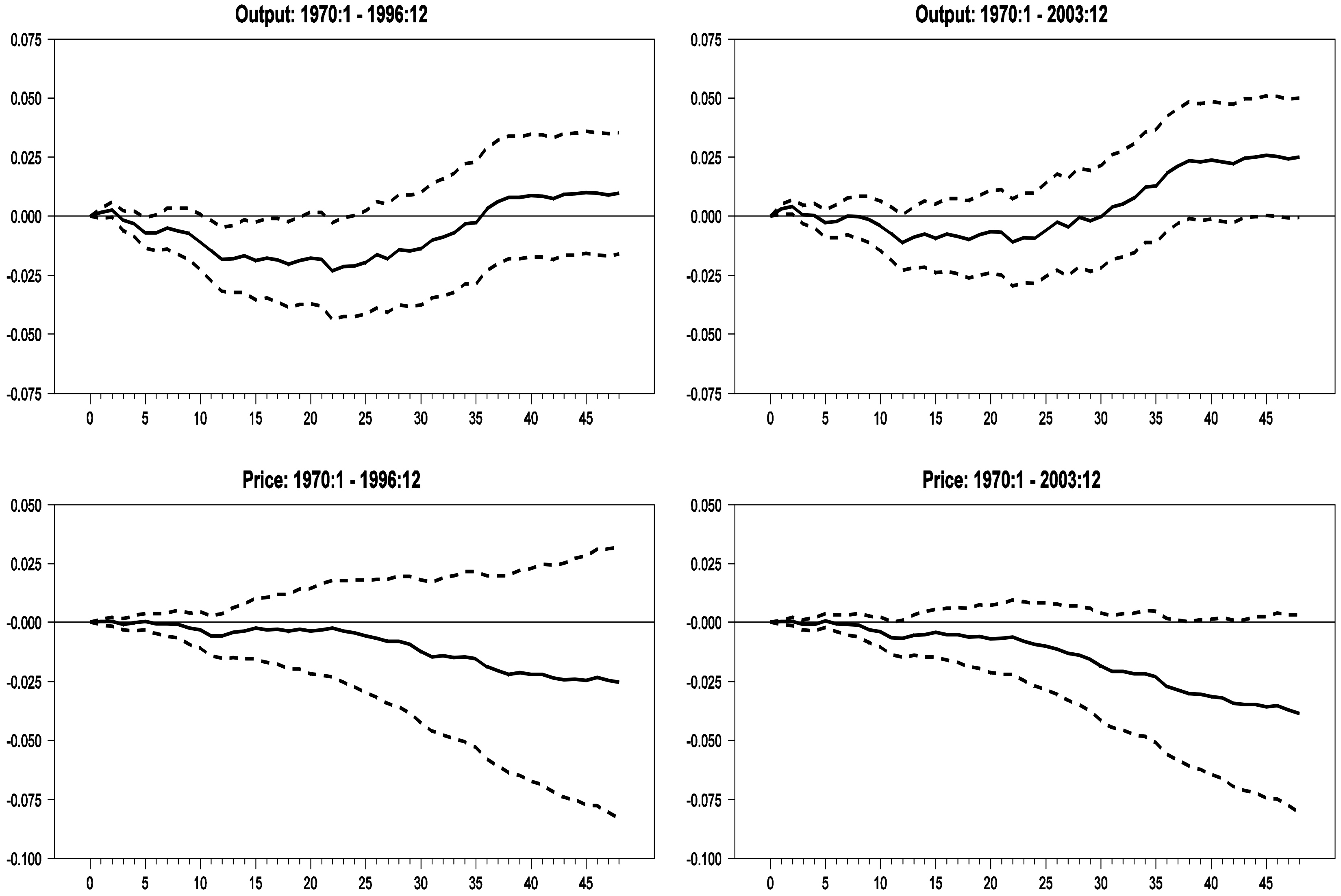


Figure 3.7 – Single Equation Impulse Response Functions: Chairmen Specification

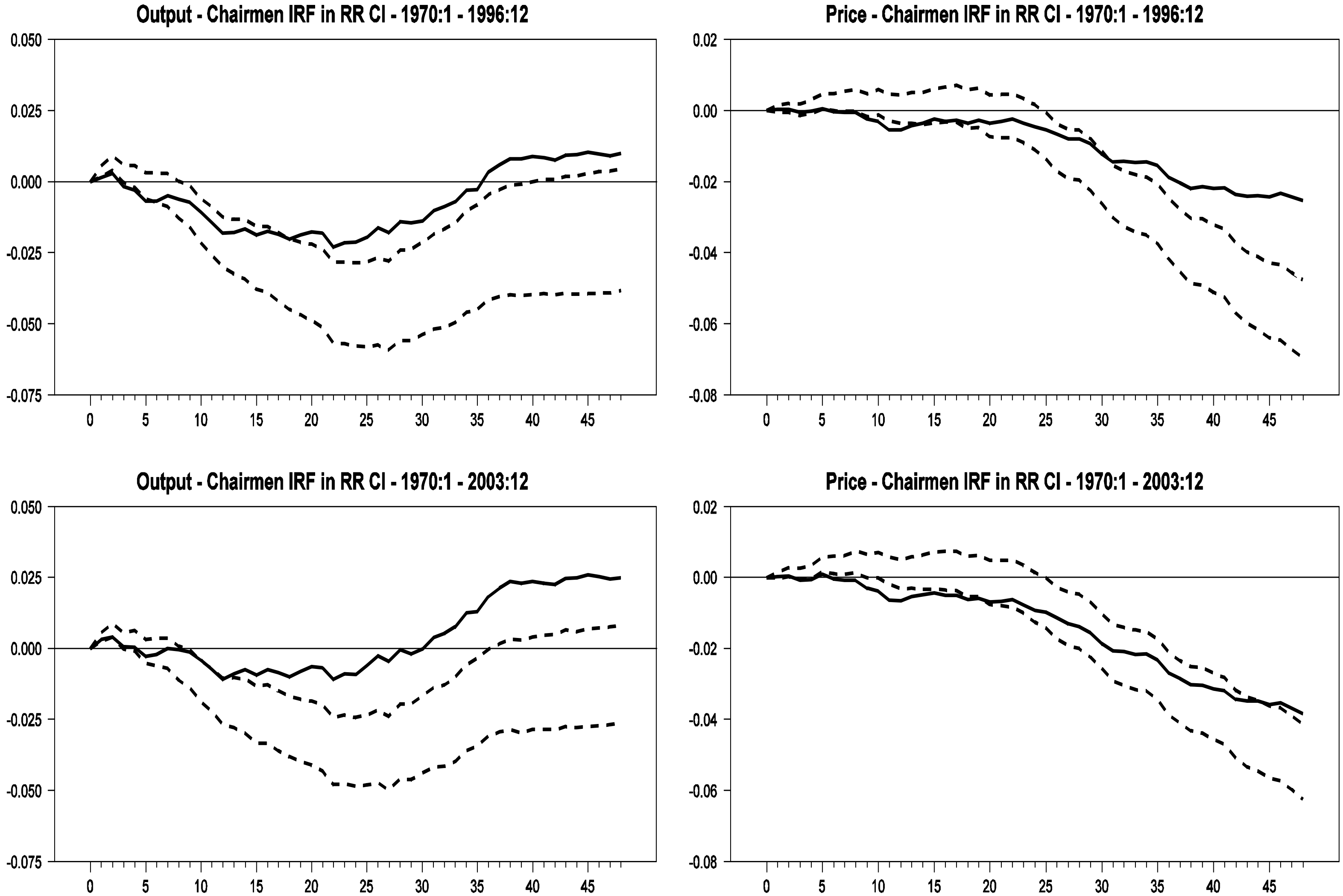


Figure 3.8 – Comparison of Romer-Romer and Chairmen Specification Single Equation IRF’s

RR CI bands for 1996 sample and the Chairmen responses for the 2003 sample with the RR CI bands from the 2003 sample.

The responses of output exhibit a significant negative effect initially. Over time, output returns to its initial level. The response of the price level shows an almost immediate significant negative drop from a contractionary monetary policy shock. The responses of prices become negative one month after the shock in the 1996 and 2003 samples and remain significant thereafter. The own effect of the monetary policy becomes completely insignificant twenty-four months after the shock in the original sample and twenty-seven months in the extended sample.

As with the single equation IRF's, Figure 3.10 shows that the Chairmen specification shocks also produce significantly weaker responses in output for both samples. The point estimates for the Chairmen specification shocks first lie very slightly below the lower RR CI band at early horizons and then rise above the upper RR CI bands at longer horizons for both samples. However, in the extended sample the Chairmen output response returns to the RR output CI bands forty-one months after the contractionary shock.

The point estimates for prices from the Chairmen specification lie below the lower RR CI band at early and intermediate horizons and then within the RR CI bands at longer horizons for both samples. This implies a stronger response in prices initially from a monetary policy. The Chairmen responses of monetary policy lay completely below the lower RR CI band at almost all horizons for both samples. This indicates that the Chairmen own responses of monetary policy are significantly smaller than those obtained by RR.

Allowing for a differential response to Greenbook forecasts for different chairmen of the FOMC shows that the most contractionary responses in the intended funds rate to output and inflation came during the term of Volcker. The monetary shocks constructed dramatically affect the magnitude and significance of the responses of macroeconomic variables.

In the single equation IRF's, the response of output is only significant for a brief period of time in the 1996 sample and is completely insignificant in the 2003 sample. Though the responses of price become

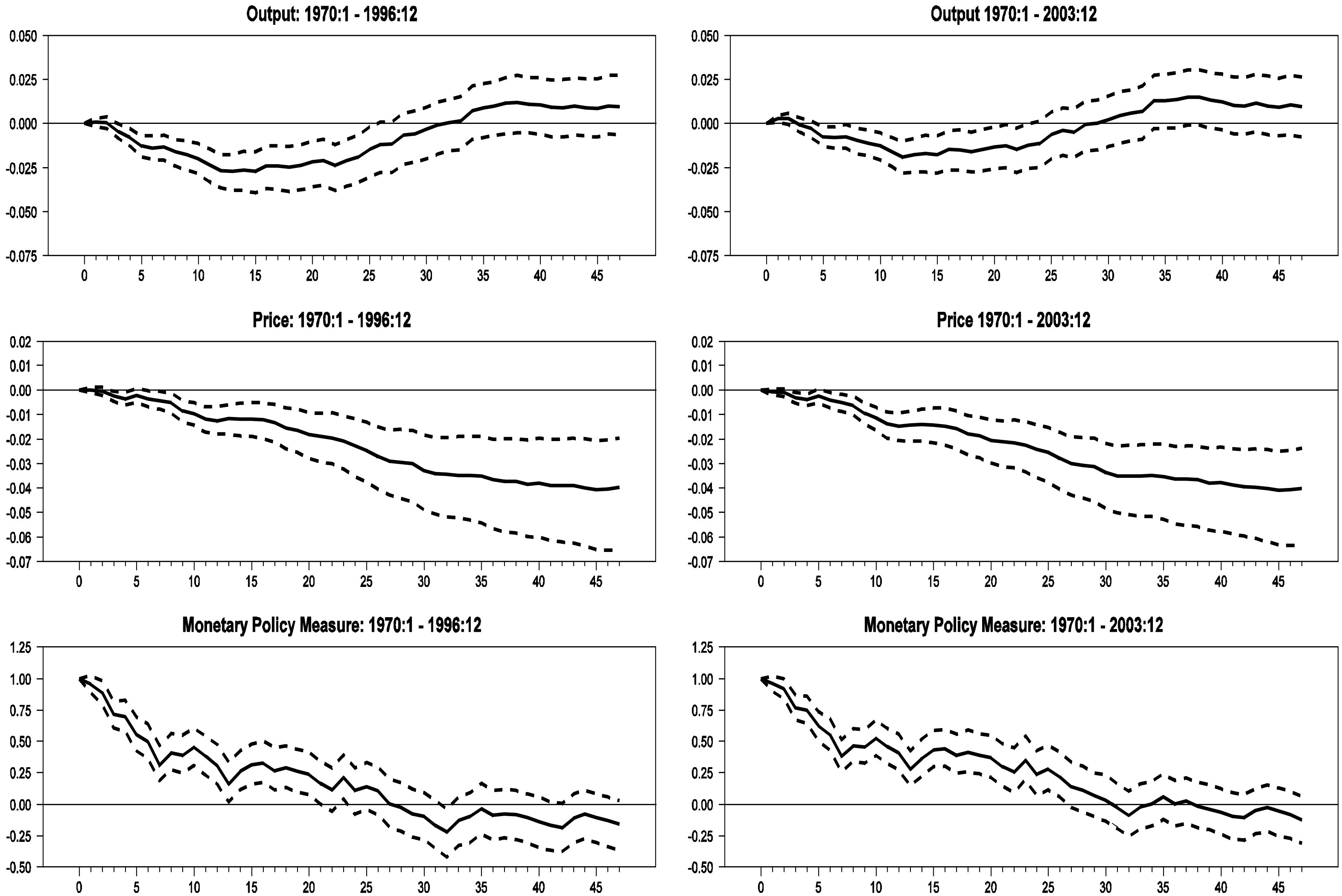


Figure 3.9 – VAR Impulse Response Functions: Chairmen Specification

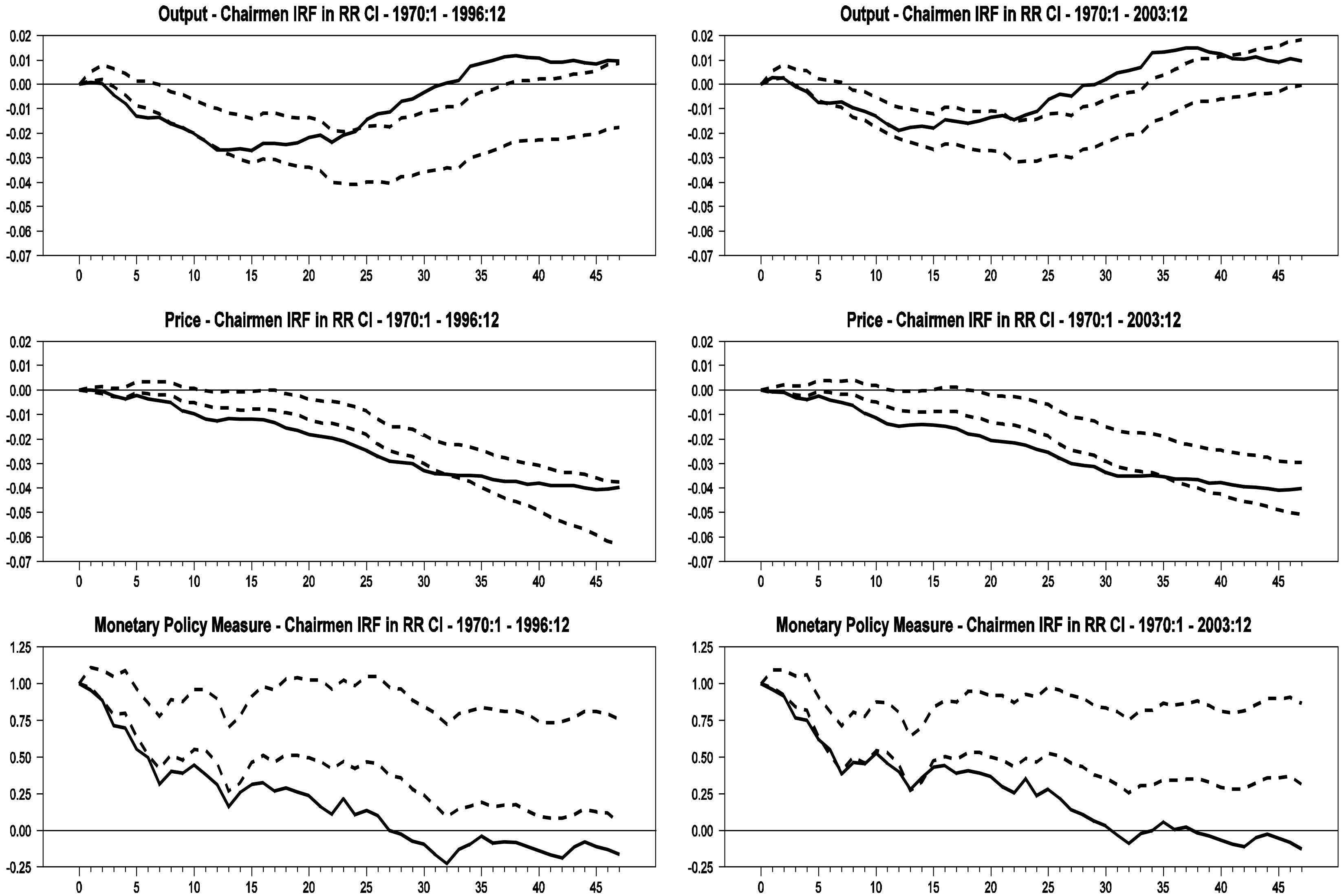


Figure 3.10 – Comparison of Romer-Romer and Chairmen Specification VAR IRF’s

negative very quickly, the responses are insignificant at all horizons for both samples. The differences among the RR responses and those that control for chairmen are drastic. The Chairmen responses of output are significantly weaker compared to those of RR at most horizons. The chairmen responses of prices are first significantly stronger at early horizons and then significantly weaker at longer horizons.

The VAR IRF's show that the responses of output from the cumulated Chairmen residuals produce the expected hump-shaped pattern in output before becoming insignificant approximately two years after the shock. The responses of prices become negative and significant faster than those of RR. The own effect of monetary policy is not sustained as in RR and becomes insignificant at intermediate horizons. The differences between the Chairmen and RR VAR responses are large and prolonged at most horizons.

These results show that changes in chairmen are a very important source of shocks in the RR quasi-narrative approach. If the responses of the intended funds rate in the policy equation are to vary across terms of chairmen, the results obtained from the shocks differ significantly from the original RR quasi-narrative measures. Compared to the original RR measures, the maximum and minimum values of the shocks decrease substantially. The single equation responses of output and price are almost completely insignificant and display significant differences to the original RR results. The VAR responses show significant differences and shorter lengths of significance in the monetary policy responses compared to the RR results. The significant differences are large and are not transitory as they last for relatively long periods of time.

3.4 Carter Credit Controls

Executive Order 12201 was signed by President Carter on March 14, 1980 and the Federal Reserve Board's Credit Restraint program was implemented that same month.[13] As mentioned earlier, Volcker felt compelled to go along with the credit controls as Carter had accepted his suggestions for reducing the budget deficit. While not a measure of political influence, there is a political element to this time period. In the economy the response to the Carter credit controls (CCC) was a sharp drop in the amount of credit

[13] For a detailed description of the Credit Controls imposed in 1980, see Schreft, Stacey L. "Credit Controls: 1980", Richmond Federal Reserve Economic Review (Nov/Dec 1980).

extended and the demand for credit. The FOMC responded by cutting the intended funds rate in response to these economics conditions and not to any direct political pressure.

The imposition of the CCC led to large changes in the intended funds rate. The FOMC meeting on March 18, 1980, was the first meeting during which the CCC were in place. In the original RR dataset, the change in the intended funds rate was 1.75 percentage points and the shock measure was 1.42 percentage points. The largest monetary policy shock in magnitude in the original RR results occurs at the next FOMC meeting on April 20, 1980. A change in the intended funds rate is reported to be -3.875 percentage points and the monetary policy shock from this action is -3.22 percentage points. At the next meeting on May 22, 1980, there was a further reduction in the intended funds rate of -1.375 percentage points with a shock of -0.76 percentage points. These CCC appear to be a significant source of shocks as the Fed responded strongly to these controls which were not in the Greenbook forecasts.

To examine the importance of the CCC in the quasi-narrative approach, the responses of the intended funds rate, the measure of monetary policy shocks, and the responses of output and prices are investigated by controlling for these credit controls. A dummy variable is created for the three meetings in which the credit controls were in place and is added to the regression to obtain shocks. The dummy variable is equal to 1 when during the three meetings discussed in the previous paragraph in which the CCC were in place and 0 at all other meetings. The equation to estimate becomes

$$\Delta ff_m = \alpha + \beta ffb_m + \sum_{i=-1}^{2} \gamma_i \, \Delta\tilde{y}_{mi} + \sum_{i=-1}^{2} \delta_i \left(\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}\right) + \sum_{i=-1}^{2} \varphi_i \, \Delta\tilde{\pi}_{mi} + \sum_{i=-1}^{2} \theta_i \left(\Delta\tilde{\pi}_{mi} - \Delta\tilde{\pi}_{m-1,i}\right) + \rho\tilde{\mu}_{mi} + \tau CCC + \varepsilon_m, \qquad (4)$$

where *CCC* is a dummy for the Carter Credit Controls. The regression is estimated over the original sample as well as the extended sample to 2003. The results are shown in Table 3.7.

The coefficients on the credit control dummies are very large in absolute value and significant. For both samples the coefficient on the variable is -1.173. This implies that meetings with the CCC in place had a 1.173 percentage point reduction in the intended funds rate compared to the meetings that did not.

Table 3.7 - Determinants of the Change in the Intended Federal Funds Rate – Carter Credit Controls

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.128	0.136	0.077	0.103
Initial level of intended funds rate	-0.024	0.012	-0.020	0.010
Forecasted output growth, Quarters ahead:				
-1	0.010	0.010	0.009	0.009
0	0.002	0.018	0.007	0.016
1	0.016	0.031	0.018	0.024
2	-0.010	0.032	-0.010	0.024
Change in forecasted output growth since last meeting, Quarters ahead:				
-1	0.057	0.029	0.052	0.024
0	0.141	0.029	0.128	0.025
1	0.036	0.044	0.030	0.036
2	0.048	0.050	0.051	0.040
Forecasted inflation growth, Quarters ahead:				
-1	0.010	0.023	0.012	0.020
0	-0.042	0.028	-0.038	0.025
1	-0.010	0.042	-0.012	0.038
2	0.099	0.046	0.096	0.041
Change in forecasted inflation growth since last meeting, Quarters ahead:				
-1	0.079	0.043	0.075	0.038
0	0.021	0.047	0.004	0.040
1	0.078	0.072	0.082	0.063
2	-0.120	0.079	-0.108	0.066
Forecasted unemployment rate (current quarter)	-0.036	0.020	-0.038	0.017
Carter Credit Control Dummy	-1.173	0.255	-1.173	0.231
R^2	0.34		0.34	
S.E.E.	0.38		0.35	
D-W	2.04		1.99	

The sample of FOMC meetings over the period 1969:1 – 1996:12 have 263 observations. The sample of FOMC meetings over the period 1969:1 – 2003:12 have 319 observations.

The negative coefficient is picking up the large negative shock associated with the April FOMC meeting. The minutes of the April FOMC meeting indicate a concern about the drop in the growth rate of the money supply below the desired rate in March. The FOMC agreed that open market operations should be directed towards the expansion of reserves to be consistent with a somewhat higher growth rate of the money supply. This reduced the upper range for the intended federal funds rate. In between the April and May FOMC meetings, RR’s narrative appendix shows there were further drops in the intended funds rate

from 14.5 to 10.875. At the May FOMC meeting, the FOMC expected the funds rate to fall again but to 9.5% at the lowest. The FOMC allowed this to occur in response to the credit conditions and changed the intended funds to 9.5%.

Chapter 2 showed extending the original RR regression to 2003 produced evidence of first order serial correlation. Adding the CCC dummy to the regressions produced Durbin-Watson statistics of 2.04 for the original sample and 1.99 for the 2003 sample. Adding a dummy variable for these three meetings has substantially reduced the persistence in the shocks seen in the RR shocks from the 2003 sample. Thus, it seems that the serial correlation found in the original RR equation through 2003 was due to the CCC. When adding a CCC dummy, the standard error of estimate falls slightly for the 1996 sample to 0.38 and falls by a greater amount to 0.35 for the 2003 sample.

The sum of the coefficients on forecasted output growth for both samples is positive, but insignificant; for the original sample it is 0.018 (t-statistic = 1.07) and for the extended sample the sum is 0.024 (t-statistic = 1.66). Compared to the original RR regressions, adding the CCC has made the sum of coefficients on forecasted output insignificant. The sum of the coefficients on forecast inflation is positive and significant for both samples— 0.057 (t-statistic = 3.30) for the original sample and 0.058 (t-statistic = 3.96) for the extended sample. The sum of the coefficients on the change in forecasted output growth is 0.282 (t-statistic = 4.71) for the original sample and 0.261 (t-statistic = 5.46) for the extended sample. For the change in forecast inflation, the sum of the coefficients is 0.059 (t-statistic = 0.65) for the original sample and 0.053 (t-statistic = 0.67) for the extended sample. The coefficient for the current unemployment rate is negative and significant for both samples: -0.036 (t-statistic = -1.79) for the original sample and -0.038 (t-statistic = -2.22) for the extended sample. The unemployment rate goes from being significant at the 10% level to being significant at the 5% level once the sample is extended.

When testing each group of variables for joint significance, the results differ between the samples. The forecasted output growth variables have an F-statistic of 0.95 (p-value = 0.44) for the original sample and 2.01 (p-value = 0.09) for the extended sample. The forecasted output growth variables become jointly significant when the sample is extended to 2003. The forecasted inflation variables are jointly significant

in each sample. The F-statistic for the original sample is 3.46 (p-value = 0.01) and 4.85 (p-value = 0.00) for the extended sample. The change in forecast output variables have an F-statistic of 11.84 (p-value = 0.00) for the original sample and 13.91 (p-value = 0.00) for the extended sample. The change in the forecast inflation variables have an F-statistic of 1.49 (p-value = 0.21) for the original sample and 1.76 (p-value = 0.14) for the extended sample. The change in forecast output variables are jointly significant in both samples while the change in the forecasted inflation variables are not.

3.4.1 Description of Monetary Policy Shocks

Figure 3.11 shows the monthly monetary policy shocks from the original RR regressions and those obtained from the regressions that included dummies for the CCC for both samples. For the CCC residuals, the smallest shock is -2.35 for the original sample and -2.37 for the extended sample. These are not as small as those obtained in the RR regressions which were -3.22 in the original sample and -3.26 in the extended sample. However, the Carter Credit Control dummies produce a larger maximum shock of 2.30 for the original sample and 2.33 for the extended sample. These are larger than the RR maximum residuals of 1.87 for both the original and extended sample results. The correlation between the RR residuals and the Credit Control specification residuals is 0.96 for both samples.

3.4.2 The Effects of Monetary Policy on Output and Price

The residuals obtained from the regressions with the CCC dummy included are interpreted as measures of changes in monetary policy at each FOMC meeting. The residuals are converted to a monthly series and the effects of shocks to monetary policy on the levels of output and price are estimated by computing cumulative IRFs from single equation estimates of output and prices. The coefficient estimates for the single equation regressions for output and prices are shown in the Appendix.

Single equation IRFs and confidence interval bands are computed in the same manner as before. Figure 3.12 illustrates the output and price IRF’s for a one percentage point increase in the shock measure for equations that use the CCC specification residuals for the original and extended samples.

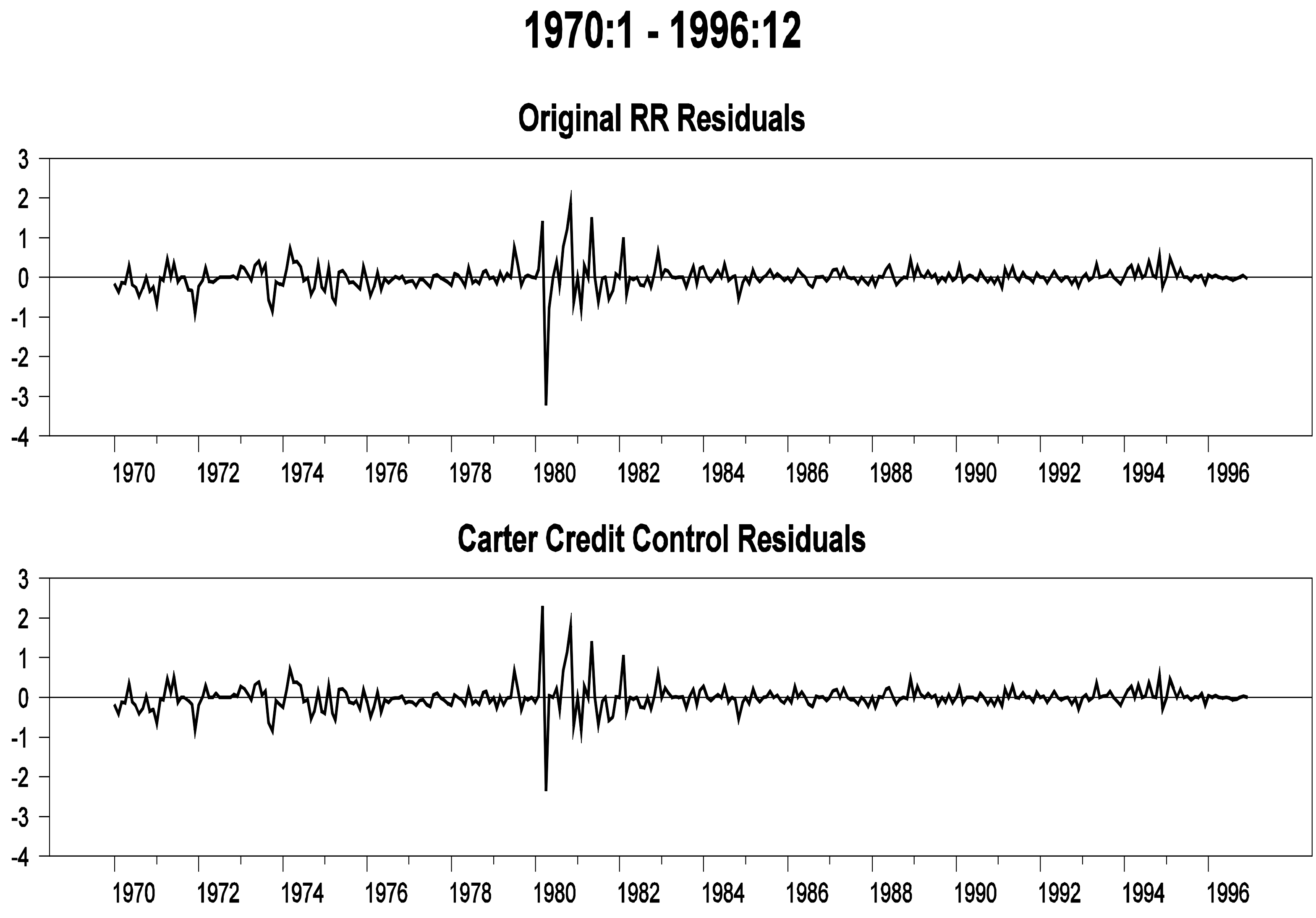
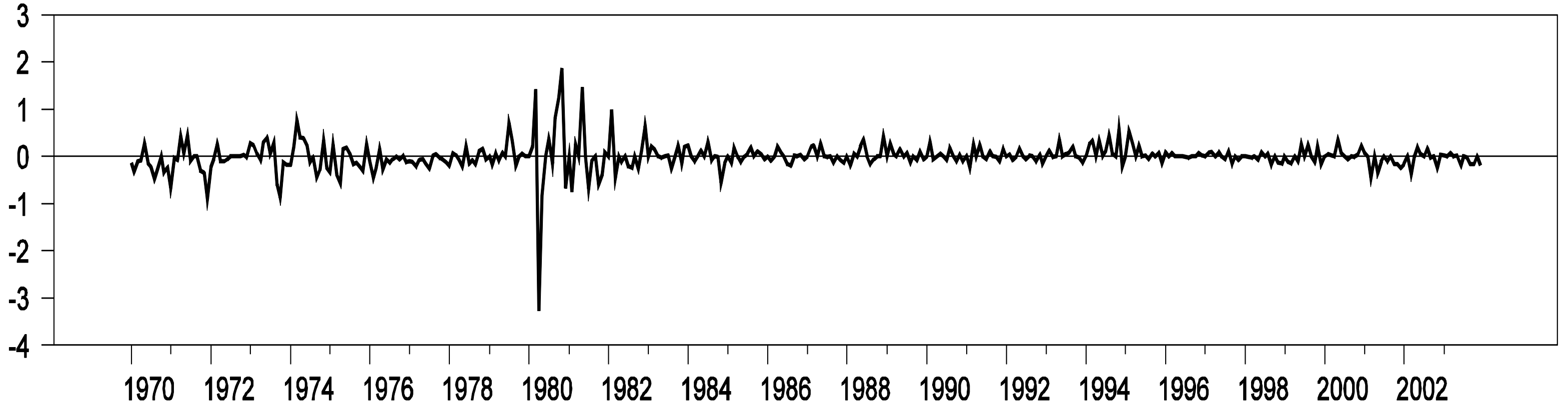


Figure 3.11 – Monthly Residuals

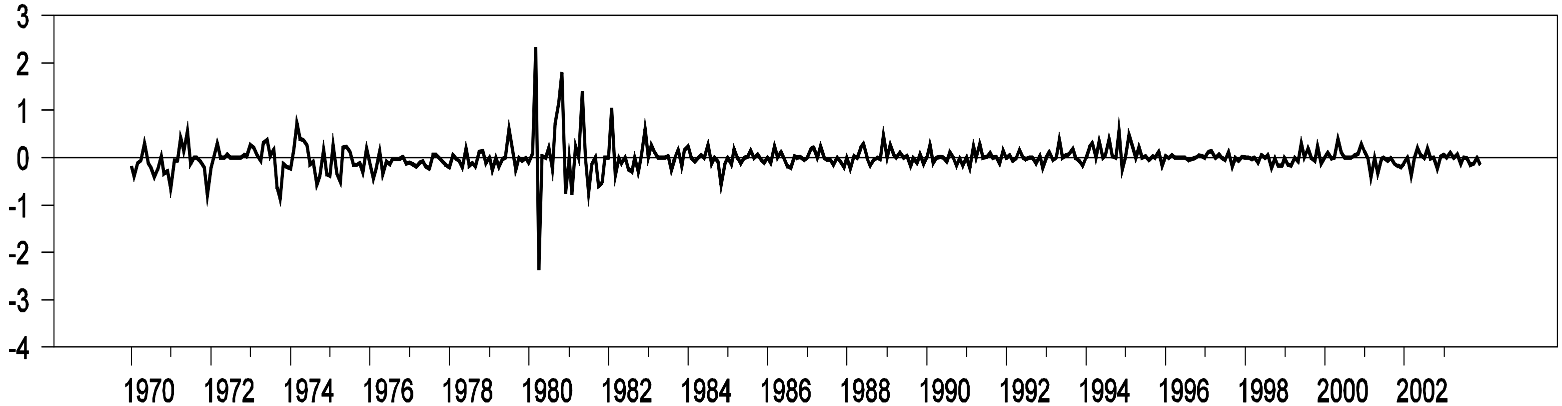
(fig. 3.11 cont'd.)

1970:1 - 2003:12

Original RR Residuals



Carter Credit Control Residuals



The point estimates are the solid lines and the dotted lines represent one standard deviation confidence intervals. Figure 3.13 plots the point estimates obtained from the CCC residuals in the 1996 sample with the RR CI bands for 1996 sample. It then plots the CCC responses for the 2003 sample with the RR CI bands from the 2003 sample.

Figure 3.12 shows that the single equation IRF's from the Carter Credit Control equation residuals display very similar patterns to those computed using the original RR residuals. The response of output becomes negative eight months after the shock and significant eleven months after the shock. Output returns to its initial value at longer horizons. The response in prices for the original sample becomes permanently negative twenty months after the shock. For the extended sample, the response becomes negative eleven months after the shock. The response in price becomes significant twenty-seven months after the shock for the original sample and twenty-five months after the shock for the extended sample.

Figure 3.13 shows there are no significant differences between the RR responses and CCC responses for the price level in either sample. The CCC point estimates are completely within the RR CI bands for both samples. However, the CCC point estimates for output are above the upper RR CI bands in both samples. For both samples, the CCC specification produces a transitorily weaker response in output at intermediate horizons.

3.4.3 Vector Autoregression Analysis

A monthly three variable VAR that includes a cumulated measure of monetary policy shocks as the monetary policy measure for the original sample to 1996 and the extended sample to 2003 is estimated for both samples. Figure 3.14 illustrates the output, price, and monetary policy measure IRF's for the cumulated residuals obtained from the CCC specification for the original and extended samples. Figure 3.15 plots the point estimates obtained from the CCC residuals in the 1996 sample with the RR CI bands for 1996 sample. It then plots the CCC responses for the 2003 sample with the RR CI bands from the 2003 sample.

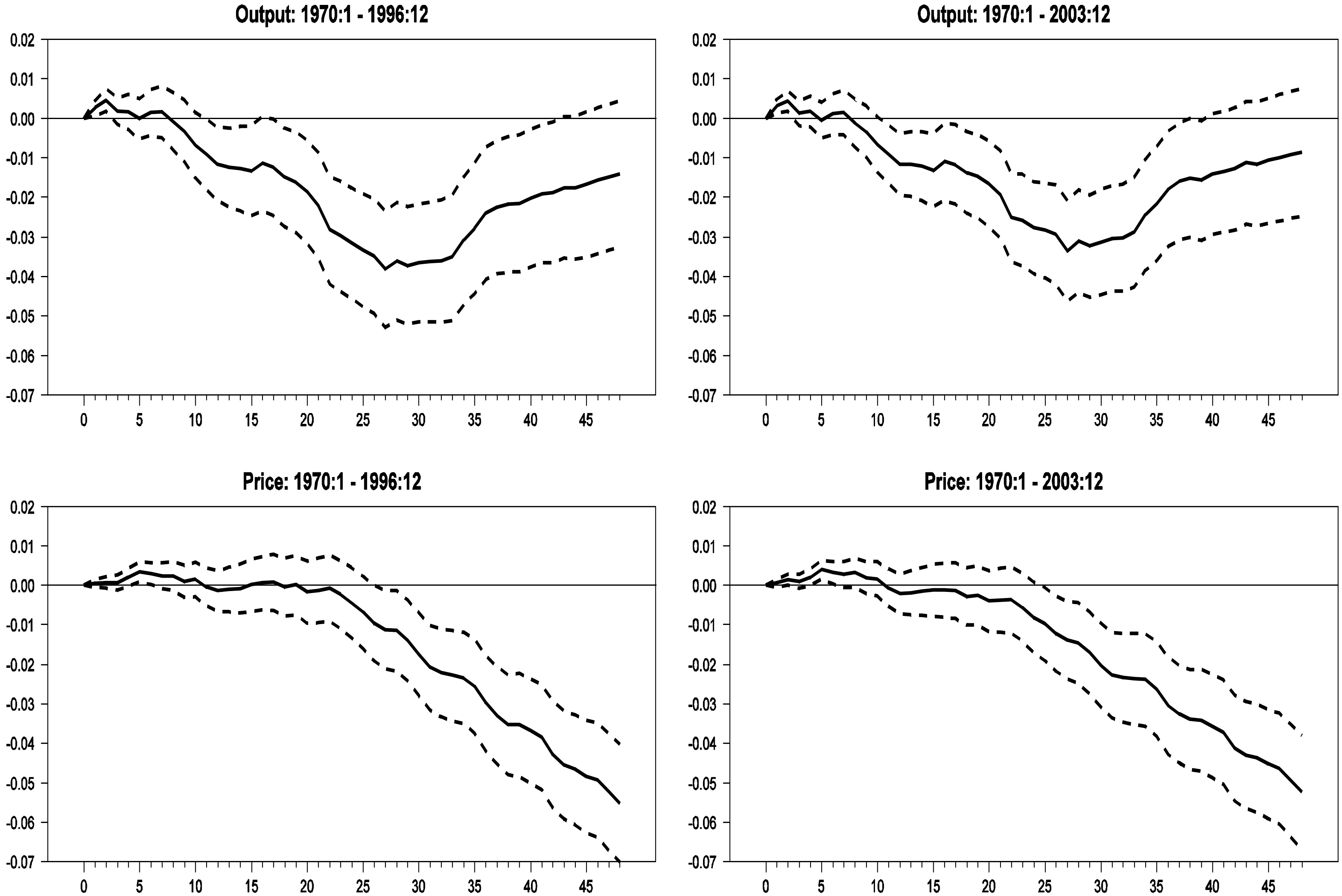


Figure 3.12 – Impulse Response Functions: Carter Credit Controls Specification

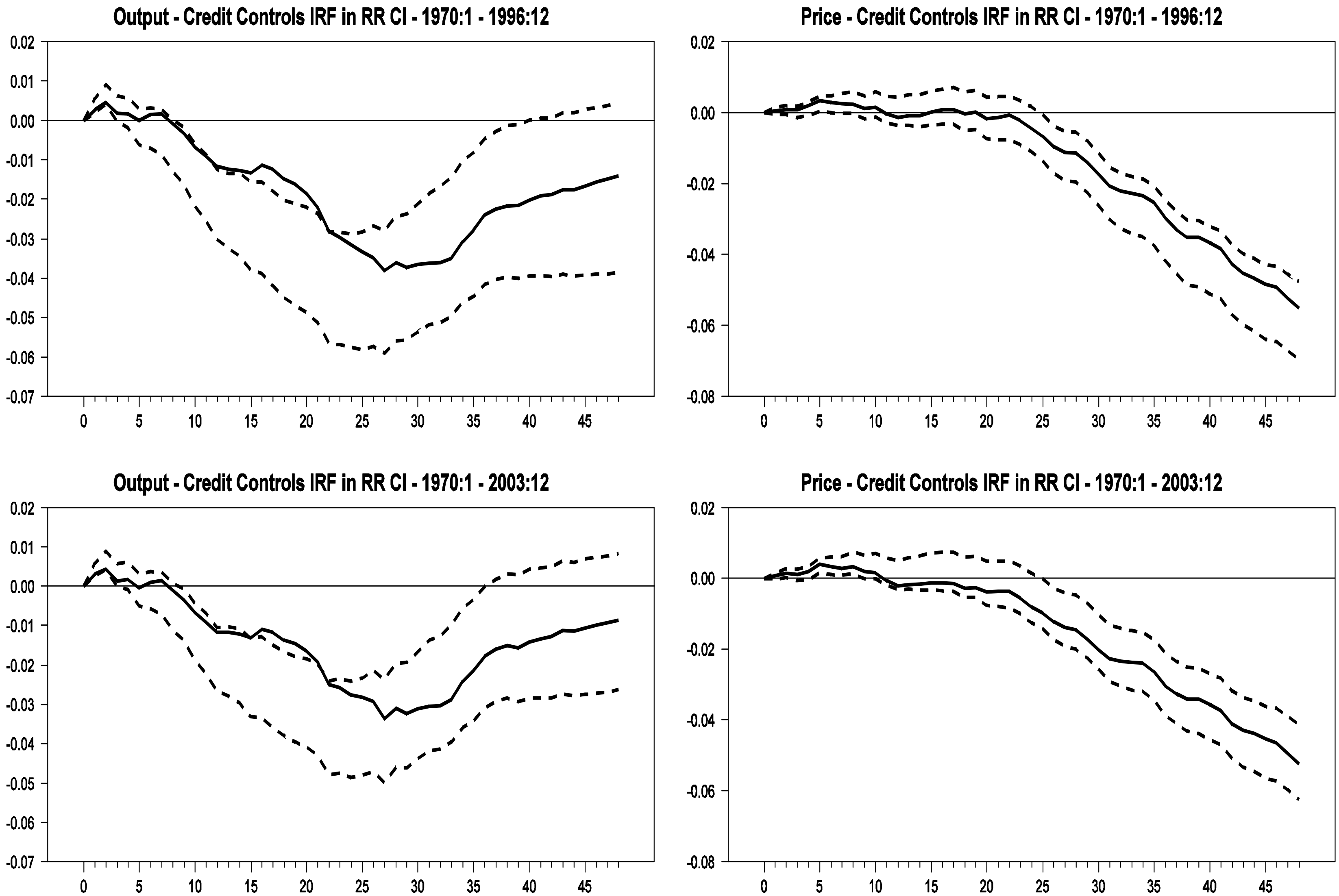


Figure 3.13 – Comparison of Romer-Romer and Carter Credit Controls Specification Single Equation IRF’s

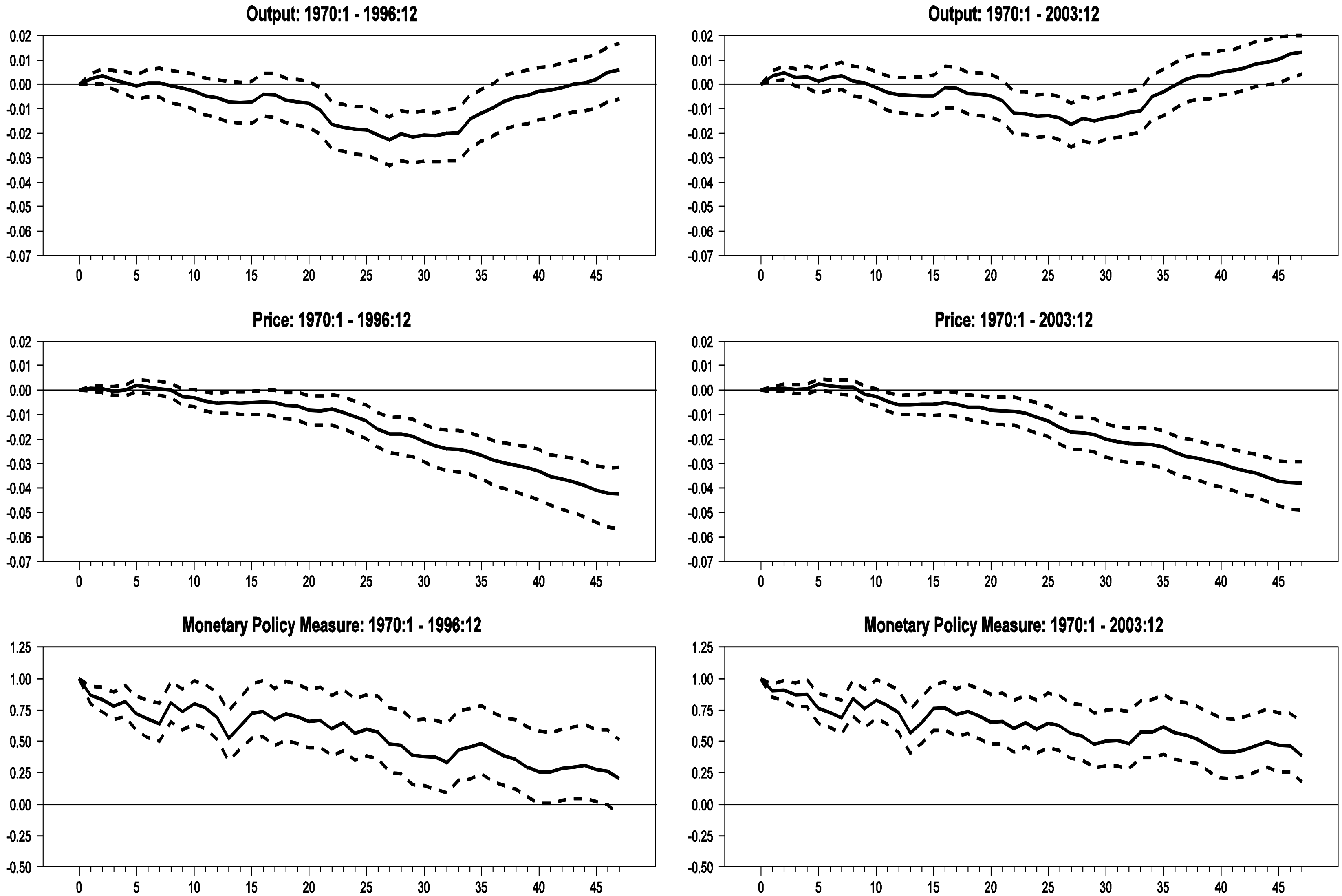


Figure 3.14 – VAR Impulse Response Functions: Carter Credit Controls Specification

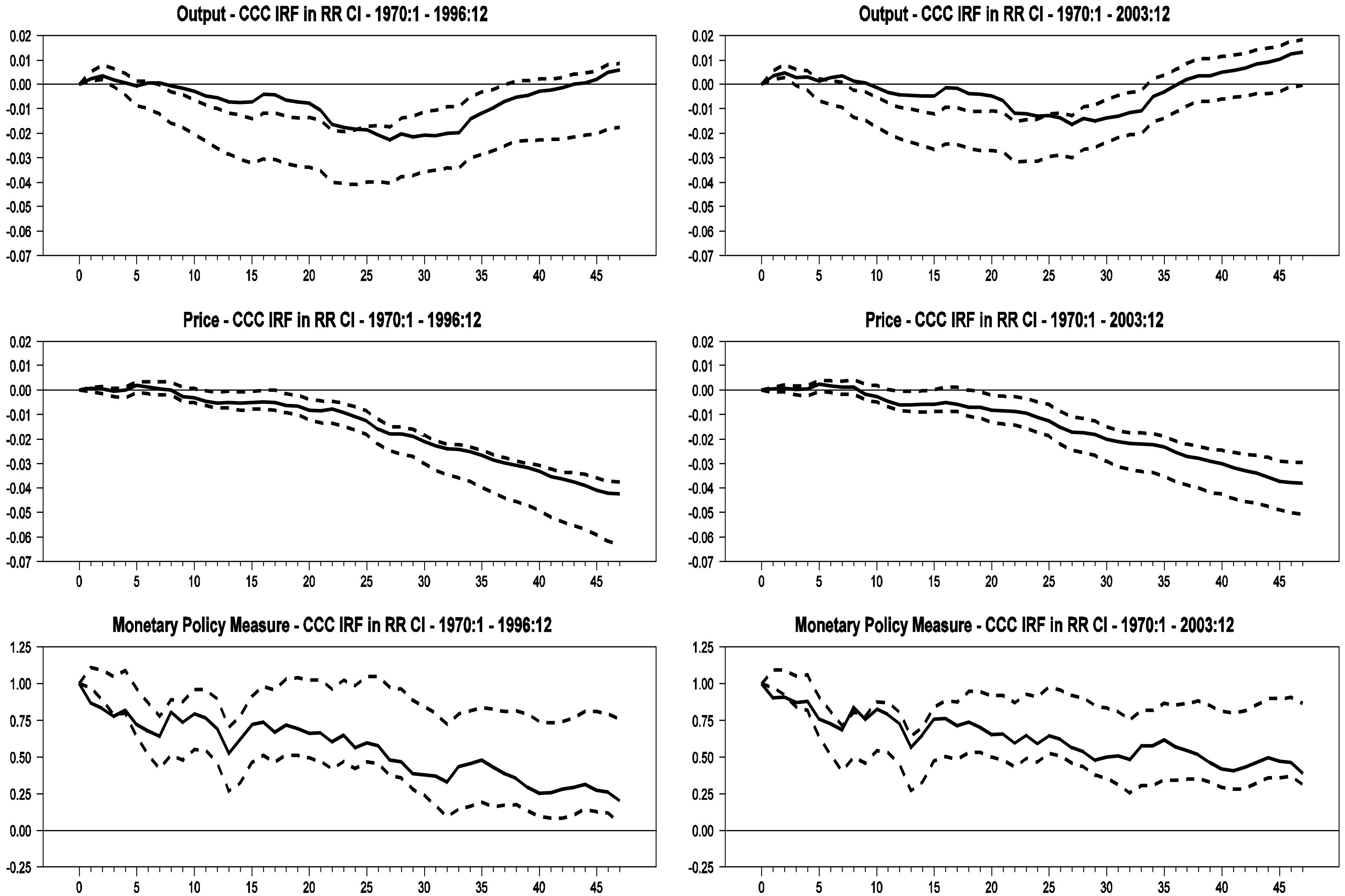


Figure 3.15 – Comparison of Romer-Romer and Carter Credit Controls Specification VAR IRF’s

The responses of output shown in Figure 3.14 are not significant for a considerable amount of time in either sample. In the original (extended) sample, the response of output becomes negative eight (ten) months after the shock. The response becomes significant twenty-one (twenty-two) months after the shock and remains significant for fifteen (twelve) months. The effects are not significant at all other horizons. The response of prices becomes permanently negative eight (nine) months after the shock and significant eleven (eleven) months after the shock. In both samples, the own effect of monetary policy is long-lived. In the 1996 sample, the response of monetary policy is positive and the CI bands are above zero at all horizons, with the exception of the final two months where the response is insignificant. In the extended sample, the CI bands do not span zero.

Figure 3.15 shows there are significant transitory differences in the responses of output generated by the cumulated RR residuals and the cumulated CCC residuals. The CCC IRF is above the upper RR CI band beginning seven (five) months after the shock. The response lies above the upper CI band for eighteen (twenty) months. There are no significant differences among the responses of prices or the monetary policy measure for either sample.

The Credit Control specification produces a significantly transitory weaker response in output for both the single equation and VAR IRFs. The responses of prices and monetary policy are not different from those produced in RR.

The imposition of credit controls during the Carter administration helps explain the large changes in the intended funds rate and the magnitude of the monetary policy shocks in early 1980. While they are a source of shocks in the quasi-narrative approach, they do not appear to be as important as the changes in chairmen. Adding a CCC dummy to the policy equation gives a negative coefficient that is large in magnitude and significance and eliminates serial correlation. However, the shocks obtained from the CCC specification do not differ greatly in terms of maximum and minimum values compared to the original RR measures. The responses of output are the only ones that are significantly different from those of RR and these differences are small and transitory.

3.5 Conclusions

This chapter has examined the relative importance of measurable factors that RR argue account for monetary policy shocks in their quasi-narrative approach. Specifically, the factors of changes in regimes, changes in chairmen, and the Carter Credit Controls were analyzed.

This chapter has allowed for a differential response of the FOMC to Greenbook forecasts for the NBR and FFR targeting regimes. The responses in the intended forecasts during the NBR targeting regime and all other FOMC meetings were shown. New measures of monetary policy shocks were constructed and compared to those of RR. The responses of output and prices to the new shock measures were shown for the single equation and VAR methods for samples until 1996 and 2003.

The monetary policy shocks from the Regimes specification were highly correlated with those of RR but displayed much smaller maximum and minimum values. The responses of output to the Regimes shocks were mostly insignificant in the single equation and VAR estimations. The responses of output were generally significantly weaker at intermediate horizons, but these differences were only transitory. The responses of prices showed significantly weaker responses in prices at intermediate horizons, but these differences were very small. In the VARs, the responses of monetary policy displayed only transitory differences. While the NBR targeting period is an important source of shocks, controlling for it only caused slight and transitory differences to RR.

Chow tests found significant differences in the responses of the intended funds rate across the terms of different chairmen. The response of the FOMC to Greenbook forecasts was allowed to differ across chairmen by separately estimating the policy equation over samples of FOMC meetings prior to Volcker's term, during Volcker's term, and during Greenspan's term.

The contractionary responses to increases in forecasted output growth and inflation were the strongest during the term of Volcker. The changes in the intended federal funds rate to forecasted output and inflation were more than twice what was found from the pre-Volcker period and the Greenspan period. Higher R^2 were found for each sample compared to RR. The pre-Volcker and both Greenspan

samples had lower standard errors of estimates. The monetary policy shocks derived from these equations had a high correlation for both samples, but the magnitude of the maximum effects was smaller.

The responses of output and prices to the Chairmen shocks were insignificant at almost all horizons in the single equation estimations. The responses of output were significantly weaker at intermediate horizons and later horizons compared to those from RR. The responses of prices showed significantly stronger responses in prices at early horizons and significantly weaker responses at longer horizons. In the VARs, the responses of output became negative and significant at early horizons and became insignificant after approximately two years. Compared to RR, the responses were significantly stronger at early horizons and significantly weaker at later horizons. The responses in the price level became negative and significant almost immediately after the shock and were significantly stronger at early and intermediate horizons. The responses of monetary policy were significantly weaker for almost all months after the shock.

Changes in the chairman of the FOMC are a very important source of shocks in the RR quasi-narrative approach and the most important source explored. Controlling for the changes in chairmen by allowing a differential response in monetary policy greatly reduced the magnitude of the shocks' maximum and minimum values. The responses of macroeconomic variables lose a great deal of significance in the single equation and VAR methods. The responses were significantly different from those of RR for long periods of time in each method.

The RR policy equation was modified with an additional dummy variable for the period of Credit Controls enforced by the Board. Adding a dummy for CCC to the RR policy equation produced a negative coefficient of -1.173 that was highly significant. The R^2s increased substantially for both samples, as did the D-W statistics, and no serial correlation was indicated in either sample. The sum of coefficients on forecasted output growth became insignificant in both samples. The monetary policy shocks derived from the CCC equation were highly correlated with the RR measures. The largest shock increased in magnitude while the smallest shock decreased in magnitude. The responses of output were

transitorily weaker at intermediate horizons for the single equation and VAR methods. The responses of prices and monetary policy were not significantly different.

Comparing these three sources of shocks, this chapter provides evidence that the changes in chairman are the most significant source in the quasi-narrative approach. Allowing the responses of monetary policy to vary across chairmen produces shocks that are much smaller in maximum magnitudes compared to RR. The responses of output and prices are larger and significantly different for most horizons, while the Regimes and CCC specifications produce only small transitory differences.

Chapter 4
Measures of Monetary Policy Shocks From Alternative Datasets

4.1 Introduction

A key conceptual element in the construction of the RR quasi-narrative regression based shocks is FOMC reliance on real time forecasts of, and information about, the future, current, and immediate past state of the economy. One assumption made in constructing the RR measures of monetary policy is that the Greenbook is the only information the FOMC uses in making monetary policy decisions. RR (2008) compare FOMC forecasts from the *Monetary Policy Report* to those made by the staff in the Greenbook, as well as using narrative evidence of the FOMC debates of the staff forecasts, to investigate the role of outside information on monetary policy decisions. They find that policymakers systematically respond to information outside of the Greenbooks.

If policymakers respond to information about the economy beyond what is contained in the Greenbook forecasts, the RR quasi-narrative shocks may still contain anticipatory movements. Therefore, these shocks may not be accurate measures of exogenous changes in monetary policy. The fact that information beyond that in the Greenbooks systematically influences policy decisions leaves open the possibility that new measures may be constructed using alternative real-time data. This alternative data can be considered along with the Greenbook forecasts to account for outside information. Alternative real-time data is added to the RR regression and the joint significance of the new variables based on expanded regressions is tested. Monetary policy shocks are constructed and compared to those using only the Greenbook. Responses of macroeconomic variables to these alternative shocks are computed for single equation and VAR methods and compared to the responses of RR.

Since the RR monetary shocks are based on Greenbook forecasts which are released to the public with a five-year lag, the sample over which the RR shocks can be constructed is limited. As of this writing, the RR shocks can only be updated to 2003. A researcher hoping to investigate the role of

monetary policy in a more recent time period would not be able to construct the measure of monetary policy shocks using Greenbook data. This may lead to researchers and businesses not having the optimal amount of information to analyze monetary policy and future movements in the economy.

This chapter uses the quasi-narrative approach of RR to construct new measures of monetary policy shocks using only the alternative real-time data. The investigation is done over the original 1996 sample, the 2003 sample, and a sample ending in March 2007 before the start of the recent financial crisis. The effects on output and prices from these alternative shocks are estimated using the single equation and VAR methods for all three samples. The alternative shock measures and the responses of macroeconomic variables to these new shock measures are compared to the original RR results for the 1996 and 2003 samples. This determines if alternative shock measures constructed using only alternative real-time data are reasonable proxies for the measures obtained from the Greenbook.

4.2 Description of Alternative Data Sources

Three real-time data sources are used to construct new measures of policy shocks throughout this chapter. This alternative data is released on a timelier basis compared to the Greenbook. Each data source contains information about the economy that is examined by professional forecasters, researchers, and policymakers. The following sections describe the alternative data sources and how the data was aligned with FOMC meetings.[14]

4.2.1 The Survey of Professional Forecasters

The Survey of Professional Forecasts (SPF) began in 1968 and was a joint compilation between the American Statistical Association and the National Bureau of Economic Research initially, but later the Philadelphia Fed took over the Survey. It was often referred to as the ASA-NBER Survey. In a description of the ASA-NBER survey, Zarnowitz (1969, pg. 2) states, “The questionnaires are scheduled to be mailed at times when regular forecasters generally review and update their predictions: in late January, after the release of the President's Economic Report and the Budget Message; in late April, after the release of the OBE-SEC and McGraw-Hill surveys of investment anticipations; in late July, after the

[14] See Chapter 2 for a description of the Greenbook dataset used in Romer and Romer (2004).

annual GNP revision and budget review; and in late November, after the McGraw-Hill fall survey is released and the most active forecasting season is under way." However, there are no specific release dates available for the time the ASA and NBER were compiling the survey. When the Philadelphia Fed took over the survey in 1990, the dates the surveys were "mailed out and collected were changed to make them more consistent through time". (Croushore, p. 4) The Philadelphia Fed website posts a history of release dates for the SPF since it began compiling the survey. Prior to 1990, assumptions were made concerning when the participants had the knowledge to make the forecasts, when the survey was mailed out by the forecasters, and when it was made public. All assumptions were based on the criteria mentioned above in Zarnowitz. If an FOMC meeting took place before the middle of February, the information for the first quarter SPF was assumed to be unavailable. If the meeting took place before late April, the information for the second quarter SPF was assumed to be unavailable, and so on.

$f_{a,b}^{SPF[Qtr,Yr]}$ is the general format that is used to represent a particular forecast from the SPF. The values in the upper brackets represent the forecast information. The lower values represent the SPF release information. *Qtr* represents the quarter that is being forecasted and *Yr* represents the year. *a* represents the quarter of the particular SPF release and *b* represents the year. For example, $f_{1,69}^{SPF[Q2,69]}$ represents an SPF forecast for the 2^{nd} quarter of 1969 that was released in the first quarter of 1969. The data for the first two quarters of 1969 are laid out as shown in Table 4.1.

There are differences that must be pointed out concerning the SPF dataset in comparison to the Greenbook. A new Greenbook is compiled before each FOMC meeting, while the SPF is only released once every three months. This leads to the same SPF forecast often being used for multiple meetings. For earlier meetings in the quarter, the latest SPF is often not released. So forecasts from the previous release must be used. For example, in 1969 the first meeting of the first quarter took place on January 14, 1969. This meeting took place before an SPF release for that quarter. So forecasts for the first quarter of 1969 were taken from the SPF release for the fourth quarter of 1968. This method uses only data that were

available at the time of the FOMC meeting. The mean forecasts[15] for the annualized percentage change in the GNP / GDP deflator, the annualized percentage change in real GNP / GDP[16], and the unemployment rate were taken from the SPF.

Table 4.1 – SPF Data Layout Example

Meeting Date	Previous Quarter Value	Current Quarter Forecast	One Quarter Ahead Forecast	Change In the Previous Quarter's Forecast	Change In the Current Quarter's Forecast
1-14-69	$f_{4,68}^{SPF[Q4,68]}$	$f_{4,68}^{SPF[Q1,69]}$	$f_{4,68}^{SPF[Q2,69]}$	NA[17]	NA
2-4-69	$f_{4,68}^{SPF[Q4,68]}$	$f_{4,68}^{SPF[Q1,69]}$	$f_{4,68}^{SPF[Q2,69]}$	$f_{4,68}^{SPF[Q4,68]} - f_{3,68}^{SPF[Q4,68]}$	$f_{4,68}^{SPF[Q1,69]} - f_{3,68}^{SPF[Q1,69]}$
3-4-69[18]	$f_{1,69}^{SPF[Q4,69]}$	$f_{1,69}^{SPF[Q1,69]}$	$f_{1,69}^{SPF[Q2,69]}$	$f_{1,69}^{SPF[Q4,68]} - f_{4,68}^{SPF[Q4,68]}$	$f_{1,69}^{SPF[Q1,69]} - f_{4,68}^{SPF[Q1,69]}$
4-1-69	$f_{1,69}^{SPF[Q4,69]}$	$f_{1,69}^{SPF[Q1,69]}$	$f_{1,69}^{SPF[Q2,69]}$	$f_{1,69}^{SPF[Q4,68]} - f_{4,68}^{SPF[Q4,68]}$	$f_{1,69}^{SPF[Q1,69]} - f_{4,68}^{SPF[Q1,69]}$
4-29-69	$f_{1,69}^{SPF[Q1,69]}$	$f_{1,69}^{SPF[Q2,69]}$	$f_{1,69}^{SPF[Q3,69]}$	$f_{1,69}^{SPF[Q1,69]} - f_{4,68}^{SPF[Q1,69]}$	$f_{1,69}^{SPF[Q2,69]} - f_{4,68}^{SPF[Q2,69]}$
5-27-69	$f_{2,69}^{SPF[Q1,69]}$	$f_{2,69}^{SPF[Q2,69]}$	$f_{2,69}^{SPF[Q3,69]}$	$f_{2,69}^{SPF[Q1,69]} - f_{1,69}^{SPF[Q1,69]}$	$f_{2,69}^{SPF[Q2,69]} - f_{1,69}^{SPF[Q2,69]}$
6-24-69	$f_{2,69}^{SPF[Q1,69]}$	$f_{2,69}^{SPF[Q2,69]}$	$f_{2,69}^{SPF[Q3,69]}$	$f_{2,69}^{SPF[Q1,69]} - f_{1,69}^{SPF[Q1,69]}$	$f_{2,69}^{SPF[Q2,69]} - f_{1,69}^{SPF[Q2,69]}$

4.2.2 Previous Quarter Values from ALFRED

In constructing data to proxy for the RR Greenbook dataset, the previous quarter's values for the annualized percentage change in inflation and output were obtained from Archival Federal Reserve Economic Data (ALFRED) at the Federal Reserve Bank of St. Louis website. ALFRED provides all values, including revisions, that took place within a quarter and the dates the revisions occurred. At some

[15] The SPF releases both mean and median forecasts of all questionnaires received.

[16] Prior to 1981, the SPF did not present forecasts of real output, only nominal values. To obtain a measure of the forecast growth in real output before 1981, the forecast rate of change in the deflator was subtracted from the forecast rate of change in nominal output.

[17] Observations that were dropped from RR dataset due to lack of Greenbook data were also dropped from all analyses. This allows for the closest possible replication of the RR Greenbook dataset.

[18] The data from the SPF are released as quarterly levels and growth rates. The growth rates are reported for the current quarter and for the three quarters ahead. The levels are reported for the previous quarter, the current quarter, and three quarters ahead. In certain cases the rate of change for the lagged value of a variable is computed by using the level of the previous quarter in the current release and the level of the previous quarter in the previous release. This gives a value for the rate of change from one quarter to the next and keeps the dataset completely confined to the SPF.

FOMC meetings that took place at later months within the quarter, preliminary estimates and revisions of macroeconomic variables for the previous quarter were available.

The values for the annualized rate of change in output and the inflation rate for the previous quarter are at times used in place of the SPF values for the previous quarter forecasts. This source allows for use of actual data, preliminary and revised, that the FOMC had available at each meeting. Using the previous quarter's values of forecasted output growth and inflation completely from the SPF values does not allow for the use of actual available data that was released during the later months of the quarter. This data clearly may contain useful information available to the FOMC at the time of the meeting.

The notation $f_{m,n}^{ALFRED[Qtr,Yr]}$ is used to represent particular values from ALFRED in the datasets that use previous quarter values from AFLRED. The values in the upper brackets represent the information for data pertaining to the quarter and year. The lower value represents the release date and revision number. Specifically, *Qtr* represents the quarter that is being measured and *Yr* represents the year. *m* represents the revision number and *n* represents the date the revision was available. For example, $f_{1,7/21/82}^{ALFRED[2,82]}$ represents the initial estimate for the second quarter of 1982 that was available on July 21, 1982.

ALFRED also shows the further revisions that took place in that quarter. So $f_{2,8/19/82}^{ALFRED[2,82]}$ represents the revision to the initial estimate. This represents the new estimate for the second quarter of 1982 that was available on August 19, 1982. In some cases, the initial estimate and a revised estimate (or two revised estimates) within a particular quarter will be the same. An example of how the ALFRED data is laid out is shown in Table 4.2.

The real-time values for the annualized percentage change in the GNP / GDP deflator and the annualized percentage change in real GNP / GDP were taken from ALFRED.

4.2.3 Business Cycle Indicators (BCI) Composite Indexes

The Business Cycle Indicators (BCI) consists of three composite indexes: the Index of Lagging Economic Indicators (Lag), the Index of Coincident Economic Indicators (Coin), and the Index of

Leading Economic Indicators (Lead). Each index represents past, current, and anticipated economic activity, respectively. The indexes consist of single values that represent a great deal of information in terms of lagged, current, and anticipated economic variables. The BCI are released on a monthly basis which is a different frequency from the FOMC meetings. The most recent available release of the BCI is used for each FOMC meeting in the sample.

Table 4.2 – ALFRED Data Layout Example

Meeting Date	Previous Quarter Value
1-14-69	$f_{1,1/14/69}^{ALFRED[4,68]}$
2-4-69	$f_{1,1/14/69}^{ALFRED[4,68]}$
3-4-69	$f_{2,2/14/69}^{ALFRED[4,68]}$
4-1-69	$f_{2,2/14/69}^{ALFRED[4,68]}$
4-29-69[19]	$f_{1,4/17/69}^{ALFRED[1,69]}$
5-27-69	$f_{2,5/16/69}^{ALFRED[1,69]}$
6-24-69	$f_{2,5/16/69}^{ALFRED[1,69]}$

The timing of the BCI is important. According to the Business Cycle Indicators Handbook (2001) put out by the Conference Board, "Prior to 2001, the leading index for a particular month was typically available about five weeks after the month's end." (p. 16) After 2001, the index for a particular month was available the month after. [20] The Business Cycle Indicators (BCI) that were available at the time of the meeting are used. The real-time values were obtained from three sources. The Business Conditions Digest reported the indicators from 1969 until March of 1990. The Survey of Current Business reported the indicators until 1996 when the Conference Board took over the measures and has released the "Business Cycle Indicators" since this time. The BCI are often looked at by researchers, businesses, and policymakers to gauge the past, present, and future state of the economy.

[19] There is not always a value from ALFRED available at the first meeting of every quarter. If there is no value available, a single equation forecast, generated from a simple AR equation with a constant and eight lags, for that quarter from the latest ALFRED revision is used.

[20] When updating the measure, the BCI availability is changed to reflect this for the months of 2001 – 2007.

The notation $BCI_a^{Month,Yr}$ is used to represent particular BCI values in the dataset. The values in the superscripts represent the month and year of the data. The subscript represents the fact that the each release contains the latest month's initial estimate as well as the previous month's revised value. a = 1 represents the initial release for the latest month available while a = 2 represents the revision for the previous month since the previous release. The values for the latest month available and the previous month were collected from each BCI release. The term BCI is replaced with Lag, Coin, or Lead, depending on which of the indices are used, and the BCI data are laid out as shown in Table 4.3.

Table 4.3 – BCI Data Layout Example

Meeting Date	Lagging Index		Coincident Index		Leading Index	
1-14-69	$Lag_1^{Nov,68}$	$Lag_2^{Oct,68}$	$Coin_1^{Nov,68}$	$Coin_2^{Oct,68}$	$Lead_1^{Nov,68}$	$Lead_2^{Oct,68}$
2-4-69	$Lag_1^{Dec,68}$	$Lag_2^{Nov,68}$	$Coin_1^{Dec,68}$	$Coin_2^{Nov,68}$	$Lead_1^{Dec,68}$	$Lead_2^{Nov,68}$
3-4-69	$Lag_1^{Jan,69}$	$Lag_2^{Dec,68}$	$Coin_1^{Jan,69}$	$Coin_2^{Dec,68}$	$Lead_1^{Jan,69}$	$Lead_2^{Dec,68}$
4-1-69	$Lag_1^{Feb,69}$	$Lag_2^{Jan,69}$	$Coin_1^{Feb,69}$	$Coin_2^{Jan,69}$	$Lead_1^{Feb,69}$	$Lead_2^{Jan,69}$
4-29-69	$Lag_1^{Feb,69}$	$Lag_2^{Jan,69}$	$Coin_1^{Feb,69}$	$Coin_2^{Jan,69}$	$Lead_1^{Feb,69}$	$Lead_2^{Jan,69}$
5-27-69	$Lag_1^{Mar,69}$	$Lag_2^{Feb,69}$	$Coin_1^{Mar,69}$	$Coin_2^{Feb,69}$	$Lead_1^{Mar,69}$	$Lead_2^{Feb,69}$
6-24-69	$Lag_1^{Apr,69}$	$Lag_2^{Mar,69}$	$Coin_1^{Apr,69}$	$Coin_2^{Feb,69}$	$Lead_1^{Apr,69}$	$Lead_2^{Feb,69}$

According to the Conference Board, the composite indexes are currently composed of the following series and standardization factors[21]:

Leading Economic Index:

Average weekly hours, manufacturing 0.2549
Average weekly initial claims for unemployment insurance 0.0307
Manufacturers' new orders, consumer goods and materials 0.0774
Index of supplier deliveries – vendor performance 0.0677
Manufacturers' new orders, nondefense capital goods 0.0180
Building permits, new private housing units 0.0270

[21] Taken from the latest available release: http://www.conference-board.org/pdf_free/economics/bci/flaky.pdf

Stock prices, 500 common stocks 0.0390
Money supply, M2 0.3580
Interest rate spread, 10-year Treasury bonds less federal funds 0.0991
Index of consumer expectations 0.0282

Coincident Economic Index:

Employees on nonagricultural payrolls 0.5439
Personal income less transfer payments 0.1873
Industrial production 0.1497
Manufacturing and trade sales 0.1191

Lagging Economic Index

Average duration of unemployment 0.0371
Inventories to sales ratio, manufacturing and trade 0.1238
Labor cost per unit of output, manufacturing 0.0608
Average prime rate 0.2825
Commercial and industrial loans 0.1127
Consumer installment credit to personal income ratio 0.1872
Consumer price index for services 0.1959

There have been changes in the compositions and measurements of the indexes over the sample periods. These occur when there is a change in base year, new series are added or withdrawn, or new estimation techniques are implemented in the indexes leading to major changes in their values over time. However, each release of the BCI contains the initial estimate as well as the previous month's revision taking into account any new composition change that may have occurred. For each BCI release, these two measures were obtained and the annualized rate of change was computed, in line with the calculation method of the SPF, as follows:

$$100 * \left[\left(\left(\frac{BCI_1^{Month,Yr}}{BCI_2^{Month_{-1},Yr}} \right)^{12} \right) - 1 \right]$$

The annualized rates of change in the composite indexes were included in the regressions thereby eliminating the large jumps that occur in the level of the indexes when there were changes in the composition and measurement of the indexes.

4.3 Alternative Data in Conjunction with the Greenbook Data

RR (2004, p. 1066) state, "to the extent that policy makers employ useful information about the paths of output and inflation beyond what is in the Greenbooks, some of what we classify is shocks will be responses to information about future movements in output and inflation."

If the FOMC does respond systematically to information and forecasts about the economy beyond what is in the Greenbooks, the RR measures of monetary policy shocks are truly not exogenous as they could contain anticipatory movements. This section considers proxies for additional information the FOMC has at the time of each meeting. The SPF and BCI are used as proxies for data about the economy beyond the Greenbooks that policymakers would have access to at each meeting. FOMC forecasts from the *Monetary Policy Report* are not used as these are only available from July 1979.

The data, as described in section 2, are considered with the Greenbook dataset of RR. To first test whether the FOMC responds to information beyond what is in the Greenbooks, the equation to obtain shocks is modified by adding the alternative data and the joint significance of the new variables is tested. Joint significance of the variables in the regression suggests some significant variability in the intended funds rate can be attributed to information contained in the alternative data. The adjusted R^2 for each regression is also reported to show if the alternative data increased the goodness-of-fit. The regressions are estimated for the samples of FOMC meetings from January 1969 until December 1996 and then for FOMC meetings from January 1969 until December 2003.

To investigate the effect of alternative-real time data on the RR quasi-narrative shocks, new measures of shocks are generated from the regressions and the responses of output and prices are investigated. As in Chapter 3, all residuals that are used as measures of monetary policy shocks are from the original OLS regressions. The residuals have not been corrected for serial correlation. Chapter 2 showed there were no significant differences in the responses of output, prices, or monetary policy, among the measures that had not been corrected for serial correlation and those that had been adjusted with a lagged dependent variable or Prais-Winstein correction. The responses are compared to those of RR for both samples.

4.3.1 Joint Consideration of the SPF and Greenbook Data

The significance of the SPF forecasts in the RR equation can be investigated by adding the variables of the SPF to the RR Greenbook dataset and testing the coefficients on the SPF forecasts for joint significance. To do this the following equation is estimated

$$\Delta ff_m = \alpha + \beta\, ffb_m + \sum_{i=-1}^{2}\gamma_i \Delta\tilde{y}_{mi} + \sum_{i=-1}^{2}\delta_i(\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}) + \sum_{i=-1}^{2}\varphi_i\tilde{\pi}_{mi} + \sum_{i=-1}^{2}\theta_i(\tilde{\pi}_{mi} - \tilde{\pi}_{m-1,i}) + \rho\tilde{\mu}_{m0} +$$
$$\sum_{i=-1}^{2}\gamma_i \Delta\tilde{y}_{mi}^{SPF} + \sum_{i=-1}^{2}\delta_i(\Delta\tilde{y}_{mi}^{SPF} - \Delta\tilde{y}_{m-1,i}^{SPF}) + \sum_{i=-1}^{2}\varphi_i\tilde{\pi}_{mi}^{SPF} + \sum_{i=-1}^{2}\theta_i(\tilde{\pi}_{mi}^{SPF} - \tilde{\pi}_{m-1,i}^{SPF}) + \rho\tilde{\mu}_{m0}^{SPF} + \varepsilon_m \qquad (1)$$

where Greenbook forecasts are represented by the variables without superscripts and the SPF forecasts are variables denoted with superscript. The results of this regression are displayed in Table 4.4.

The results in table give D-W statistics of 1.76 for the original sample and 1.72 for the extended sample. These fall in the indeterminate range of critical values of for first order serial correlation in the D-W test. As in previous chapters, the Breusch-Godfrey test was run for the original sample to 1996 and the 2003 sample to determine if serial correlation is present. Tests were conducted for first order and second order serial correlation.

The BG statistics in the tests for first order serial correlation are 6.34 (p-value = 0.01) for the original sample 9.20 (p-value = 0.00) for the sample to 2003. The coefficients on the first lag of residuals have t-statistics of 2.19 for the original sample and 2.75 for the sample to 2003.

The BG statistics in the tests for second order serial correlation are 11.22 (p-value = 0.00) for the original sample and 15.37 (p-value = 0.00) for the 2003 sample. The coefficients on the second lag of residuals have t-statistics of -1.95 for the original sample, -2.23 for the sample to 2003. This implies second order serial correlation in the residuals for the residuals in both samples.

To correct the standard errors for serial correlation, the regression was estimated and Newey-West (NW) standard errors with 2 lags were computed. To address serial correlation, the regressions were also estimated with a lagged dependent variable (LDV) and again with a Prais-Winstein (PW) correction. These residuals were then checked for serial correlation.

The results for the regression using NW standard errors are shown in Table 4.5. The results for the LDV specification are shown in Table 4.6. The results for the regression with the PW correction are shown in Table 4.7.

For the original (extended) sample, a BG test on the residuals that were obtained from the LDV specification produce a BG statistic of 2.76 (3.99) with a p-value of 0.10 (0.05).

Table 4.4 – Determinants of the Change in the Intended Federal Funds Rate – Greenbook and SPF

	Sample 1969:1 – 1996:12 Greenbook		**SPF**		**Sample 1969:1 – 2003:12 Greenbook**		**SPF**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.117	0.169			0.010	0.125		
Initial level of intended funds rate	-0.009	0.013			-0.007	0.011		
Forecasted output growth, Quarters ahead:								
-1	0.021	0.018	0.002	0.023	0.018	0.015	0.006	0.019
0	0.015	0.030	-0.024	0.047	0.010	0.026	-0.021	0.041
1	-0.033	0.038	0.041	0.057	-0.011	0.030	0.027	0.050
2	0.075	0.039	-0.101	0.049	0.058	0.029	-0.089	0.043
Change in forecasted output growth since last meeting, Quarters ahead:								
-1	0.026	0.033	-0.022	0.022	0.023	0.027	-0.021	0.018
0	0.122	0.033	-0.022	0.040	0.113	0.028	-0.016	0.034
1	0.062	0.048	0.118	0.050	0.044	0.039	0.124	0.043
2	-0.009	0.053	0.053	0.046	0.000	0.042	0.039	0.040
Forecasted inflation, Quarters ahead:								
-1	0.009	0.028	0.190	0.059	0.015	0.025	0.191	0.053
0	-0.047	0.034	-0.071	0.095	-0.041	0.030	-0.086	0.086
1	0.032	0.046	-0.191	0.096	0.038	0.040	-0.212	0.086
2	0.047	0.055	0.045	0.094	0.048	0.047	0.063	0.083
Change in forecasted inflation since last meeting, Quarters ahead:								
-1	0.074	0.044	-0.195	0.059	0.064	0.038	-0.194	0.052
0	-0.033	0.049	0.163	0.085	-0.038	0.042	0.169	0.077
1	0.016	0.073	0.123	0.086	0.019	0.064	0.141	0.077
2	0.027	0.083	-0.139	0.064	0.007	0.067	-0.134	0.057
Forecasted unemployment rate (current quarter)	-0.284	0.125	0.274	0.127	-0.267	0.108	0.270	0.110
Adjusted R^2	0.33				0.35			
S.E.E.	0.37				0.34			
D-W	1.76				1.72			

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

Table 4.5 – Determinants of the Change in the Intended Federal Funds Rate - Newey-West Standard Errors – Greenbook and SPF

	Sample 1969:1 – 1996:12 Greenbook		SPF		**Sample 1969:1 – 2003:12** Greenbook		SPF	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.117	0.139			0.010	0.100		
Initial level of intended funds rate	-0.009	0.012			-0.007	0.011		
Forecasted output growth, Quarters ahead:								
-1	0.021	0.015	0.002	0.019	0.018	0.013	0.006	0.017
0	0.015	0.032	-0.024	0.057	0.010	0.030	-0.021	0.053
1	-0.033	0.041	0.041	0.065	-0.011	0.030	0.027	0.062
2	0.075	0.057	-0.101	0.081	0.058	0.044	-0.089	0.075
Change in forecasted output growth since last meeting, Quarters ahead:								
-1	0.026	0.026	-0.022	0.024	0.023	0.022	-0.021	0.020
0	0.122	0.043	-0.022	0.043	0.113	0.041	-0.016	0.038
1	0.062	0.047	0.118	0.052	0.044	0.037	0.124	0.050
2	-0.009	0.058	0.053	0.037	0.000	0.045	0.039	0.033
Forecasted inflation, Quarters ahead:								
-1	0.009	0.022	0.190	0.108	0.015	0.021	0.191	0.104
0	-0.047	0.036	-0.071	0.095	-0.041	0.033	-0.086	0.091
1	0.032	0.056	-0.191	0.086	0.038	0.054	-0.212	0.087
2	0.047	0.058	0.045	0.075	0.048	0.055	0.063	0.072
Change in forecasted inflation since last meeting, Quarters ahead:								
-1	0.074	0.039	-0.195	0.109	0.064	0.034	-0.194	0.105
0	-0.033	0.051	0.163	0.100	-0.038	0.043	0.169	0.097
1	0.016	0.061	0.123	0.084	0.019	0.057	0.141	0.083
2	0.027	0.080	-0.139	0.099	0.007	0.063	-0.134	0.099
Forecasted unemployment rate (current quarter)	-0.284	0.121	0.274	0.123	-0.267	0.113	0.270	0.116
Adjusted R^2	0.33				0.42			
S.E.E.	0.37				0.35			
D-W	1.76				1.72			

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations.

Table 4.6 – Determinants of the Change in the Intended Federal Funds Rate with Lagged Dependent Variable – Greenbook and SPF

	Sample 1969:1 – 1996:12				Sample 1969:1 – 2003:12			
	Greenbook		**SPF**		**Greenbook**		**SPF**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.110	0.168			0.020	0.125		
Initial level of intended funds rate	-0.012	0.013			-0.011	0.011		
Forecasted output growth, Quarters ahead:								
-1	0.019	0.018	0.002	0.022	0.016	0.015	0.005	0.019
0	0.012	0.030	-0.013	0.047	0.008	0.026	-0.011	0.041
1	-0.027	0.038	0.023	0.058	-0.008	0.030	0.012	0.050
2	0.065	0.039	-0.089	0.049	0.051	0.029	-0.079	0.043
Change in forecasted output growth since last meeting, Quarters ahead:								
-1	0.024	0.033	-0.025	0.022	0.022	0.027	-0.023	0.018
0	0.113	0.033	-0.039	0.041	0.105	0.028	-0.033	0.035
1	0.068	0.048	0.122	0.050	0.051	0.039	0.126	0.043
2	0.007	0.054	0.046	0.046	0.014	0.042	0.035	0.040
Forecasted inflation, Quarters ahead:								
-1	0.006	0.028	0.193	0.059	0.011	0.025	0.192	0.052
0	-0.039	0.034	-0.092	0.096	-0.032	0.030	-0.106	0.086
1	0.028	0.046	-0.175	0.096	0.033	0.040	-0.193	0.086
2	0.047	0.055	0.049	0.093	0.047	0.047	0.066	0.082
Change in forecasted inflation since last meeting, Quarters ahead:								
-1	0.081	0.044	-0.203	0.059	0.070	0.038	-0.200	0.052
0	-0.035	0.049	0.174	0.085	-0.039	0.041	0.178	0.076
1	0.011	0.073	0.111	0.086	0.017	0.064	0.128	0.077
2	0.029	0.082	-0.132	0.064	0.007	0.067	-0.127	0.057
Forecasted unemployment rate (current quarter)	-0.267	0.125	0.262	0.127	-0.250	0.108	0.255	0.110
Previous meeting's change in intended target	0.102	0.061			0.105	0.054		
Adjusted R^2	0.33				0.35			
S.E.E.	0.37				0.33			
D-W	1.89				1.86			

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations.

Table 4.7 – Determinants of the Change in the Intended Federal Funds Rate with Serial Correlation Correction – Greenbook and SPF

	Sample 1969:1 – 1996:12				**Sample 1969:1 – 2003:12**			
	Greenbook		**SPF**		**Greenbook**		**SPF**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.105	0.207			0.040	0.156		
Initial level of intended funds rate	-0.017	0.016			-0.016	0.013		
Forecasted output growth, Quarters ahead:								
-1	0.023	0.018	0.002	0.023	0.020	0.015	0.005	0.018
0	0.028	0.030	-0.043	0.046	0.026	0.026	-0.038	0.040
1	-0.009	0.039	0.027	0.058	0.009	0.031	0.013	0.050
2	0.066	0.042	-0.106	0.052	0.052	0.031	-0.097	0.046
Change in forecasted output growth since last meeting, Quarters ahead:								
-1	0.015	0.031	-0.026	0.022	0.011	0.026	-0.024	0.017
0	0.083	0.031	-0.015	0.038	0.076	0.027	-0.014	0.032
1	0.057	0.047	0.099	0.050	0.042	0.038	0.105	0.043
2	0.015	0.053	0.063	0.047	0.023	0.041	0.052	0.041
Forecasted inflation, Quarters ahead:								
-1	-0.002	0.029	0.247	0.060	0.002	0.025	0.246	0.054
0	-0.049	0.036	-0.111	0.098	-0.043	0.032	-0.124	0.088
1	0.030	0.049	-0.230	0.099	0.035	0.043	-0.244	0.088
2	0.057	0.059	0.083	0.099	0.054	0.050	0.101	0.087
Change in forecasted inflation since last meeting, Quarters ahead:								
-1	0.068	0.041	-0.260	0.060	0.056	0.035	-0.256	0.053
0	-0.015	0.047	0.218	0.083	-0.019	0.039	0.218	0.074
1	0.024	0.071	0.128	0.086	0.030	0.062	0.143	0.076
2	-0.017	0.080	-0.129	0.065	-0.031	0.065	-0.127	0.058
Forecasted unemployment rate (current quarter)	-0.243	0.128	0.240	0.131	-0.232	0.109	0.235	0.112
Rho	0.249	0.083			0.258	0.072		
Adjusted R^2	0.35				0.37			
S.E.E.	0.36				0.33			
D-W	1.96				1.95			

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations.

The t-statistic on the first lag of residuals is 0.58 (1.13).

A BG test on the residuals from the regression with the PW correction gives a BG statistic of 3.66 (4.14) with a p-value of 0.06 (0.04).The t-statistic on the first lag of residuals is 0.34 (0.42). Although the BG statistics suggest first order serial correlation in the residuals obtained from the LDV and PW specifications, inspection of the t-statistic on the lagged residuals reveal none are significant at the 10% significance level.

The F-statistic on the SPF coefficients in the regression incorporating NW standard errors is 1.42 (1.66) with a p-value of 0.12 (0.04).The F-statistic on the SPF coefficients in the regression with a LDV is 2.93 (3.53) with a p-value of 0.00 (0.00).The F-statistic on the SPF coefficients in the regression with a PW correction is 3.73(4.56) with a p-value of 0.00 (0.00). Compared to just using the Greenbooks, the adjusted R^2 statistics also increase dramatically for each specification when the SPF is added. The increases in the goodness-of-fit and the joint significance of the variables suggest some significant variability in the intended funds rate can be attributed to information contained in the SPF.

4.3.2 Joint Consideration of the BCI and Greenbook Data

Like the SPF forecasts, the significance of the BCI can be investigated by adding the variables of the BCI to the RR Greenbook dataset and testing the coefficients on the BCI for joint significance. To do this the following equation is estimated

$$\Delta ff_m = \alpha + \beta\, ffb_m + \sum_{i=-1}^{2}\gamma_i \Delta\tilde{y}_{mi} + \sum_{i=-1}^{2}\delta_i(\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}) + \sum_{i=-1}^{2}\varphi_i\tilde{\pi}_{mi} + \sum_{i=-1}^{2}\theta_i(\tilde{\pi}_{mi} - \tilde{\pi}_{m-1,i}) + \rho\tilde{\mu}_{m0} + \omega_1 RCLead_m + \omega_2 RCCoin_m + \omega_3 RCLag + \varepsilon_t \qquad (2)$$

where $RCLead_m$ $(RCCoin_m)$ $(RCLag_m)$ are the rate of change in the leading (coincident) (lagging) composite indexes. The results of the regression are shown in Table 4.8.

The D-W statistic is 1.97 for the original sample and 1.98 for the 2003 sample. Both of these indicate no presence of serial correlation. The F-statistic on the BCI coefficients is 7.63 with a p-value of 0.00 for the sample through 1996 and an F-statistic of 9.39 with a p-value of 0.00 for the sample through 2003.

The adjusted R^2 statistics are slightly higher than RR, when the BCI is added, compared to those obtained from just using the Greenbook. The increases in the goodness-of-fit and the joint significance of

Table 4.8 - Determinants of the Change in the Intended Federal Funds Rate – Greenbook and BCI

	Sample 1969:1 – 1996:12		Sample 1969:1 – 2003:12	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.234	0.137	0.119	0.103
Initial level of intended funds rate	-0.016	0.012	-0.014	0.010
Forecasted output growth, Quarters ahead:				
-1	0.016	0.010	0.011	0.009
0	0.001	0.021	0.009	0.017
1	0.015	0.031	0.014	0.024
2	0.004	0.031	0.006	0.024
Change in forecasted output growth since last meeting, Quarters ahead:				
-1	0.035	0.029	0.027	0.024
0	0.135	0.030	0.095	0.027
1	0.007	0.044	0.015	0.036
2	0.035	0.049	0.036	0.039
Forecasted inflation, Quarters ahead:				
-1	0.026	0.023	0.035	0.020
0	-0.024	0.029	-0.019	0.025
1	0.005	0.043	0.007	0.037
2	0.040	0.045	0.025	0.040
Change in forecasted inflation since last meeting, Quarters ahead:				
-1	0.036	0.044	0.024	0.038
0	-0.027	0.048	-0.052	0.040
1	0.018	0.072	0.036	0.062
2	-0.053	0.079	-0.033	0.065
Forecasted unemployment rate (current quarter)	-0.066	0.021	-0.343	0.095
Rate of Change in Leading Index	0.005	0.002	0.005	0.002
Rate of Change in Coincident Index	-0.001	0.004	-0.003	0.004
Rate of Change in Lagging Index	-0.004	0.001	-0.005	0.001
Adjusted R^2	0.29		0.30	
S.E.E.	0.38		0.34	
D-W	1.97		1.98	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations.

the variables suggest some significant variability in the intended funds rate can be attributed to systematic reaction to information contained in the BCI.

4.3.3 Joint Consideration of Both the SPF and BCI with Greenbook Data

The significance of the SPF forecasts and the BCI can be investigated by adding the variables of both datasets to the RR Greenbook dataset and testing the coefficients for joint significance. To do this the following equation is estimated

$$\Delta ff_m = \alpha + \beta\, ffb_m + \sum_{i=-1}^{2}\gamma_i \Delta\tilde{y}_{mi} + \sum_{i=-1}^{2}\delta_i(\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}) + \sum_{i=-1}^{2}\varphi_i\tilde{\pi}_{mi} + \sum_{i=-1}^{2}\theta_i(\tilde{\pi}_{mi} - \tilde{\pi}_{m-1,i}) + \rho\tilde{\mu}_{m0} +$$
$$\sum_{i=-1}^{2}\gamma_i \Delta\tilde{y}_{mi}^{SPF} + \sum_{i=-1}^{2}\delta_i(\Delta\tilde{y}_{mi}^{SPF} - \Delta\tilde{y}_{m-1,i}^{SPF}) + \sum_{i=-1}^{2}\varphi_i\tilde{\pi}_{mi}^{SPF} + \sum_{i=-1}^{2}\theta_i(\tilde{\pi}_{mi}^{SPF} - \tilde{\pi}_{m-1,i}^{SPF}) + \rho\tilde{\mu}_{m0}^{SPF} +$$
$$\omega_1 RCLead_m + \omega_2 RCCoin_m + \omega_3 RCLag + \varepsilon_m \qquad (3)$$

The results of the regression are shown in Table 4.9.

The results in table 4.9 give D-W statistics of 1.87 for the original sample and 1.82 for the extended sample. These fall in the indeterminate range of critical values for first order serial correlation in the D-W test. The Breusch-Godfrey test was run for the original sample to 1996 and the 2003 sample to determine if serial correlation is present.

For the original (extended) sample, a BG test on the residuals that were obtained produce a BG statistic of 3.18 (5.19) with a p-value of 0.07 (0.02). The t-statistic on the first lag of residuals is 1.26 (1.86).Although the BG statistics suggest first order serial correlations, inspection of the t-statistic on the lagged residuals revel none are significant at the 10% significance level. However, the regression was still estimated to correct the standard errors for serial correlation. The regression was first estimated and NW standard errors with one lag were computed. The regression was also estimated with a lagged dependent variable (LDV) and again with a Prais-Winstein (PW) correction. The results for the regression and NW standard errors are shown in Table 4.10. The results for the LDV specification are shown in Table 4.11. The results for the regression with the PW correction are shown in Table 4.12.

The F-statistic on the SPF coefficients in the regression incorporating the NW standard errors is 1.99 (2.29) with a p-value of 0.01 (0.00).The F-statistic on the SPF coefficients in the regression with a LDV is 3.07 (3.66) with a p-value of 0.00 (0.00).The F-statistic on the SPF coefficients in the regression with a PW correction is 3.65 (4.52) with a p-value of 0.00 (0.00).

Table 4.9 – Determinants of the Intended Federal Funds Rate – Greenbook and SPF and BCI

	Sample 1969:1 - 1996:12 Greenbook		SPF		BCI		Sample 1969:1 - 2003:12 Greenbook		SPF		BCI	
	Coeff	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**
Constant	0.235	0.164					0.107	0.122				
Initial level of intended funds rate	-0.009	0.012					-0.007	0.010				
Forecasted output growth, Quarters ahead:												
-1	0.022	0.018	0.004	0.022			0.021	0.015	0.005	0.018		
0	0.004	0.030	-0.008	0.046			0.005	0.025	-0.008	0.039		
1	-0.021	0.037	0.017	0.056			-0.005	0.029	0.006	0.049		
2	0.045	0.038	-0.073	0.048			0.035	0.029	-0.065	0.042		
Change in forecasted output growth since last meeting, Quarters ahead:												
-1	0.018	0.032	-0.013	0.021			0.015	0.026	-0.013	0.017		
0	0.110	0.032	-0.013	0.038			0.102	0.028	-0.010	0.033		
1	0.043	0.046	0.116	0.048			0.032	0.037	0.119	0.042		
2	0.013	0.051	0.048	0.044			0.015	0.040	0.038	0.039		
Forecasted inflation, Quarters ahead:												
-1	0.017	0.027	0.182	0.057			0.019	0.024	0.186	0.051		
0	-0.032	0.033	-0.062	0.091			-0.029	0.029	-0.072	0.082		
1	0.021	0.045	-0.171	0.092			0.029	0.039	-0.194	0.083		
2	0.012	0.053	0.069	0.090			0.021	0.046	0.075	0.080		
Change in forecasted inflation since last meeting, Quarters ahead:												
-1	0.054	0.043	-0.190	0.056			0.048	0.037	-0.013	0.017		
0	-0.054	0.048	0.180	0.082			-0.054	0.040	-0.010	0.033		
1	0.006	0.070	0.071	0.083			0.013	0.062	0.119	0.042		
2	0.040	0.081	-0.137	0.061			0.010	0.065	0.038	0.039		
Forecasted unemployment rate (current quarter)	-0.340	0.123	0.298	0.124			-0.312	0.106	0.287	0.107		
Rate of Change in Leading Index					0.004	0.002					0.004	0.002
Rate of Change in Coincident Index					0.000	0.004					-0.001	0.004
Rate of Change in Lagging Index					-0.005	0.001					0.004	0.002
Adjusted R^2	0.39						0.40					
S.E.E.	0.35						0.32					
D-W	1.87						1.82					

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations.

Table 4.10 – Determinants of the Change in the Intended Federal Funds Rate - Newey-West Standard Errors – Greenbook and SPF and BCI

	Sample 1969:1 - 1996:12						**Sample 1969:1 - 2003:12**					
	Greenbook		**SPF**		**BCI**		**Greenbook**		**SPF**		**BCI**	
	Coeff	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**
Constant	0.235	0.117					0.107	0.088				
Initial level of intended funds rate	-0.009	0.011					-0.007	0.010				
Forecasted output growth, Quarters ahead:												
-1	0.022	0.017	0.004	0.018			0.021	0.015	0.005	0.016		
0	0.004	0.032	-0.008	0.051			0.005	0.030	-0.008	0.048		
1	-0.021	0.041	0.017	0.056			-0.005	0.031	0.006	0.053		
2	0.045	0.056	-0.073	0.078			0.035	0.044	-0.065	0.072		
Change in forecasted output growth since last meeting, Quarters ahead:												
-1	0.018	0.028	-0.013	0.019			0.015	0.024	-0.013	0.016		
0	0.110	0.037	-0.013	0.047			0.102	0.035	-0.010	0.041		
1	0.043	0.045	0.116	0.050			0.032	0.036	0.119	0.048		
2	0.013	0.056	0.048	0.038			0.015	0.044	0.038	0.034		
Forecasted inflation, Quarters ahead:												
-1	0.017	0.021	0.182	0.105			0.019	0.019	0.186	0.099		
0	-0.032	0.033	-0.062	0.090			-0.029	0.031	-0.072	0.086		
1	0.021	0.047	-0.171	0.084			0.029	0.045	-0.194	0.083		
2	0.012	0.054	0.069	0.073			0.021	0.051	0.075	0.070		
Change in forecasted inflation since last meeting, Quarters ahead:												
-1	0.054	0.042	-0.190	0.106			0.048	0.037	-0.013	0.101		
0	-0.054	0.052	0.180	0.099			-0.054	0.044	-0.010	0.096		
1	0.006	0.062	0.071	0.079			0.013	0.058	0.119	0.077		
2	0.040	0.087	-0.137	0.100			0.010	0.069	0.038	0.100		
Forecasted unemployment rate (current quarter)	-0.340	0.117	0.298	0.119			-0.312	0.105	0.287	0.109		
Rate of Change in Leading Index					0.004	0.002					0.004	0.002
Rate of Change in Coincident Index					0.000	0.004					-0.001	0.003
Rate of Change in Lagging Index					-0.005	0.001					0.004	0.001
Adjusted R^2	0.39						0.40					
S.E.E.	0.35						0.32					
D-W	1.87						1.82					

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations.

Table 4.11 – Determinants of the Change in the Intended Federal Funds Rate with Lagged Dependent Variable – Greenbook and SPF and BCI

	Sample 1969:1 - 1996:12						**Sample 1969:1 - 2003:12**					
	Greenbook		**SPF**		**BCI**		**Greenbook**		**SPF**		**BCI**	
	Coeff	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**
Constant	0.226	0.165					0.109	0.122				
Initial level of intended funds rate	-0.011	0.013					-0.009	0.011				
Forecasted output growth, Quarters ahead:												
-1	0.021	0.018	0.003	0.022			0.020	0.015	0.005	0.018		
0	0.003	0.030	-0.001	0.046			0.005	0.025	0.000	0.040		
1	-0.017	0.037	0.006	0.056			-0.003	0.029	-0.005	0.049		
2	0.040	0.038	-0.066	0.049			0.031	0.029	-0.058	0.043		
Change in forecasted output growth since last meeting, Quarters ahead:												
-1	0.017	0.032	-0.015	0.021			0.014	0.026	-0.015	0.017		
0	0.105	0.032	-0.024	0.040			0.097	0.028	-0.022	0.034		
1	0.047	0.046	0.119	0.048			0.037	0.037	0.121	0.042		
2	0.023	0.052	0.044	0.045			0.024	0.041	0.035	0.039		
Forecasted inflation, Quarters ahead:												
-1	0.014	0.027	0.185	0.057			0.016	0.024	0.187	0.051		
0	-0.027	0.033	-0.075	0.092			-0.024	0.029	-0.086	0.083		
1	0.020	0.045	-0.162	0.093			0.027	0.039	-0.183	0.083		
2	0.013	0.053	0.070	0.090			0.022	0.046	0.077	0.080		
Change in forecasted inflation since last meeting, Quarters ahead:												
-1	0.060	0.044	-0.195	0.056			0.053	0.037	-0.196	0.050		
0	-0.055	0.048	0.187	0.082			-0.054	0.040	0.191	0.073		
1	0.004	0.070	0.065	0.083			0.012	0.061	0.082	0.074		
2	0.041	0.081	-0.132	0.062			0.009	0.065	-0.123	0.055		
Forecasted unemployment rate (current quarter)	-0.328	0.124	0.291	0.124			-0.301	0.106	0.278	0.107		
Rate of Change in Leading Index					0.004	0.002					0.004	0.002
Rate of Change in Coincident Index					0.000	0.004					-0.001	0.004
Rate of Change in Lagging Index					-0.005	0.001					-0.005	0.001
Previous meeting's change in intended target	0.063	0.060					0.071	0.053				
Adjusted R^2	0.39						0.40					
S.E.E.	0.35						0.32					
D-W	1.96						1.93					

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations.

Table 4.12 – Determinants of the Change in the Intended Federal Funds Rate with Serial Correlation Correction – Greenbook and SPF and BCI

	Sample 1969:1 - 1996:12						**Sample 1969:1 - 2003:12**					
	Greenbook		**SPF**		**BCI**		**Greenbook**		**SPF**		**BCI**	
	Coeff	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**	**Coeff**	**Std Err**
Constant	0.210	0.188					0.120	0.144				
Initial level of intended funds rate	-0.014	0.014					-0.014	0.012				
Forecasted output growth, Quarters ahead:												
-1	0.025	0.018	0.002	0.022			0.023	0.015	0.003	0.018		
0	0.013	0.030	-0.021	0.045			0.017	0.026	-0.020	0.039		
1	0.000	0.038	0.000	0.056			0.014	0.030	-0.012	0.049		
2	0.034	0.040	-0.072	0.051			0.029	0.031	-0.067	0.045		
Change in forecasted output growth since last meeting, Quarters ahead:												
-1	0.014	0.031	-0.017	0.021			0.009	0.025	-0.015	0.017		
0	0.089	0.031	-0.008	0.037			0.078	0.027	-0.009	0.032		
1	0.039	0.046	0.112	0.049			0.030	0.037	0.113	0.042		
2	0.035	0.052	0.054	0.046			0.035	0.041	0.048	0.039		
Forecasted inflation, Quarters ahead:												
-1	0.011	0.028	0.219	0.058			0.012	0.024	0.225	0.052		
0	-0.035	0.035	-0.091	0.094			-0.031	0.030	-0.103	0.085		
1	0.027	0.047	-0.207	0.095			0.032	0.041	-0.227	0.085		
2	0.018	0.056	0.100	0.095			0.026	0.049	0.111	0.084		
Change in forecasted inflation since last meeting, Quarters ahead:												
-1	0.059	0.042	-0.231	0.058			0.047	0.035	-0.235	0.051		
0	-0.035	0.047	0.214	0.081			-0.035	0.039	0.218	0.072		
1	0.011	0.069	0.087	0.083			0.022	0.061	0.102	0.074		
2	0.010	0.080	-0.140	0.063			-0.017	0.064	-0.133	0.056		
Forecasted unemployment rate (current quarter)	-0.292	0.126	0.260	0.127			-0.270	0.107	0.249	0.109		
Rate of Change in Leading Index					0.003	0.002					0.003	0.002
Rate of Change in Coincident Index					0.000	0.004					0.000	0.004
Rate of Change in Lagging Index					-0.004	0.001					-0.004	0.001
Rho	0.170	0.085					0.198	0.073				
Adjusted R^2	0.39						0.41					
S.E.E.	0.35						0.32					
D-W	1.99						1.99					

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations.

The F-statistic on the BCI coefficients in the regression incorporating the NW standard errors is 7.90 (8.33) with a p-value of 0.00 (0.00).The F-statistic on the coefficients in the regression with a LDV is

7.22 (8.53) with a p-value of 0.00 (0.00).The F-statistic on the coefficients in the regression with a PW correction is 6.52 (7.59) with a p-value of 0.00 (0.00).

The F-statistic on the BCI and SPF coefficients in the regression incorporating the NW standard errors is 3.72 (4.10) with a p-value of 0.00 (0.00).The F-statistic on the coefficients in the regression with a LDV is 3.78 (4.52) with a p-value of 0.00 (0.00).The F-statistic on the coefficients in the regression with a PW correction is 4.16 (5.09) with a p-value of 0.00 (0.00).

Compared to just using the Greenbooks, the adjusted R^2 statistics also increase to approximately 0.40 for each specification when the BCI and SPF is added. The increases in the goodness-of-fit and the joint significance of the variables suggest some significant variability in the intended funds rate can be attributed to information contained in the BCI and SPF.

Each regression has shown that alternative real-time data exhibits significance and that policymakers respond to data beyond the Greenbooks in formulating monetary policy.

4.3.4 Alternative Measures of Monetary Policy Shocks

The three regressions above add the SPF, the BCI, and both the SPF and BCI to the Greenbook data. The residuals from the regressions without correction for serial correlation are new measures of exogenous changes in monetary policy. Figure 4.1 shows the residuals from each regression for the 1996 sample and the 2003 sample. Each measure is converted to a monthly series. A monthly series is needed to obtain the responses of output and prices to these new measures of policy shocks. All measures follow a similar pattern with the most volatility occurring during the period of nonborrowed reserve targeting of the Federal Reserve.

The residual measures are all highly correlated with each other as well as with the RR shocks from the original and 2003 samples. Tables 4.13(a) and 4.13(b) report the overall correlations among all shock measures for each sample.

Table 4.13(a) – Correlations Among Shock Measures – Meetings from 1969:1 – 1996:12

	Romer-Romer	RR / SPF	RR / BCI	RR / SPF / BCI
Romer-Romer	1.00			
RR / SPF	0.90	1.00		
RR / BCI	0.96	0.85	1.00	
RR / SPF / BCI	0.86	0.95	0.90	1.00

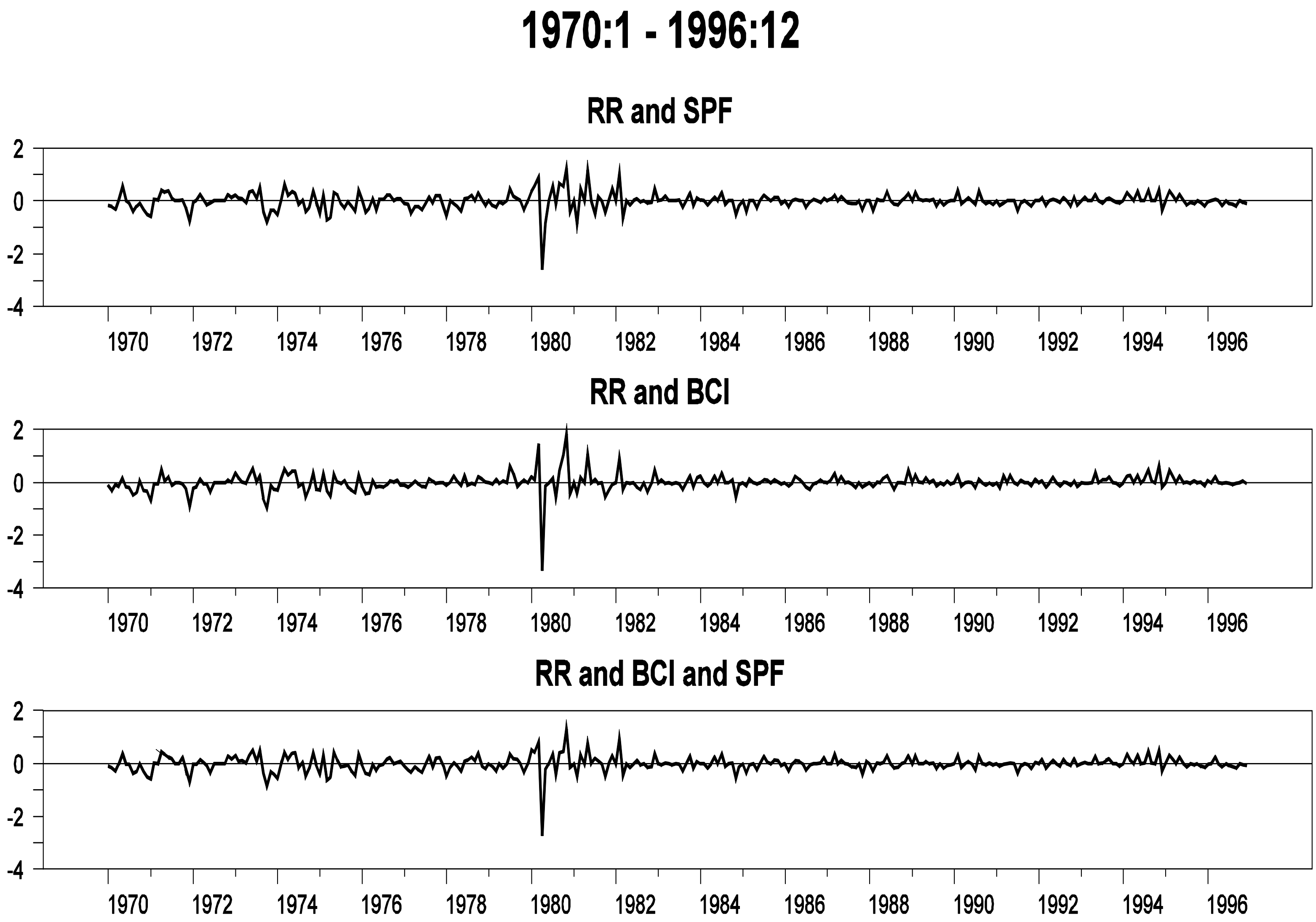


Figure 4.1 – Monthly Residuals

(fig. 4.1 cont'd.)

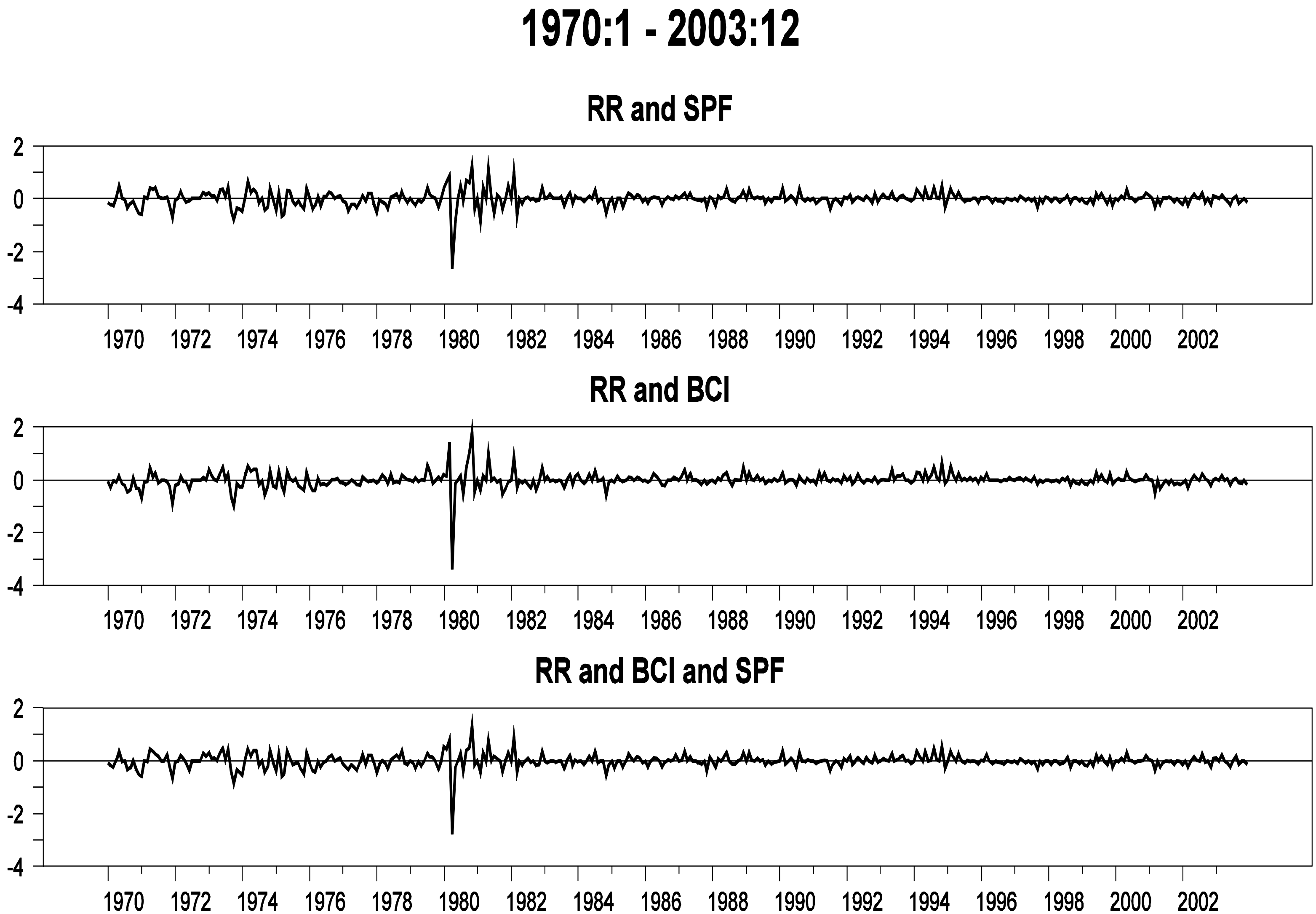

1970:1 - 2003:12
RR and SPF
2
0
-2
-4
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002
RR and BCI
2
0
-2
-4
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002
RR and BCI and SPF
2
0
-2
-4
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002

Table 4.13(b) – Correlations Among Shock Measures – Meetings from 1969:1 – 2003:12

	Romer-Romer	RR / SPF	RR / BCI	RR / SPF / BCI
Romer-Romer	1.00			
RR / SPF	0.90	1.00		
RR / BCI	0.96	0.85	1.00	
RR / SPF / BCI	0.86	0.95	0.90	1.00

The residuals obtained from adding information about the economy beyond the Greenbook are highly correlated with the original RR residuals obtained from only using the Greenbook. The lowest correlation, for both samples, with the RR residuals is with those obtained when adding both the SPF and BCI. The correlation is 0.86 for both the 1996 and 2003 samples. The highest correlation is with the residuals obtained from adding the BCI to the Greenbook. The overall correlation with the RR residuals is 0.96 for both samples.

4.3.5 Responses of Output and Price to Alternative Measures of Shocks

The macroeconomic effects of the alternative monetary policy shocks are estimated in the same way as in Chapter 2. First, monthly regressions for output and price were estimated and single equation IRF's using polynomial division were computed for both output and price. The results for the monthly regressions are shown in the Appendix. Next, the residuals from each specification were cumulated and placed into the standard three-variable VAR used in previous chapters as the measure of monetary policy. These responses were computed for the residuals from the 1996 sample and the 2003 sample.

4.3.5.1 Greenbook and SPF Specification

For the single equation IRF's, Figure 4.2 plots the responses of output and prices for both samples to a one percentage point increase in the shock measures from adding the SPF to the Greenbook. Figure 4.3 plots the Greenbook / SPF (referred to as RR / SPF) point estimates along with the CI bands from the RR specification for the 1996 sample and 2003 samples. If the responses lie outside the RR CI bands, the responses are interpreted to be significantly different.

Figure 4.2 shows the response of output and price are similar in patterns and magnitudes to those obtained for both samples in the RR equation. The negative response in output becomes significant five months after the shock in the 1996 and 2003 samples. In both samples, the point estimates return to the

origins and the CI bands span zero at later horizons. The response of prices becomes negative two months after the shock in the 1996 sample and three months after the shock in the 2003 sample. The responses do not become significant until twenty-five months after the shock in 1996 sample and after twenty-six months after the shock in the 2003 sample.

For both samples, Figure 4.3 shows there are slight, significant transitory differences in the responses at early horizons. The RR response of output is slightly stronger at early horizons before showing no significant differences at longer horizons. The RR / SPF response in prices is significantly stronger for approximately two years before showing no significant differences.

The responses for both samples obtained from cumulating the RR / SPF residuals and placing them in a three-variable VAR are shown in Figure 4.4. Figure 4.5 plots the RR / SPF point estimates along with the CI bands from the RR specification for the 1996 and 2003 samples.

Figure 4.4 shows that the responses of output for both samples become negative and significant before rising above the origin at later horizons. The response of output becomes negative three months after the shock in both samples. While the CI bands span the origin at later horizons for the original sample, the lower CI band lies above the origin at later horizons in the 2003 sample. The responses of price become negative and significant at very early horizons.

In both samples, the response of price becomes negative immediately in the first month after the shock. The response become significant three months after the shock in both samples. The own effect of monetary policy is significantly positive until the CI bands span the origin forty-five months after the shock for the original sample. The entire effect is significantly negative for at all horizons for the sample to 2003.

There are significant differences in output at early and later horizons shown in Figure 4.5. The responses of output are first significantly stronger than those of RR but then become significantly weaker at later horizons. Both samples also show that the responses of prices significantly stronger at early and intermediate horizons. The significant differences occur for approximately two years after the shock in both samples. The responses of monetary policy are not significantly different.

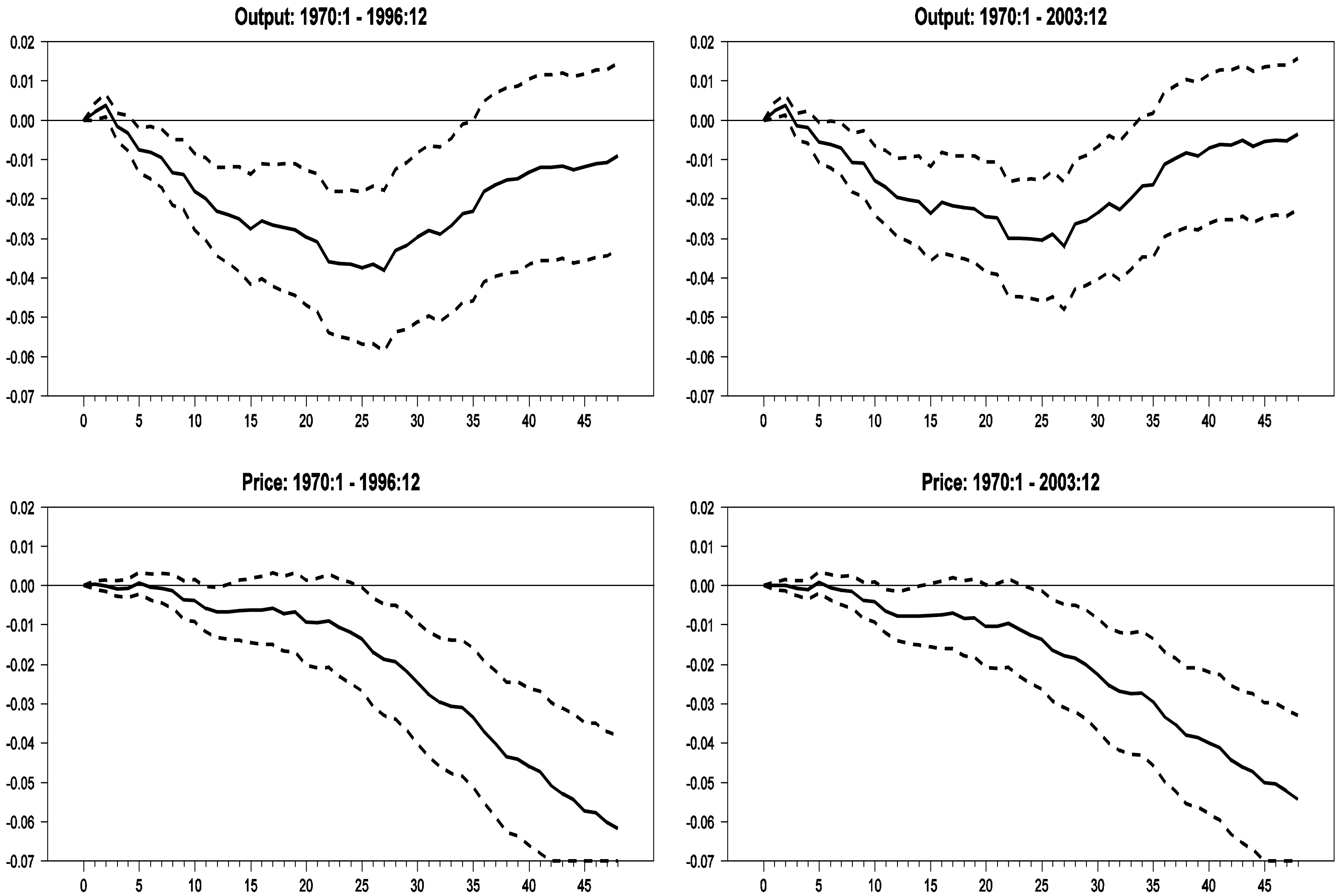


Figure 4.2 – Single Equation Impulse Response Functions: RR / SPF Specification

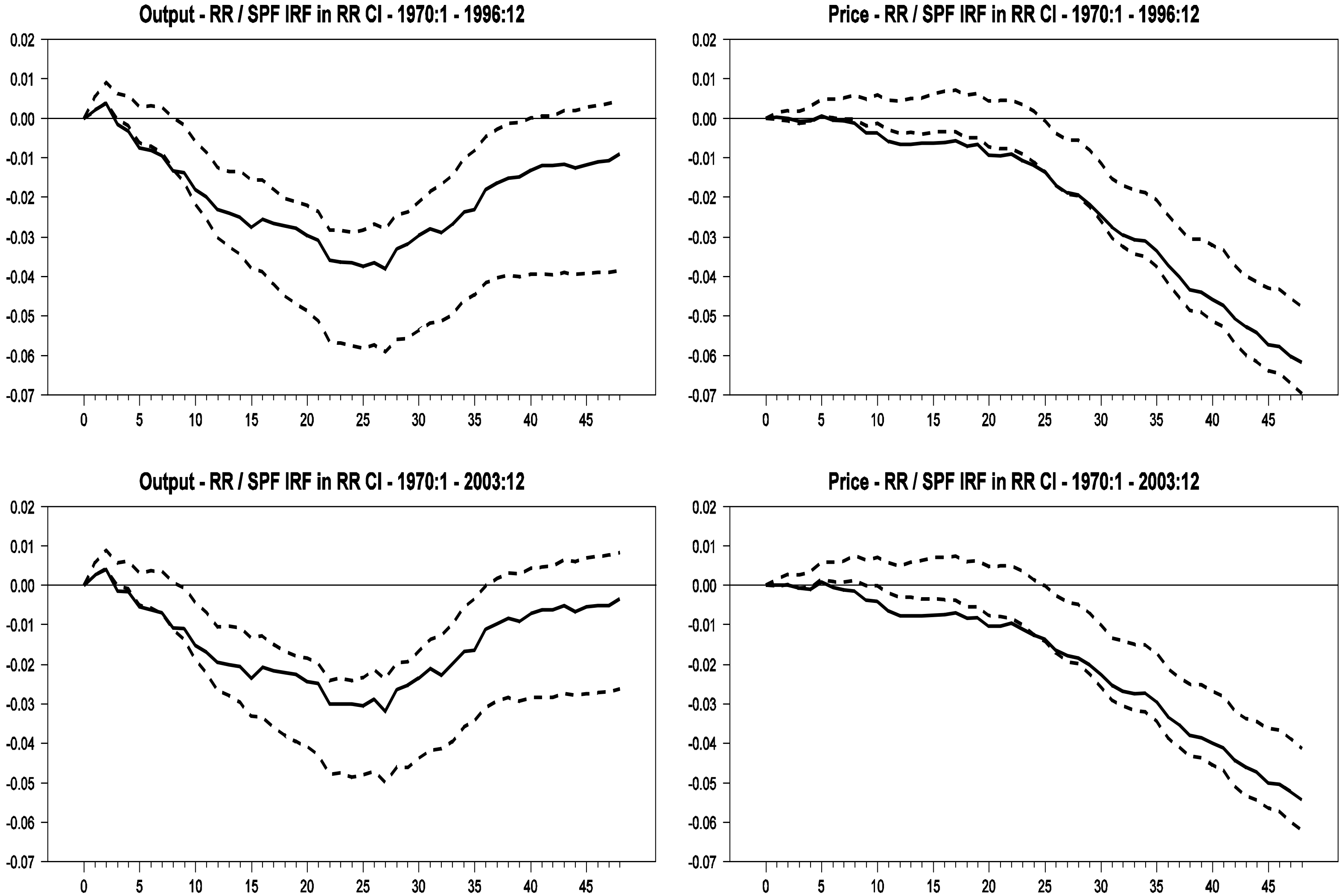


Figure 4.3 – Comparison of Romer-Romer and RR / SPF Specification Single Equation IRF's

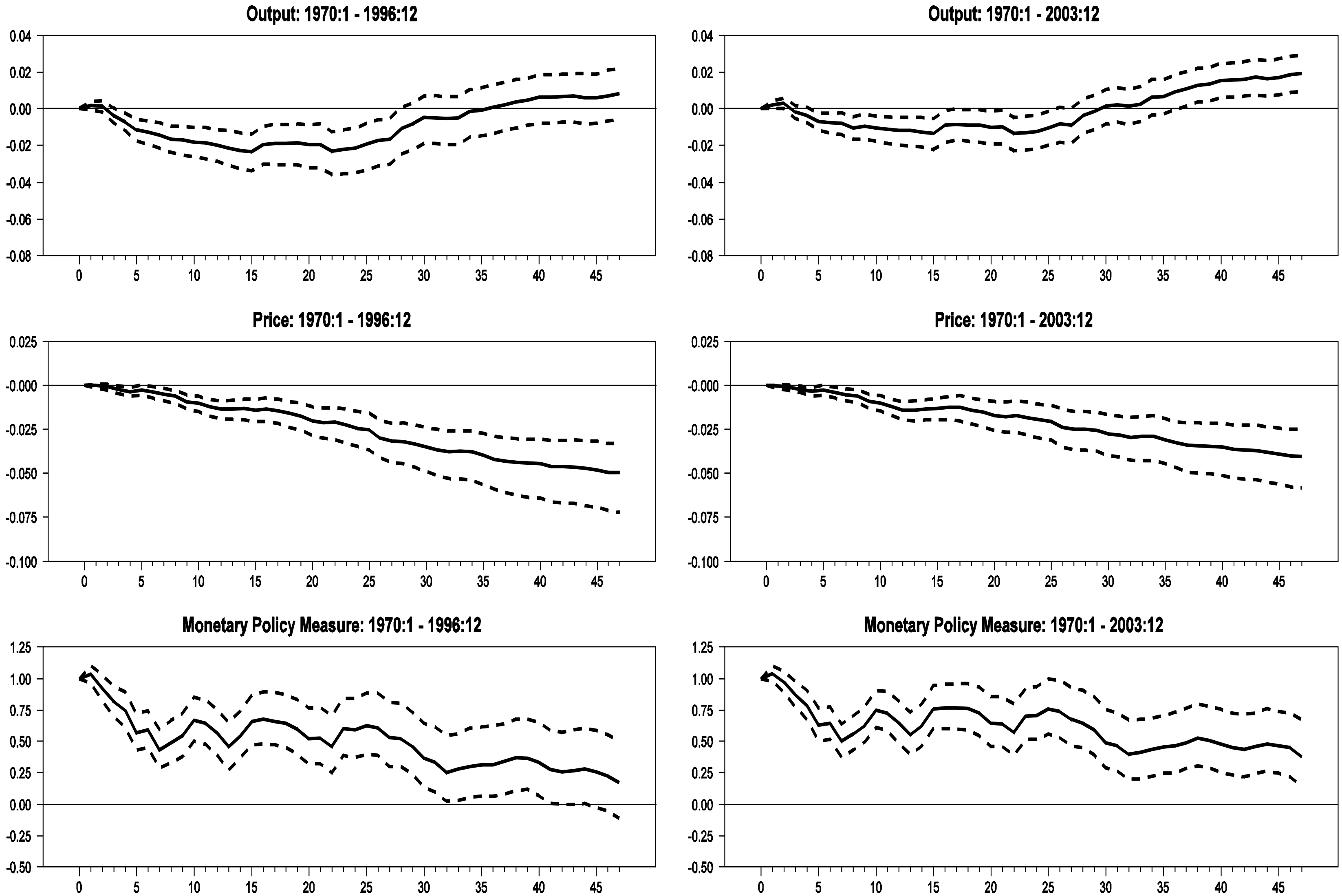


Figure 4.4 – VAR Impulse Response Functions: RR / SPF Specifications

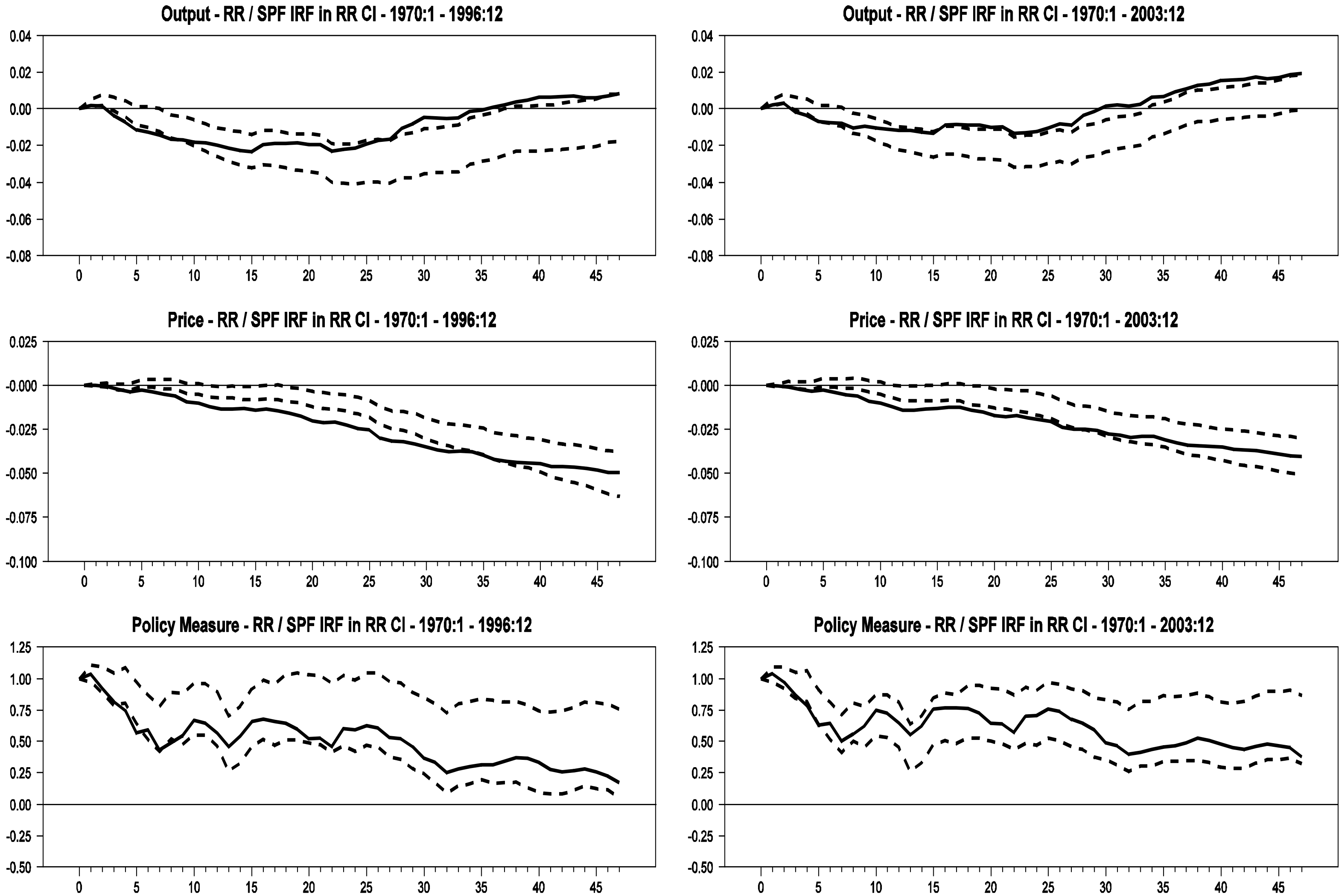


Figure 4.5 – Comparison of Romer-Romer and RR / SPF VAR IRF's

Adding the SPF to the Greenbook produces measures of monetary policy that give significantly stronger responses of output at early horizons for both the single equation and VAR IRF's. The VAR IRF's show weaker responses in output at later horizons. In both the single equation and VAR IRF's, the responses in prices from the RR /SPF residuals are significantly stronger at early and intermediate horizons before showing no significant differences.

4.3.5.2 Greenbook and BCI Specification

For the single equation IRF's, Figure 4.6 plots the responses of output and price for both samples to a one percentage point increase in the shock measures from adding the BCI to the Greenbook (RR / BCI). To compare the responses to RR, figure 4.7 plots the RR / BCI point estimates along with the CI bands from the RR specification for both samples.

As found in the RR / SPF results, Figure 4.6 shows the responses of output and prices are similar in patterns and magnitudes to those obtained for both samples in the RR method. The response of output becomes negative five months after the shock in both samples. The negative response in output becomes significant nine months after the shock in the 1996 and 2003 samples. In both samples, the point estimates return to the origins and the CI bands span zero at later horizons.

The responses of prices display longer times to become negative and significant compared to the RR and RR / SPF results. The point estimates become negative twenty-five months after the shock in the 1996 sample and the 2003 sample. The responses do not become significant until thirty-one months after the shock in both samples.

There are no significant differences in the responses of output obtained from the RR and RR / BCI specifications. This is true for both samples as the RR / BCI point estimates are completely within the RR CI bands. There are slightly significant differences in prices at later horizons. Figure 4.7 shows that the RR / BCI response in prices is significantly weaker beginning approximately two years after the shock for the 1996 sample. This difference becomes much smaller when the sample is extended to 2003.

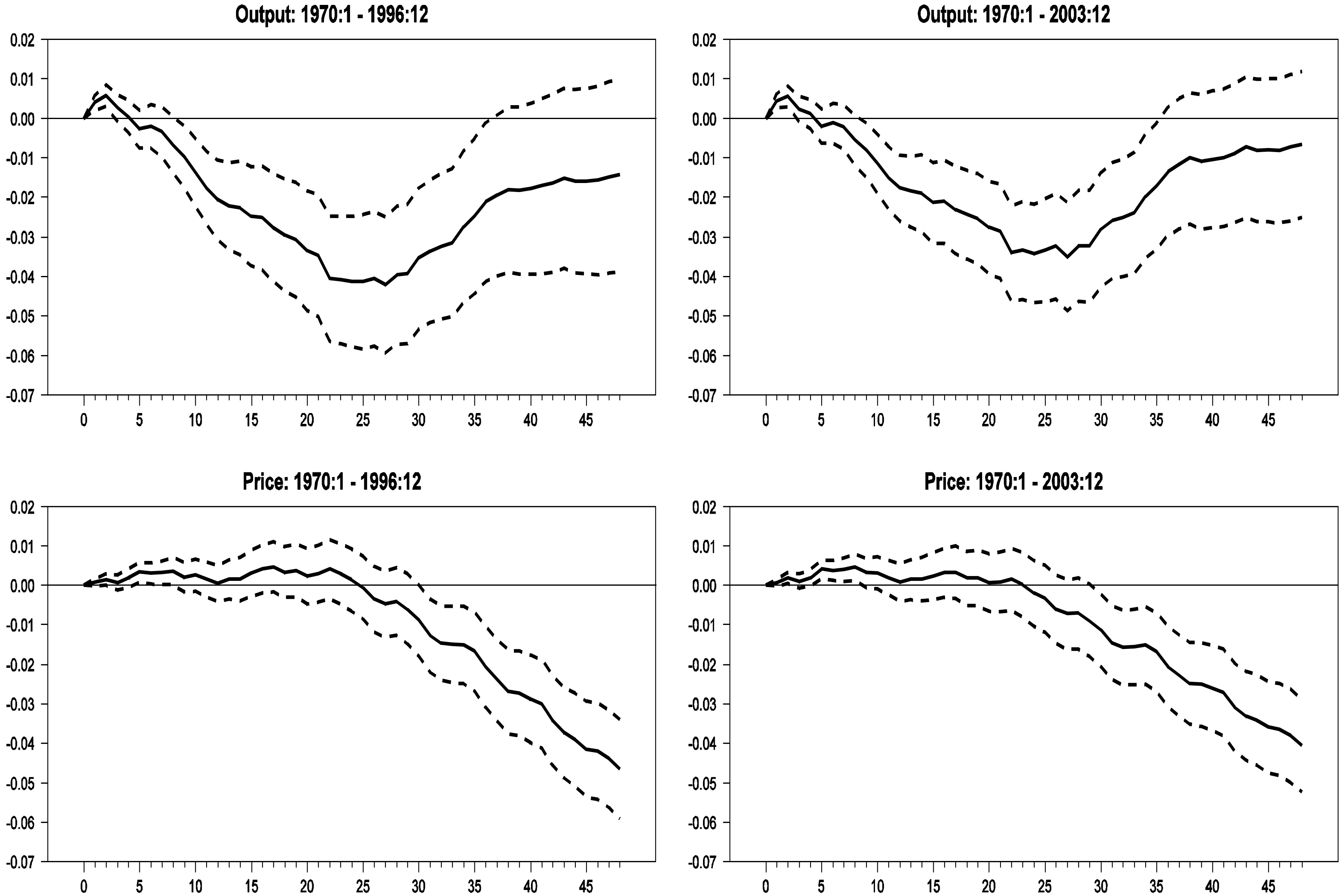


Figure 4.6 – Single Equation Impulse Response Functions: RR / BCI Specification

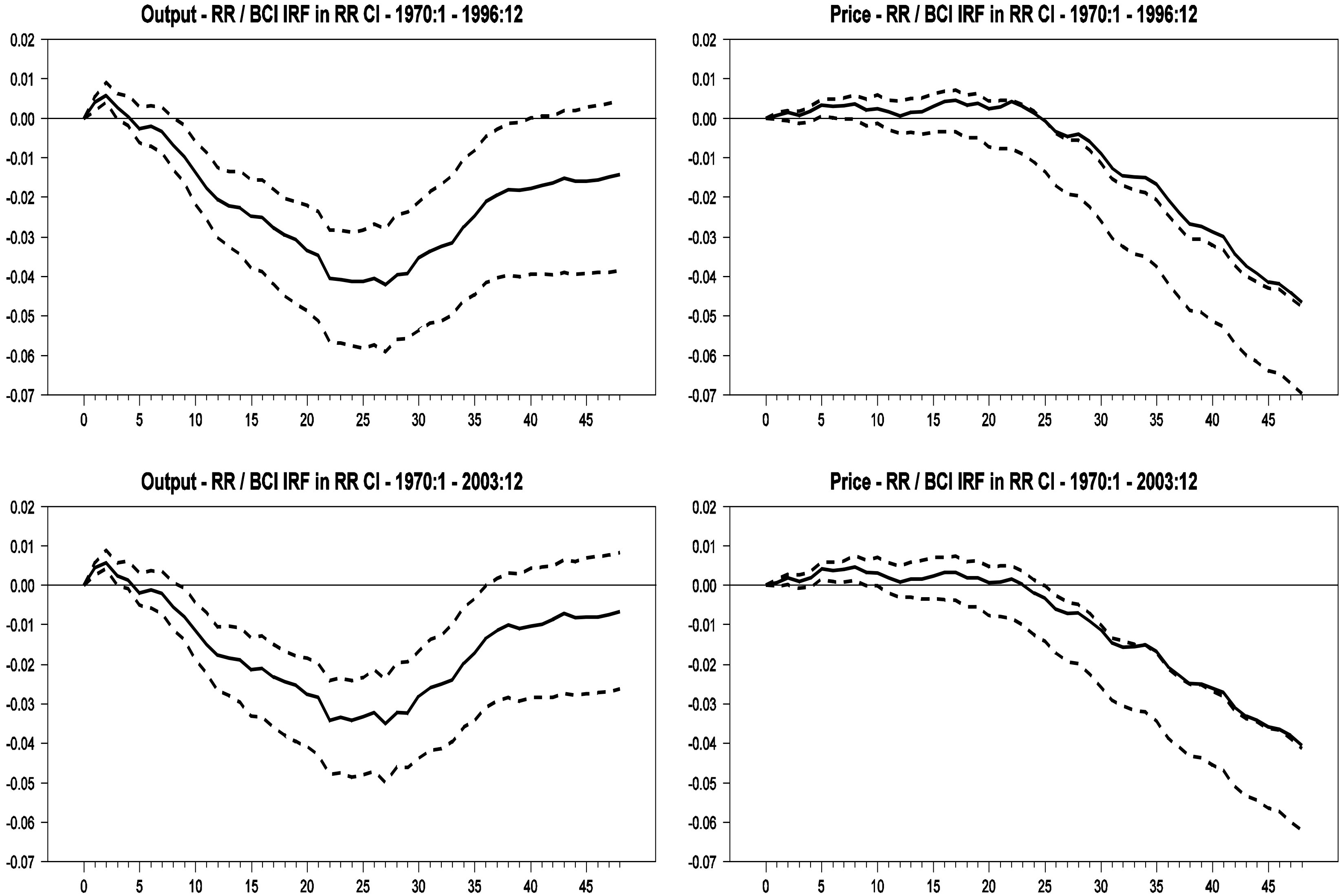


Figure 4.7 – Comparison of Romer-Romer and RR / BCI Specification Single Equation IRF’s

The responses both samples obtained from cumulating the RR / SPF residuals and placing them in the VAR are shown in Figure 4.8 Figure 4.9 plots the RR / BCI point estimates along with the CI bands from the RR specification for the 1996 and 2003 samples.

Figure 4.8 shows that the responses of output for both samples become negative four months after the shock and are significant before rising above the origin at later horizons for the 2003 sample. The CI bands span zero at longer horizons for both samples. In both the 1996 and 2003 samples, the response of price becomes negative nine months after the shock. The responses become significant twenty-five months after the shock in the 1996 sample and twenty months after the shock in the 2003 samples. The own effect of monetary policy is long lived and is always significantly positive at all horizons.

Figure 4.9 shows there are no significant differences in output for either sample. The point estimates from the RR / BCI specification are completely within the RR CI bands. The RR / BCI response in prices begins to lie above the upper RR CI band approximately twenty-months after the shock. However, the 2003 price response shows no significant differences. There are no significant differences in the responses of monetary policy for either sample.

Adding the BCI to the Greenbook produces measures of monetary policy that produce responses in output that are not significantly different from RR results. This is true for both samples for the single equation and VAR IRF's. In both the single equation and VAR IRF's, the responses in prices from the RR / BCI residuals are significantly weaker at early at intermediate and longer horizons. There are no significant differences in the responses of monetary policy.

4.3.5.3 Greenbook and SPF and BCI Specification

For the single equation IRF's, Figure 4.10 plots the responses of output and price for both samples to a one percentage point increase in the shock measures from adding the SPF and BCI to the Greenbook. Figure 4.11 plots the Greenbook with SPF and BCI (referred to as RR / SPF / BCI) point estimates along with the CI bands from the RR specification.

Figure 4.10 shows the responses of output and price are similar in patterns and magnitudes to those obtained for both samples in the RR equation.

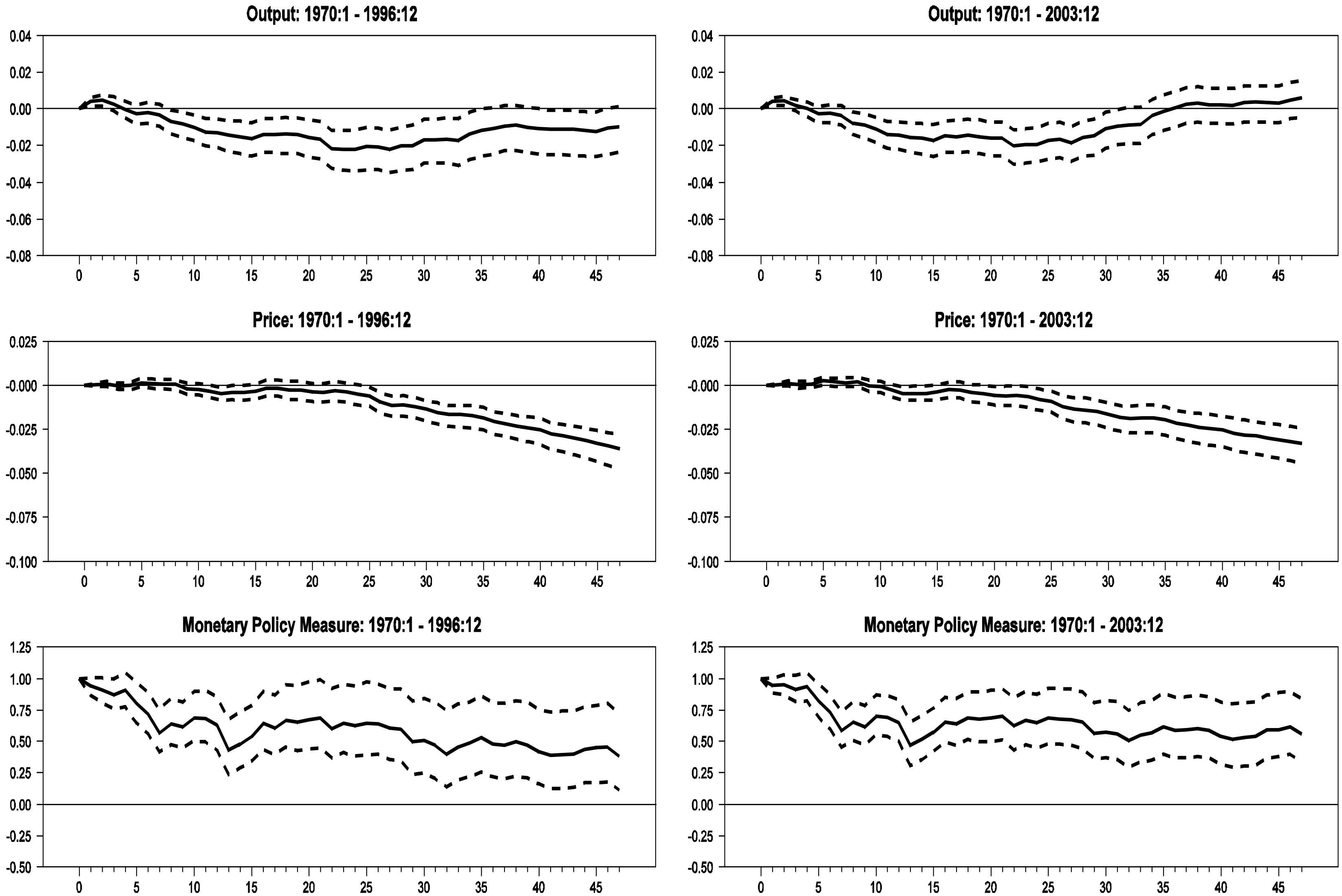


Figure 4.8 – VAR Impulse Response Functions: RR / BCI Specification

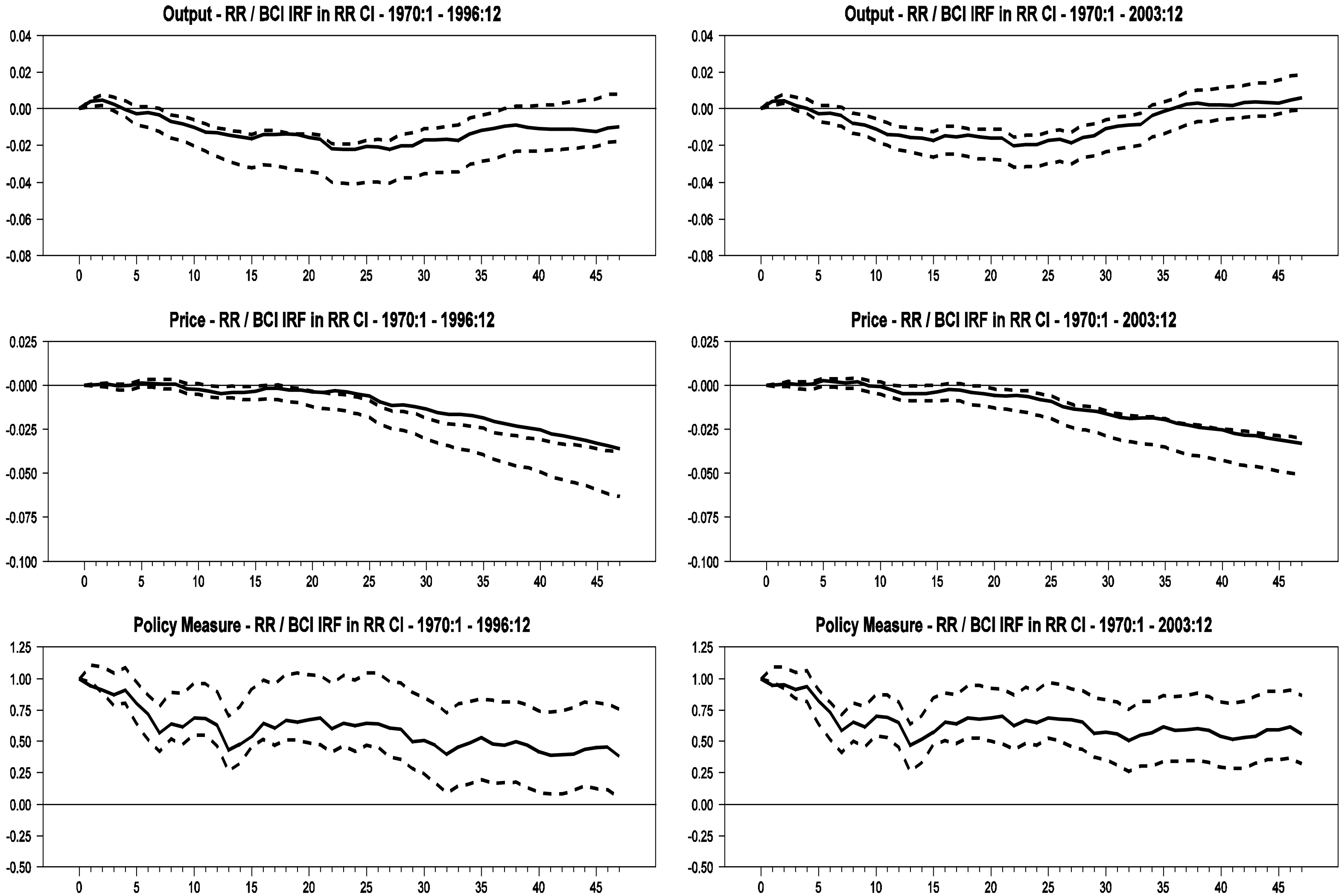


Figure 4.9 – Comparison of Romer-Romer and RR / BCI VAR IRF’s

The response of output becomes negative three months after the shock in the 1996 and 2003 samples. The negative response becomes significant eight months after the shock in both samples. In both samples, the point estimates return to the origins and the CI bands span zero at later horizons. The response of prices becomes permanently negative beginning six months after the shock in the 1996 and 2003 samples. The responses do not become significant until thirty months after the shock in the 1996 and 2003 samples. The CI bands for prices from RR / SPF / BCI specification appear much wider than those obtained from the RR specification for both samples.

Figure 4.11 shows that the responses of output from the RR / SPF / BCI specification are slightly stronger than those of RR at early horizons but display no other significant differences. The RR / SPF / BCI responses in prices are significantly stronger for approximately two years before showing no significant differences at later horizons.

The VAR responses for both samples obtained from cumulating the RR / SPF / BCI residuals are shown in Figure 4.12. Figure 4.13 plots the RR / SPF / BCI point estimates along with the CI bands from the RR specification for the 1996 and 2003 samples.

Figure 4.12 shows that the responses of output for both samples become negative and significant before rising above the origin at later horizons. The response of output becomes negative three months after the shock in both samples. The negative response becomes significant four months after the shock in the 1996 sample and five months after the shock in the 2003 sample. While the CI bands span the origin at later horizons for the original sample, the CI bands lie above the origin at later horizons in the 2003 sample. The responses of price become negative and significant at very early horizons. In both samples, the response of price becomes negative the first month after the shock and becomes significant three months after the shock. The own effect of monetary policy is significantly positive at all horizons for the original sample, with the exception of the final month. The entire effect is significantly positive for at all horizons for the sample to 2003.

Figure 4.13 shows that there are significant and transitory differences in output at early and intermediate horizons. The RR /SPF / BCI responses of output are first significantly stronger than those of

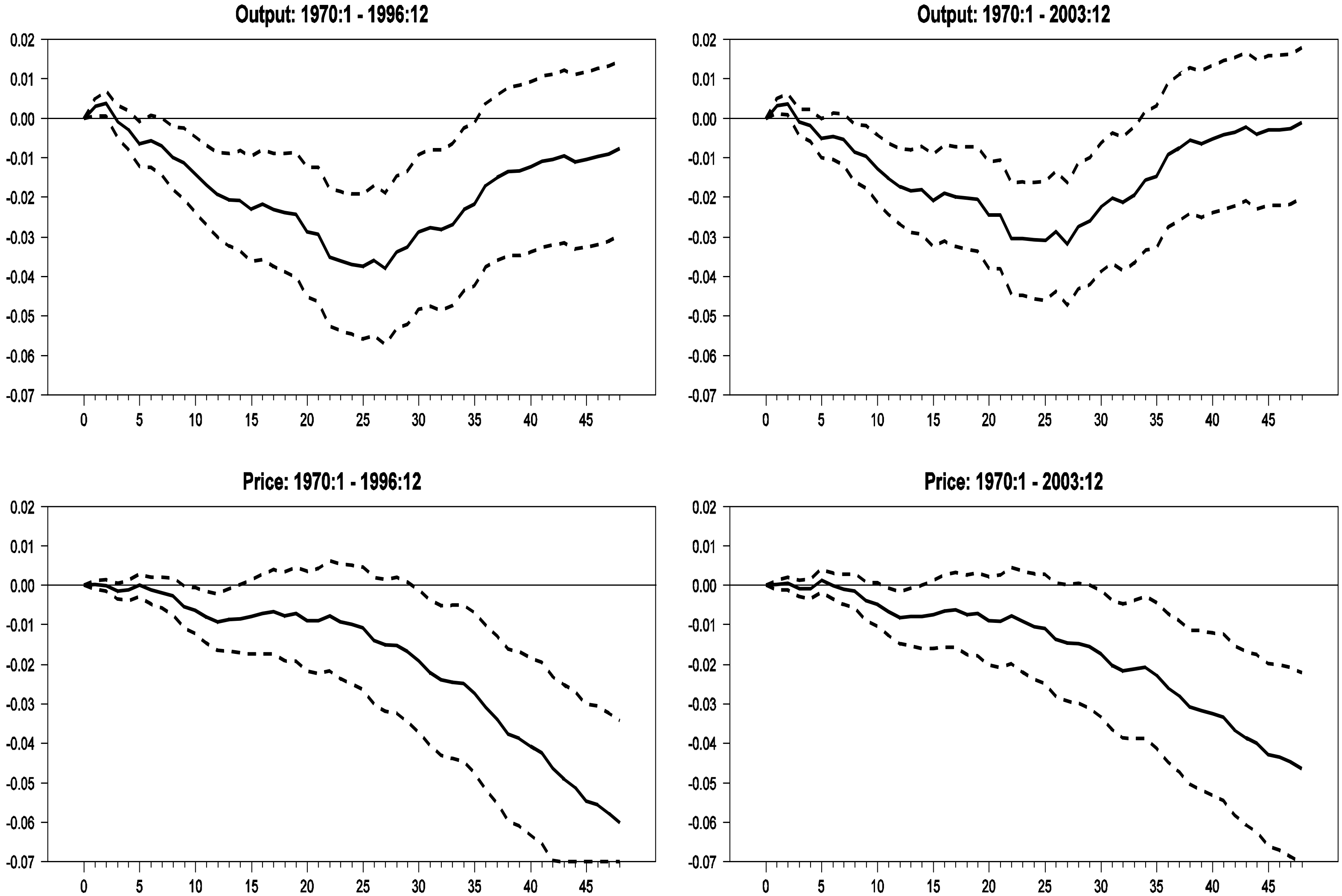


Figure 4.10 – Single Equation Impulse Response Functions: RR / SPF / BCI Specification

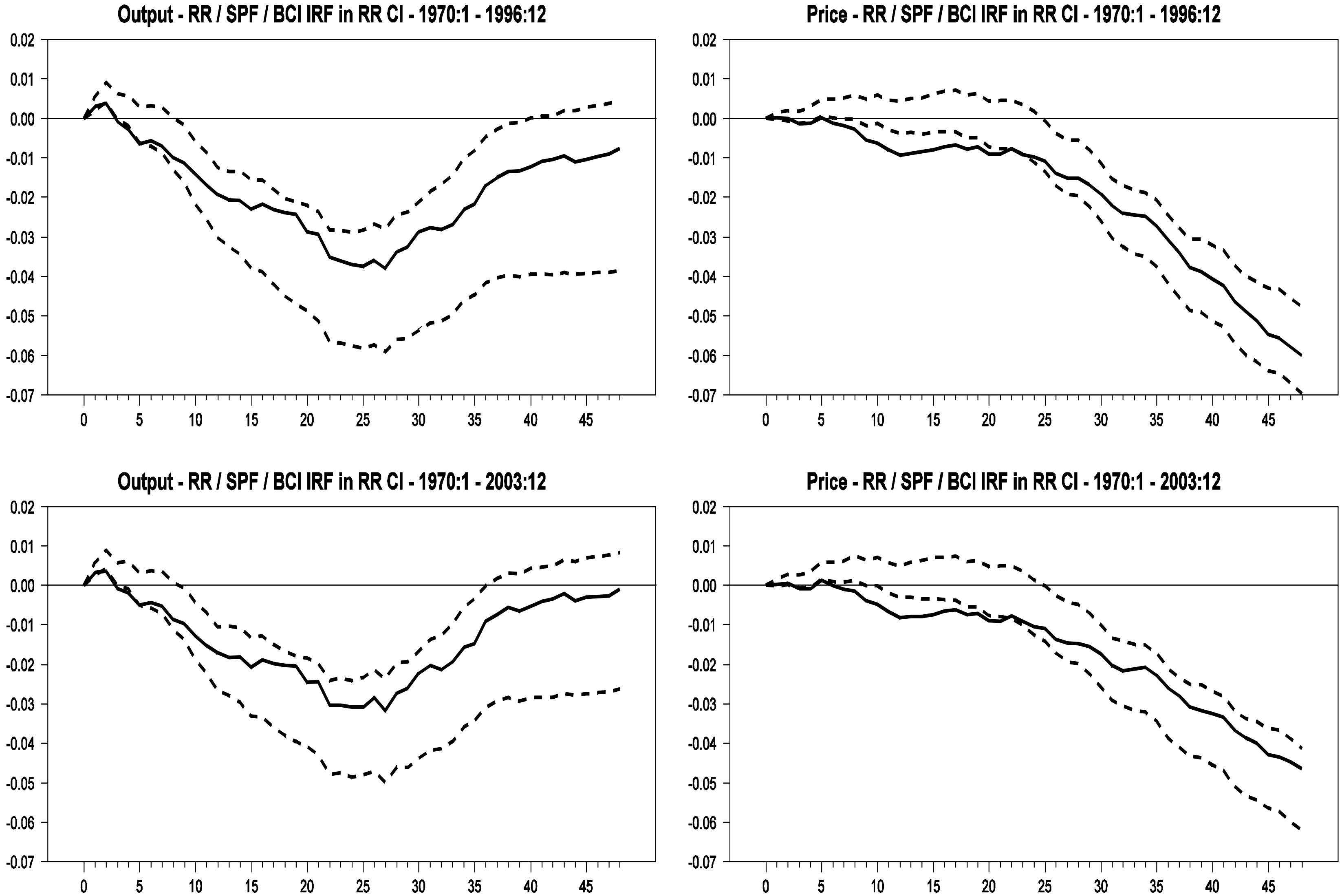


Figure 4.7 – Comparison of Romer-Romer and RR / SPF / BCI Specification Single Equation IRF's

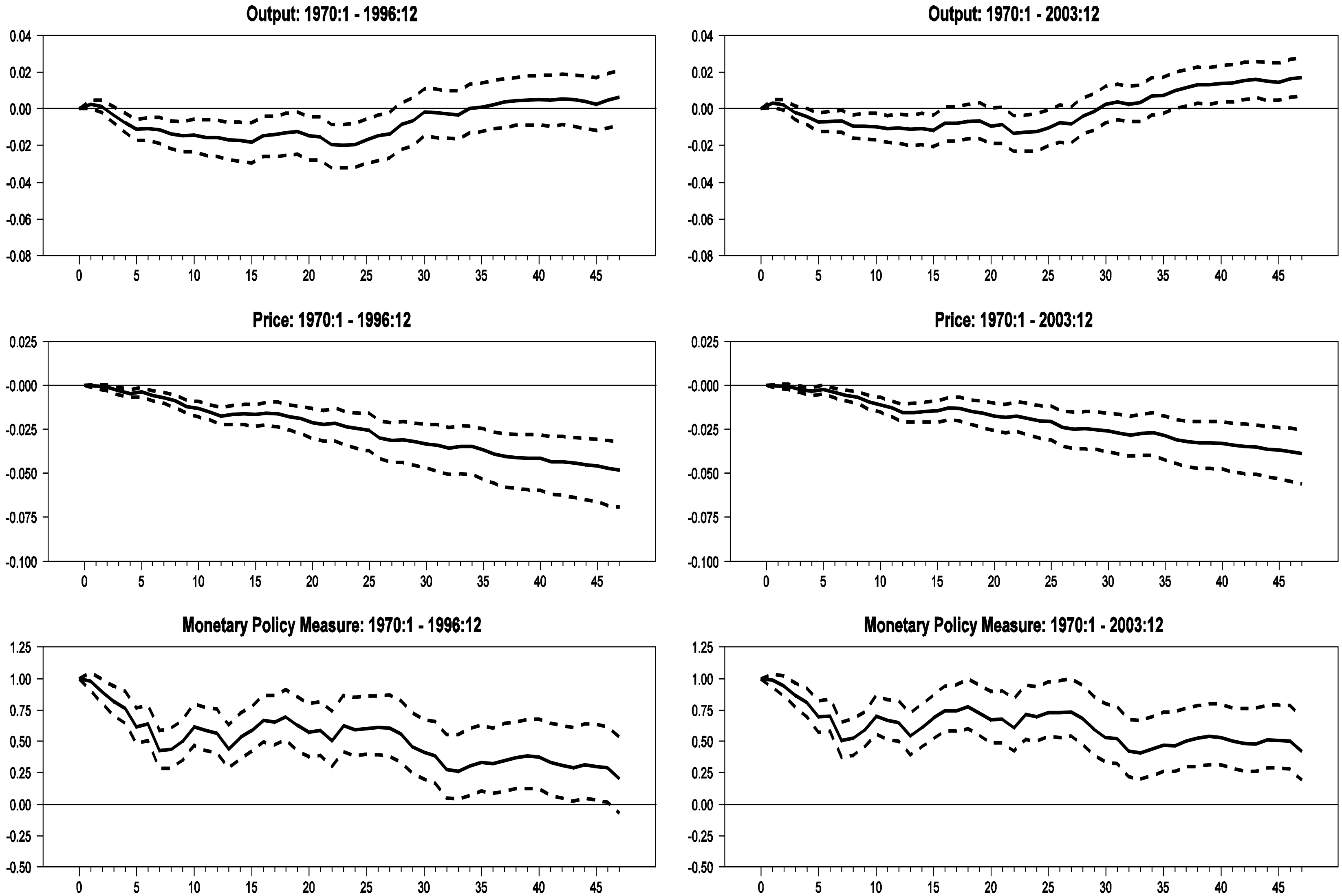


Figure 4.12 – VAR Impulse Response Functions: RR / SPF / BCI Specification

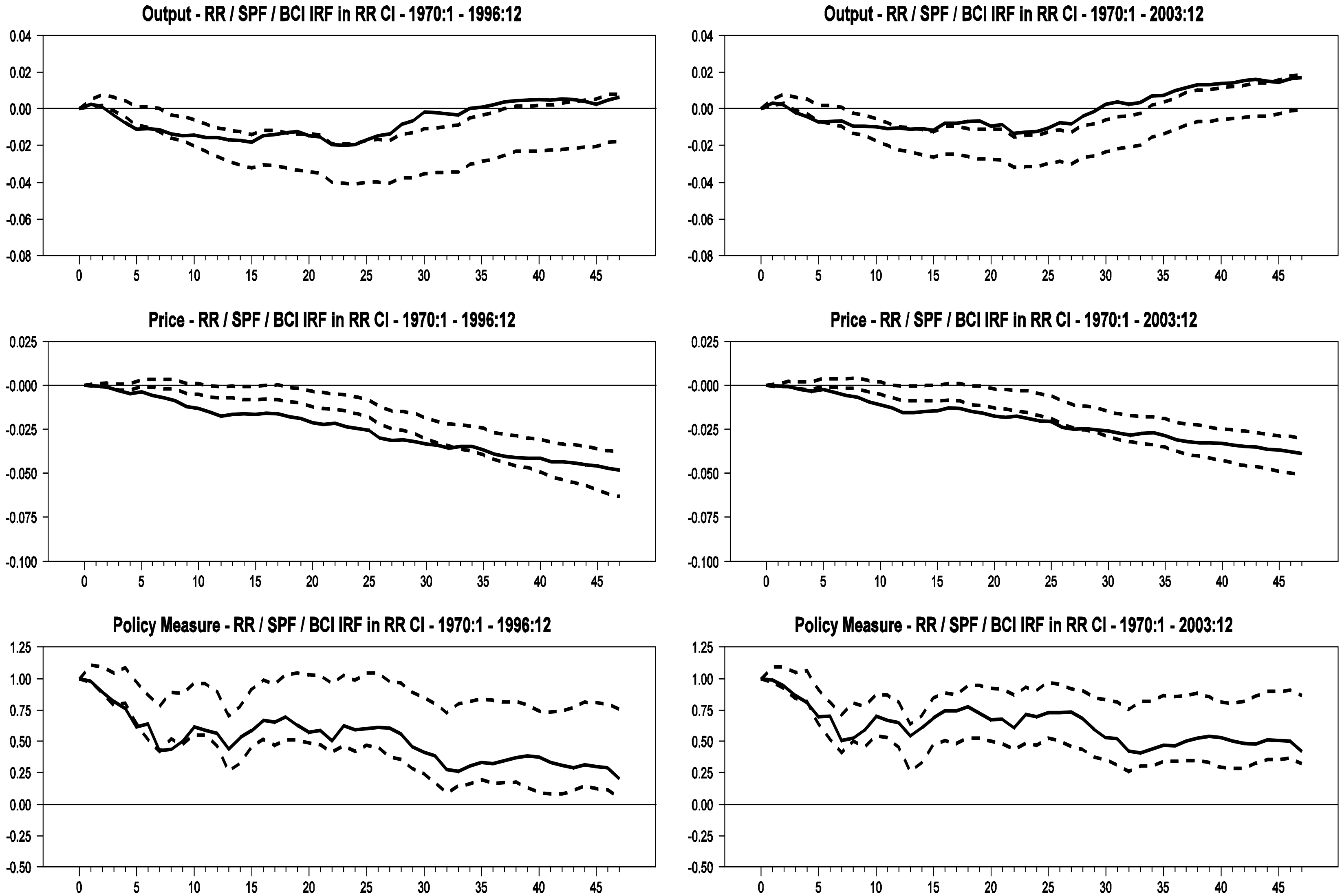


Figure 4.13 – Comparison of Romer-Romer and RR / SPF / BCI VAR IRF’s

the RR but become significantly weaker at later horizons. In the 2003 sample, the RR / SPF / BCI point estimates lie slightly above the upper RR CI band beginning approximately fifteen months after the shock. Both samples also show that the responses of prices are significantly weaker for approximately two years after the shock. The responses of monetary policy are not significantly different.

Adding the SPF and BCI to the Greenbook produces measures of monetary policy that that give significantly stronger responses of output at early horizons for both the single equation and VAR IRF's. The VAR IRF's show weaker responses in output at later horizons. In both the single equation and VAR IRF's, the responses in prices from the RR / SPF / BCI residuals are significantly stronger at early horizons.

Policymakers do respond to information about economic activity beyond what is contained in the Greenbooks. Each alternative data source was added to the RR equation and the coefficients for the response to the alternative datasets were jointly significant. However, the shocks obtained from adding this new data were all highly correlated with the original RR quasi-narrative shocks. The responses of output and prices to these alternative shocks generally displayed similar patterns, magnitudes, and times to significance as those of RR. The significant differences were also generally relatively small and transitory.

4.4 Obtaining Measures of Shocks from Alternative Datasets Only

Greenbook data are not available until five years after it is produced, but the alternative data considered in the previous section is available with a very short lag. The previous section showed that alternative real-time data provides significant information in explaining changes in the intended funds rate. This opens the possibility that new measures of monetary policy shocks that are a good substitute for the RR shocks may be constructed on a timelier basis using only the alternative real-time data considered in the previous section. These new measures can be constructed over a longer time period that includes more recent data than the Greenbook. To construct alternative measures of monetary policy shocks that do not use Greenbook data, five datasets are constructed from the three real-time data sources. The first dataset consists of only the SPF. The second dataset consists of ALFRED previous quarter values with the

SPF forecasts. The third consists of only the BCI and the fourth combines the SPF and BCI. The final dataset combines the ALFRED previous quarter values with the SPF and BCI.

The regressions to obtain shocks are estimated for the samples of FOMC meetings from January 1969 until December 1996, for FOMC meetings from January 1969 until December 2003, and then for FOMC meetings from January 1969 until March 2007. New measures of shocks are generated from the regressions and the responses of output and prices are investigated. The responses are compared to those of RR for the 1996 and 2003 samples. The responses for the 2007 sample are compared to the alternative responses from earlier samples.

4.4.1 Using the SPF Only

In this section, data from the SPF are used to obtain new measures of policy shocks. While Romer and Romer (2000) found that Greenbook forecasts of inflation are superior to those of the SPF, the SPF forecasts of inflation, output growth, and the unemployment rate available before each FOMC meeting are highly correlated with the Greenbook forecasts for the original sample (extended sample to 2003). For the previous quarter inflation forecast, the correlation is .85 (.87), for the current quarter forecast it is .92 (.94), for the one-quarter ahead forecast the correlation is .92 (.94), and for the two-quarter ahead forecast the correlation is .91 (.94). For the previous quarter output growth forecast, the correlation is .86 (.85), for the current quarter forecast it is .90 (.89), for the one-quarter ahead forecast the correlation is .87 (.86), and for the two-quarter ahead forecast the correlation is .79 (.77). For the unemployment rate forecast, the correlation is .98 (.98). However, for both inflation and output growth the correlations for the changes in the forecasts at all horizons are low. The previous quarter change in inflation forecast is .21 (.21), for the current quarter is .23 (.22), for the one-quarter ahead is .14 (.15), and the two-quarter ahead is .18 (.17). The previous quarter change in output forecast is .20 (.22), for the current quarter is .23 (.19), for the one-quarter ahead is .17 (.16), and the two-quarter ahead is .04 (.03). These results are not surprising since the Greenbook forecasts are revised more frequently (before each FOMC meeting) than the SPF forecasts (every three months) so the magnitude of the change in the forecasts can be quite different between the Greenbook and SPF forecasts.

To obtain new measures of policy shocks, the following regression is estimated over all three sample periods:

$$\Delta ff_m = \alpha + \beta\, ffb_m + \sum_{i=-1}^{2}\gamma_i \Delta\tilde{y}_{mi}^{SPF} + \sum_{i=-1}^{2}\delta_i(\Delta\tilde{y}_{mi}^{SPF} - \Delta\tilde{y}_{m-1,i}^{SPF}) + \sum_{i=-1}^{2}\varphi_i\tilde{\pi}_{mi}^{SPF} + \sum_{i=-1}^{2}\theta_i(\tilde{\pi}_{mi}^{SPF} - \tilde{\pi}_{m-1,i}^{SPF}) + \rho\tilde{\mu}_{m0}^{SPF} + \varepsilon_m$$

(4).

The equation is similar to RR's with forecasts from the SPF replacing the values from the Greenbook and the sample can be estimated over FOMC meetings until March 2007. The residuals from this regression are new measures of monetary policy shocks. The results for the regression for all three samples are shown in Table 4.14.

The Durbin-Watson statistics are 1.43 for the 1996 and 2007 samples, and is 1.45 for the 2003 sample. All three of these are below the lower critical values giving evidence of positive serial correlation. There is strong evidence of serial correlation in these three regressions. To check for first order and second order serial correlation, BG tests are conducted for the residuals from the SPF specification.

The Breusch-Godfrey test for first order serial correlation produces a Chi-squared statistics of 26.55 (p-value = 0.00), 31.11 (p-value = 0.00), and 36.22 (p-value = 0.00) for the 1996, 2003, and 2007 samples respectively. For second order serial correlation, the Breusch-Godfrey test produces Chi-squared statistics of 31.04 (p-value = 0.00), 35.67 (p-value = 0.00), and 40.07 (p-value = 0.00) for the 1996, 2003, and 2007 samples respectively. In the tests for second order correlation, the t-statistics on the second lag of residuals is -1.95, -1.97, -1.76. The BG statistics indicate second order serial correlation at the 1% level and the standard errors of the coefficients on the second lag of residuals are all significant at the 10% level.

This is strong evidence of second order serial correlation in the SPF specification. The main source of serial correlation is the fact that the SPF forecasts are often unchanged from one meeting to the next in the SPF regression. For both inflation and output growth the correlations for the changes in the forecasts at all horizons are very low, ranging from .03-.23. To deal with serial correlation, the regression was first estimated incorporating Newey-West standard errors with two lags. The regression was then estimated

again using a correction method for second order serial correlation. A common method for dealing with second order serial correlation is shown below in generalized terms.

Table 4.14 - Determinants of the Change in the Intended Federal Funds Rate – SPF

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.058	0.176	0.009	0.136	0.063	0.129
Initial level of intended funds rate	-0.016	0.013	-0.014	0.011	-0.016	0.010
Forecasted output growth, Quarters ahead:						
-1	0.030	0.020	0.033	0.017	0.034	0.016
0	-0.036	0.040	-0.033	0.035	-0.035	0.034
1	0.005	0.056	0.000	0.050	0.004	0.048
2	-0.012	0.044	-0.013	0.039	-0.016	0.038
Change in forecasted output growth since last meeting, Quarters ahead:						
-1	-0.022	0.023	-0.026	0.019	-0.028	0.018
0	0.045	0.043	0.046	0.037	0.048	0.036
1	0.151	0.054	0.149	0.048	0.145	0.046
2	-0.043	0.048	-0.038	0.043	-0.035	0.042
Forecasted inflation, Quarters ahead:						
-1	0.196	0.063	0.199	0.057	0.197	0.054
0	-0.161	0.097	-0.161	0.089	-0.155	0.084
1	-0.209	0.103	-0.209	0.094	-0.205	0.090
2	0.195	0.092	0.189	0.083	0.179	0.079
Change in forecasted inflation since last meeting, Quarters ahead:						
-1	-0.196	0.064	-0.196	0.058	-0.191	0.056
0	0.166	0.095	0.168	0.086	0.159	0.083
1	0.155	0.093	0.149	0.084	0.151	0.081
2	-0.085	0.068	-0.085	0.063	-0.080	0.060
Forecasted unemployment rate (current quarter)	0.005	0.031	0.010	0.027	0.007	0.026
R^2	0.17		0.17		0.17	
S.E.E.	0.42		0.39		0.38	
D-W	1.43		1.45		1.43	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

Consider a simple regression with second order serial correlation, $y_t = \beta x'_t + \mu_t$, where x_t is a vector of exogenous regressors and $\mu_t = \rho_1\mu_{t-1} + \rho_2\mu_{t-2} + \varepsilon_t$. The serial correlation can be corrected

with a nonlinear regression of the following form, $y_t = \rho_1 y_{t-1} + \rho_2 y_{t-2} - \rho_1(\beta x'_{t-1}) - \rho_2(\beta x'_{t-2})$. This correction was applied to the SPF specification.

The results for the regression and NW standard errors are shown in Table 4.15 for all samples. The results for the second order serial correlation correction are shown in Table 4.16 for all samples.

The coefficient estimates in Table 4.15 are similar for all samples analyzed. Unlike the RR results, the sum of coefficients on forecasted output growth is negative for all samples but not significant. For the original sample the sum of coefficients is -0.014 (t-statistic = -0.53), the sum for the sample to 2003 is -0.014 (t-statistic = -0.52), and for the sample until 2007, the sum is -0.013 (t-statistic = -0.50). The forecasted output variables are not jointly significant in any regression. The sum of forecasted inflation coefficients are positive for all samples but insignificant as well. For the original sample the sum of coefficients is 0.021 (t-statistic = 0.73), the sum for the sample to 2003 is 0.019 (t-statistic = 0.68), and for the sample until 2007, the sum is 0.016 (t-statistic = 0.60). The forecasted inflation variables are not jointly significant in any regression with F-statistics equal to 1.73, 1.79, and 1.72, for the original, 2003, and 2007 samples, respectively. The sum of coefficients on the change in forecasted output growth since the last meeting is positive and significant for all samples. For the original sample the sum of coefficients is 0.132 (t-statistic = 2.04), the sum for the sample to 2003 is 0.131 (t-statistic = 2.26), and for the sample until 2007, the sum is 0.131 (t-statistic = 2.27). The change in forecasted output variables are all jointly significant in each regression with F-statistics equal to 3.22, 3.60, and 3.65, for the original, 2003, and 2007 samples, respectively. The sum of the change in forecasted inflation coefficients are positive for all samples but insignificant. For the original sample the sum of coefficients is 0.039 (t-statistic = 0.41), the sum for the sample to 2003 is 0.036 (t-statistic = 0.39), and for the sample until 2007, the sum is 0.040 (t-statistic = 0.43). The change in forecasted inflation variables are all jointly insignificant in each regression with F-statistics equal to 0.99, 1.03, and 1.06, for the original, 2003, and 2007 samples, respectively. The coefficient on the forecasted unemployment rate is positive but insignificant for all samples. This is a puzzling result since it suggests the Fed raises the target funds rate when the unemployment rate rises; however, the coefficient is insignificant. The SPF regression suggests there is no response by the Federal

Reserve to the unemployment rate. When compared to the original RR regression, using only the SPF gives results that show much lower R^2s of 0.17 for all samples.

Table 4.15 - Determinants of the Change in the Intended Federal Funds Rate - Newey-West Standard Errors – SPF

	Sample 1969:1 – 1996:12		Sample 1969:1 – 2003:12		Sample 1969:1 – 2007:3	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.058	0.173	0.009	0.134	0.063	0.135
Initial level of intended funds rate	-0.016	0.014	-0.014	0.013	-0.016	0.013
Forecasted output growth, Quarters ahead:						
-1	0.030	0.024	0.033	0.022	0.034	0.022
0	-0.036	0.038	-0.033	0.036	-0.035	0.036
1	0.005	0.064	0.000	0.061	0.004	0.059
2	-0.012	0.060	-0.013	0.057	-0.016	0.056
Change in forecasted output growth since last meeting, Quarters ahead:						
-1	-0.022	0.029	-0.026	0.027	-0.028	0.027
0	0.045	0.041	0.046	0.039	0.048	0.040
1	0.151	0.071	0.149	0.068	0.145	0.068
2	-0.043	0.049	-0.038	0.045	-0.035	0.045
Forecasted inflation, Quarters ahead:						
-1	0.196	0.136	0.199	0.131	0.197	0.129
0	-0.161	0.132	-0.161	0.127	-0.155	0.123
1	-0.209	0.100	-0.209	0.097	-0.205	0.094
2	0.195	0.084	0.189	0.082	0.179	0.079
Change in forecasted inflation since last meeting, Quarters ahead:						
-1	-0.196	0.142	-0.196	0.136	-0.191	0.134
0	0.166	0.121	0.168	0.116	0.159	0.114
1	0.155	0.105	0.149	0.100	0.151	0.099
2	-0.085	0.108	-0.085	0.106	-0.080	0.105
Forecasted unemployment rate (current quarter)	0.005	0.029	0.010	0.026	0.007	0.026
R^2	0.17		0.17		0.17	
S.E.E.	0.42		0.39		0.38	
D-W	1.44		1.45		1.43	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

The nonlinear estimation to correct for second order serial correlation does not allow the standard test statistics to be computed. The results do show the coefficient estimates do not change drastically from the

results in tables 4.14 and 4.15. The sums of coefficients on inflation, the change in forecasted output, and the change in forecasted inflation are all positive while the sum of coefficients on output growth is negative. The coefficients on the forecasted unemployment rate are all positive. The coefficients on ρ_1 are positive and significant for all samples while they are negative and significant for ρ_2.

Using the SPF as the only proxy for the Greenbook produces very different results in the policy equation compared to RR. The only sum of coefficients that is significant is on the change in forecasted output growth variables and this is the only group of variables that is jointly significant. The results also show the response to the forecasted unemployment rate is positive but insignificant. Using only the SPF produces very low R^2s and second order serial correlation in the residuals.

4.4.2 ALFRED Previous Values with the SPF (ALFRED / SPF)

Using only the SPF confines the analysis to one dataset in which some elements are often unchanged from one meeting to the next. It also ignores the fact that policymakers may have access to preliminary estimates of previous quarter variables at each FOMC meeting, as opposed to using only the previous SPF forecast. The focus on real-time data allows for incorporation of ALFRED from the St. Louis Federal Reserve. Using the annualized percentage change in output and inflation for the previous quarter values in the dataset at each FOMC meeting allows for more variation in the previous meeting variables which may help with the serial correlation. It also allows the use of preliminary and revised values of actual data in the dataset, rather than just unrevised forecasts from the SPF. The ALFRED values of the previous quarter’s inflation and output growth have higher correlations with the similar measures in the Greenbook. For the previous quarter’s output, the correlation between the Greenbook and ALFRED values is 0.90 for the 1996 and 2003 samples. For the previous quarter’s inflation, the correlation between the Greenbook and ALFRED values is 0.96 for the original sample and 0.97 for the sample extended to 2003. These high correlations can be explained by the fact that Greenbooks often incorporate actual data values for previous quarter rather than forecasts. At meetings when the preliminary value has not been released, a Greenbook forecast is generated by the staff.

Table 4.16 - Determinants of the Change in the Intended Federal Funds Rate with Serial Correlation Correction – SPF

	Sample 1969:1 – 1996:12		Sample 1969:1 – 2003:12		Sample 1969:1 – 2007:3	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.127	0.215	0.098	0.171	0.176	0.167
Initial level of intended funds rate	-0.026	0.017	-0.025	0.015	-0.031	0.015
Forecasted output growth, Quarters ahead:						
-1	0.022	0.019	0.023	0.016	0.023	0.016
0	-0.005	0.038	-0.003	0.034	-0.005	0.032
1	-0.020	0.056	-0.021	0.050	-0.014	0.048
2	-0.036	0.048	-0.039	0.044	-0.047	0.042
Change in forecasted output growth since last meeting, Quarters ahead:						
-1	-0.016	0.022	-0.019	0.018	-0.021	0.017
0	-0.010	0.039	-0.013	0.034	-0.016	0.033
1	0.187	0.053	0.174	0.047	0.166	0.045
2	-0.026	0.049	-0.018	0.043	-0.013	0.041
Forecasted inflation, Quarters ahead:						
-1	0.236	0.063	0.235	0.057	0.235	0.054
0	-0.168	0.103	-0.178	0.093	-0.175	0.088
1	-0.243	0.111	-0.235	0.100	-0.230	0.095
2	0.202	0.098	0.208	0.089	0.201	0.085
Change in forecasted inflation since last meeting, Quarters ahead:						
-1	-0.250	0.065	-0.246	0.058	-0.245	0.056
0	0.214	0.087	0.217	0.079	0.212	0.075
1	0.150	0.089	0.136	0.081	0.132	0.077
2	-0.104	0.070	-0.103	0.064	-0.101	0.062
Forecasted unemployment rate (current quarter)	0.012	0.036	0.013	0.032	0.009	0.032
Rho One	0.396	0.074	0.398	0.067	0.417	0.065
Rho Two	-0.163	0.070	-0.143	0.063	-0.123	0.061
R^2	0.29		0.28		0.28	
S.E.E.	0.40		0.37		0.36	
D-W	2.07		2.06		2.05	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 255 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 311 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 337 observations.[22]

[22] Any specification that uses the nonlinear second order serial correlation correction will contain fewer observations than ones that do not. This is due to missing observations in the dataset that are used to correct in future time periods.

When incorporating the ALFRED values, equation (4) becomes:

$$\Delta ff_m = \alpha + \beta\, ffb_m + \eta \Delta \tilde{y}_{m,-1}{}^{ALFRED} + \sum_{i=0}^{2} \gamma_i \Delta \tilde{y}_{mi}^{SPF} + \sum_{i=-1}^{2} \delta_i (\Delta \tilde{y}_{mi}^{SPF} - \Delta \tilde{y}_{m-1,i}^{SPF}) + \phi \Delta \tilde{\pi}_{m,-1}{}^{ALFRED} + \sum_{i=0}^{2} \varphi_i \tilde{\pi}_{mi}^{SPF} + \sum_{i=-1}^{2} \theta_i (\tilde{\pi}_{mi}^{SPF} - \tilde{\pi}_{m-1,i}^{SPF}) + \rho \tilde{\mu}_{m0}^{SPF} + \varepsilon_m \quad (5)$$

with ALFRED replacing the previous quarter values. The residuals from this equation are a new measure of monetary policy shocks. The results are shown in Table 4.17.

Table 4.17 - Determinants of the Change in the Intended Federal Funds Rate – ALFRED / SPF

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.174	0.170	0.101	0.133	0.154	0.125
Initial level of intended funds rate	-0.020	0.013	-0.017	0.011	-0.020	0.011
Forecasted output growth, Quarters ahead:						
-1	0.011	0.012	0.014	0.011	0.014	0.010
0	-0.023	0.034	-0.018	0.030	-0.018	0.029
1	-0.013	0.055	-0.018	0.049	-0.014	0.047
2	0.008	0.044	0.007	0.040	0.003	0.039
Change in forecasted output growth since last meeting, Quarters ahead:						
-1	-0.002	0.017	-0.005	0.014	-0.006	0.013
0	0.035	0.038	0.032	0.033	0.033	0.032
1	0.164	0.054	0.162	0.048	0.159	0.046
2	-0.057	0.050	-0.052	0.044	-0.049	0.042
Forecasted inflation, Quarters ahead:						
-1	0.023	0.025	0.025	0.022	0.027	0.021
0	-0.025	0.087	-0.023	0.079	-0.024	0.075
1	-0.160	0.103	-0.159	0.094	-0.157	0.090
2	0.200	0.092	0.196	0.084	0.190	0.080
Change in forecasted inflation growth since last meeting, Quarters ahead:						
-1	-0.009	0.022	-0.006	0.019	-0.004	0.018
0	0.039	0.088	0.038	0.079	0.033	0.076
1	0.109	0.095	0.105	0.086	0.107	0.083
2	-0.072	0.070	-0.072	0.064	-0.068	0.061
Forecasted unemployment rate (current quarter)	-0.020	0.029	-0.014	0.026	-0.017	0.025
R^2	0.14		0.14		0.14	
S.E.E.	0.43		0.40		0.38	
D-W	1.52		1.52		1.50	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

The increased frequency of the ALFRED releases increases the D-W statistic as compared to the results from using just the SPF. However, the Durbin-Watson statistics are relatively low at 1.52 for the 1996 and 2003 samples, and is 1.50 for the 2003 sample. All three of these are below the lower critical values giving evidence of positive serial correlation. There is strong evidence of serial correlation in these three regressions. To check for first order and second order serial correlation, BG tests are conducted for the residuals.

The Breusch-Godfrey test for first order serial correlation produce Chi-squared statistics of 19.90 (p-value = 0.00), 23.71 (p-value = 0.00), and 27.94 (p-value = 0.00) for the 1996, 2003, and 2007 samples respectively. For second order serial correlation, the Breusch-Godfrey test produces Chi-squared statistics of 24.30 (p-value = 0.00), 28.20 (p-value = 0.00), and 31.72 (p-value = 0.00) for the 1996, 2003, and 2007 samples respectively. In the tests for second order correlation, the t-statistics on the second lag of residuals is -1.89, -1.93, -1.72. The BG statistics indicate second order serial correlation at the 1% level and the standard errors of the coefficients on the second lag of residuals are all significant at the 10% level.

To deal with serial correlation, the regression was first estimated and Newey-West standard errors with two lags were computed. The regression was then estimated again using the correction method for second order serial correlation shown earlier. The results for the regression and the NW standard errors are shown in Table 4.18 all samples. The results for the second order serial correlation correction are shown in Table 4.19 for all samples.

Adding ALFRED values to the SPF dataset does not drastically alter the results compared to just using the SPF. Once again, all the sample sizes yield similar coefficients in Table 4.18. The sum of coefficients on forecasted output growth is negative for all samples but not significant. For the original sample the sum of coefficients is -0.017 (t-statistic = -0.62), the sum for the sample to 2003 is -0.015 (t-statistic = -0.59), and for the sample until 2007, the sum is -0.015 (t-statistic = -0.58). The forecasted output variables are not jointly significant in any regression. The sum of forecasted inflation coefficients are positive for all samples but insignificant as well. For the original sample the sum of coefficients is

0.038 (t-statistic = 1.40), the sum for the sample to 2003 is 0.039 (t-statistic = 1.46), and for the sample until 2007, the sum is 0.036 (t-statistic = 1.40). The forecasted inflation variables are jointly significant in the regressions for each sample period with F-statistics equal to 1.95, 2.05, and 2.06, for the 1996, 2003, and 2007 samples, respectively. The sum of coefficients on the change in forecasted output growth since the last meeting is positive and significant for all samples. For the original sample the sum of coefficients is 0.139 (t-statistic = 2.30), the sum for the sample to 2003 is 0.136 (t-statistic =2.05), and for the sample until 2007, the sum is 0.137 (t-statistic = 2.50).

The change in forecasted output variables are all jointly significant in each regression with F-statistics equal to 2.98, 3.26, and 3.21, for the original, 2003, and 2007 samples, respectively. The sum of the change in forecasted inflation coefficients are positive for all samples but insignificant. For the original sample the sum of coefficients is 0.067 (t-statistic = .71), the sum for the sample to 2003 is 0.065 (t-statistic = 0.71), and for the sample until 2007, the sum is 0.068 (t-statistic = 0.75). The change in forecasted inflation variables are jointly insignificant in each regression with F-statistics equal to 0.65 , 0.67, and 0.71, for the original, 2003, and 2007 samples, respectively. Although the unemployment rate is insignificant in all samples, it is now negative in sign, unlike in the SPF specification.

As with the SPF specification, the coefficients in table 4.19 do not change drastically from the original OLS results given in tables 4.17 and 4.18. The sums of coefficients on inflation, the change in forecasted output, and the change in forecasted inflation, are all positive while the sum of coefficients on output growth is negative. The coefficients on ρ_1 are positive and significant for all samples while they are negative and significant for ρ_2.

Using the ALFRED / SPF data as the only proxy for the Greenbook produces very different results in the policy equation compared to RR. The only sum of coefficients that is significant is on the change in forecasted output growth variables. This group of variables is jointly significant as are the forecasted inflation variables. The results also show the response to the forecasted unemployment rate is negative but insignificant. Using only the ALFRED / SPF in place of the Greenbook produces very low R^2s and second order serial correlation in the residuals.

Table 4.18 - Determinants of the Change in the Intended Federal Funds Rate - Newey-West Standard Errors – ALFRED / SPF

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.174	0.164	0.101	0.131	0.154	0.129
Initial level of intended funds rate	-0.020	0.015	-0.017	0.013	-0.020	0.013
Forecasted output growth, Quarters ahead:						
-1	0.011	0.011	0.014	0.010	0.014	0.010
0	-0.023	0.039	-0.018	0.037	-0.018	0.037
1	-0.013	0.060	-0.018	0.056	-0.014	0.056
2	0.008	0.051	0.007	0.048	0.003	0.048
Change in forecasted output growth since last meeting, Quarters ahead:						
-1	-0.002	0.015	-0.005	0.013	-0.006	0.013
0	0.035	0.044	0.032	0.041	0.033	0.041
1	0.164	0.072	0.162	0.068	0.159	0.068
2	-0.057	0.053	-0.052	0.049	-0.049	0.048
Forecasted inflation, Quarters ahead:						
-1	0.023	0.020	0.025	0.019	0.027	0.019
0	-0.025	0.069	-0.023	0.067	-0.024	0.065
1	-0.160	0.082	-0.159	0.080	-0.157	0.078
2	0.200	0.081	0.196	0.079	0.190	0.078
Change in forecasted inflation since last meeting, Quarters ahead:						
-1	-0.009	0.026	-0.006	0.024	-0.004	0.023
0	0.039	0.074	0.038	0.072	0.033	0.071
1	0.109	0.098	0.105	0.094	0.107	0.093
2	-0.072	0.104	-0.072	0.103	-0.068	0.102
Forecasted unemployment rate (current quarter)	-0.020	0.023	-0.014	0.021	-0.017	0.021
R^2	0.14		0.14		0.14	
S.E.E.	0.43		0.40		0.38	
D-W	1.52		1.52		1.50	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

Table 4.19 - Determinants of the Change in the Intended Federal Funds Rate with Serial Correlation Correction – ALFRED / SPF

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.222	0.198	0.187	0.160	0.271	0.157
Initial level of intended funds rate	-0.024	0.016	-0.025	0.015	-0.032	0.015
Forecasted output growth, Quarters ahead:						
-1	-0.006	0.012	-0.002	0.011	-0.002	0.010
0	0.016	0.035	0.016	0.031	0.014	0.030
1	-0.052	0.057	-0.049	0.051	-0.041	0.049
2	-0.002	0.050	-0.010	0.045	-0.019	0.043
Change in forecasted output growth since last meeting, Quarters ahead:						
-1	0.007	0.016	0.001	0.013	-0.001	0.012
0	-0.013	0.037	-0.019	0.033	-0.022	0.031
1	0.225	0.054	0.207	0.048	0.200	0.046
2	-0.052	0.050	-0.041	0.044	-0.034	0.043
Forecasted inflation, Quarters ahead:						
-1	0.007	0.025	0.007	0.022	0.008	0.021
0	-0.002	0.097	-0.015	0.088	-0.021	0.084
1	-0.147	0.110	-0.136	0.099	-0.129	0.094
2	0.187	0.099	0.194	0.090	0.195	0.086
Change in forecasted inflation since last meeting, Quarters ahead:						
-1	-0.021	0.022	-0.018	0.019	-0.016	0.018
0	0.100	0.084	0.100	0.076	0.098	0.073
1	0.090	0.091	0.073	0.082	0.067	0.078
2	-0.104	0.073	-0.099	0.067	-0.100	0.064
Forecasted unemployment rate (current quarter)	-0.014	0.034	-0.013	0.031	-0.018	0.030
Rho One	0.357	0.072	0.364	0.066	0.385	0.064
Rho Two	-0.185	0.070	-0.159	0.063	-0.137	0.060
R^2	0.25		0.24		0.24	
S.E.E.	0.45		0.38		0.37	
D-W	2.10		2.08		2.07	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 255 observations. The sample of FOMC Meetings over the period 1969:1 – 2003:12 has 311 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 337 observations.

4.4.3 Using the BCI Only

The leading, coincident, and lagging composite indexes that make up the Business Cycle Indicators provide monthly measures of past, current, and expected economic activity. Theoretically, using the

annualized rates of change in the indexes in place of the Greenbook forecasts can incorporate a great amount of information about the state of the economy. Regressing the change in the intended federal funds rate target on the three composite indexes at each meeting can yield a measure of monetary policy shocks by removing past, current, and anticipated effects of economic activity in line with the objective of using alternative datasets. However, using only these three indexes drastically alters the specification. The equation to be estimated becomes

$$\Delta ff_m = \alpha + \beta\, ffb_m + \omega_1 RCLead_m + \omega_2 RCCoin_m + \omega_3 RCLag_m + \varepsilon_m, \qquad (6)$$

where $RCLead_m$ $(RCCoin_m)$ $(RClag_m)$ is the rate of change of the leading (coincident) (lagging) economic indicator index just before the current FOMC meeting.

The residuals from equation 6 are new measures of monetary policy shocks. The results for the regression are shown in Table 4.20.

Table 4.20 - Determinants of the Change in the Intended Federal Funds Rate – BCI

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	-0.016	0.071	-0.044	0.054	0.011	0.048
Initial level of intended funds rate	-0.006	0.009	-0.003	0.007	-0.008	0.006
Rate of Change in Leading Index	0.008	0.002	0.008	0.002	0.008	0.002
Rate of Change in Coincident Index	0.007	0.003	0.008	0.003	0.008	0.003
Rate of Change in Lagging Index	-0.004	0.001	-0.004	0.001	-0.004	0.001
R^2	0.16		0.15		0.15	
S.E.E.	0.41		0.39		0.38	
D-W	1.69		1.66		1.59	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 –2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

The original, 2003, and 2007 samples give D-W statistics of 1.69, 1.66, and 1.59, respectively. Once again, each D-W statistic is still below the lower critical value showing evidence of serial correlation. The Breusch-Godfrey tests for first order serial correlation produce Chi-squared statistics of 6.75 (p-value = 0.01), 9.96 (p-value = 0.00), and 14.99 (p-value = 0.00) for the 1996, 2003, and 2007 samples

respectively. The Breusch-Godfrey tests for second order serial correlation produce Chi-squared statistics of 7.12 (p-value = 0.03), 10.81 (p-value = 0.01), and 16.33 (p-value = 0.00) for the 1996, 2003, and 2007 samples, respectively. While these results may suggest strong evidence in favor of second order serial correlation, closer examination of the Bresuch-Godfrey test results below point to first order serial correlation in this specification.

The BG statistics in the tests for first order serial correlation are 6.75 (p-value = 0.01) for the original sample, 9.96 (p-value = 0.00) for the sample to 2003, and 14.99 (p-value = 0.00) for the sample to 2007. The coefficients on the first lagged residuals have t-statistics of 2.60 for the original sample, 3.17 for the sample to 2003, and 3.92 for the sample to 2007.

The BG statistics in the tests for second order serial correlation are 7.12 (p-value = 0.03) for the original sample, 10.62 (p-value = 0.01) for the sample to 2003, and 16.33 (p-value = 0.00) for the sample to 2007. The coefficients on the second lagged residuals have low t-statistics of 0.39 for the original sample, 0.63 for the sample to 2003, and 1.04 for the sample to 2007.

While the Breusch-Godfrey test for second order serial correlation produced Chi-squared statistics that were highly significant, the coefficients on the second lagged residuals have very low t-statistics in all samples. This suggests the second lag of the residuals is uncorrelated with the residuals. This suggests that only first order serial correlation should be corrected for. As in chapter 2, first order serial correlation is corrected for in three ways. First, equation 6 was estimated incorporating Newey-West standard errors with one lag. The regression was estimated again with a lagged dependent variable (LDV) added to the specification. Finally, equation 6 was estimated using the Prais-Winsten correction for first order serial correlation. The results, for all samples, for the regression and NW standard errors are shown in Table 4.21. The results for the regression with a LDV are shown in Table 4.22 for all samples. The results with the PW correction are shown in Table 4.23 for all samples.

The results show very low R^2s compared to the original RR results. The R^2s range from 0.15 – 0.20 for the BCI results compared to 0.28 for the RR results. The coefficients on all the rates of change in the indexes are significant in the regressions that use NW standard errors for all samples. For each sample

and specification, the coefficient on the rate of change in the leading index is positive and significant. The coefficient on the rate of change in the coincident index is insignificant in the LDV and PW specifications. The coefficient on the rate of change in the lagging index is puzzling as it is negative and significant in each specification and sample. This suggests the Federal Reserve decreases the federal funds rate in past increases in economic activity. The intercept is not significant in any sample, as is the case in the previous regressions. The initial level of the intended funds rate is negative and insignificant in each sample and specification.

Table 4.21 - Determinants of the Change in the Intended Federal Funds Rate - Newey-West Standard Errors – BCI

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	-0.016	0.122	-0.044	0.090	0.011	0.80
Initial level of intended funds rate	-0.006	0.018	-0.003	0.015	-0.008	0.014
Rate of Change in Leading Index	0.008	0.003	0.008	0.002	0.008	0.002
Rate of Change in Coincident Index	0.007	0.003	0.008	0.003	0.008	0.003
Rate of Change in Lagging Index	-0.004	0.001	-0.004	0.001	-0.004	0.001
R^2	0.16		0.15		0.15	
S.E.E.	0.46		0.39		0.38	
D-W	1.69		1.66		1.59	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 –2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

Table 4.22 - Determinants of the Change in the Intended Federal Funds Rate with Lagged Dependent Variable – BCI

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.037	0.071	0.002	0.054	0.045	0.047
Initial level of intended funds rate	-0.011	0.009	-0.007	0.007	-0.011	0.006
Rate of Change in Leading Index	0.007	0.002	0.007	0.002	0.006	0.002
Rate of Change in Coincident Index	0.005	0.003	0.005	0.003	0.005	0.003

(table 3.22 cont.)

Rate of Change in Lagging Index	-0.004	0.001	-0.004	0.001	-0.004	0.001
Previous meeting's change in intended target	0.184	0.056	0.197	0.051	0.219	0.048
R^2	0.19		0.19		0.20	
S.E.E.	0.41		0.39		0.37	
D-W	2.03		2.03		2.02	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 –2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

Table 4.23 - Determinants of the Change in the Intended Federal Funds Rate with Serial Correlation Correction – BCI

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.042	0.083	0.003	0.065	0.058	0.060
Initial level of intended funds rate	-0.012	0.010	-0.008	0.008	-0.014	0.008
Rate of Change in Leading Index	0.007	0.002	0.007	0.002	0.006	0.002
Rate of Change in Coincident Index	0.005	0.003	0.005	0.003	0.005	0.003
Rate of Change in Lagging Index	-0.004	0.001	-0.004	0.001	-0.004	0.001
Rho	0.187	0.067	0.206	0.060	0.239	0.057
R^2	0.18		0.18		0.19	
S.E.E.	0.45		0.42		0.37	
D-W	2.01		2.01		2.02	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 –2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

4.4.4 BCI and SPF Forecasts of Output and Inflation (BCI / SPF)

As previously mentioned, for both inflation and output growth, the correlations between the SPF and the Greenbook for the changes in the forecasts at all horizons are all very low. The fact that the SPF forecasts are often unchanged from one FOMC meeting to another suggests that the change in these forecasts be also be a source of serial correlation. This suggests these variables are not valid to include in the alternative datasets to the Greenbook. Instead of using the changes in SPF forecast variables, rates of

changes in the BCI leading, coincident, and lagging indicators are used as proxies for changes in information about the future, current, and past states of the economy available just before each FOMC meeting along with the SPF forecasts of output, inflation, and the unemployment rate. This changes the specification to the following:

$$\Delta ff_m = \alpha + \beta\, ffb_m + \sum_{i=-1}^{2} \gamma_i \Delta\tilde{y}_{mi}^{SPF} + + \sum_{i=-1}^{2} \varphi_i \tilde{\pi}_{mi}^{SPF} + \rho\tilde{\mu}_{m0}^{SPF} + \omega_1 RCLead_m + \omega_2 RCCoin_m + \omega_3 RCLag_m + \varepsilon_m \quad (7).$$

The results are shown in Table 4.24. The residuals from this regression are new measures of monetary policy shocks.

Table 4.24 - Determinants of the Change in the Intended Federal Funds Rate – BCI / SPF Specification

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.264	0.153	0.201	0.120	0.267	0.114
Initial level of intended funds rate	-0.022	0.012	-0.018	0.010	-0.022	0.010
Forecasted output growth, Quarters ahead:						
-1	0.014	0.010	0.014	0.009	0.014	0.009
0	-0.039	0.027	-0.026	0.024	-0.023	0.023
1	0.064	0.039	0.052	0.035	0.052	0.034
2	-0.062	0.035	-0.058	0.032	-0.058	0.031
Forecasted inflation, Quarters ahead:						
-1	-0.009	0.018	-0.005	0.017	0.001	0.016
0	0.055	0.062	0.063	0.056	0.059	0.054
1	-0.122	0.085	-0.137	0.077	-0.138	0.074
2	0.128	0.075	0.130	0.068	0.127	0.066
Forecasted unemployment rate (current quarter)	-0.051	0.026	-0.047	0.023	-0.050	0.023
Rate of Change in Leading Index	0.011	0.002	0.011	0.002	0.010	0.002
Rate of Change in Coincident Index	0.006	0.004	0.005	0.004	0.005	0.004
Rate of Change in Lagging Index	-0.004	0.001	-0.004	0.001	-0.004	0.001
R^2	0.22		0.21		0.21	
S.E.E.	0.40		0.38		0.37	
D-W	1.70		1.66		1.59	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 –2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

The higher Durbin-Watson statistics, compared to using only the SPF, show improvements compared to the previous alternative specifications but still show evidence of serial correlation. The original sample produces a D-W statistic of 1.70 that falls within the inconclusive range but the 2003 and 2007 samples produce statistics of 1.66 and 1.59, respectively. These are both below the lower critical values showing serial correlation. The original sample produces an inconclusive D-W statistic, but the Breusch-Godfrey test for first order serial correlation produces a Chi-squared statistic of 7.63 (p-value = 0.01) giving evidence of serial correlation. The Chi-squared statistics for the 2003 and 2007 samples are 11.67 (p-value = 0.00) and 17.55 (p-value = 0.00), respectively. Looking at the tests for second order serial correlation show Chi-squared statistics for the 1996, 2003 and 2007 samples are 8.35 (p-value = 0.02), 12.53 (p-value = 0.00), and 16.33 (p-value = 0.00), respectively.

The BG statistics in the tests for second order serial correlation are 8.35 (p-value = 0.02) for the original sample, 12.53 (p-value = 0.00) for the sample to 2003, and 18.94 (p-value = 0.00) for the sample to 2007. The coefficients on the second lagged residuals have low t-statistics of 0.12 for the original sample, 0.23 for the sample to 2003, and 0.70 for the sample to 2007.

While the Breusch-Godfrey test for second order serial correlation produced Chi-squared statistics that were highly significant, the coefficients on the second lagged residuals have very low t-statistics in all samples. This suggests the second lag of the residuals is uncorrelated with the residuals. This suggests that only first order serial correlation should be corrected for. First order serial correlation is addresssed in three ways. First, equation 7 was estimated and Newey-West standard errors with one lag were calculated. The regression was estimated again with a lagged dependent variable (LDV) added to the specification. Finally, equation 7 was estimated using the Prais-Winsten correction for first order serial correlation. The results, for all samples, for the regression with NW standard errors are shown in Table 4.25. The results for the regression with a LDV are shown in Table 4.26 for all samples. The results with the PW correction are shown in table 4.27 for all samples.

The results from tables 4.25 – 4.27 are summarized in tables 4.28 and 4.29. Table 4.28 shows the sums of coefficients, and the corresponding t-statistics and p-values, for each group of SPF forecast

variables for all three samples. Table 4.29 shows the F-statistics and p-values for the tests of joint significance for each group of SPF forecast variables for all samples. The tests of joint significance for all three BCI indexes are also shown. The results for the regressions incoporating Newey-West standard errors are shown without brackets. The LDV specification results are shown in the square brackets. The PW correction results are shown in the definite brackets.

Each specification produces R^2s of approximately 0.25 and standard errors of estimates between 0.36 – 0.40. These are similar to the original RR results for both the 1996 and 2003 samples.

Table 4.25 - Determinants of the Change in the Intended Federal Funds Rate - Newey-West Standard Errors – BCI / SPF

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.264	0.152	0.201	0.121	0.267	0.116
Initial level of intended funds rate	-0.022	0.017	-0.018	0.015	-0.022	0.014
Forecasted output growth, Quarters ahead:						
-1	0.014	0.009	0.014	0.008	0.014	0.008
0	-0.039	0.034	-0.026	0.031	-0.023	0.031
1	0.064	0.069	0.052	0.065	0.052	0.065
2	-0.062	0.058	-0.058	0.054	-0.058	0.055
Forecasted inflation, Quarters ahead:						
-1	-0.009	0.020	-0.005	0.019	0.001	0.019
0	0.055	0.066	0.063	0.064	0.059	0.062
1	-0.122	0.070	-0.137	0.068	-0.138	0.066
2	0.128	0.063	0.130	0.062	0.127	0.061
Forecasted unemployment rate (current quarter)	-0.051	0.023	-0.047	0.022	-0.050	0.022
Rate of Change in Leading Index	0.011	0.002	0.011	0.002	0.010	0.002
Rate of Change in Coincident Index	0.006	0.004	0.005	0.003	0.005	0.003
Rate of Change in Lagging Index	-0.004	0.001	-0.004	0.001	-0.004	0.001
R^2	0.22		0.21		0.21	
S.E.E.	0.40		0.38		0.37	
D-W	1.70		1.66		1.59	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 –2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

Each of the regressions show a negative coefficient on the unemployment rate; however, the significance varies. In the 1996 sample, the p-value on the unemployment rate for the NW [LDV] {PW} regression is 0.03 [0.08] {0.17}. The 2003 sample gives a p-value of 0.03 [0.07] {0.16}. In the 2007 sample, the p-value for the unemployment rate is 0.02 [0.04] {0.13}.

For each sample and specification, the sums of coefficients on forecasted output growth are negative but insignificant. The sums of coefficients on forecasted inflation are positive and significant in each sample and specification. The sums of coefficients range from 0.049 – 0.063. The largest sum of 0.069 occurs in the PW specification for the 2007 sample. The only instance in which the forecasted output growth variables are jointly marginally significant is the PW specification for the 2007 sample. The p-value is 0.07. In each specification and sample, the forecasted inflation variables are jointly significant. The p-values range from 0.01 – 0.06.

Table 4.26 - Determinants of the Change in the Intended Federal Funds Rate with Lagged Dependent Variable – BCI / SPF

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.281	0.151	0.214	0.118	0.266	0.112
Initial level of intended funds rate	-0.027	0.012	-0.024	0.010	-0.027	0.010
Forecasted output growth, Quarters ahead:						
-1	0.012	0.010	0.013	0.009	0.012	0.009
0	-0.040	0.027	-0.029	0.023	-0.026	0.023
1	0.053	0.038	0.042	0.035	0.040	0.033
2	-0.049	0.035	-0.044	0.032	-0.043	0.031
Forecasted inflation, Quarters ahead:						
-1	-0.012	0.018	-0.008	0.016	-0.004	0.015
0	0.050	0.061	0.056	0.055	0.052	0.053
1	-0.112	0.084	-0.124	0.076	-0.123	0.073
2	0.126	0.074	0.129	0.067	0.126	0.065
Forecasted unemployment rate (current quarter)	-0.046	0.026	-0.042	0.023	-0.045	0.022
Rate of Change in Leading Index	0.009	0.002	0.009	0.002	0.008	0.002
Rate of Change in Coincident Index	0.005	0.004	0.005	0.004	0.004	0.004
Rate of Change in Lagging Index	-0.004	0.001	-0.004	0.001	-0.004	0.001

(table 4.26 cont.)

Previous Meeting's Change in Intended Target	0.160	0.056	0.174	0.051	0.196	0.049
R^2	0.25		0.24		0.24	
S.E.E.	0.40		0.37		0.36	
D-W	2.01		1.99		1.98	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 –2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

Table 4.27 - Determinants of the Change in the Intended Federal Funds Rate with Serial Correlation Correction – BCI / SPF

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.289	0.184	0.237	0.148	0.309	0.144
Initial level of intended funds rate	-0.033	0.014	-0.030	0.012	-0.036	0.012
Forecasted output growth, <u>Quarters ahead</u>:						
-1	0.011	0.011	0.010	0.009	0.009	0.009
0	-0.031	0.026	-0.020	0.023	-0.018	0.022
1	0.070	0.040	0.061	0.036	0.063	0.034
2	-0.081	0.037	-0.079	0.034	-0.083	0.033
Forecasted inflation, <u>Quarters ahead</u>:						
-1	-0.006	0.019	-0.003	0.017	0.001	0.016
0	0.069	0.063	0.071	0.057	0.069	0.055
1	-0.130	0.085	-0.141	0.077	-0.142	0.074
2	0.128	0.078	0.134	0.072	0.134	0.069
Forecasted unemployment rate (current quarter)	-0.042	0.031	-0.040	0.028	-0.042	0.028
Rate of Change in Leading Index	0.008	0.002	0.008	0.002	0.007	0.002
Rate of Change in Coincident Index	0.004	0.004	0.004	0.004	0.003	0.004
Rate of Change in Lagging Index	-0.004	0.001	-0.004	0.001	-0.004	0.001
Rho	0.211	0.073	0.233	0.065	0.270	0.062
R^2	0.25		0.24		0.25	
S.E.E.	0.40		0.37		0.36	
D-W	2.01		2.01		2.02	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 –2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

The BCI indexes are all jointly significant as each specification produces an F-statistic over eleven for each specification and sample. In the regressions, the coefficient on the rate of change in the leading index ranges from 0.008 – 0.011 and each coefficient is significant. The coefficients on the coincident index are positive but in significant for all specifications and samples. As in the BCI specification, the coefficient on the lagging index is puzzling. It is equal to -0.004 in all specifications and samples with t-statistics above three.

Table 4.28 - Sums of Coefficients – BCI / SPF – Newey-West [LDV] {Serial Correlation Correction}

	1969:1 – 1996:12			**1969:1 – 2003:12**			**1969:1 –2007:3**		
	Sum of Coefficients	**t-statistic**	**p-value**	**Sum of Coefficients**	**t-statistic**	**p-value**	**Sum of Coefficients**	**t-statistic**	**p-value**
Forecasted output growth	-0.023 [-0.023] {-0.031}	-0.86 [-1.03] {-1.20}	0.39 [0.30] {0.23}	-0.018 [-0.018] {-0.028}	-0.73 [-0.91] {-1.19}	0.47 [0.36] {0.23}	-0.015 [-0.016] {-0.029}	-0.60 [-0.82] {-1.23}	0.55 [0.41] {0.22}
Forecasted inflation	0.052 [0.053] {0.061}	2.69 [2.35] {2.22}	0.01 [0.02] {0.03}	0.051 [0.053] {0.061}	2.73 [2.57] {2.44}	0.01 [0.01] {0.02}	0.049 [0.051] {0.063}	2.61 [2.59] {2.49}	0.01 [0.01] {0.01}

Table 4.29 – Tests of Joint Significance – BCI / SPF– Newey-West [LDV] {Serial Correlation Correction}

	1969:1 – 1996:12		**1969:1 –2003:12**		**1969:1 –2007:3**	
	F-statistic	**p - Value**	**F-statistic**	**p - Value**	**F-statistic**	**p - Value**
Forecasted output growth	1.34 [1.10] {1.65}	0.25 [0.36] {0.16}	1.45 [1.18] {1.93}	0.22 [0.32] {0.11}	1.39 [1.17] {2.16}	0.23 [0.32] {0.07}
Forecasted inflation	2.93 [2.30] {2.38}	0.02 [0.06] {0.05}	3.42 [2.91] {3.06}	0.01 [0.02] {0.02}	3.31 [2.94] {3.23}	0.01 [0.02] {0.01}
BCI	14.04 [12.62] {11.09}	0.00 [0.00] {0.00}	14.75 [14.68] {12.51}	0.00 [0.00] {0.00}	13.51 [14.36] {11.98}	0.00 [0.00] {0.00}

4.4.5 ALFRED Previous Values with BCI and SPF Forecasts (ALFRED / BCI / SPF)

It is once again useful to look at the effectiveness of using preliminary and revised releases of output and inflation in the previous quarter from ALFRED. The equation to estimate to gain a new measure of shocks is as follows:

$$\Delta ff_m = \alpha + \beta\, ffb_m + \eta \Delta \tilde{y}_{m,-1}^{\;\;ALFRED} + \sum_{i=0}^{2} \gamma_i \Delta \tilde{y}_{mi}^{SPF} + \phi \Delta \tilde{\pi}_{m,-1}^{\;\;ALFRED} + \sum_{i=-1}^{2} \varphi_i \tilde{\pi}_{mi}^{SPF} + \rho \tilde{\mu}_{m0}^{SPF} + \omega_1 RCLead_m + \omega_2 RCCoin_m + \omega_3 RCLag_m + \varepsilon_m$$

(8).

The results are shown in Table 4.30.

The results are similar to those shown in Table 4.24 when the BCI and SPF are the only data used. Once again, the R^2s are comparable to the RR specification and the D-W statistics are higher compared to alternative dataset specifications that include the differences in the SPF forecasts. The original and 2003 samples produce inconclusive D-W statistics, 1.73 and 1.70, respectively. The D-W statistic for the 2007 sample is below the critical range indicating serial correlation. The Breusch-Godfrey test for first order serial correlation produces a Chi-squared statistic of 6.40 (p-value = 0.01) for the original sample and a statistic of 9.75 (p-value = 0.00) for the 2003 sample. The 2007 sample also shows positive serial correlation with a Chi-squared statistic of 14.47 (p-value = 0.00). The tests for second order serial correlation produce Chi-squared statistics of 7.38 (p-value = 0.03), 10.98 (p-value = 0.01), and 16.65 (p-value = 0.00) for the 1996, 2003, and 2007 samples, respectively.

The coefficients on the second lagged residuals have low t-statistics of 0.72 for the original sample, 0.85 for the sample to 2003, and 1.27 for the sample to 2007. While the Breusch-Godfrey test for second order serial correlation produced Chi-squared statistics that were highly significant, the coefficients on the second lagged residuals have very low t-statistics in all samples. This suggests the second lag of the residuals is uncorrelated with the residuals and only first order serial correlation should be corrected for.

As with the BCI specification, first order serial correlation is corrected for in three ways. First, the regression is estimated and Newey-West standard errors with one lag were computed. The regression was estimated again with a lagged dependent variable (LDV) added to the specification. Finally, the regression was estimated using the Prais-Winsten correction for first order serial correlation. The results, for all samples, for the regression and NW standard errors are shown in Table 4.31. The results for the regression with a LDV are shown in Table 4.32 for all samples. The results with the PW correction are shown in Table 4.33 for all samples.

Table 4.30 - Determinants of the Change in the Intended Federal Funds Rate – ALFRED / BCI / SPF Specification

	Sample 1969:1 – 1996:12		Sample 1969:1 – 2003:12		Sample 1969:1 – 2007:3	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.254	0.152	0.185	0.120	0.246	0.114
Initial level of intended funds rate	-0.022	0.012	-0.018	0.010	-0.022	0.010
Forecasted output growth, Quarters ahead:						
-1	0.019	0.010	0.021	0.009	0.021	0.009
0	-0.037	0.026	-0.026	0.023	-0.023	0.022
1	0.066	0.039	0.056	0.035	0.057	0.034
2	-0.069	0.035	-0.066	0.032	-0.068	0.031
Forecasted inflation, Quarters ahead:						
-1	0.021	0.022	0.022	0.019	0.027	0.019
0	0.023	0.061	0.033	0.056	0.030	0.054
1	-0.145	0.084	-0.154	0.076	-0.152	0.073
2	0.154	0.073	0.151	0.067	0.144	0.065
Forecasted unemployment rate (current quarter)	-0.049	0.027	-0.045	0.023	-0.047	0.023
Rate of Change in Leading Index	0.010	0.002	0.010	0.002	0.010	0.002
Rate of Change in Coincident Index	0.005	0.004	0.005	0.004	0.004	0.004
Rate of Change in Lagging Index	-0.004	0.001	-0.005	0.001	-0.004	0.001
R^2	0.23		0.22		0.21	
S.E.E.	0.40		0.38		0.37	
D-W	1.73		1.70		1.64	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 –2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

The results from tables 4.31 – 4.33 are summarized in tables 4.34 and 4.35. Table 4.34 shows the sums of coefficients, and the corresponding t-statistics and p-values, for each group of SPF forecast variables for all three samples. Table 4.32 shows the F-statistics and p-values for the tests of joint significance for each group of SPF forecast variables for all samples. The tests of joint significance for all three BCI indexes are also shown. The results for the regressions incorporating NW standard errors are shown without brackets. The LDV specification results are shown in the square brackets. The PW correction results are shown in the definite brackets.

Table 4.31 - Determinants of the Change in the Intended Federal Funds Rate - Newey-West Standard Errors – ALFRED / BCI / SPF

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.254	0.154	0.185	0.123	0.246	0.117
Initial level of intended funds rate	-0.022	0.017	-0.018	0.014	-0.022	0.014
Forecasted output growth, Quarters ahead:						
-1	0.019	0.010	0.021	0.009	0.021	0.009
0	-0.037	0.035	-0.026	0.033	-0.023	0.033
1	0.066	0.068	0.056	0.063	0.057	0.063
2	-0.069	0.057	-0.066	0.054	-0.068	0.054
Forecasted inflation, Quarters ahead:						
-1	0.021	0.014	0.022	0.014	0.027	0.013
0	0.023	0.063	0.033	0.062	0.030	0.061
1	-0.145	0.071	-0.154	0.069	-0.152	0.067
2	0.154	0.066	0.151	0.065	0.144	0.064
Forecasted unemployment rate (current quarter)	-0.049	0.023	-0.045	0.022	-0.047	0.022
Rate of Change in Leading Index	0.010	0.002	0.010	0.002	0.010	0.002
Rate of Change in Coincident Index	0.005	0.004	0.005	0.003	0.004	0.003
Rate of Change in Lagging Index	-0.004	0.001	-0.005	0.001	-0.004	0.001
R^2	0.23		0.22		0.21	
S.E.E.	0.40		0.38		0.37	
D-W	1.73		1.70		1.64	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 –2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

Table 4.32 - Determinants of the Change in the Intended Federal Funds Rate with Lagged Dependent Variable – ALFRED / BCI / SPF

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.272	0.151	0.202	0.118	0.251	0.111
Initial level of intended funds rate	-0.028	0.012	-0.024	0.010	-0.027	0.010

(table 4.32 cont.)

Forecasted output growth, <u>Quarters ahead</u>:						
-1	0.017	0.010	0.017	0.009	0.017	0.008
0	-0.038	0.026	-0.027	0.023	-0.025	0.022
1	0.055	0.038	0.045	0.035	0.045	0.033
2	-0.055	0.035	-0.052	0.032	-0.051	0.031
Forecasted inflation, <u>Quarters ahead</u>:						
-1	0.016	0.021	0.016	0.019	0.019	0.018
0	0.021	0.061	0.029	0.055	0.027	0.053
1	-0.134	0.083	-0.141	0.075	-0.138	0.072
2	0.151	0.073	0.149	0.066	0.143	0.064
Forecasted unemployment rate (current quarter)	-0.045	0.026	-0.041	0.023	-0.043	0.022
Rate of Change in Leading Index	0.009	0.002	0.009	0.002	0.008	0.002
Rate of Change in Coincident Index	0.005	0.004	0.004	0.004	0.003	0.004
Rate of Change in Lagging Index	-0.004	0.001	-0.004	0.001	-0.004	0.001
Change in Previous Meeting's Target Rate	0.150	0.057	0.163	0.051	0.185	0.049
R^2	0.25		0.24		0.25	
S.E.E.	0.40		0.37		0.36	
D-W	2.01		2.00		2.00	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 –2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

Table 4.33 - Determinants of the Change in the Intended Federal Funds Rate with Serial Correlation Correction – ALFRED / BCI / SPF

	Sample 1969:1 – 1996:12		**Sample 1969:1 – 2003:12**		**Sample 1969:1 – 2007:3**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	0.288	0.182	0.231	0.145	0.303	0.141
Initial level of intended funds rate	-0.033	0.014	-0.030	0.012	-0.035	0.012
Forecasted output growth, <u>Quarters ahead</u>:						
-1	0.014	0.010	0.014	0.009	0.013	0.009
0	-0.030	0.026	-0.020	0.023	-0.018	0.022
1	0.070	0.039	0.062	0.035	0.064	0.034
2	-0.084	0.037	-0.082	0.034	-0.086	0.033
Forecasted inflation, <u>Quarters ahead</u>:						
-1	0.011	0.022	0.010	0.020	0.011	0.019
0	0.050	0.063	0.055	0.057	0.057	0.055

(table 4.33 cont.)

1	-0.144	0.084	-0.148	0.076	-0.145	0.073
2	0.144	0.077	0.146	0.071	0.141	0.068
Forecasted unemployment rate (current quarter)	-0.043	0.031	-0.040	0.028	-0.043	0.028
Rate of Change in Leading Index	0.008	0.002	0.008	0.002	0.008	0.002
Rate of Change in Coincident Index	0.004	0.004	0.003	0.004	0.003	0.004
Rate of Change in Lagging Index	-0.004	0.001	-0.004	0.001	-0.004	0.001
Rho	0.201	0.073	0.222	0.065	0.258	0.062
R^2	0.25		0.24		0.25	
S.E.E.	0.40		0.37		0.36	
D-W	2.02		2.02		2.03	

The sample of FOMC Meetings over the period 1969:1 – 1996:12 has 263 observations. The sample of FOMC Meetings over the period 1969:1 –2003:12 has 319 observations. The sample of FOMC Meetings over the period 1969:1 –2007:3 has 345 observations.

Table 4.34 - Sums of Coefficients – ALFRED / BCI / SPF – Newey-West [LDV] {Serial Correlation Correction}

	1969:1 – 1996:12			**1969:1 – 2003:12**			**1969:1 –2007:3**		
	Sum of Coefficients	**t-statistic**	**p-value**	**Sum of Coefficients**	**t-statistic**	**p-value**	**Sum of Coefficients**	**t-statistic**	**p-value**
Forecasted output growth	-0.021 [-0.021] {-0.029}	-0.80 [-0.95] {-1.16}	0.43 [0.35] {0.25}	-0.016 [-0.16] {-0.026}	-0.66 [-0.82] {-1.13}	0.51 [0.41] {0.26}	-0.013 [-0.015] {-0.027}	-0.54 [-0.75] {-1.19}	0.59 [0.45] {0.24}
Forecasted inflation	0.052 [0.053] {0.061}	2.68 [2.35] {2.26}	0.01 [0.02] {0.03}	0.052 [0.054] {0.063}	2.74 [2.60] {2.51}	0.01 [0.01] {0.01}	0.049 [0.052] {0.063}	2.62 [2.60] {2.55}	0.01 [0.01] {0.01}

Table 4.35 – Tests of Joint Signficance – ALFRED / BCI / SPF – Newey-West [LDV] {Serial Correlation Correction}

	1969:1 – 1996:12		**1969:1 –2003:12**		**1969:1 –2007:3**	
	F-statistic	**p - Value**	**F-statistic**	**p - Value**	**F-statistic**	**p - Value**
Forecasted output growth	1.59 [1.43] {1.82}	0.17 [0.23] {0.13}	2.03 [1.68] {2.20}	0.09 [0.16] {0.07}	2.14 [1.71] {2.40}	0.07 [0.15] {0.05}
Forecasted inflation	3.35 [2.41] {2.47}	0.01 [0.05] {0.05}	3.92 [3.17] {3.21}	0.00 [0.01] {0.01}	4.07 [3.34] {3.39}	0.00 [0.01] {0.01}
BCI	13.95 [12.65] {11.40}	0.00 [0.00] {0.00}	14.63 [14.86] {13.03}	0.00 [0.00] {0.00}	13.30 [14.67] {12.51}	0.00 [0.00] {0.00}

Each specification produces R^2s between 0.21 – 0.25 and standard errors of estimates between 0.36 – 0.40. These are similar to the original RR results for both the 1996 and 2003 samples. Each of the regressions shows a negative coefficient on the unemployment rate, however, the significance varies. In the 1996 sample, the p-value on the unemployment rate for the NW [LDV] {PW} regression is 0.04 [0.09] {0.17}. The 2003 sample gives a p-value of 0.04 [0.08] {0.15}. In the 2007 sample, the p-value for the unemployment rate is 0.03 [0.06] {0.13}.

Replacing the previous quarter values from the SPF with those from ALFRED only causes slight differences. For each sample and specification, the sums of coefficients on forecasted output growth are still negative and insignificant. The sums of coefficients on forecasted inflation are positive and significant in each sample and specification. The sums of coefficients range from 0.049 – 0.063. The largest sum of 0.063 occurs in the PW specification for the 2003 and 2007 samples. The forecasted output growth variables are jointly marginally significant is the regression incorporating NW standard errors (p-value = 0.07) and the PW specification (p-value = 0.05) for the 2007 sample. These are also marginally jointly significant for the PW specification in the 2003 sample (p-value = 0.09). In each specification and sample, the forecasted inflation variables are jointly significant. The p-values range from 0.01 – 0.05.

The BCI indexes are all jointly significant as each specification produces an F-statistic over eleven for each specification and sample. In the regressions, the coefficient on the rate of change in the leading index ranges from 0.008 – 0.010 and each coefficient is significant. The coefficients on the coincident index are positive but in significant for all specifications and samples. As in the BCI specification, the coefficient on the lagging index is puzzling. The coefficients on the lagging index range from -0.004 to -0.005 in all specifications and samples with t-statistics above three.

4.5 Alternative Measures of Monetary Policy Shocks from Alternative Datasets Only

As noted earlier, the residuals from the regressions without corrections for serial correlation are used as new measures of exogenous changes in monetary policy. Figure 4.14 shows the residuals from each regression for the original sample, 2003 sample, and 2007 sample, respectively. Each measure is

converted to a monthly series. All measures follow a similar pattern with the most volatility occurring during the period of nonborrowed reserve targeting of the Federal Reserve.

The residual measures are all highly correlated with each other as well as with the RR shocks from the original and 2003 samples. Tables 4.36(a) – 4.36(c) report the overall correlations among all shock measures.

Table 4.36(a) – Correlations Among Shock Measures – Meetings from 1969:1 – 1996:12

	Romer-Romer	SPF	ALFRED / SPF	BCI	BCI / SPF	ALFRED / BCI / SPF
Romer-Romer	1.00					
SPF	0.81	1.00				
ALFRED / SPF	0.83	0.98	1.00			
BCI	0.84	0.85	0.86	1.00		
BCI / SPF	0.82	0.85	0.87	0.96	1.00	
ALFRED / BCI / SPF	0.82	0.85	0.87	0.96	0.99	1.00

Table 4.36(b) – Correlations Among Shock Measures – Meetings from 1969:1 – 2003:12

	Romer-Romer	SPF	ALFRED / SPF	BCI	BCI / SPF	ALFRED / BCI / SPF
Romer-Romer	1.00					
SPF	0.80	1.00				
ALFRED / SPF	0.83	0.98	1.00			
BCI	0.84	0.85	0.86	1.00		
BCI / SPF	0.82	0.86	0.87	0.96	1.00	
ALFRED / BCI / SPF	0.82	0.86	0.88	0.96	0.99	1.00

Table 4.36(c) – Correlations Among Shock Measures – Meetings from 1969:1 – 2007:3

	SPF	ALFRED / SPF	BCI	BCI / SPF	ALFRED / BCI / SPF
SPF	1.00				
ALFRED / SPF	0.98	1.00			
BCI	0.86	0.87	1.00		
BCI / SPF	0.87	0.88	0.97	1.00	
ALFRED / BCI / SPF	0.87	0.89	0.96	0.99	1.00

Tables 4.36(a) and 4.36(b) show that the residuals obtained from the alternative specification of using only the BCI have the highest overall correlation with the RR residuals in the original sample as well as the extended sample to 2003. However, all the measures are very highly correlated with the original measure with the lowest being 0.81 in the original sample and 0.80 in the 2003 sample for the SPF only specification. Table 4.36(c) shows that all alternative measures are highly correlated with each other. The overall correlation coefficients are in the range of 0.86 – 0.99. The lowest overall correlation for the 2007 sample residuals is between the SPF specification residuals and the BCI residuals with an overall correlation coefficient of 0.86. The BCI / SPF and ALFRED / BCI / SPF specifications also produce residuals that correlated at 0.87 with the SPF specification residuals.

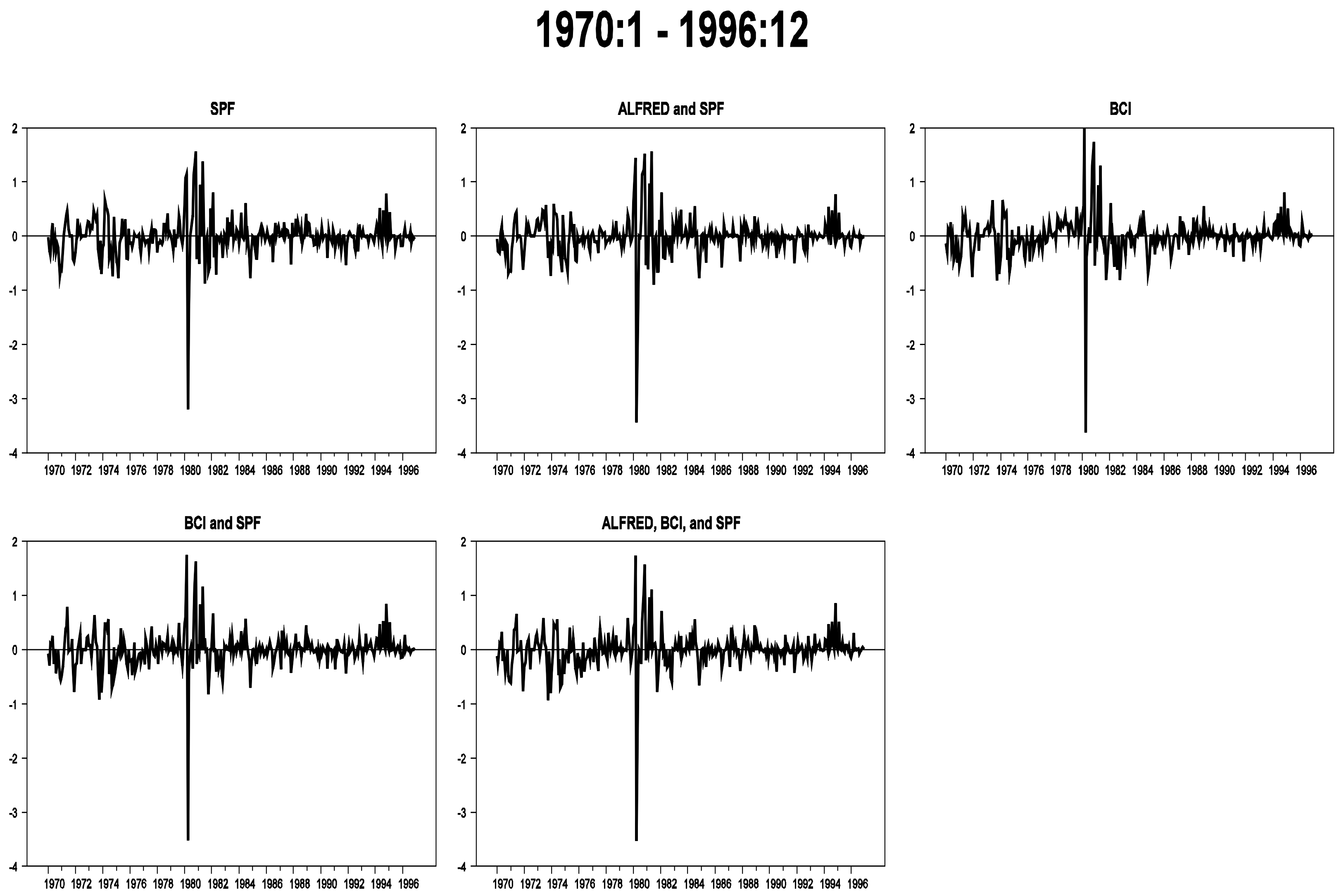
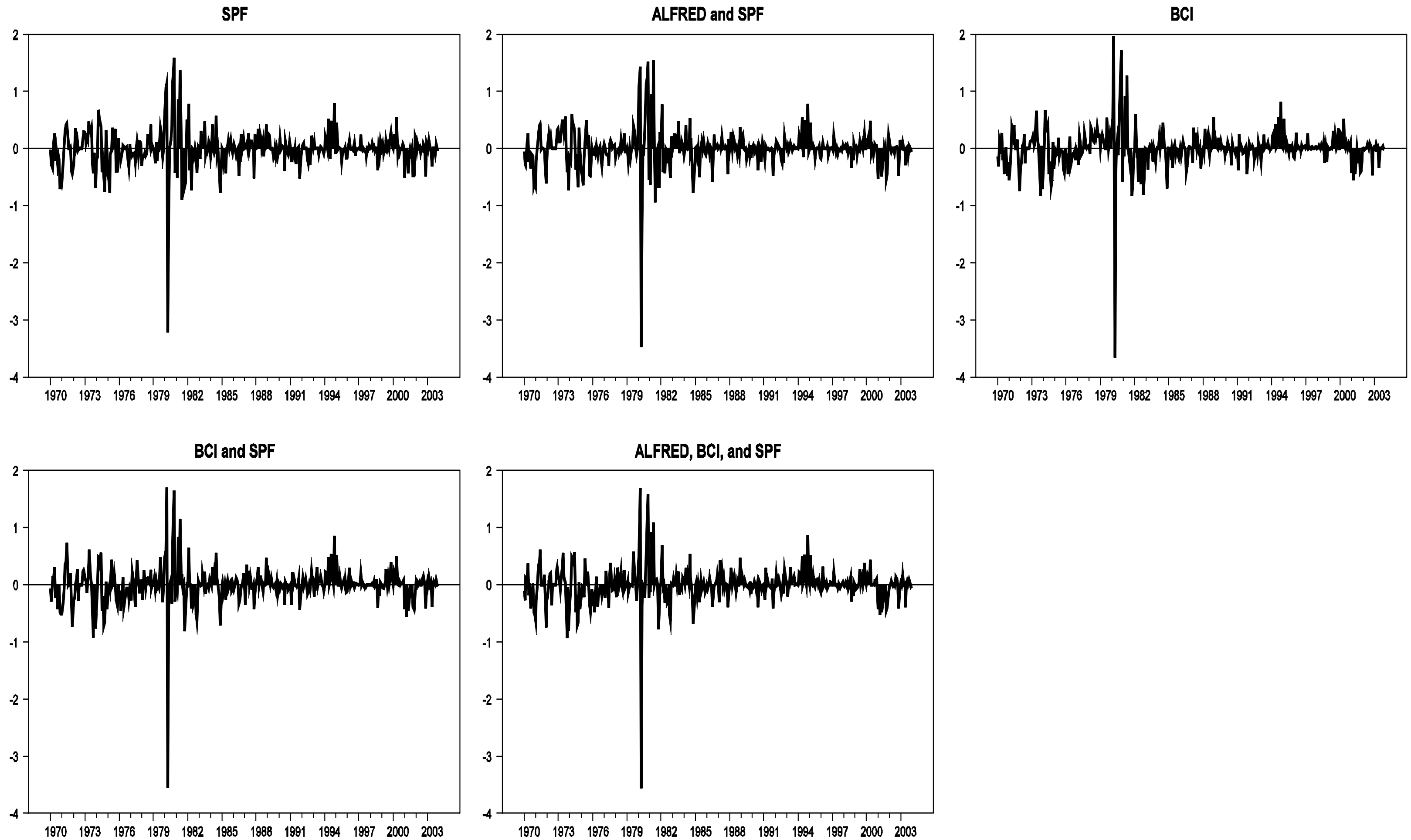


Figure 4.14 – Alternative Monthly Residuals

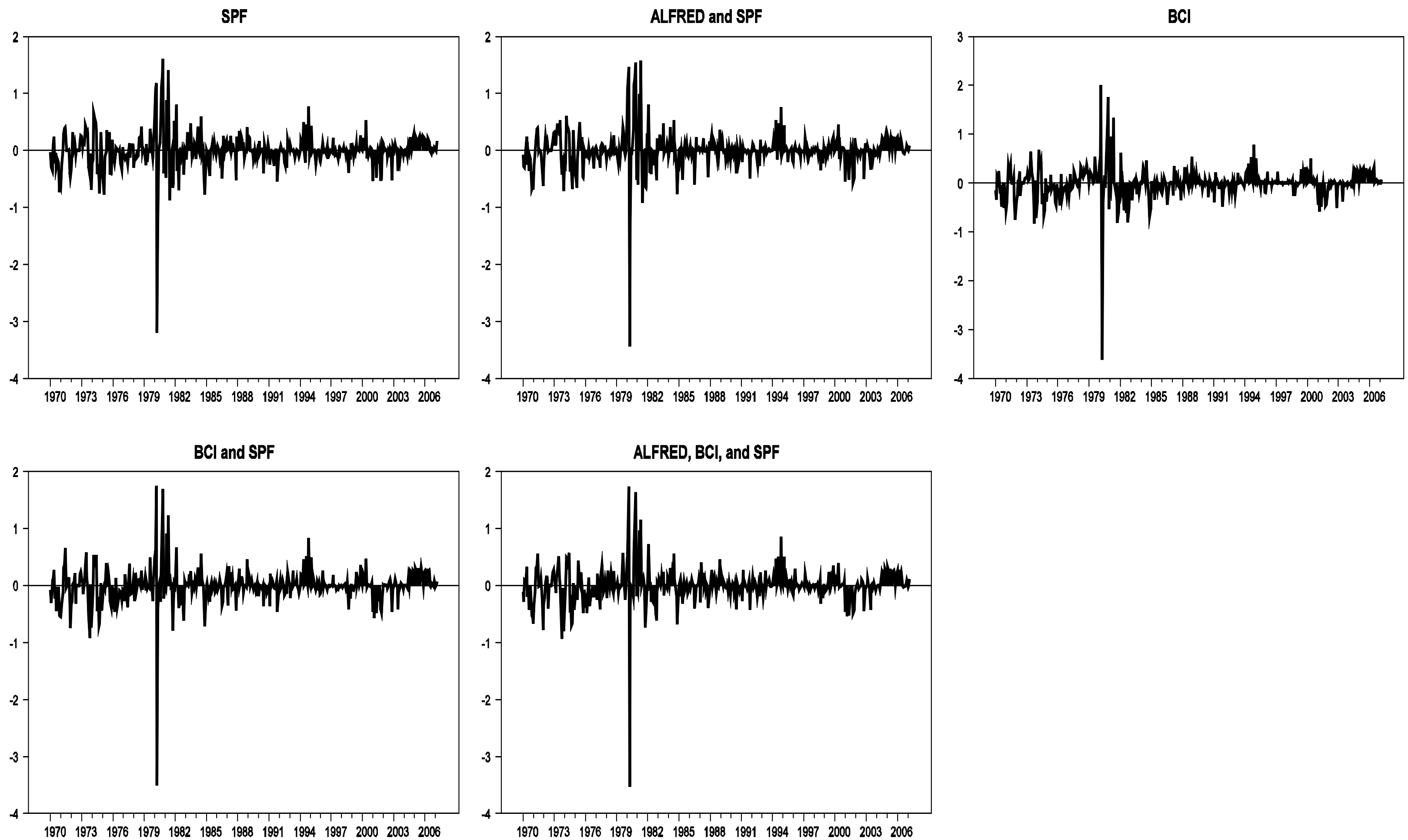
(fig. 4.14 cont'd.)

1970:1 - 2003:12



(fig. 4.14 cont'd.)

1970:1 - 2007:3



4.6 Responses of Output and Price to Alternative Measures of Shocks

The macroeconomic effects of the alternative monetary policy shocks are estimated in the same way as done previously. First, monthly regressions for output and prices were estimated for the 1996, 2003, and 2007 samples. Single equation IRF's using polynomial division were computed for output and prices, as well as confidence interval (CI) bands. The residuals from each specification were then cumulated and placed into the standard three-variable VAR as the measure of monetary policy. These responses were computed for the residuals from the 1996, 2003, and 2007 samples.

For comparison with the original RR results, the responses of output and prices for each sample are plotted with the respective RR CI bands from Chapter 2. If the alternative measure point estimates lie outside the RR bands, the effects from the alternative shocks are judged to be significantly different from RR.

There is no method for comparing the alternative shocks obtained from the 2007 sample directly to RR shocks obtained from the Greenbook for the same sample. However, the extended 2007 sample results are plotted with the respective CI bands from the alternative specification for the original and 2003 samples. This shows if there are significantly different responses in output and price from the earlier samples. If there are no significant differences, this provides further evidence that the quasi-narrative approach is robust to updates, as found in Chapter 2 when using only Greenbooks.

4.6.1 SPF Specification

The IRF's for the responses of output and prices, for all three samples, to a one percentage point contractionary monetary policy shock are shown in Figure 4.15.

For all three samples, the maximum effect on output is felt in the same month as the RR equation. It is interesting to note that the maximum effects on output are much larger compared to RR for the 2003 sample, while the maximum effects on prices are relatively smaller for all samples. The maximum effects are shown in Table 4.37.

Table 4.37 -Comparison of Maximum Effects – Single Equation IRF's – SPF Specification

	SPF Maximum Effect on Output	RR Maximum Effect on Output	SPF Maximum Effect on Prices	RR Maximum Effect on Prices
1996 Sample	-4.2%	-4.3%	-3.8%	-5.9%
2003 Sample	-4.3%	-3.7%	-3.9%	-5.2%
2007 Sample	-3.4%	NA	-3.9%	NA

Comparing the maximum effects to RR, Table 4.37 shows that the maximum effects on output from the SPF specification are 0.1 percentage points smaller for the 1996 sample and 0.6 percentage points larger for the 2003 sample. However, the maximum effect on prices is 2.1 percentage points smaller for the 1996 sample and 2.3 percentage points smaller for the 2003 sample. The point estimates never return to the origin and the CI bands do not return span zero in any of the samples.

The results for the response of output are very troubling since these suggest that the decrease in output is very long lived and is negative at very long horizons with no gradual increase to the origin. Economic theory predicts that a contractionary monetary policy shock will decrease output in the short-run but eventually return to its initial level in the long-run. This is not what the IRF's show. Also, this is not what is seen in earlier empirical estimates, particularly RR, of the response in output to a contractionary monetary policy shock where output returns to the origin.

Like the original and extended results of RR, the point estimates for the response of prices from the shocks obtained SPF specification take approximately two years to become negative for the original and extended samples. However, the decline does not become significant until thirty-one months after the contractionary shock for the original sample and thirty-two months for the 2003 sample. When the sample of meetings is extended to 2007, the time for the response of prices to become negative slightly shortened but still takes thirty months to become significant. Each sample shows a permanently significant lower price level.

Figure 4.16 shows the point estimates obtained from the SPF specification along with the CI bands obtained from the RR specification for the original sample and the 2003 sample. The extended sample SPF results are then plotted with the CI bands from the SPF specification for the original and 2003

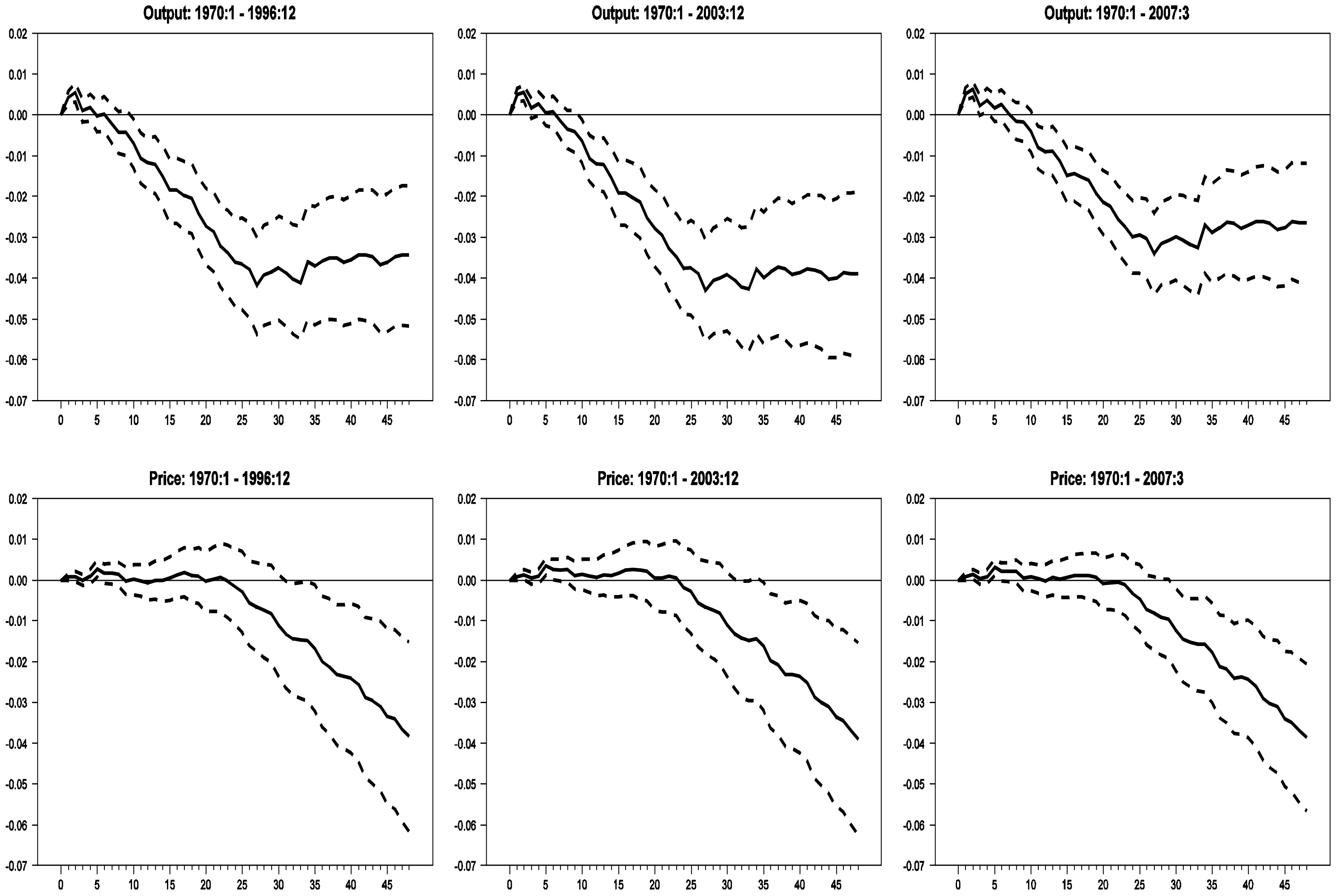


Figure 4.15 – Single Equation Impulse Response Functions: SPF Specification

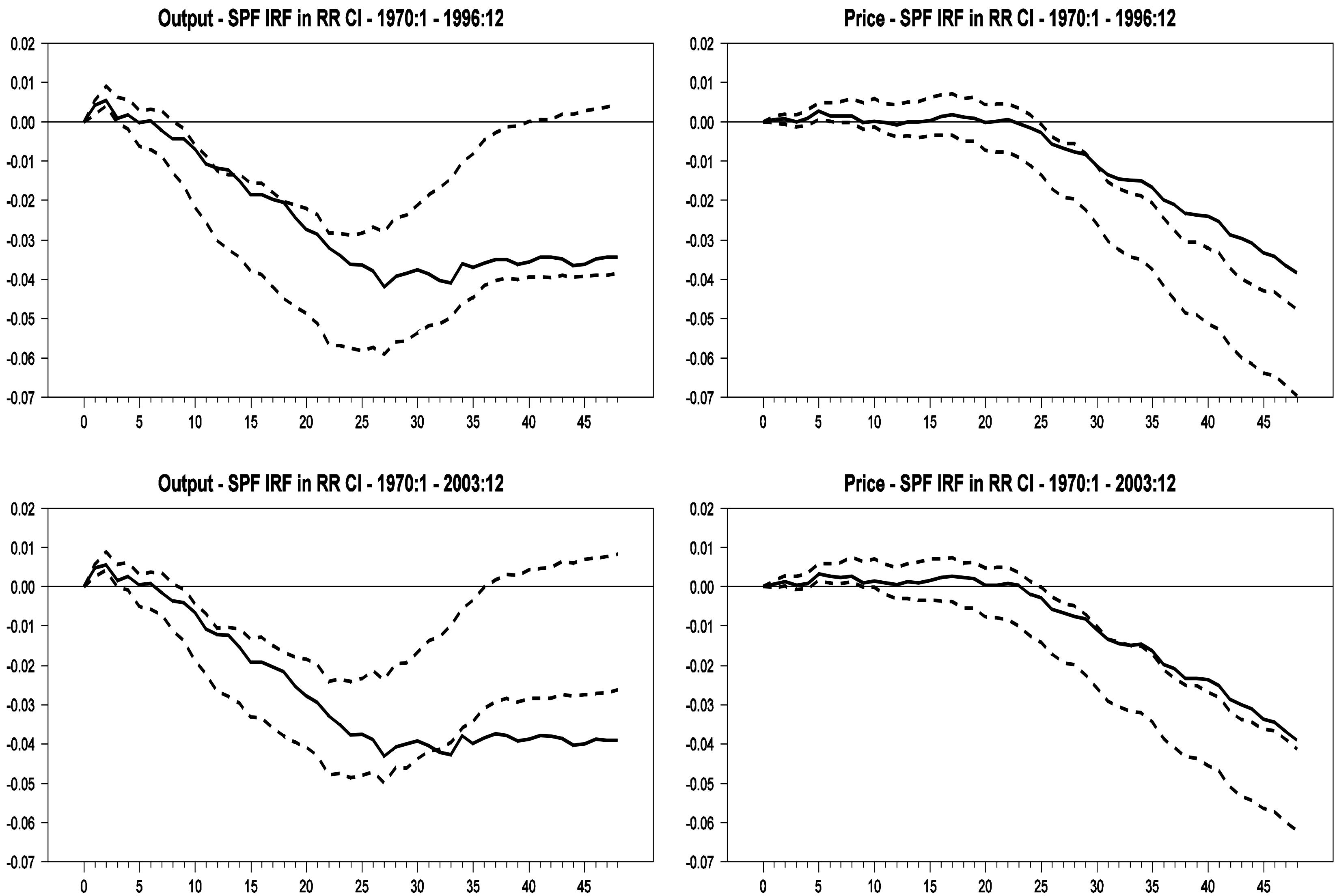


Figure 4.15 – Comparison of Romer-Romer and SPF Specification Single Equation IRF's

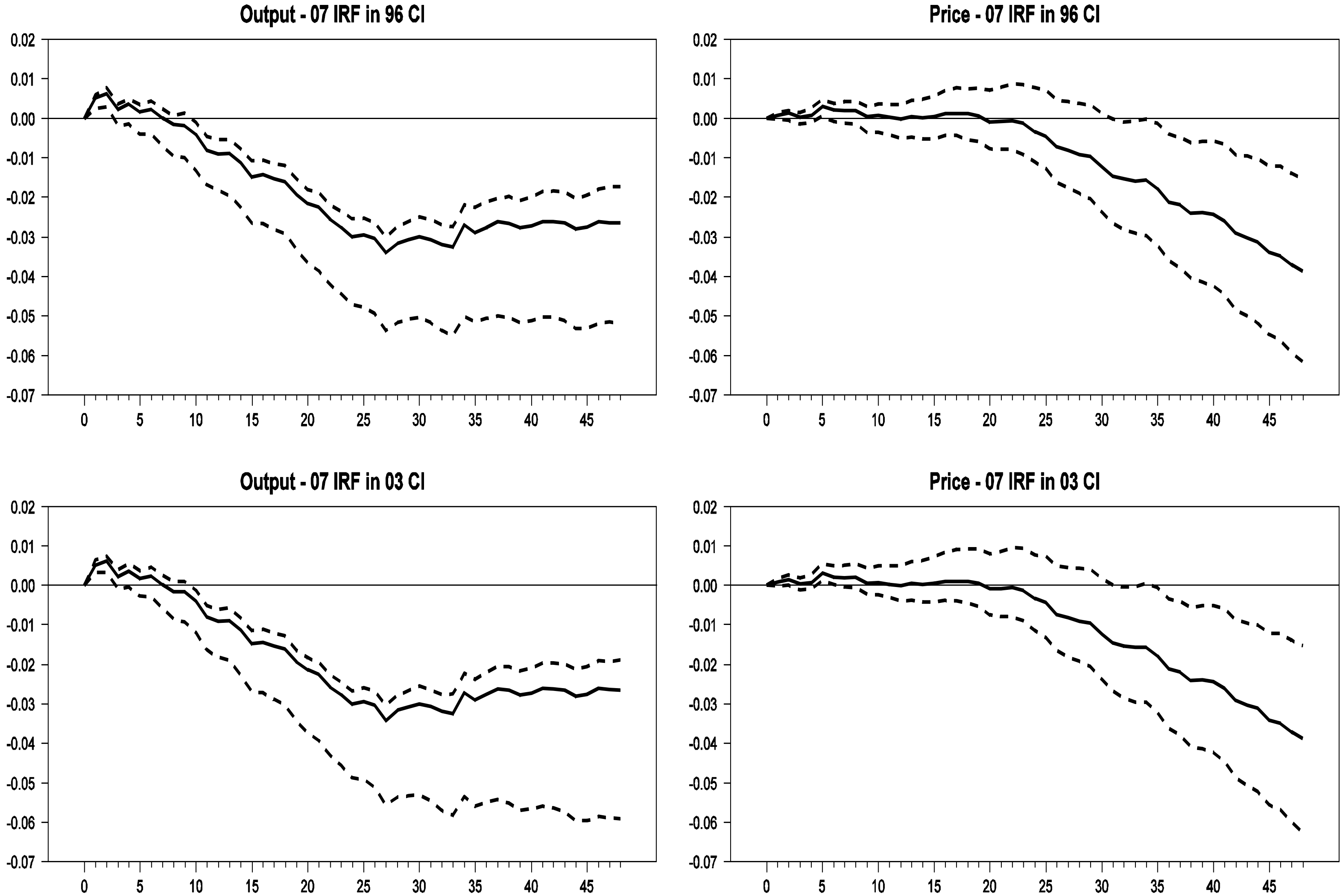


Figure 4.17 – Comparison of SPF Specification Single Equation IRF's

samples. This shows if there are significantly different responses in output and price from the earlier SPF alternatives. The results are shown in the second part of Figure 4.17.

Figure 4.16 shows that for the original sample, the response of output lies completely within the RR CI bands at all horizons. For the 2003 sample, the response of output lies within the RR CI bands until it falls below the lower RR CI band thirty-two months after the shock.

The SPF specification thus shows a significantly stronger response at longer horizons for the 2003 sample. For prices, the response is significantly weaker at longer horizons when using shocks obtained from the SPF specification. The SPF point estimates are above the upper RR CI band after approximately thirty months in the original sample and thirty-five months in the 2003 sample. Looking at the maximum effects in Table 4.37 and comparisons in Figure 4.16 shows that the effects on prices are significantly weaker at longer horizons and the effects on output are significantly stronger at longer horizons for the SPF specification. Extending the sample to 2007 does not produce any significant differences in the SPF specifications from the earlier samples.

Next, the residuals from the SPF specifications were cumulated and placed into the standard three-variable VAR as the measure of monetary policy. The IRF's for all three samples are shown in Figure 4.18.

The VAR produces responses are similar to RR for output but smaller for price for the 1996 (2003) [2007] sample. The response of output becomes significant seven (eight) [seven] months after the shock and the CI bands span zero thirty-four (thirty-four) [thirty-five] months after the shock. The response of prices becomes negative immediately in the 2003 and 2007 samples. The response becomes negative three months after the shock for the 1996 sample. The response becomes significant nineteen (seventeen) [nineteen] months after the shock.

The magnitude of the maximum effect on output is 0.4 percentage points smaller compared to RR in the 1996 sample but the same for the 2003 sample. The RR maximum effect on prices at longer horizons is larger in both samples with RR's being 1.2 percentage points larger for the original sample and 0.4 percentage points larger for the 2003 sample. The maximum effects are shown in Table 4.38.

Table 4.38 -Comparison of Maximum Effects – VAR Equation IRF's – SPF Specification

	SPF Maximum Effect on Output	RR Maximum Effect on Output	SPF Maximum Effect on Prices	RR Maximum Effect on Prices
1996 Sample	-2.5%	-2.9%	-3.6%	-4.8%
2003 Sample	-2.3%	-2.3%	-3.5%	-3.9%
2007 Sample	-2.3%	NA	-3.6%	NA

It is interesting to note that the own effect of the monetary policy shock is positive and significant for a much shorter period of time compared to RR. The CI bands begin to span zero twenty-nine months after the shock for the original and 2003 samples and after thirty-four months for the 2007 sample, while the CI bands for the monetary policy measure does not include zero in the RR VAR.

Figure 4.19 places the point estimates obtained from the SPF VAR specification in the CI bands from the RR specification for the original sample and sample to 2003. Figure 4.20 places the point estimates from the 2007 sample into the SPF specification CI bands from the 1996 and 2003 samples.

Figure 4.19 shows for the 1996 and 2003 samples, the response of output lies within the CI bands. For prices, the response is significantly weaker at very long horizons for the 1996 sample. The differences are small and the SPF point estimates are only slightly above the RR CI bands for only the final two months. The own effect of monetary policy from the SPF specification shows a significantly smaller response in both samples.

Figure 4.20 shows that for the 1970 – 2007:3 sample, there are no significant differences from the earlier samples with the exception that the point estimates for the response of monetary policy lie slightly above the CI bands for the 2003 sample at very short horizons.

Monetary policy shocks obtained from using only the SPF produce single equation IRF's that are very different from those of RR. The single equation responses of output never return to the origin after forty-eight months and the CI bands never span zero at longer horizons. The response of prices takes a very long time to become negative and significant. However, in the VAR, the responses of output and prices are comparable to those of RR. The point estimates for output do reach the initial level and the response displays a transitorily significant effect.

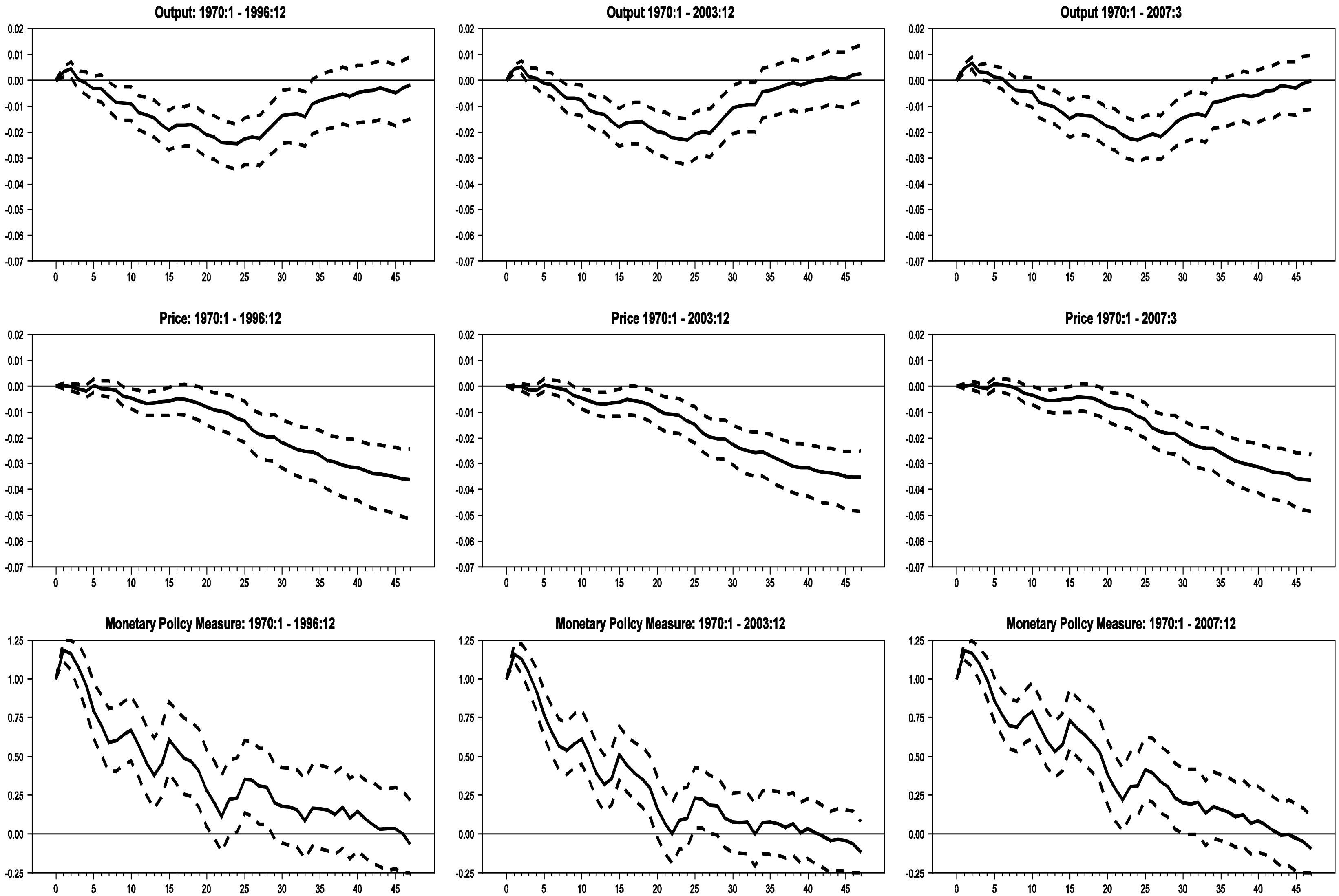


Figure 4.18 – VAR Impulse Response Functions: SPF Specification

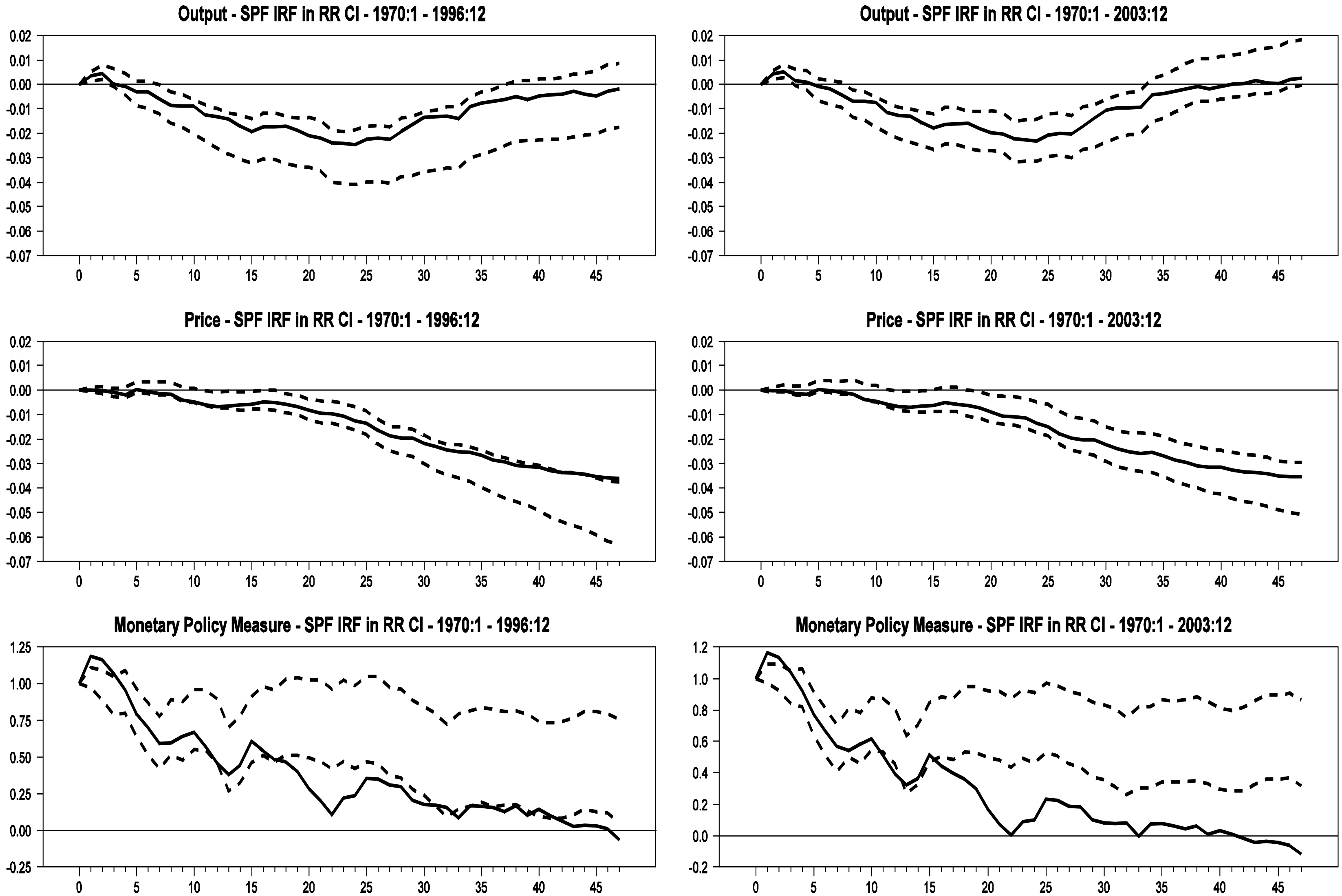


Figure 4.19 – Comparison of Romer-Romer and SPF Specification VAR IRF's

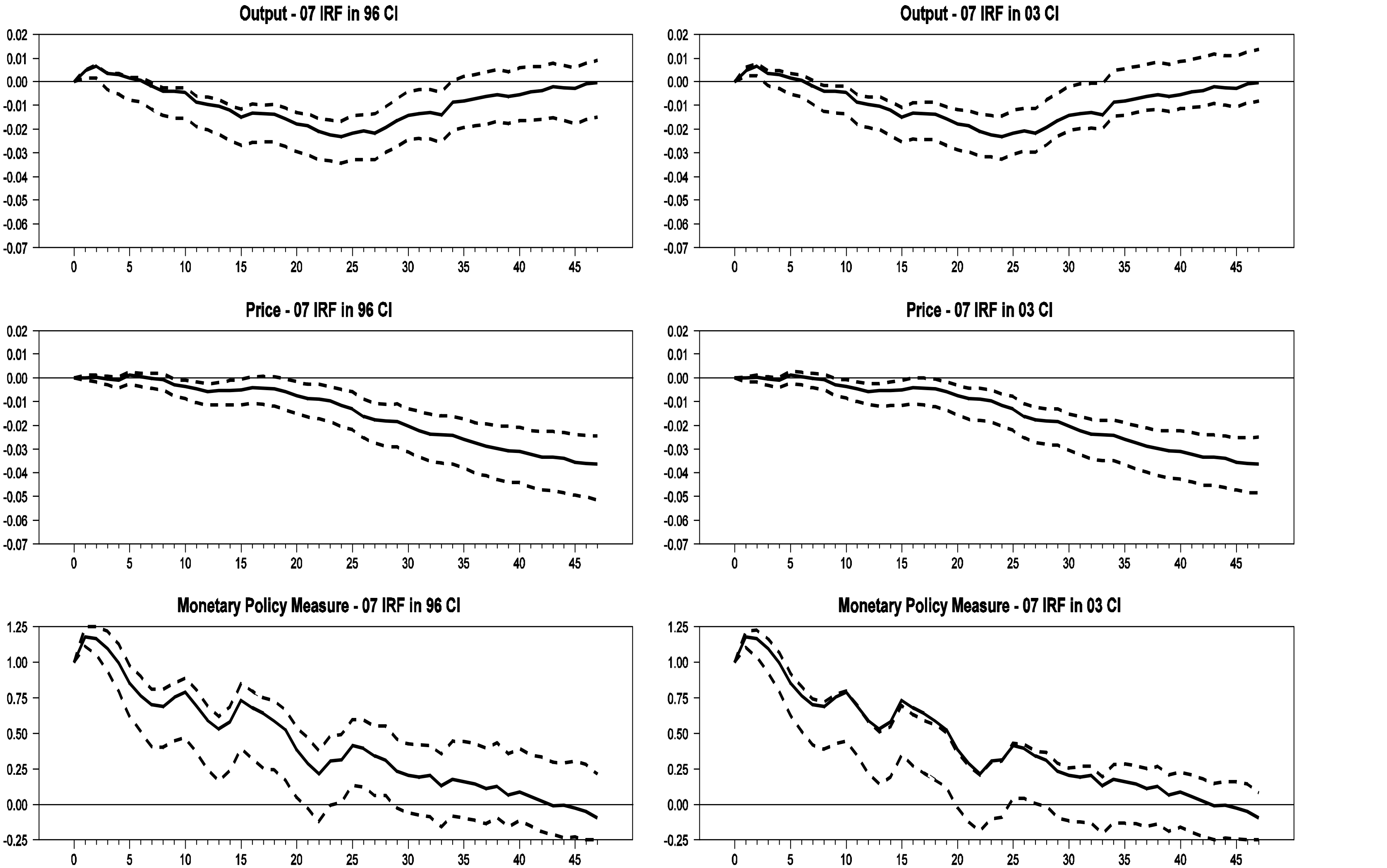


Figure 4.20 – Comparison of SPF Specification VAR IRF's

The responses of prices become negative and significant at approximately the same horizons as those in the RR VAR.

4.6.2 ALFRED / SPF Specification

The IRF's for the responses of output and prices, for all three samples, to a one percentage point contractionary monetary policy shock obtained from the ALFRED / SPF specification are show in Figure 4.21.

Figure 4.21 shows that adding the ALFRED previous values to the analysis does not improve the results for the responses of output. The point estimates never return to their initial values and the confidence bands do not span zero at longer horizons. However, there is a marked improvement in the price IRF compared to only using the SPF. For the original sample, the point estimates become permanently negative eight months after the shock but aren't significant until twenty-six months after the shock. For the 2003 sample, prices become permanently negative eighteen months after the shock, and the decline becomes significant twenty-seven months after the shock. For the 2007 sample, the response of prices becomes negative nine months after the shock and becomes significant twenty-five months after the shock. All samples show a stronger permanent decrease in prices at longer horizons compared to the specification only using the SPF. Table 4.39 shows the maximum effects for each sample.

Table 4.39 - Comparison of Maximum Effects – Single Equation IRF's – AL/SPF Specification

	AL/SPF Maximum Effect on Output	RR Maximum Effect on Output	AL/SPF Maximum Effect on Prices	RR Maximum Effect on Prices
1996 Sample	-4.1%	-4.3%	-5.3%	-5.9%
2003 Sample	-3.9%	-3.7%	-4.8%	-5.2%
2007 Sample	-3.2%	NA	-4.7%	NA

Comparing the maximum effects to RR in the 1996 and 2003 samples Table 4.39 shows that the maximum effects on output from the ALFRED /SPF specification are 0.2 percentage points smaller for the 1996 sample and 0.2 percentage points larger for the 2003 sample. The maximum effect on prices is 0.6 percentage points smaller for the 1996 sample and 0.4 percentage points smaller for the 2003 sample.

Figure 4.22 plots the CI bands obtained from the RR specification and the point estimates from the ALFRED / SPF specification for the original sample and extended sample to 2003. Figure 4.23 shows the comparison between the 2007 output and price responses to CI bands obtained when using the ALFRED / SPF specification in previous samples.

Figure 4.22 shows a slight transitory difference in the output responses between the ALFRED / SPF results and the RR results for the 1996 sample at intermediate horizons. The point estimates from the original sample lie completely within the RR CI bands at almost all horizons. When the sample is extended to 2003, the ALFRED / SPF point estimates, at longer horizons, are significantly different as they lie below the lower RR CI band beginning thirty-six months after the shock. Both figures show no significant differences in the response of prices. When the sample is extended to 2007, it is interesting to note that while there are no significant differences, the response of output appears somewhat weaker compared to responses obtained from earlier samples as shown in figure 4.23. The 2007 responses of output lie very close to the upper CI bands from the earlier samples.

Next, the residuals from the ALFRED / SPF were cumulated and placed into the standard three-variable VAR as the measure of monetary policy. The IRF's for all three samples are shown in figure 4.24.

Compared to the RR results, the VAR produces response in output and prices that are similar in patterns but smaller in magnitude for the 1996 (2003) [2007] sample. The negative response of output becomes significant seven (eleven) [eleven] months after the shock and the CI bands span zero beginning thirty-four (thirty) [thirty-four] months after the shock. The response of prices becomes negative immediately in the 1996 and 2003 samples. The response becomes permanently negative six months after the shock for the 2007 sample. The response becomes significant nine months after the shock for all three samples.

For all three samples, the magnitude of the maximum effect on output is similar to the RR in both samples. The RR maximum effect on output is 0.6 percentage points larger for the 1996 sample, 0.4 percentage points larger for the 2003 sample. The maximum effect on prices at longer horizons is much

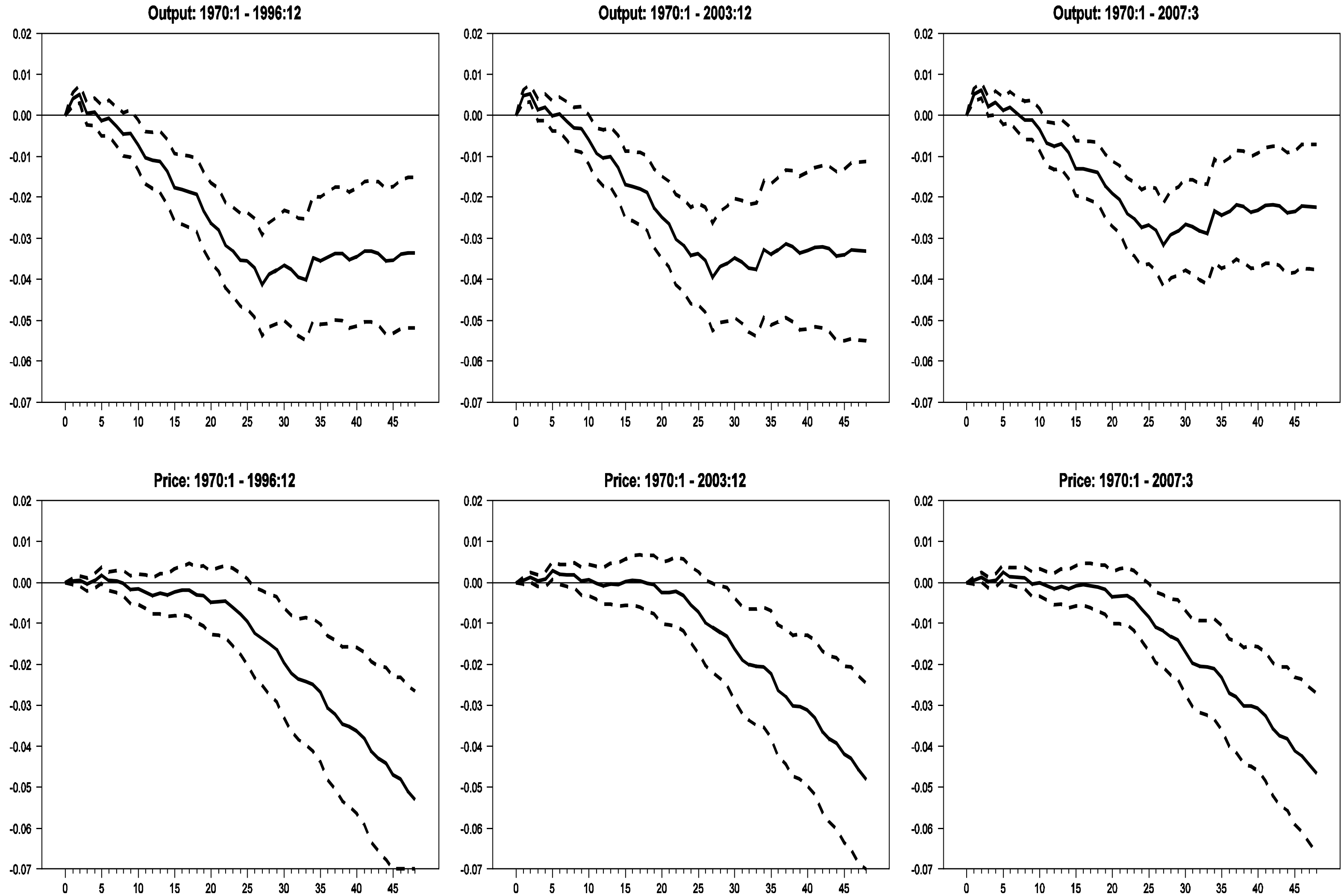


Figure 4.21 – Single Equation Impulse Response Functions: ALFRED / SPF Specification

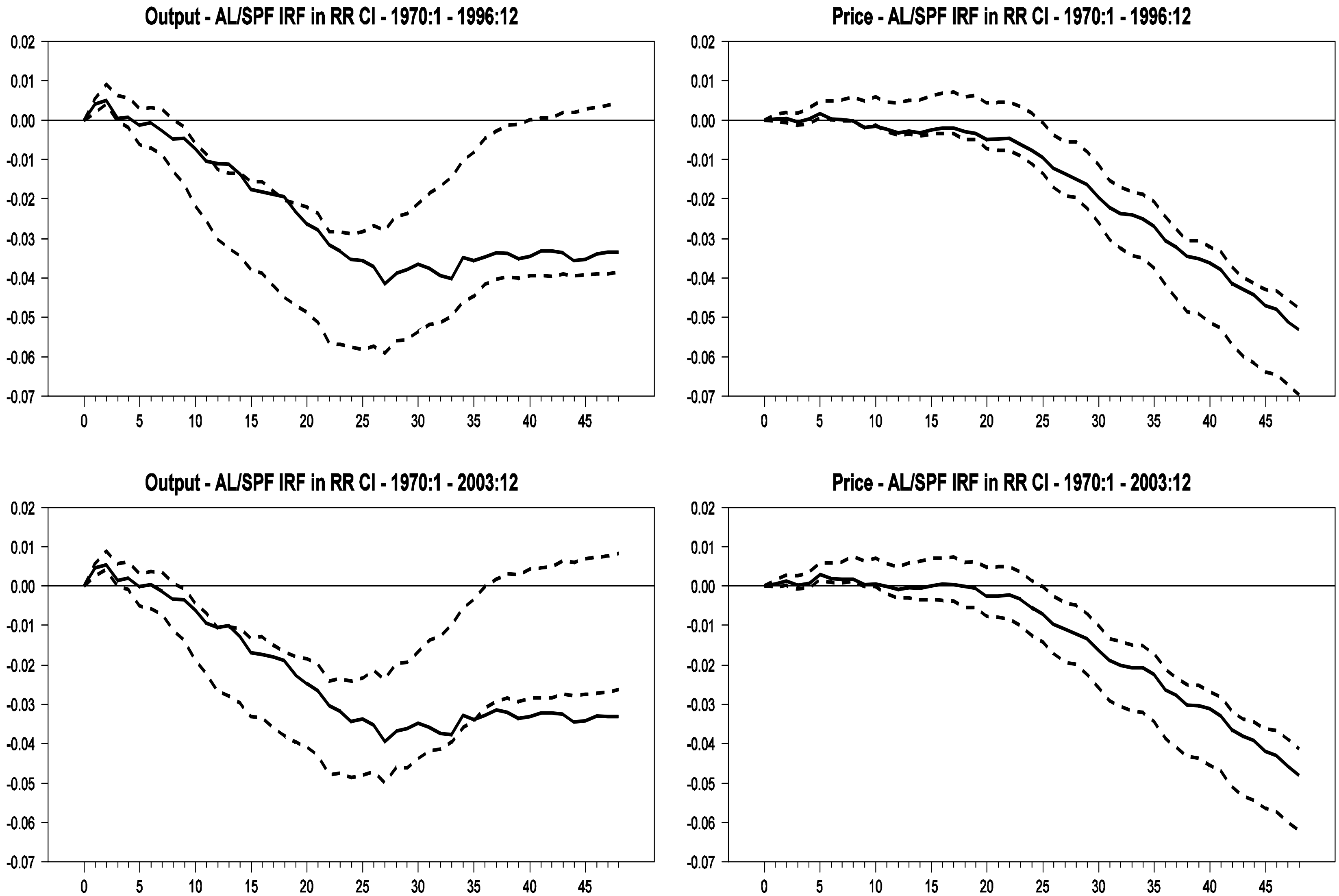


Figure 4.22 - Comparison of Romer-Romer and ALFRED / SPF Specification VAR IRF's

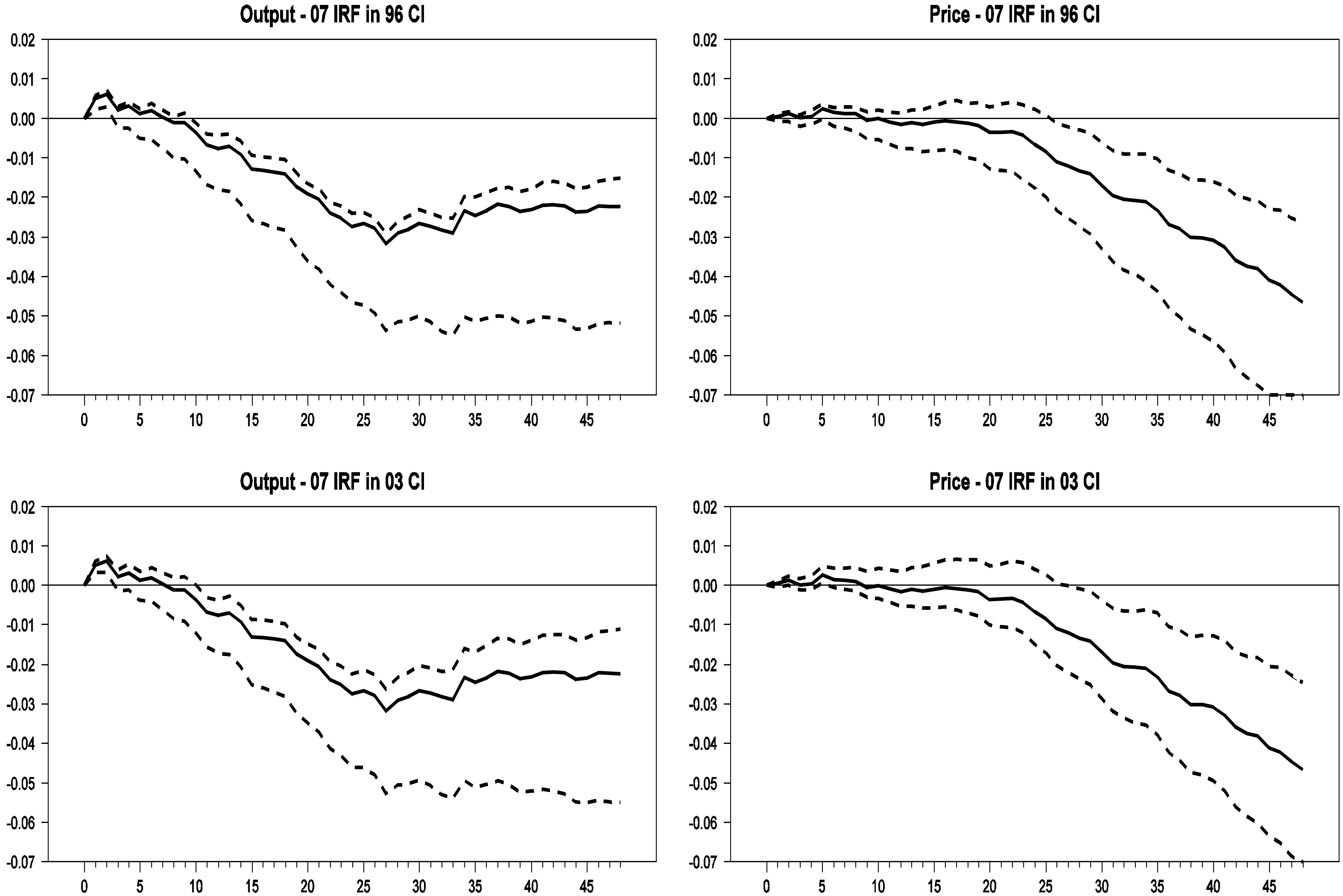


Figure 4.23 - Comparison of ALFRED / SPF Specification Single Equation IRF’s

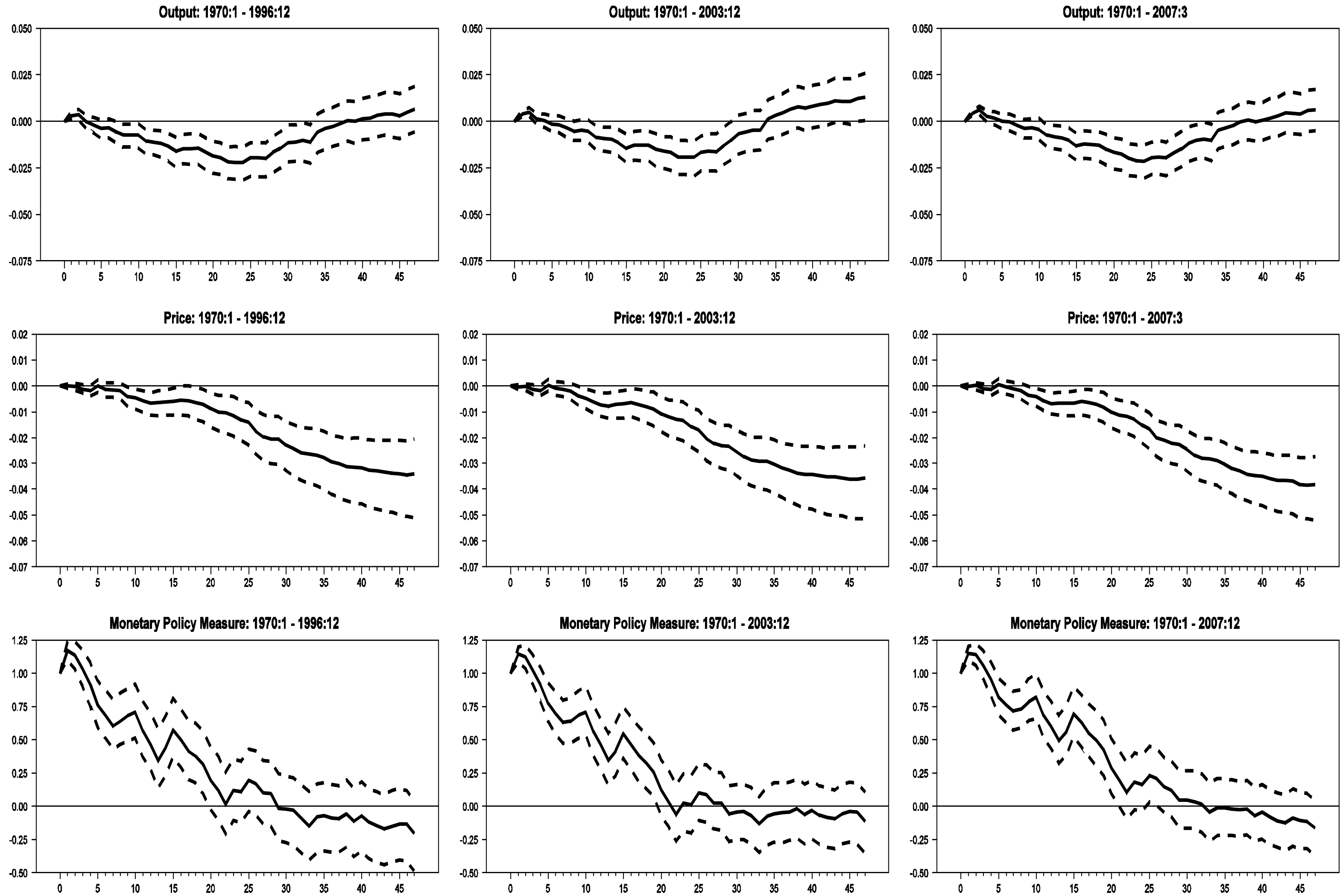


Figure 4.24 – VAR Impulse Response Functions: ALFRED / SPF Specification

smaller in both samples with RR's being 1.4 percentage points larger than the ALFRED / SPF specification for the original sample and 0.3 percentage points larger for both RR 2003 specification. The maximum effects are shown in Table 4.40.

Table 4.40 - Comparison of Maximum Effects – VAR Equation IRF's – AL/SPF Specification

	AL/SPF Maximum Effect on Output	RR Maximum Effect on Output	AL/SPF Maximum Effect on Prices	RR Maximum Effect on Prices
1996 Sample	-2.3%	-2.9%	-3.4%	-4.8%
2003 Sample	-1.9%	-2.3%	-3.6%	-3.9%
2007 Sample	-2.1%	NA	-3.8%	NA

One result worth noting particularly is that the maximum response of prices does not occur in the final month. The IRF actually shows an upward response at longer horizons. This can be explained by the fact that the ALFRED / SPF measure of monetary policy decreases to its initial lower level at longer horizons. This expansionary movement in monetary policy would cause a rise in prices at longer horizons.

Once again the own effect of the monetary policy show is much shorter lived compared to RR. The CI bands span zero twenty (twenty) [twenty-ones] months after the shock.

Figure 4.25 plots point estimates obtained from the ALFRED / SPF specification and the CI bands from the RR specification for the original sample and 2003 sample. Figure 4.26 plots the point estimates from the 2007 sample and the ALFRED / SPF specification CI bands from the 1996 and 2003 samples.

Figure 4.25 shows that for the 1996 sample, the response of output is significantly weaker than that of RR although the magnitude of the difference is not large and only lasts for two months. For the 2003 sample, the response of output displays small significant differences compared to RR for only two months as well. For prices, the response is significantly weaker at longer horizons in the 1996 sample. The ALFRED / SPF point estimates are above the upper RR CI band for the final five months. There are no significant differences in prices for the 2003 sample. Like the SPF specification, the own effect of monetary policy from the ALFRED / SPF specification shows a significantly smaller response. Figure

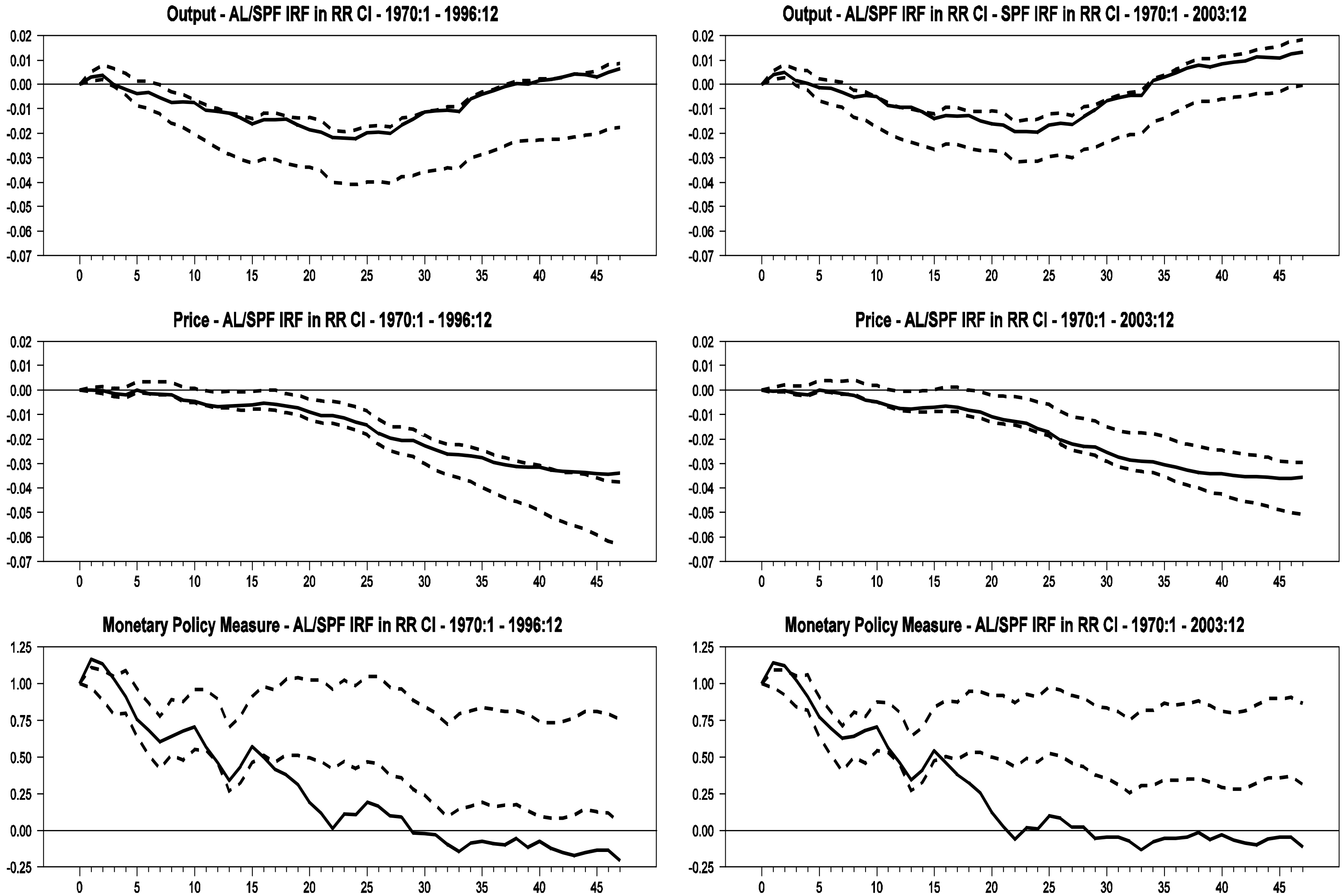


Figure 2.25 – Comparison of Romer-Romer and ALFRED / SPF Specification VAR IRF's

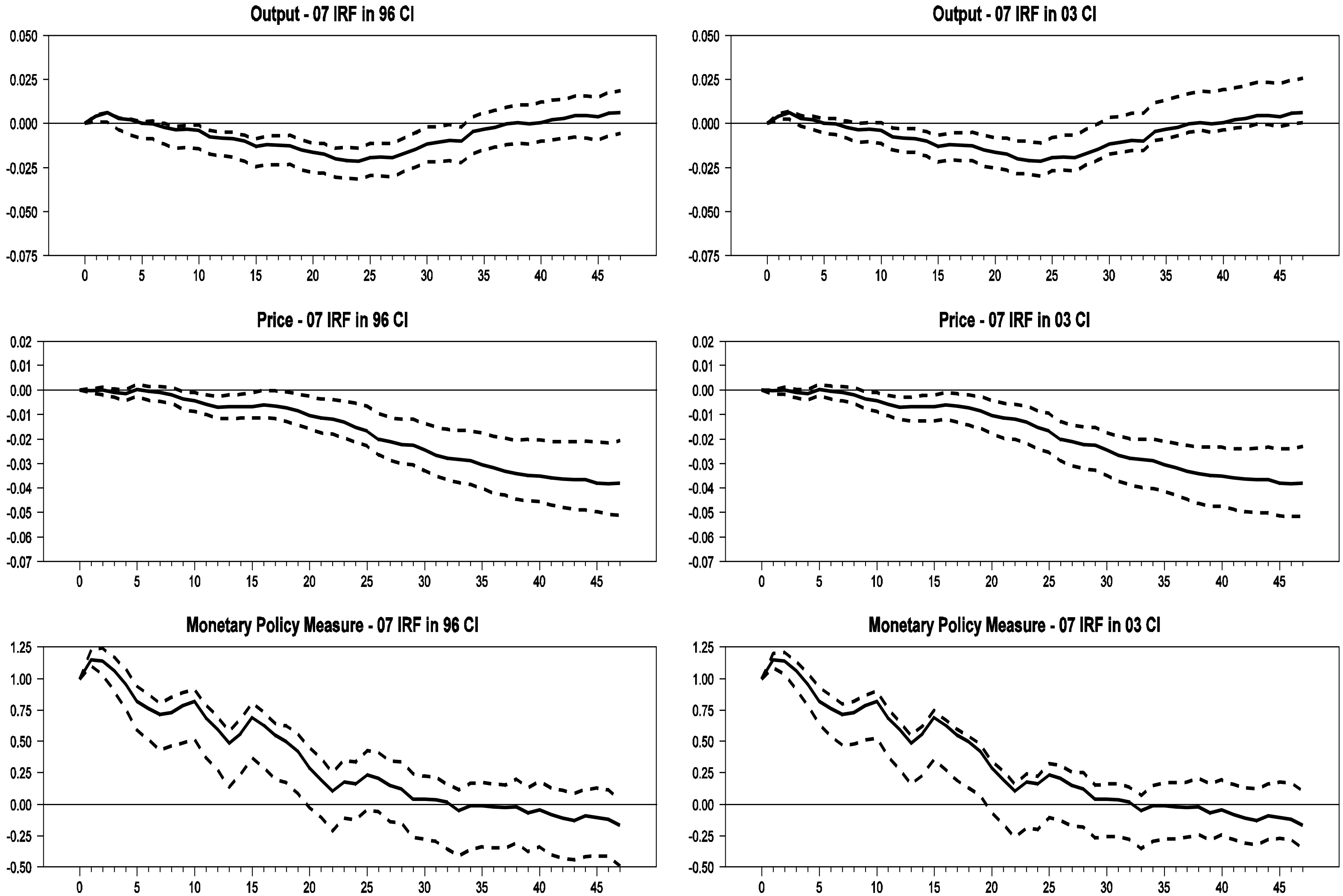


Figure 2.26 – Comparison of ALFRED / SPF Specification VAR IRF's

4.26 shows that updating the sample to 2007 produces point estimates that lie within the CI bands for each sample.

Looking at the own effect of monetary policy in the VARs, using only the SPF, as well as ALFRED with the SPF, to obtain shocks produce responses in the VARs that are significantly weaker than those of RR. Chapter 2 showed that for both the 1996 and 2003 samples, the own effect of monetary policy was significantly positive at all horizons in the original RR results. This result suggests that a contractionary monetary policy shock is not reversed after four years. The standard VAR literature is not in line with this result. However, the SPF and ALFRED / SPF results show that as output and prices begin to fall from a contractionary shock, the Federal Reserve begins to reverse the effects. The own effect of monetary policy becomes insignificant at intermediate horizons. These results are more in line with the VAR literature.

4.6.3 BCI Specification

The IRF's for the responses of output and prices, for all three samples, to a one percentage point contractionary monetary policy shock obtained from using only the BCI composite indexes are shown in Figure 4.27.

When using only the composite indexes of the BCI to obtain a measure of monetary policy shocks, the responses of output are weaker compared to the RR results by approximately one percentage point. The general patterns are the same with the point estimates returning in the direction of the origin but the CI bands do return to zero for any sample. The responses of prices are out of line with economic theory. For all samples, the point estimates become negative approximately three years after the shock and are occasionally significant. Significant price puzzles exist in each sample at very early horizons and the negative response is never significant, with the exception of the 2007 sample which shows a significant negative response for the last two months. The maximum responses of output and price are shown in table 4.41. Comparing the maximum effects to RR in the 1996 and 2003 samples, the maximum effects on output from the BCI specification are 1.1 percentage points smaller for the 1996 sample and 0.6 percentage points larger for the 2003 sample.

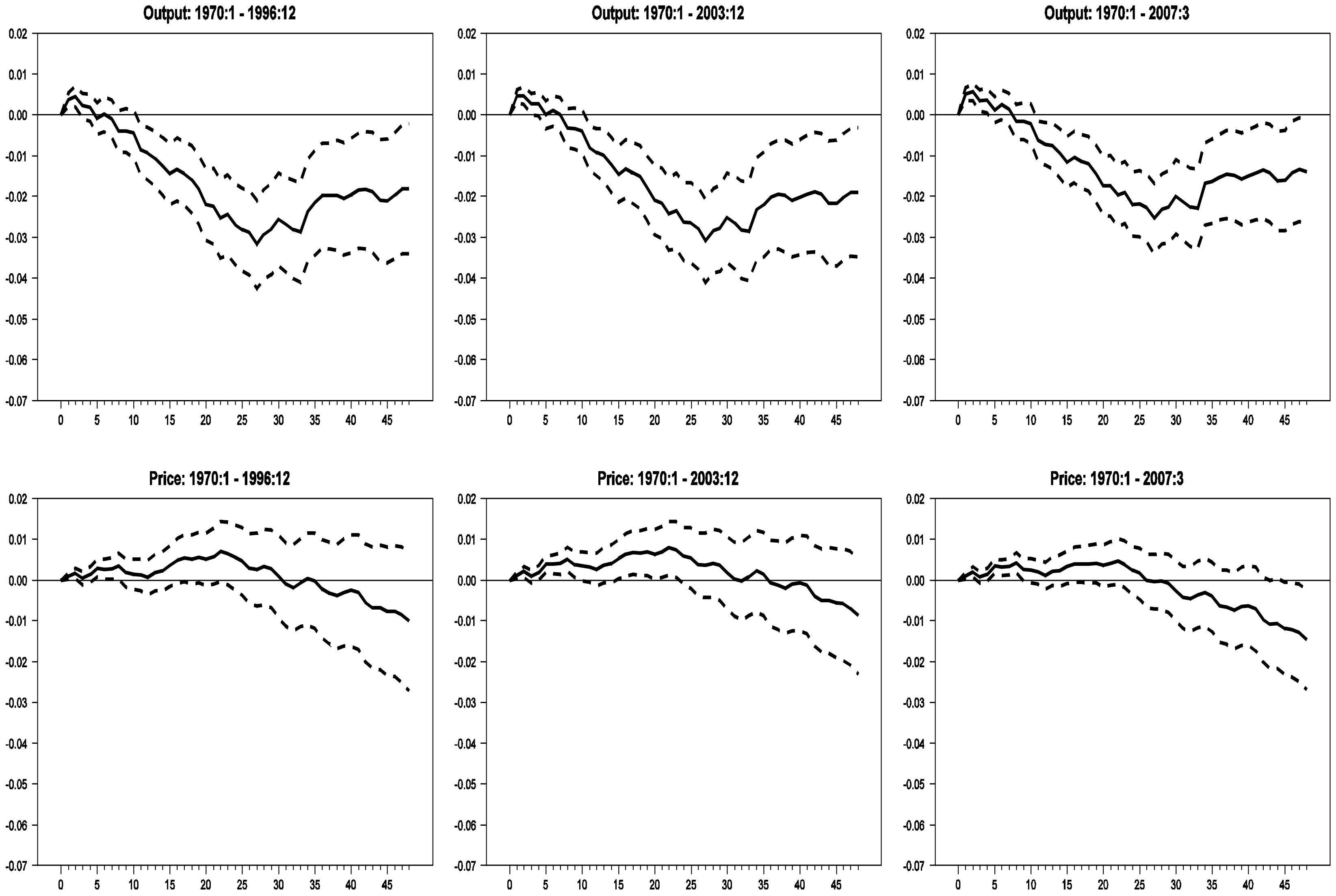


Figure 4.27 – Single Equation Impulse Response Functions: BCI Specification

Table 4.41 - Comparison of Maximum Effects – Single Equation IRF's – BCI Specification

	BCI Maximum Effect on Output	RR Maximum Effect on Output	BCI Maximum Effect on Prices	BCI Maximum Effect on Prices
1996 Sample	-3.2%	-4.3%	-1.0%	-5.9%
2003 Sample	-3.1%	-3.7%	-0.9%	-5.2%
2007 Sample	-2.5%	NA	-1.5%	NA

While the maximum responses in output are similar, albeit somewhat smaller, compared to RR and the previous SPF and ALFRED / SPF specifications, the maximum effects of prices are much smaller. Compared to RR, the maximum effect on prices is 4.9 percentage points smaller for the 1996 sample and 4.3 percentage points smaller for the 2003 sample.

Figure 4.28 illustrates comparisons between IRF's obtained from RR and the BCI specification for the original sample and extended sample to 2003. Figure 4.29 shows the comparison between the point estimates for the 2007 sample output and price responses to the CI bands obtained when using the alternative specification in previous samples.

Figure 4.28 shows slightly significant temporary differences in output. For the 1996 sample, the response of output lies slightly above the upper RR CI band for the early months. The response of output becomes significantly smaller in the 2003 sample at intermediate horizons but this difference is small and transitory. The poor performance of the BCI shocks when computing the response of prices leads to large significant differences approximately twenty months after the shock. The response of prices is significantly weaker at intermediate and later horizons. Updating the measure to 2007 does not lead to any significant differences in the responses output or prices when compared with the earlier sample BCI specification results, as shown in 4.29

Next, the residuals from the BCI specification were cumulated and placed into the standard three-variable VAR as the measure of monetary policy. The IRF's for all three samples are shown in figure 4.30.

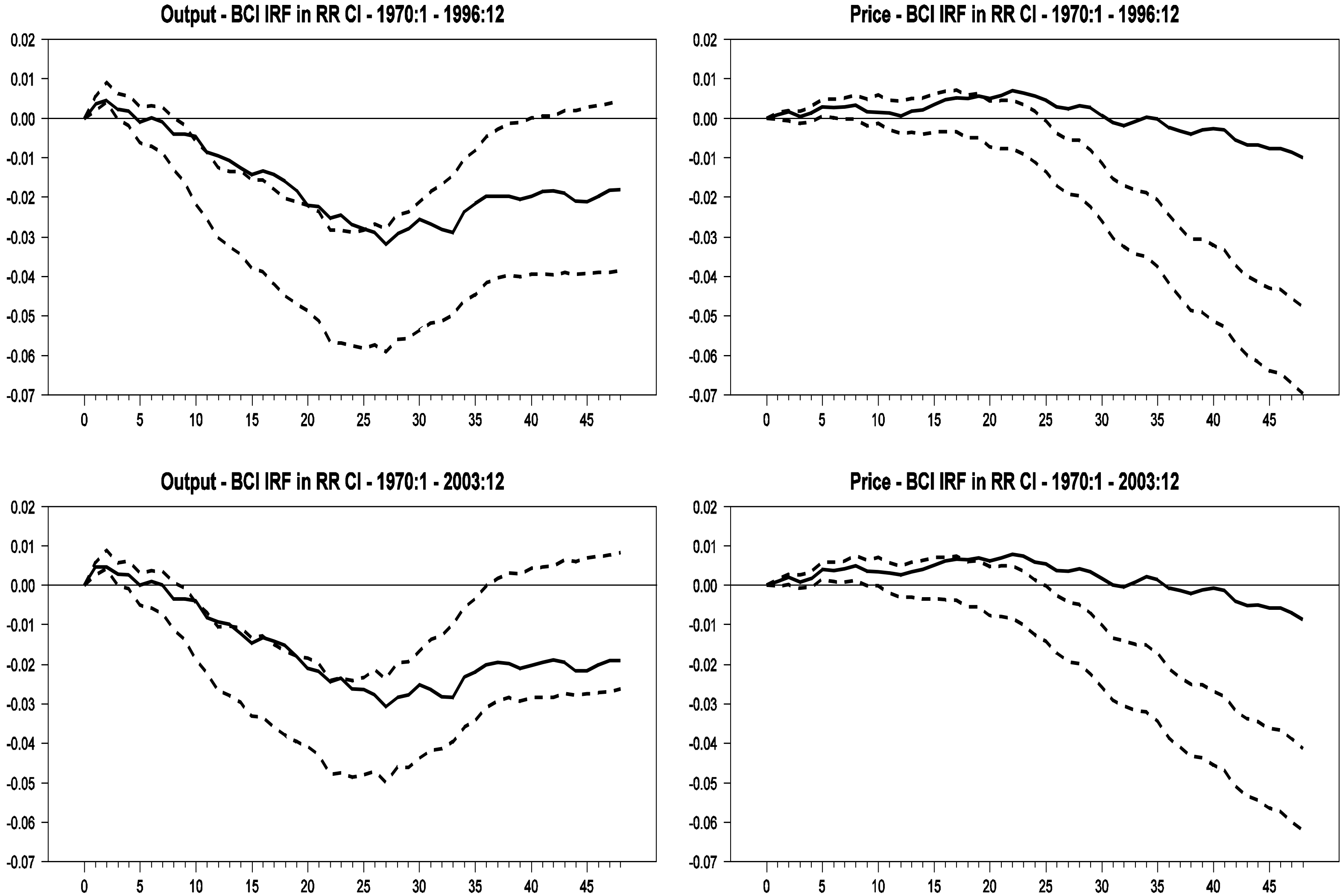


Figure 4.28 – Comparison of Romer-Romer and BCI Specification Single Equation IRF's

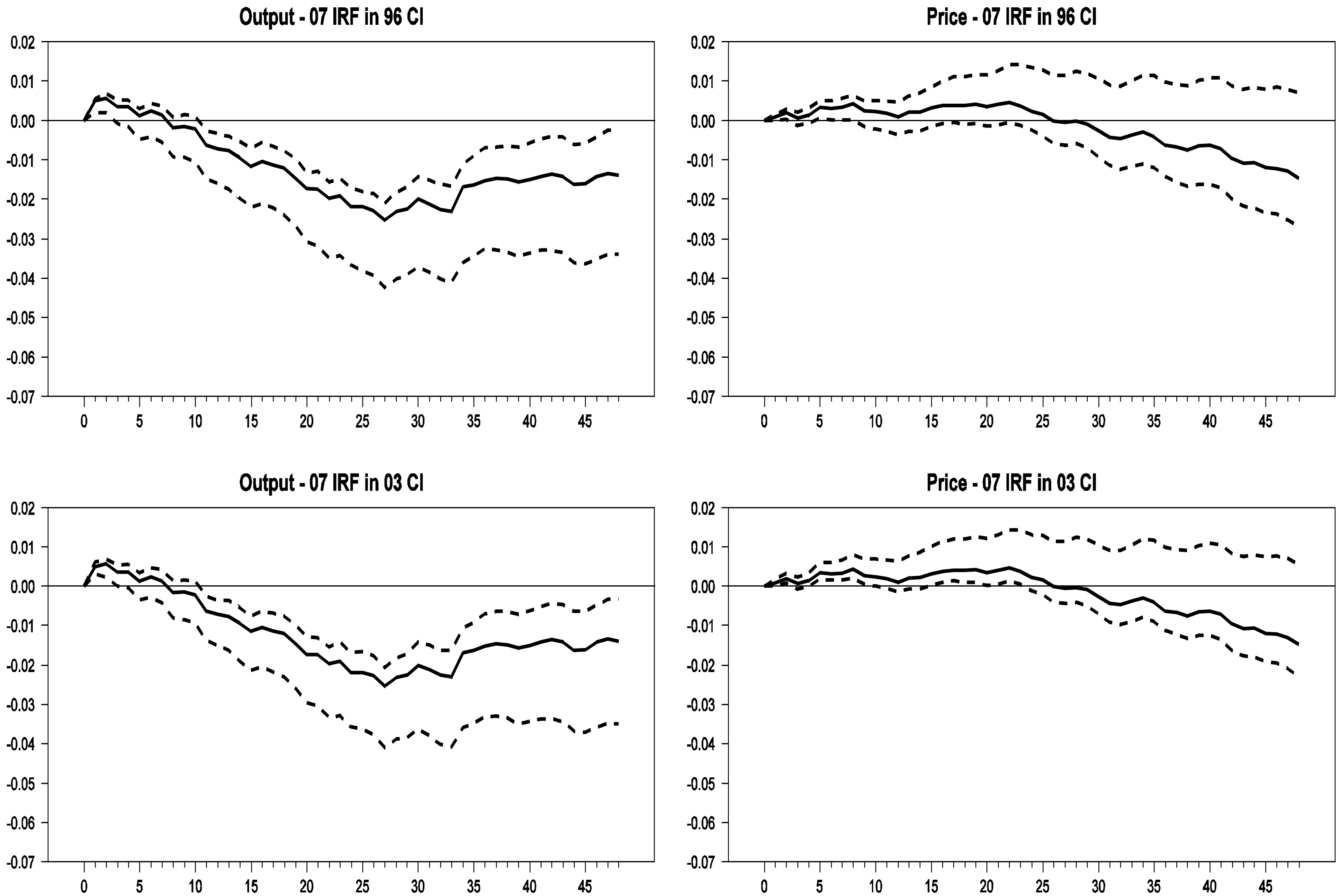


Figure 4.29 – Comparison of Romer-Romer and BCI Specification Single Equation IRF’s

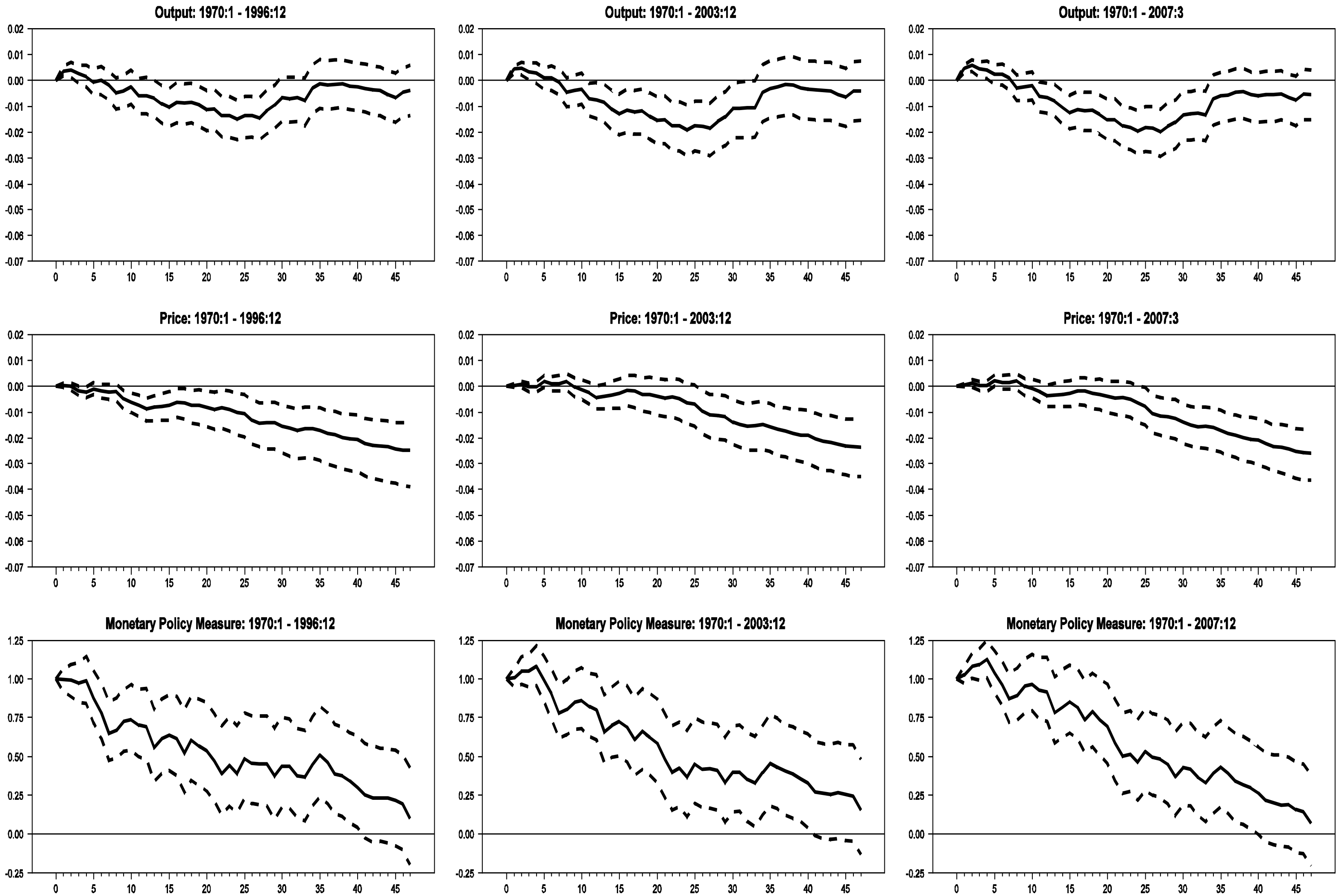


Figure 4.30 – VAR Impulse Response Functions: BCI Specification

The VAR produces responses that are similar to RR for output but smaller for price for the 1996 (2003) [2007] sample. The negative response of output becomes significant fourteen (eleven) [eleven] months after the shock in and the CI bands span zero thirty (thirty-four) [thirty-four] months after the shock. The response of prices becomes negative after three months in the 1996 and 2003 samples, and nine months after the shock for the 2007 sample. The response becomes significant nine (twenty -six) [twenty-five] months after the shock. Extended the sample decreases the significance of the BCI responses of price.

The magnitude of the maximum effect on output is much smaller compared to RR in the 1996 sample and only slightly smaller for the 2003 sample. The RR maximum effect on output is 1.4 percentage points larger for the 1996 sample and 0.4 percentage points larger for the 2003 sample, compared to the BCI specification. The maximum effect on prices at longer horizons is much larger in both samples with RR's being 2.3 for the original sample and 1.6 percentage points larger of both 2003 sample specifications. The maximum effects are shown in Table 4.42.

Table 4.42 - Comparison of Maximum Effects – VAR Equation IRF's – BCI Specification

	BCI Maximum Effect on Output	RR Maximum Effect on Output	BCI Maximum Effect on Prices	RR Maximum Effect on Prices
1996 Sample	-1.5%	-2.9%	-2.5%	-4.8%
2003 Sample	-1.9%	-2.3%	-2.3%	-3.9%
2007 Sample	-2.0%	NA	-2.6%	NA

Once again the own effect of the monetary policy show is much shorter lived compared to RR. The CI bands span zero forty months after the shock for all samples.

Figure 4.31 plots point estimates obtained from the BCI specification and the CI bands from the RR specification for the original sample and 2003 sample. Figure 4.32 plots the point estimates from the 2007 sample and the BCI specification CI bands from the 1996 and 2003 samples.

Figure 4.31 shows that the response of output from the BCI specification is significantly weaker at intermediate horizons for both samples. In the 1996 sample, the response in output is above the RR CI bands for approximately thirty months. At longer horizons, the response of output is significantly at very

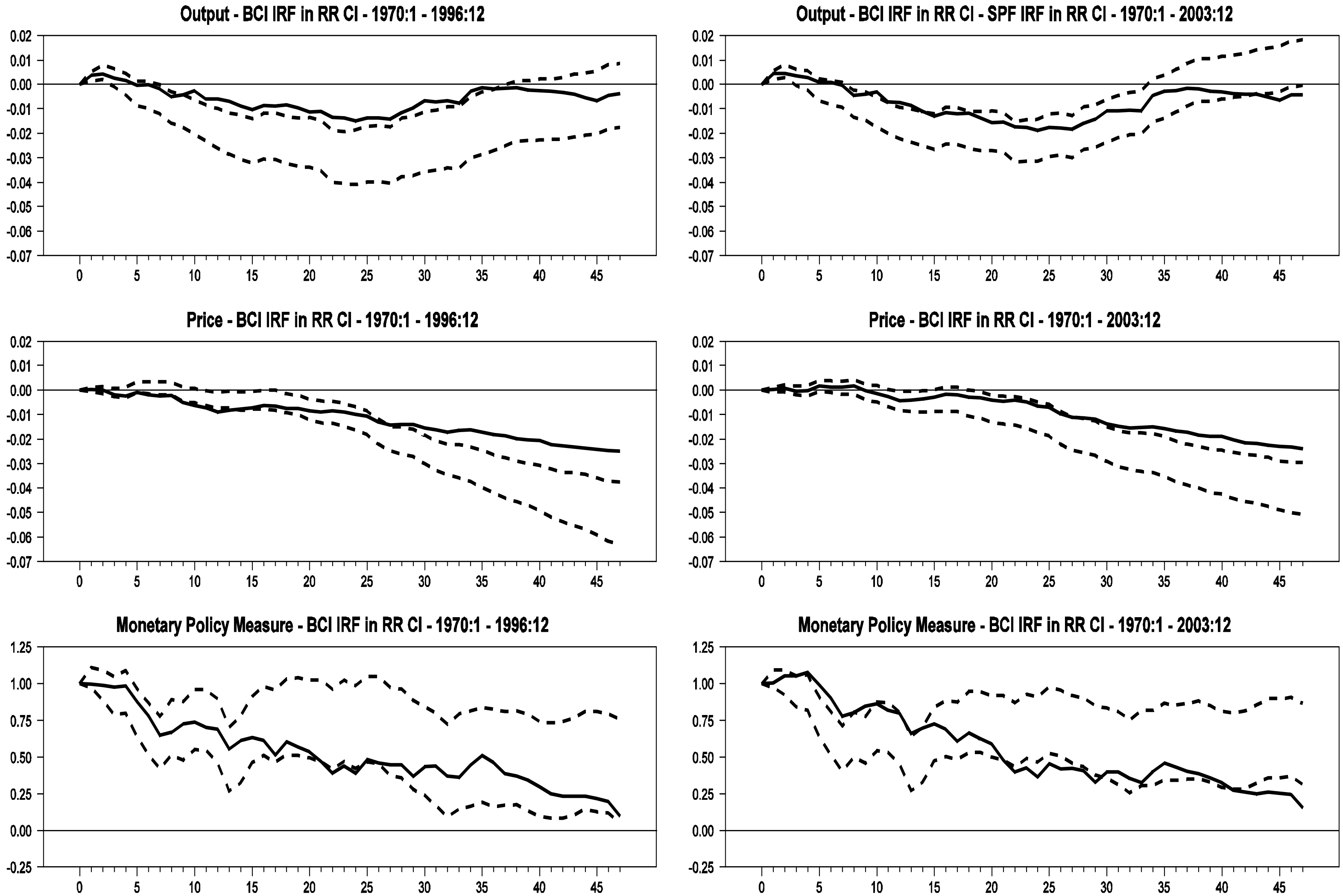


Figure 4.31 – Comparison of Romer-Romer and BCI Specification VAR IRF's

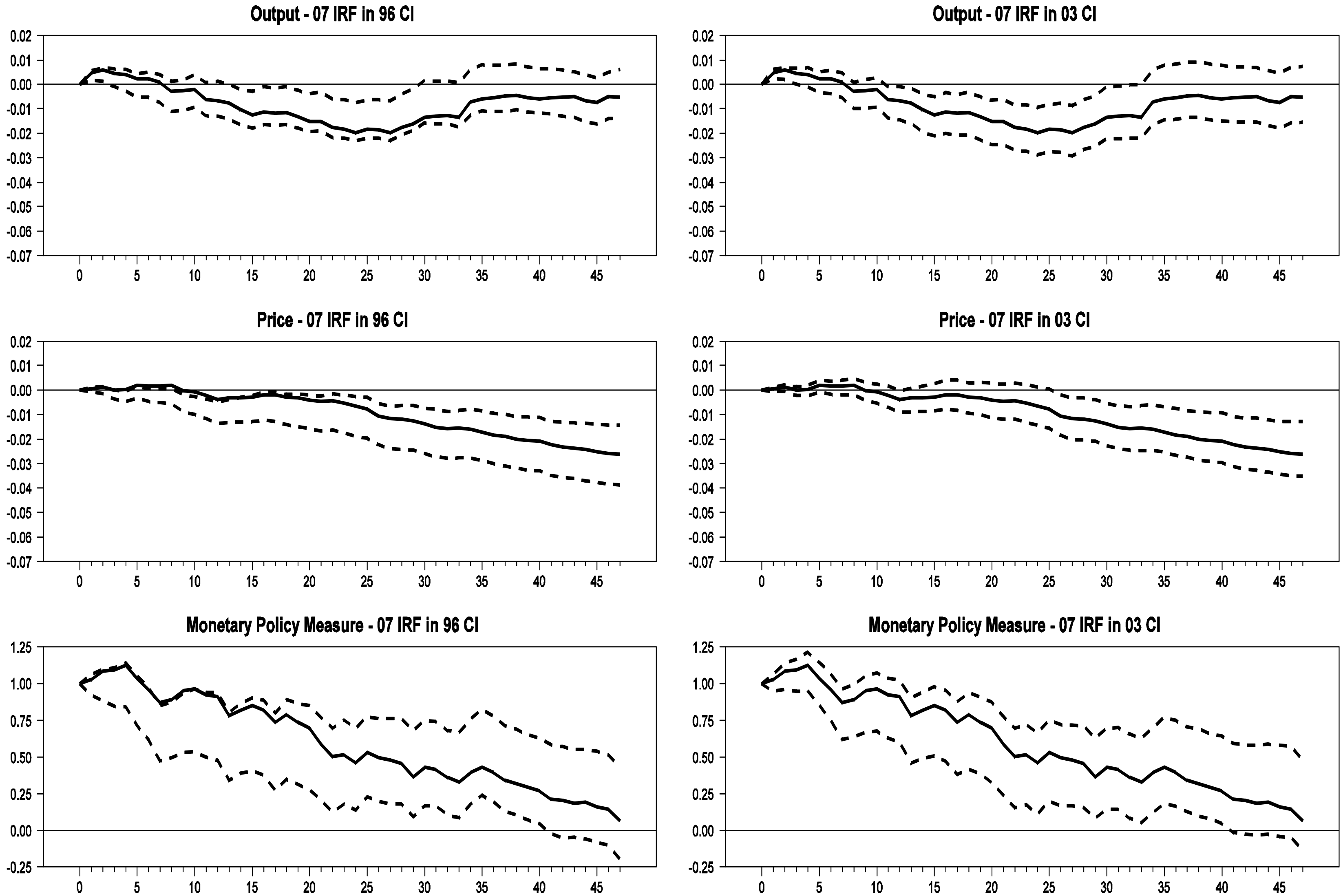


Figure 4.32 – Comparison of BCI Specification VAR IRF’s

long horizons in the 2003 sample. The response of prices is significantly weaker beginning approximately thirty months after the shock in both samples. The 1996 sample shows the BCI response in prices is significantly stronger at early horizons. The response of monetary policy in the 2003 sample is significantly stronger at early horizons before becoming significantly weaker at intermediate and longer horizons.

Extending the sample to 2007 produces a response in prices that is significantly weaker at early horizons, compared to the 1996 sample response. There are also slightly significant differences in the monetary policy measure. The 2007 response is slightly above the 1996 CI bands for a few months at early horizons. There are no other significant differences in Figure 4.32.

4.6.4 BCI / SPF Specification

Figure 4.33 shows the IRF's for output and prices that follow from a one percentage point contractionary shock in the series created from the BCI / SPF specification, when the difference in forecast variables are omitted.

As can be seen from Figure 4.33, the general pattern of effects on output is comparable to the effects of the previous specifications. For the 1996 and 2003 samples, the maximum effect is felt in the same month as the RR equation and the magnitude of the maximum effects are similar. The point estimates return towards the origin and the confidence bands span zero forty-one months after the shock for the 1996 sample, thirty-six months after the shock for the 2003 sample, and thirty-five months after the shock in the 2007 sample. For the sample ending in 2007, the point estimates reveal that the maximum decline in output occurs at the same horizon as in the previous samples, but the point estimates appear to be slightly smaller.

For prices, Figure 4.33 reveals a similar pattern of effects for the alternative shock to the effects of monetary policy shocks derived from RR equation. However, for the 1996 and 2003 samples, the effect of monetary policy shocks derived from the BCI / SPF equation becomes significant with a longer lag than for shocks derived from the RR equation, especially for the original sample, and the effect also appears to be somewhat weaker, again more so in the original sample. For the sample ending in 2007,

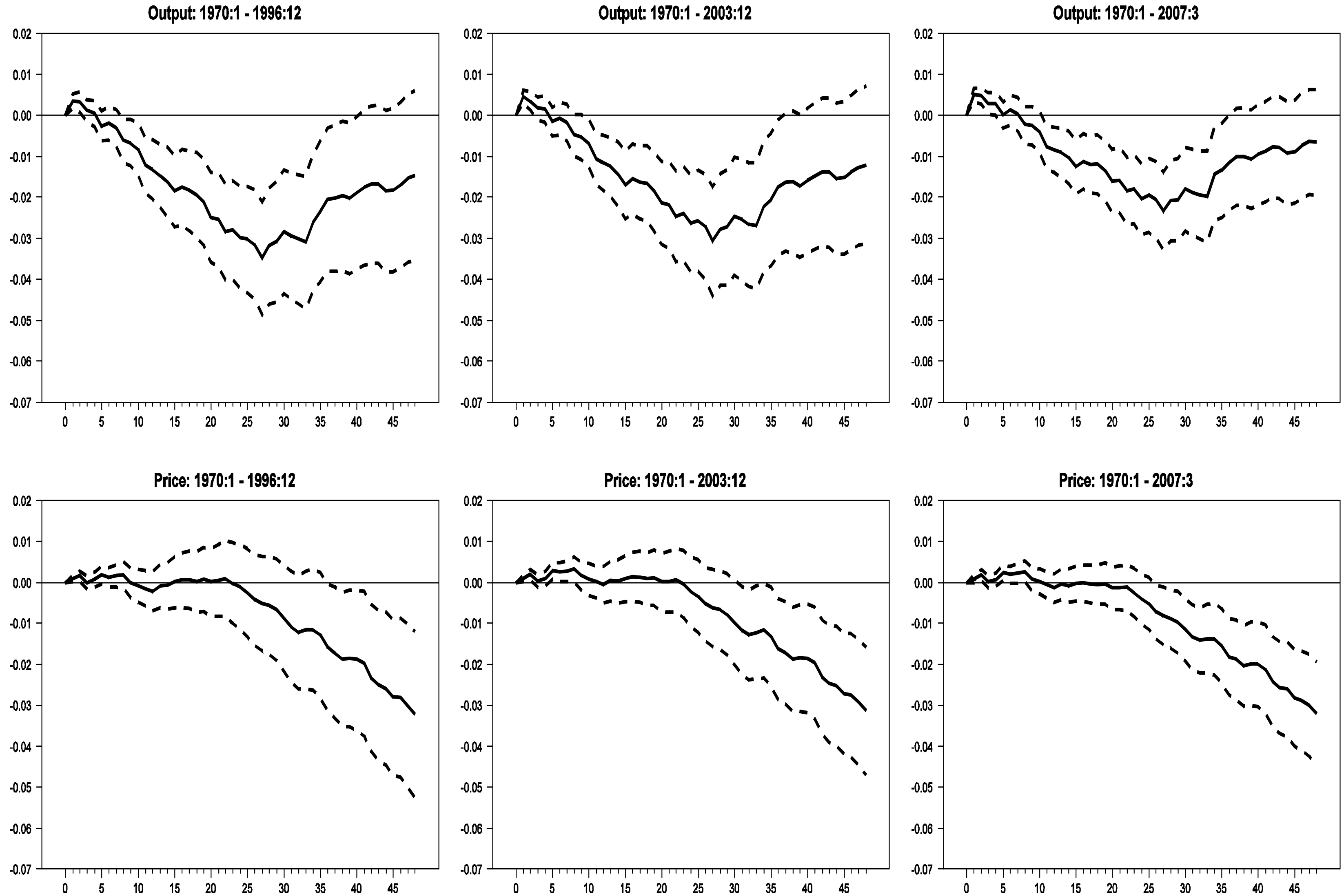


Figure 4.33 – Single Equation Impulse Response Functions: BCI / SPF Specification

Figure 4.33 reveals that the effect of a policy shock derived from the alternative equation becomes negative and significant at a shorter horizon than in the earlier samples, but the maximum effect is the same as the 1996 sample and 0.1 percentage points larger than the 2003 sample.

Comparing the maximum effects to RR, Table 4.43 shows that the maximum effects on output from the BCI/SPF specification are 0.8 percentage points smaller for the 1996 sample and 2.4 percentage points smaller for the 2003 sample. The maximum effects on prices are also much smaller. The maximum effect on prices is 2.7 percentage points smaller for the 1996 sample and 2.1 percentage points smaller for the 2003 sample.

Table 4.43 -Comparison of Maximum Effects – Single Equation IRF's – BCI/SPF Specification

	BCI/SPF Maximum Effect on Output	RR Maximum Effect on Output	BCI/SPF Maximum Effect on Prices	RR Maximum Effect on Prices
1996 Sample	-3.5%	-4.3%	-3.2%	-5.9%
2003 Sample	-3.1%	-3.7%	-3.1%	-5.2%
2007 Sample	-2.3%	NA	-3.2%	NA

Figures 4.34 compares the responses of output and price with the RR CI bands while 4.35 compares the responses from the BCI / SPF specification policy shocks when the sample is updated to 2007 to the CI bands when the alternative BCI / SPF specification is used in earlier samples.

Looking at output in Figure 4.34, the point estimates of the IRF for monetary policy shocks derived from the BCI / SPF equation in the original and 2003 samples lie within the confidence intervals from RR at all horizons. Overall, the results suggest that the estimates of the effects of monetary policy shocks on output growth do not appear to be significantly different for the two methods of generating policy shocks for the two samples.

The responses of prices show the point estimates for the policy shocks from the alternative equation lie above the upper bound of the confidence intervals from the RR results at longer horizons for the original sample twenty-seven months after the shock. The difference between the price IRF from the BCI / SPF specification and the RR upper CI band is smaller for the 2003 sample. The point estimates begin to lie above the RR CI bands beginning thirty-one months after the shock.

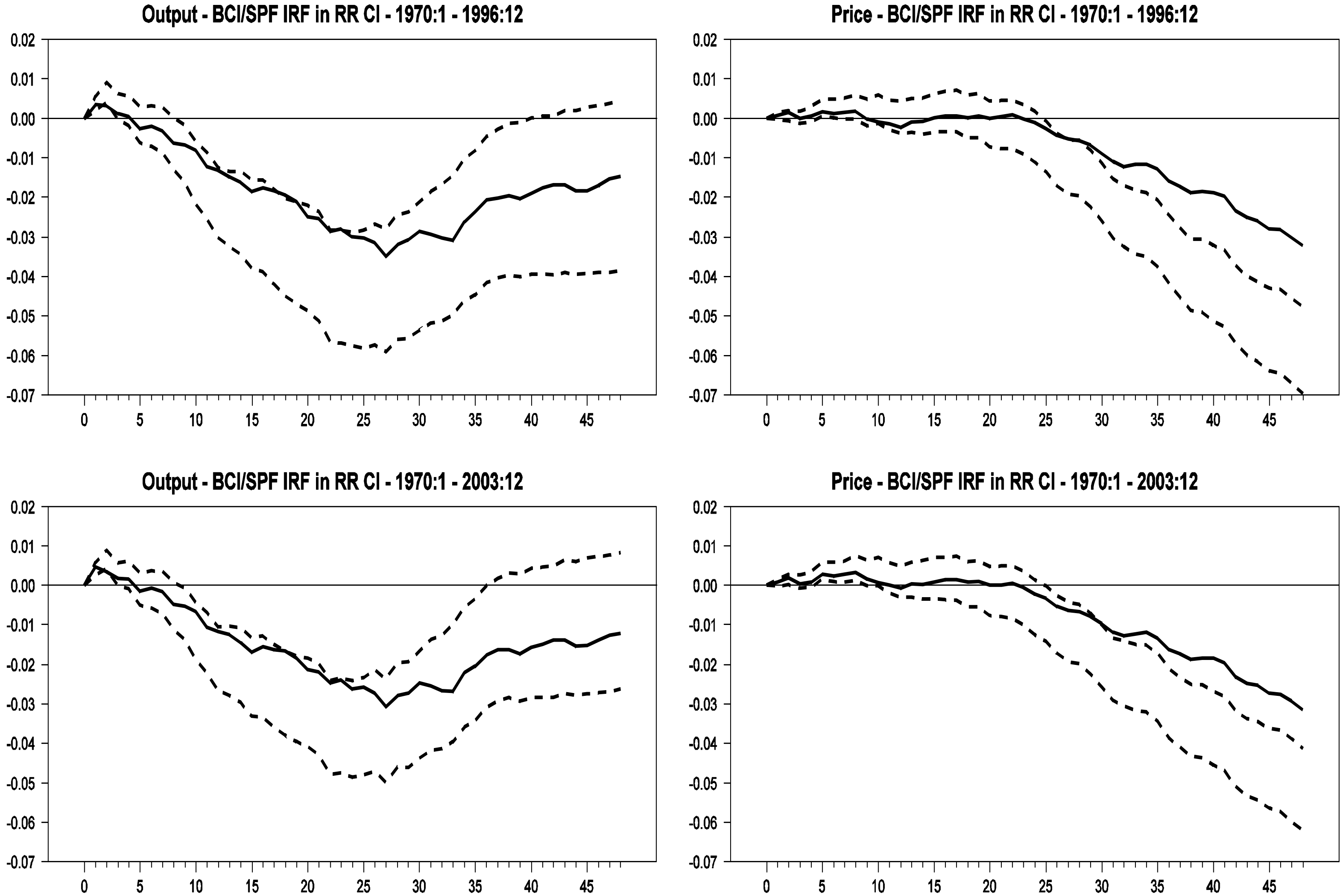


Figure 4.34 – Comparison of Romer-Romer and BCI / SPF Specification Single Equation IRF’s

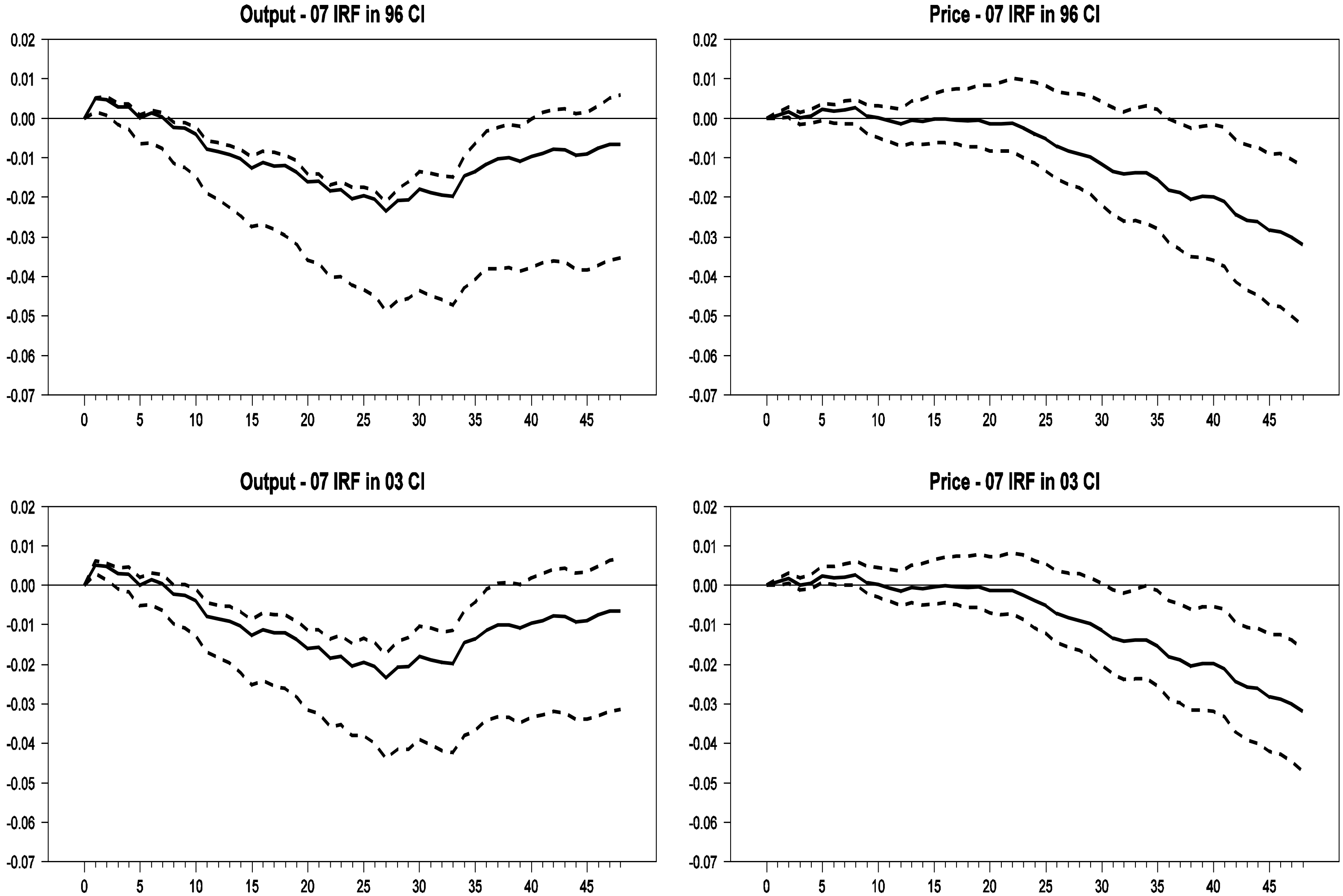


Figure 4.35 – Comparison of BCI / SPF Specification Single Equation IRF's

From Figure 4.35, the point estimates for output and prices from the 2007 sample lie within the confidence intervals for the BCI / SPF specification for the 1996 and 2003 samples. While the responses are not significantly different, the response of output appears weaker when the sample is expanded to 2007. The responses are very close to the upper CI bands for both samples at all horizons.

The residuals from the BCI / SPF specification were cumulated and placed into the standard three-variable VAR as the measure of monetary policy. The IRF's for all three samples are shown in figure 4.36.

The VAR produces responses that are smaller compared to RR for both output and prices for the 1996 (2003) [2007] sample. The response of output becomes negative four (five) [eight] months after the shock. The negative response of output becomes significant eleven months after the shock for all three samples and the CI bands span zero thirty (twenty-nine) [thirty] months after the shock. The response of prices becomes negative three months after the shock in the 1996 and 2003 samples. The negative response is no longer transitory nine months after the shock for the 2007 sample. The response becomes significant nine (ten) [ten] months after the shock. In the 2003 and 2007 samples, the response of the monetary policy instrument is significant at all horizons after the initial one percentage point increase. In the 1996 sample, the response becomes insignificant in the last month. Much like RR's cumulated measure, the BCI / SPF specification produces a monetary policy measure that experiences a very long own effect for monetary policy.

The RR maximum effect on output is 1.3 percentage point larger for the 1996 sample and 0.9 percentage points larger for the 2003 sample, compared to the BCI / SPF specification. The maximum effect on prices at longer horizons is smaller in both samples with RR's being 1.4 percentage points higher for the 1996 sample and 0.5 percentage points larger for both 2003 sample RR specifications. The maximum effects are displayed in Table 4.44.

The BCI / SPF point estimates were plotted with the RR CI bands for both samples in Figure 4.37. In Figure 4.38, the BCI / SPF point estimates from the 2007 sample are plotted with the CI bands from the BCI / SPF CI bands from the 1996 and 2003 samples.

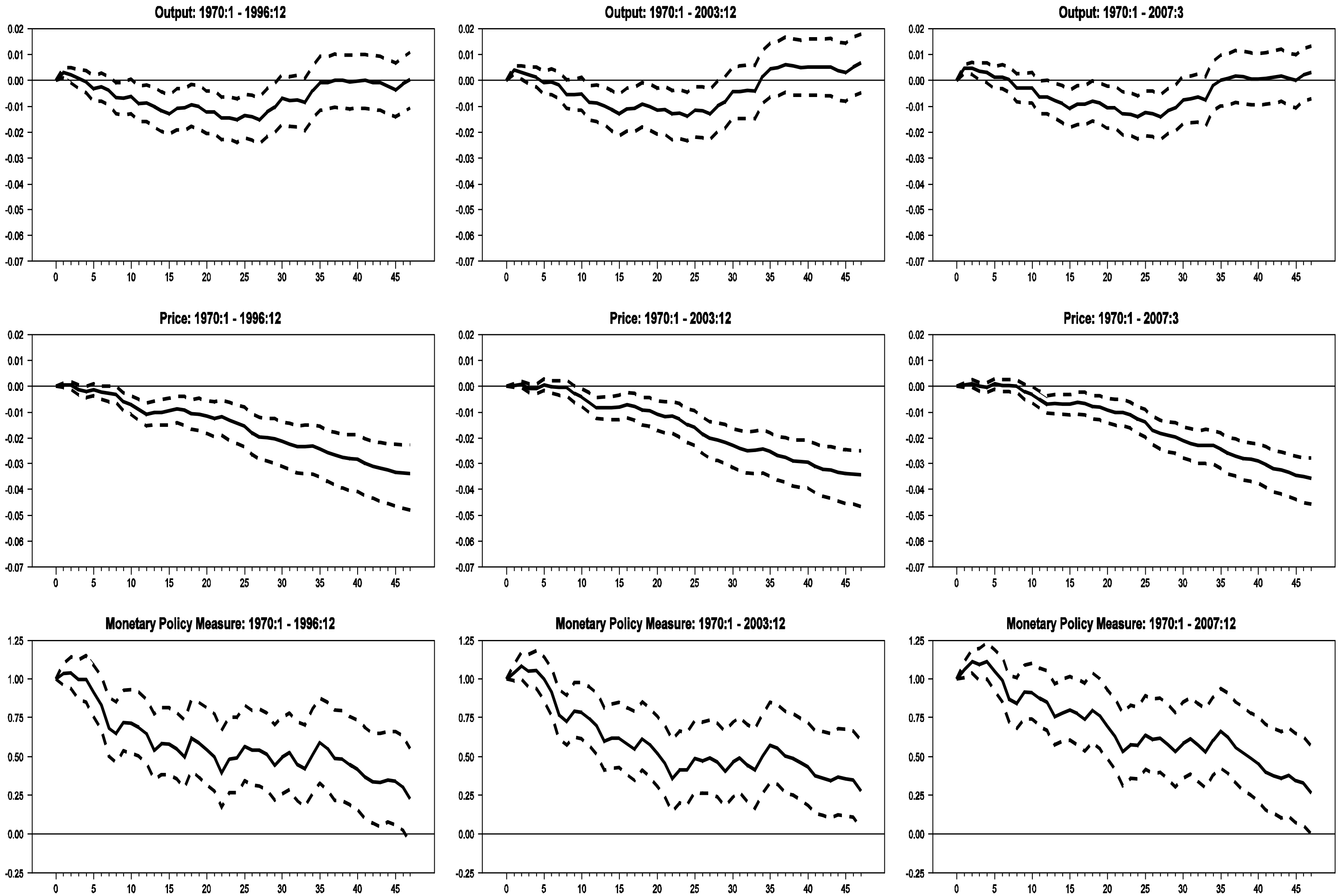


Figure 4.36 – VAR Impulse Response Functions: BCI / SPF Specification

Table 4.44 -Comparison of Maximum Effects – VAR Equation IRF's – BCI/SPF Specification

	BCI/SPF Maximum Effect on Output	RR Maximum Effect on Output	BCI/SPF Maximum Effect on Prices	RR Maximum Effect on Prices
1996 Sample	-1.6%	-2.9%	-3.4%	-4.8%
2003 Sample	-1.4%	-2.3%	-3.4%	-3.9%
2007 Sample	-1.4%	NA	-3.6%	NA

Figure 4.37 shows for the 1996 sample, the response of output is slightly above the RR CI bands at intermediate horizons. However, this difference becomes smaller in the 2003 sample and the responses are only slightly above the CI bands at intermediate horizons. For prices, the point estimates are below the RR CI bands at early horizons then above the CI bands for final months in the 1996 sample. The response of prices is completely contained in the RR CI bands in the 2003 sample. The own effect of monetary policy from the BCI / SPF specification shows no significant differences for the 1996 sample. The BCI / SPF response of monetary policy is significantly more contractionary at early horizons then significantly more expansionary at inter mediate and very long horizons. Figure 4.38 shows that updating the sample to 2007 produces point estimates that lie within the CI bands for each sample.

4.6.5 ALFRED / BCI / SPF Specification

The IRF's computed from the shocks where previous quarter values are replaced with ALFRED and SPF forecasts for output, inflation, and unemployment are used along with the BCI are shown in Figure 4.39.

These results are nearly identical to those using only BCI / SPF. The maximum response of output occurs in the same month as RR and the price IRF begins to lie outside the RR CI bands in approximately the same month. Once again, the response of output is somewhat weaker when the sample is updated to 2007. Compared to the 1996 and 2003 ALFRED / BCI / SPF results, the response of prices becomes permanently negative and significant with a much shorter lag when the sample is extended to 2007. Comparing the maximum effects shows that the differences are similar to the BCI / SPF Specification. The maximum effects are shown in table 4.45.

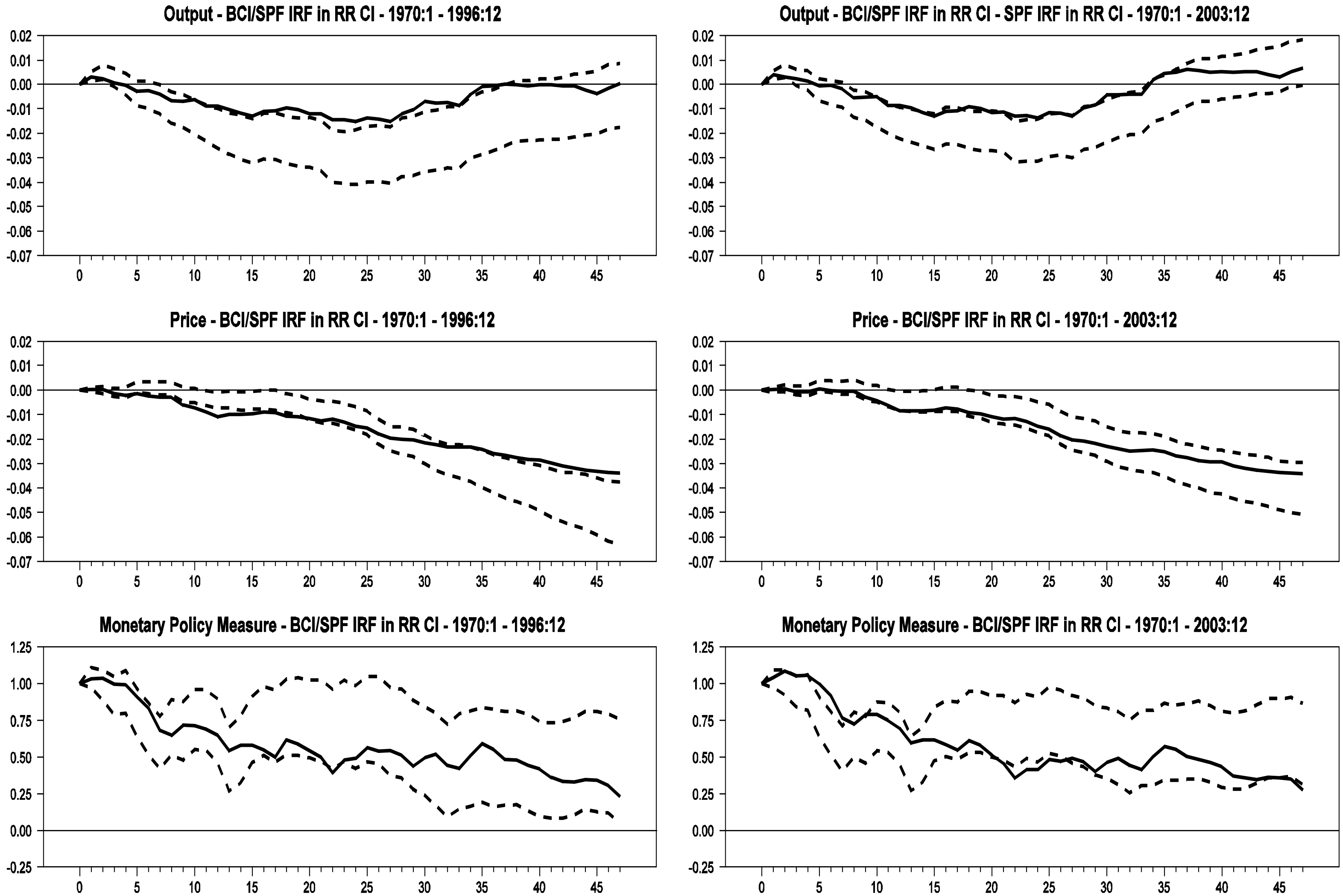


Figure 4.37 – Comparison of Romer-Romer and BCI / SPF Specification VAR Impulse Response Functions

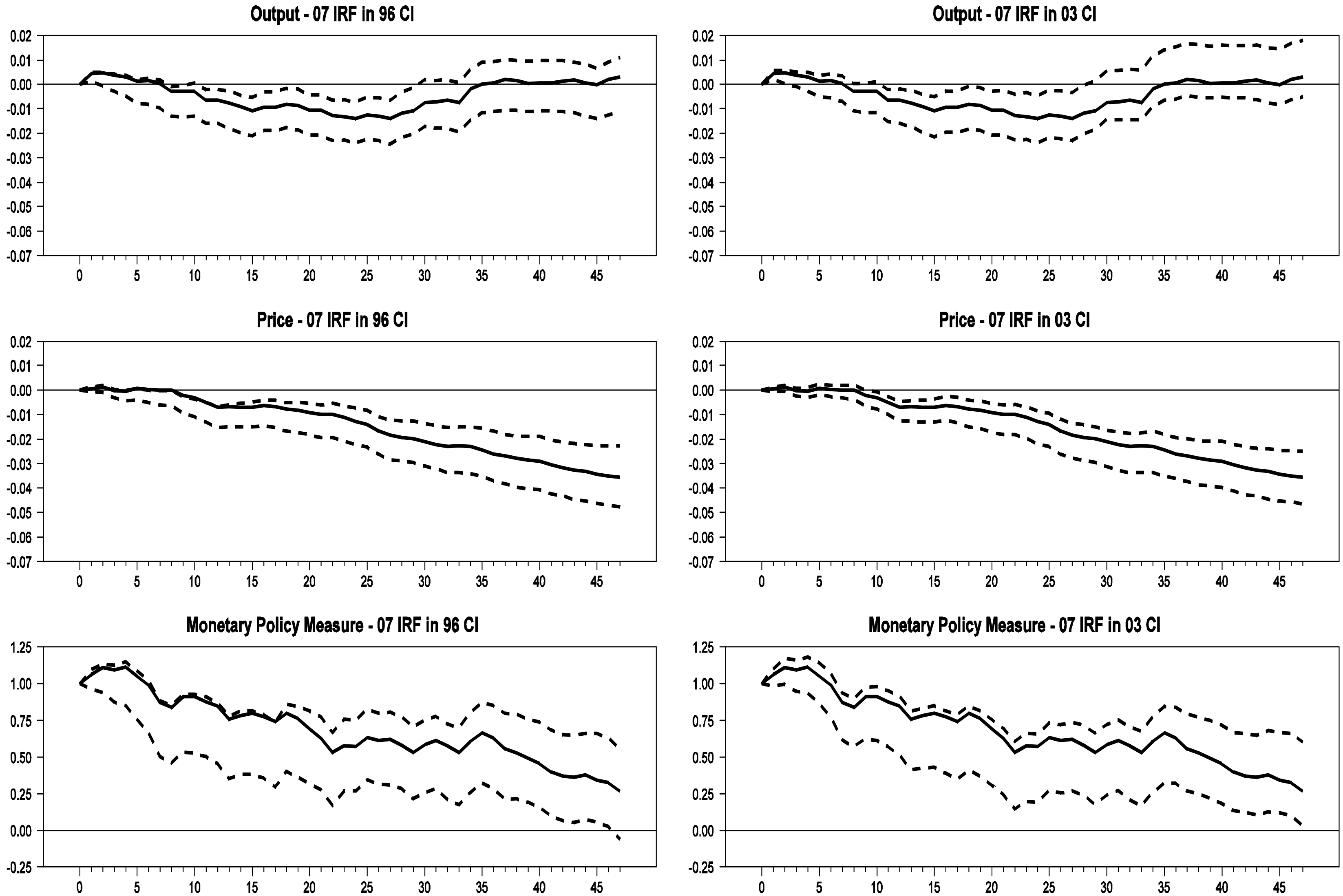


Figure 4.38 – Comparison of BCI / SPF Specification VAR Impulse Response Functions

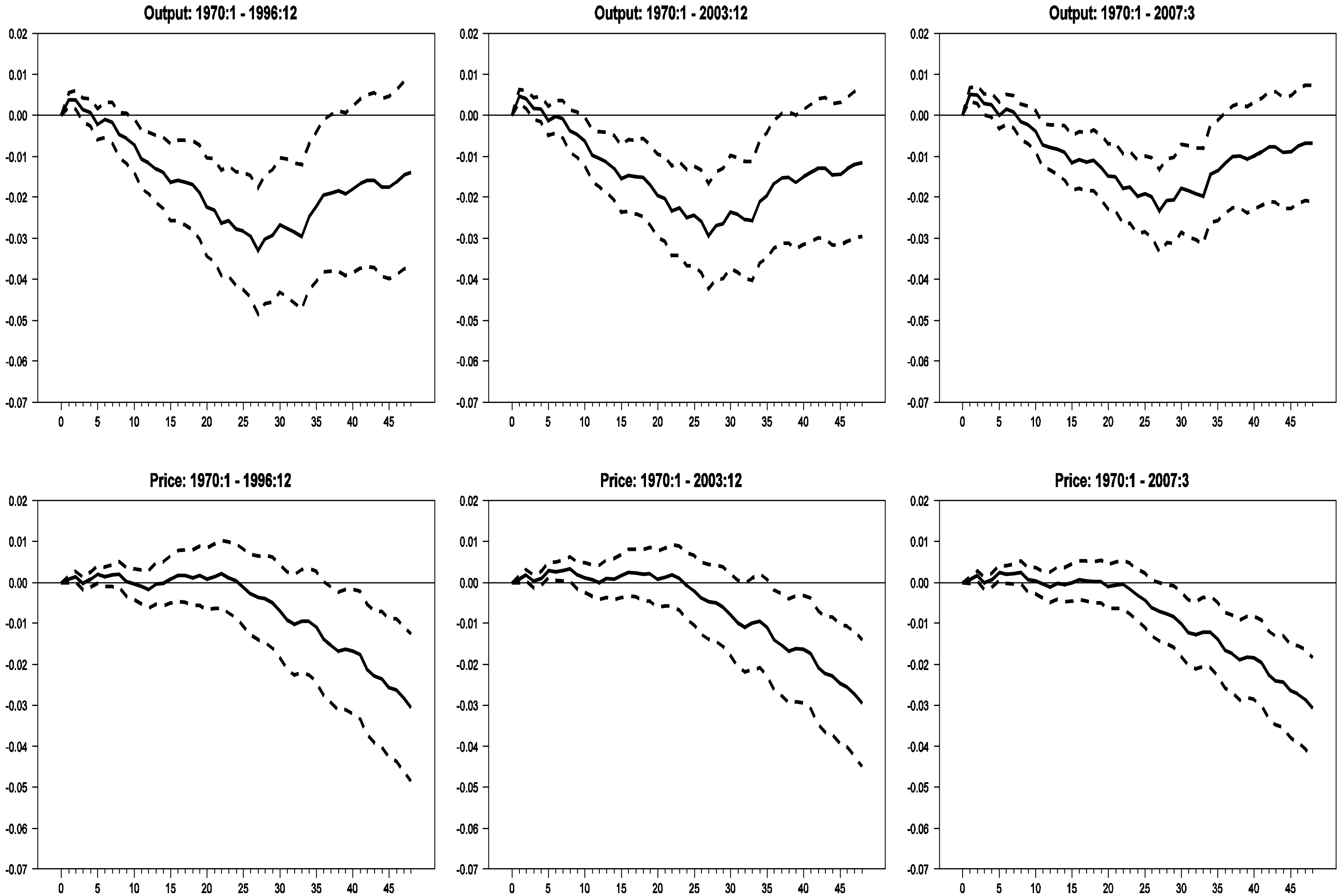


Figure 4.39 – Single Equation Impulse Response Functions: ALFRED / BCI / SPF Specification

Comparing the maximum effects to RR, the maximum effects on output from the ALFRED/BCI/SPF specification are 1.0 percentage points smaller for the 1996 sample and 0.7 percentage points larger for the 2003 sample. The maximum effect on prices from the ALFRED / SPF / BCI shocks is 2.9 percentagepoints smaller for the 1996 sample and 1.3 percentage points smaller for the 2003 sample, compared to those of RR.

Table 4.45 - Comparison of Maximum Effects – Single Equation IRF's – AL/BCI/SPF Specification

	AL/BCI/SPF Maximum Effect on Output	RR Maximum Effect on Output	AL/BCI/SPF Maximum Effect on Prices	RR Maximum Effect on Prices
1996 Sample	-3.3%	-4.3%	-3.0%	-5.9%
2003 Sample	-3.0%	-3.7%	-2.9%	-5.2%
2007 Sample	-2.3%	NA	-3.1%	NA

The comparisons with RR for the single equation IRFs's are shown in Figure 4.40. Figure 4.40 compares the responses of output and price with the RR CI bands while 4.41 compares the responses from the ALFRED / BCI / SPF specification policy shocks when the sample is updated to 2007 to the CI bands when the alternative ALFRED /BCI / SPF specification is used in earlier samples.

Unlike the BCI / SPF specification results, there are slight differences in output responses for the RR measure and this specification. The response in output is significantly weaker compared to RR, at intermediate horizons for both samples. However, the differences are very small and transitory. The long-term declines in prices are smaller compared to the RR results. These results are in line with what is seen when the BCI / SPF specification is used. Figure 4.41 shows there are no significant differences with the earlier responses when the sample is updated to 2007.

The residuals from the ALFRED / BCI / SPF specification were cumulated and placed into the standard three-variable VAR as the measure of monetary policy. The IRF's for all three samples are shown in figure 4.42.

The VAR produces responses that are smaller to RR for output and prices for the 1996 (2003) [2007] sample. The response of output becomes negative four (five) [eight] months after the shock and the

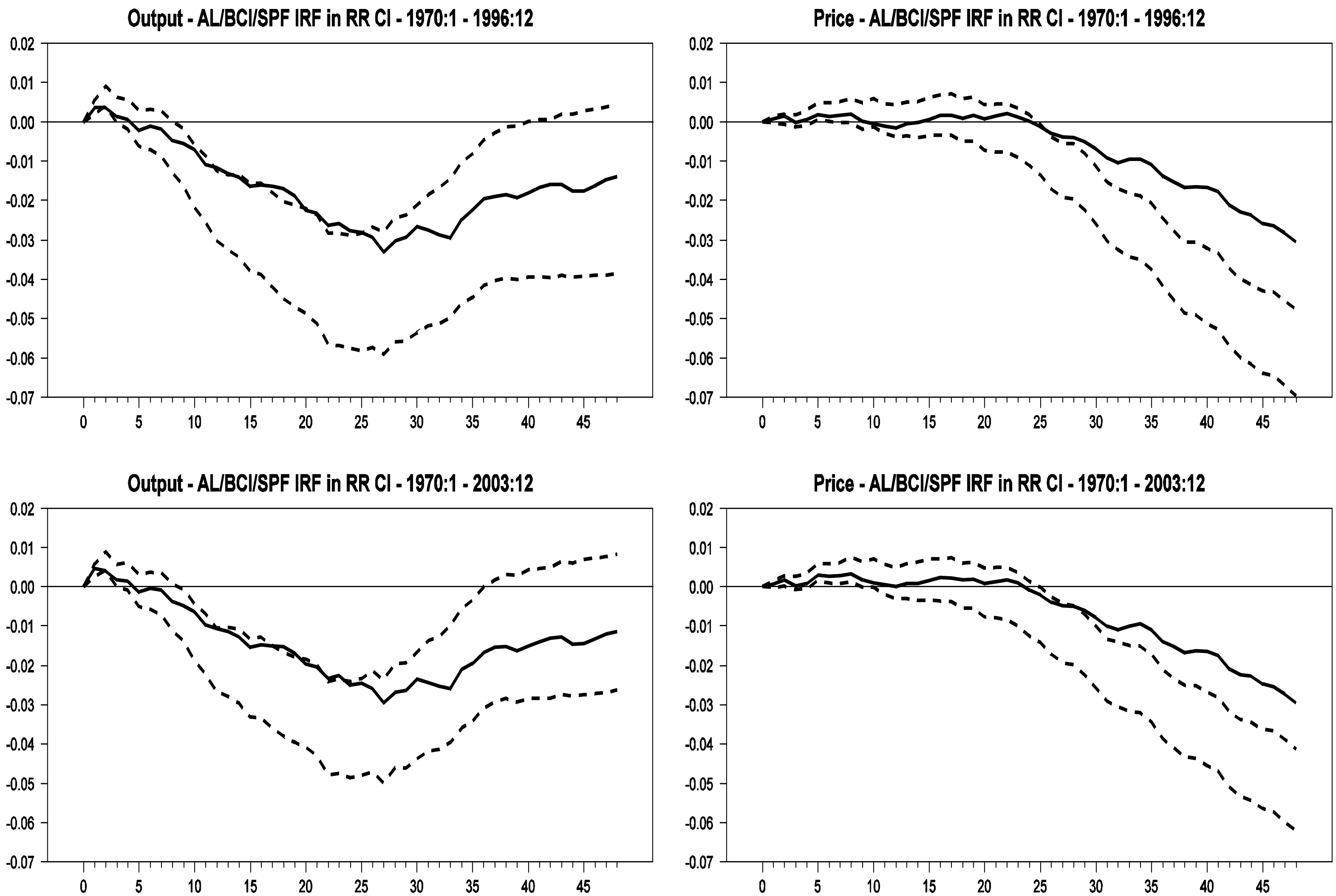


Figure 4.40 – Comparison of Romer-Romer and ALFRED / BCI / SPF Single Equation IRF’s

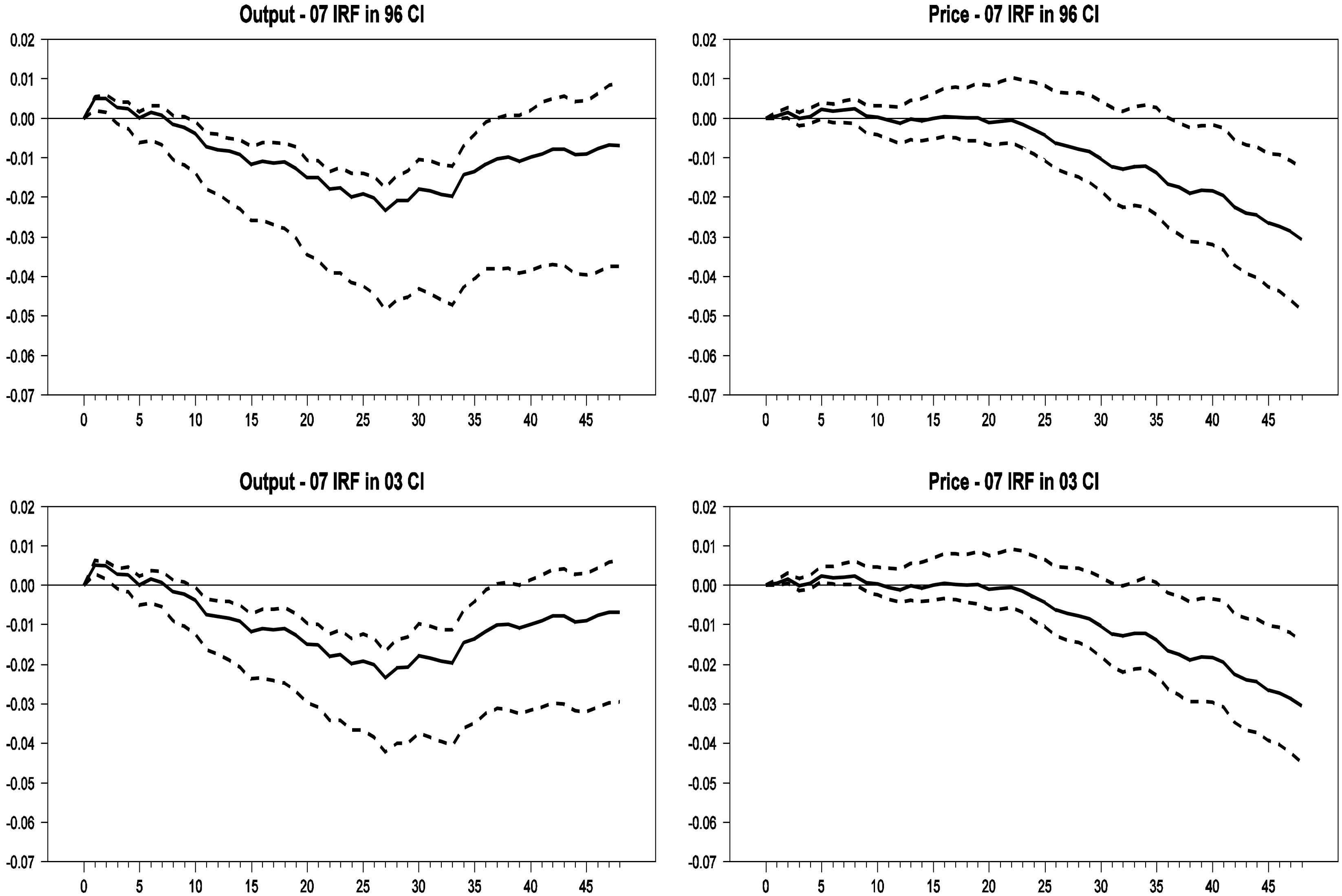


Figure 4.41 – Comparison of ALFRED / BCI / SPF Single Equation IRF's

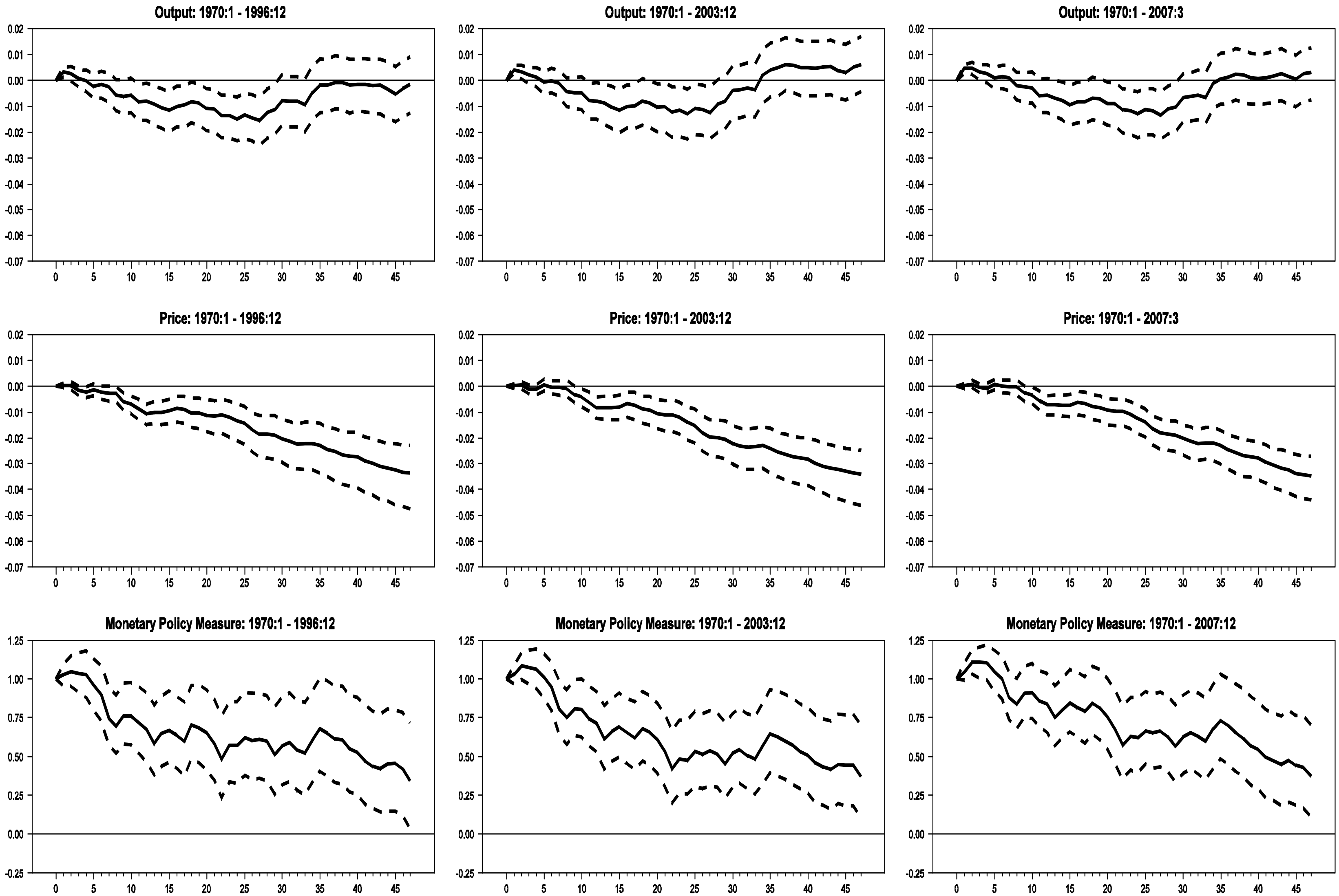


Figure 4.42 - VAR Impulse Response Functions: ALFRED / BCI / SPF Specification

negative response becomes significant eleven (eleven) [fourteen] months after the shock. The CI bands span zero thirty (twenty-eight) [thirty] months after the shock. The response of prices becomes negative three months after the shock in the 1996 sample. The response becomes permanently negative six months after the shock for the 2003 and 2007 samples. The response becomes significant seven (ten) [ten] months after the shock. The own effect of the monetary policy instrument produces CI bands that do not span zero in any sample. Once again the effects of monetary policy have long lived own effects.

The RR maximum effect on output is 1.4 percentage points larger for the 1996 sample and 1.0 percentage points larger for the 2003 sample, compared to the ALFRED / BCI / SPF specification. The maximum effect on prices at longer horizons is smaller in both samples with RR's being 1.4 percentage points higher for the 1996 sample and 0.5 percentage points larger for both 2003 sample RR specifications. These are the sample as what was found in the BCI / SPF specification. The maximum effects are displayed in Table 4.46.

Table 4.46 -Comparison of Maximum Effects – VAR Equation IRF's – AL/BCI/SPF Specification

	AL/BCI/SPF Maximum Effect on Output	RR Maximum Effect on Output	AL/BCI/SPF Maximum Effect on Prices	RR Maximum Effect on Prices
1996 Sample	-1.5%	-2.9%	-3.4%	-4.8%
2003 Sample	-1.3%	-2.3%	-3.4%	-3.9%
2007 Sample	-1.3%	NA	-3.5%	NA

The comparisons among the BCI / SPF and RR results are done the same way as in previous specifications and illustrated in Figures 4.43 and 4.44.

For both samples, there are transitory significant differences in the response of output at intermediate horizons, compared to RR. For the 1996 sample, Figure 4.43 shows the ALFRED / BCI / SPF response in prices is significantly weaker at early and intermediate horizons before rising above the RR CI bands at very long horizons. These significant differences disappear when the sample is extended to 2003. The ALFRED / BCI / SPF response of monetary policy displays only slight transitory differences in the 2003 sample.

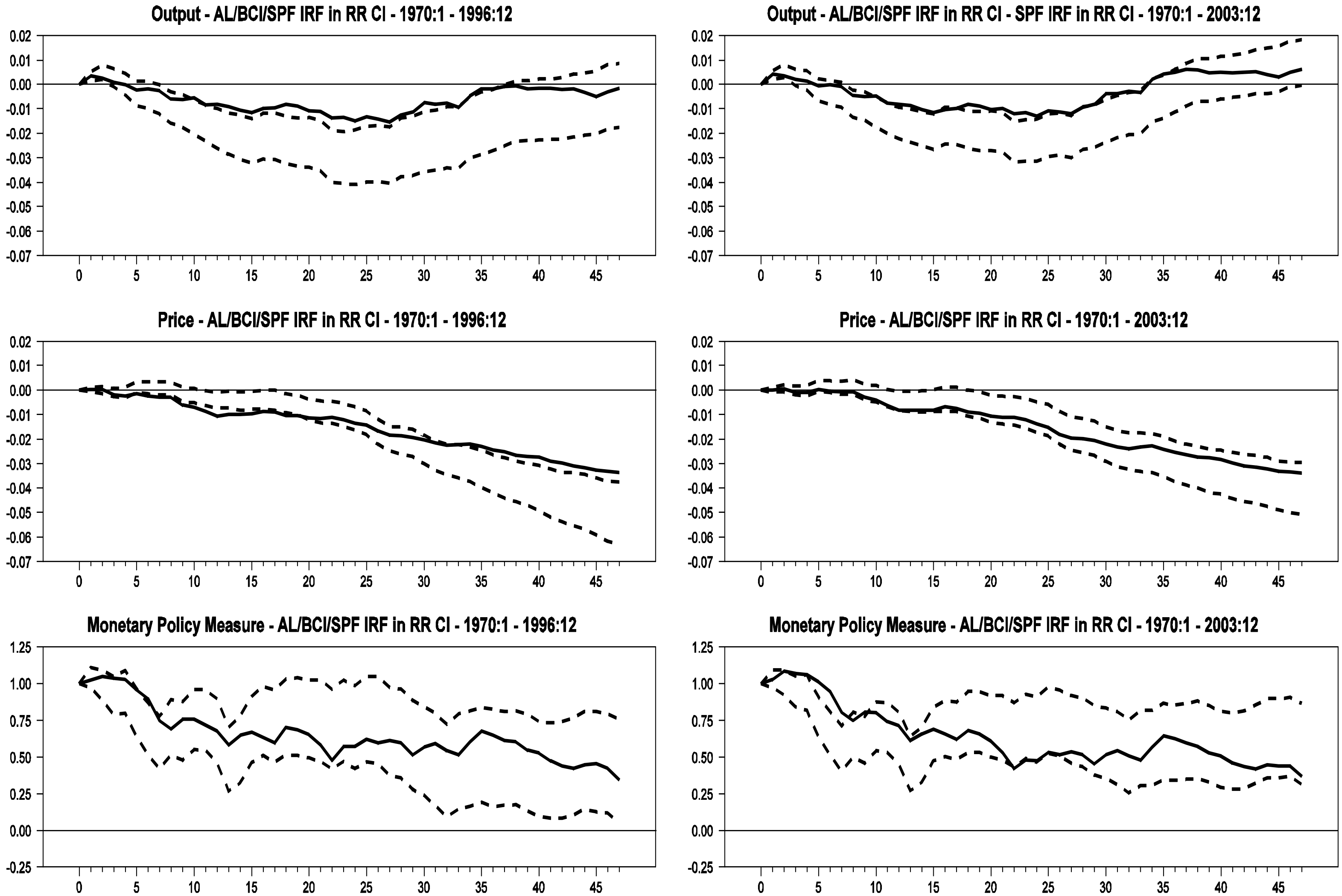


Figure 4.43 – Comparison of Romer-Romer and ALFRED / BCI / SPF VAR IRF's

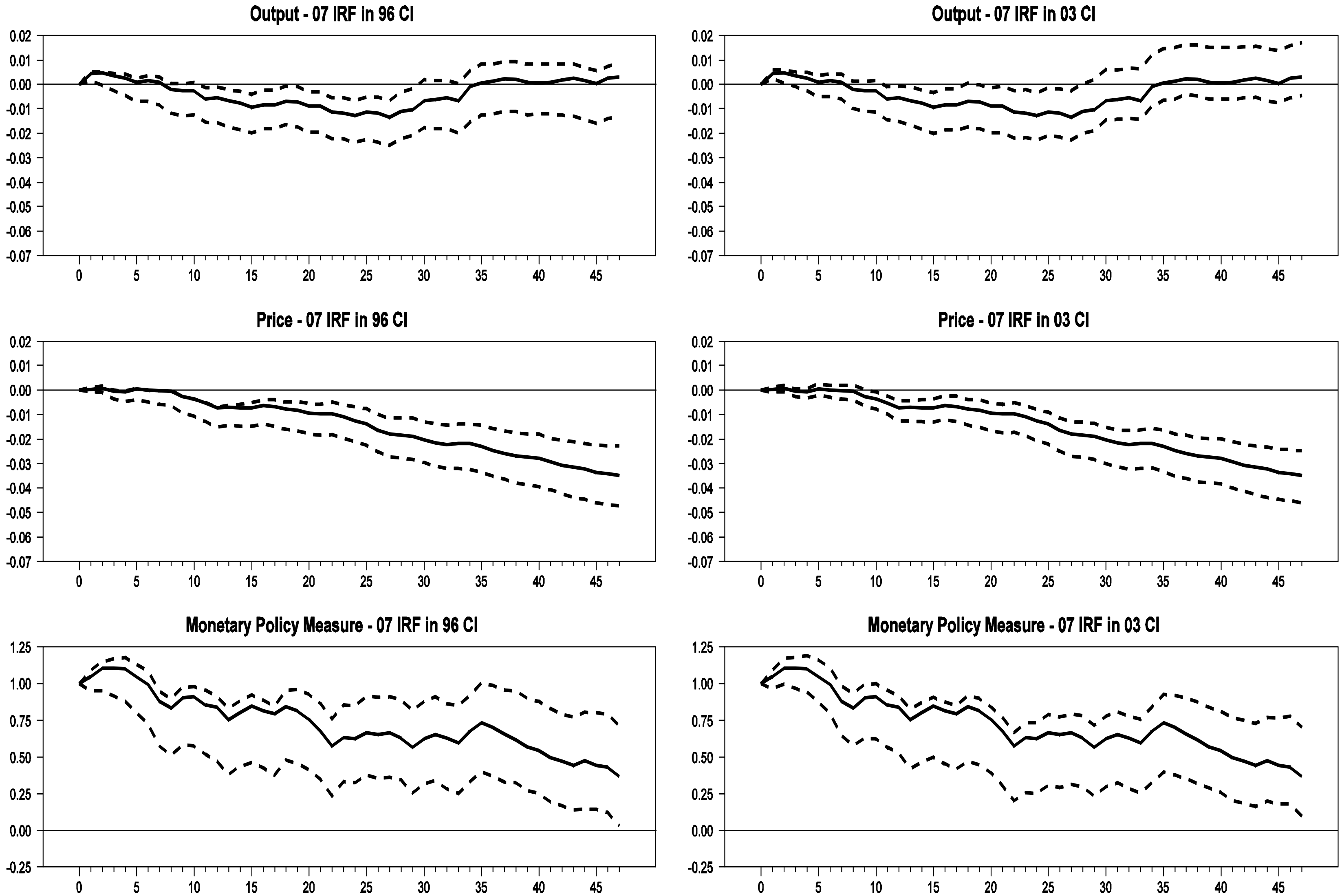


Figure 4.44 – Comparison of ALFRED / BCI / SPF VAR IRF's

Extending the sample to 2007 produces no significant differences compared to the ALFRED / BCI / SPF responses from the earlier samples. All 2007 responses are within the 1996 and 2003 CI bands at all horizons.

Using the BCI / SPF or ALFRED / BCI / SPF residuals produce responses that are most consistent with the RR results across both single equation and VAR methods. The responses in output return to the initial value and the CI bands span the origin at longer horizons after a contractionary monetary policy shock. The responses in prices are permanently lower but are significantly weaker at longer horizons. There are no significant differences in the own effects of monetary policy in the VARs.

4.7 Conclusions

This chapter has estimated alternatives to the Romer and Romer measure of monetary policy shocks. Alternative real-time data that proxies for information about the economy beyond the Greenbook that policymakers had at each FOMC meeting was added to the original RR regression to obtain monetary policy shocks. The SPF and BCI were considered separately with the Greenbook data, as well as together. Estimation showed the new information was jointly significant in each regression and increased the adjusted R^2s compared to the original RR results. This suggests significant variability in the intended funds rate can be attributed to information contained in the alternative data.

Each new measure of monetary policy from added alternative data was highly correlated with the original RR measure. Responses of output and prices were calculated for both single equation and VAR methods and compared to RR. There were significant differences from RR in each specification. However, the differences were generally small and transitory, indicating that alternative data is not a major source of monetary policy shocks in the quasi-narrative approach.

New measures of monetary policy shocks were constructed from only alternative real-time data that can be updated on an ongoing basis without waiting five years for the release of a Greenbook. Regressions for the change in the intended or target funds rate were estimated that use forecasts from the Survey of Professional Forecasters, rates of change in the leading, coincident, and lagging indicators, and previous quarter output and inflation values from ALFRED. Each of these datasets is available before

each FOMC meeting and can serve as a proxy for the Greenbook forecasts for output growth, inflation, and unemployment. Residuals from each specification were used as alternative exogenous measures of monetary policy. Each new measure was highly correlated with the original RR measures.

The first two specifications, SPF and ALFRED / SPF, do not produce suitable alternatives as new measures of policy shocks. The responses of output in the single equation IRF's from these two specifications were permanently lower and prices became negative and significant at very long horizons. The responses of output were significantly weaker than those of RR at longer horizons. Using only the BCI indexes in place of the Greenbook produced a very low R^2 in the policy equation and the responses of prices were not in line with economic theory making the BCI specification an unsuitable substitute.

The BCI / SPF and ALFRED / BCI / SPF measures are quite comparable in terms of the responses of output and price. Using the BCI / SPF or the ALFRED / BCI / SPF specification produced alternative measures of policy shocks that are qualitatively very similar to those using the RR measure. Quantitatively, the effects of the alternative measure on output were not significantly different from the effects estimated using the RR measure, except for slight transitory differences. For the price level, the effects over most horizons were not significantly different from the effects estimated using the RR measure, although at longer horizons the effects based on the alternative measures were somewhat smaller than for the RR measure.

When the alternative measures from the BCI / SPF or ALFRED / BCI / SPF specifications were updated for a sample that ends just before the start of the 2007 financial crisis, estimates of the effects of this measure on output and the price level are quantitatively very similar to estimates for the samples ending in 1996 and 2003. One can conclude that these two alternative measures developed here are a reasonable substitute for the original RR measure.

This chapter has shown that the quasi-narrative approach can be modified to use real-time data beyond the Greenbooks. The approach can also produce monetary policy shocks from only alternative data that can be updated without significant differences allowing a researcher to estimate the effects of monetary policy in a much timelier manner.

Chapter 5
Conclusion

This dissertation contributes to the literature that identifies exogenous changes in monetary policy and analyzes the effects of these changes on the economy. More specifically, this dissertation focuses on the quasi-narrative method of identifying monetary policy shocks in Romer and Romer (2004) (hereafter, RR).

The monetary policy measures and the responses of macroeconomic variables in RR (2004) were replicated over their 1969 – 1996 sample and their estimates were updated for a sample extending through 2003. The results from both samples were compared. An alternative independently formulated measure of the intended funds rate was also compared to that of RR.

The sensitivity of the RR shocks and their effects on macroeconomic variables was analyzed by explicitly considering the effects of different monetary policy regimes, different chairmen of the Board of Governors, and the imposition of credit controls at the request of President Carter in 1980 on the RR policy shocks and their effects on economic activity.

The RR method assumes the only data formally used in formulating monetary policy comes from the Greenbook, which is prepared for the FOMC before each meeting. However, alternative real-time data about the past, current, and anticipated state of the economy is available to the FOMC in addition to the Greenbook data. Consequently, the effects of jointly considering alternative real-time data with the Greenbook on the measures of exogenous changes and their effects on the economy were estimated.

The Greenbook data is made available to the public with a long five-year lag while the alternative data are available with a lag of only a few months. New measures of exogenous changes in monetary policy using were constructed using only the alternative real-time data. These measures can be updated in a more timely fashion than those of RR. The new measures and their effects on the economy were estimated and compared to those of RR.

5.1 Replicating and Updating the Quasi-Narrative Approach

Chapter 2 first replicated and updated the estimation of RR. The real-time Greenbook dataset of RR was explained and additional data from the Greenbook were added to extend the sample from FOMC meetings ending in 1996 to FOMC meetings ending in 2003. The RR policy equation was estimated over the 1996 and 2003 samples. The results showed that both samples produced coefficient estimates that were similar in magnitude and sign with no significant differences across samples. The sums of coefficients also displayed similar magnitudes and significance. Testing each group of forecast variables for joint significance produced one difference in the 2003 sample. It was found that forecasted output growth and forecasted inflation were not jointly significant in the 1996 sample but became jointly significant when the sample is updated to 2003.

The Durbin-Watson statistic and the Breusch-Godfrey test provided evidence of first order serial correlation in the residuals in the 2003 sample. The presence of serial correlation indicates the standard errors and tests of significance are invalid for this sample. Serial correlation was addressed in three ways. First, the regression was estimated using OLS and Newey-West (NW) standard errors were computed to correct the standard errors in the presence of serial correlation. Next, a lagged dependent variable (LDV) was added to the RR policy equation to account for the possibility that serial correlation was caused by interest rate smoothing by the FOMC. Finally, the possibility that serial correlation was caused by omitted shocks that are difficult to estimate was addressed by using the Prais-Winsten (PW) correction for serial correlation. Each of these methods produced similar results in the policy equation. This shows the RR policy equation in the quasi-narrative approach is robust to serial correlation correction methods.

The residuals from each of these regressions were taken as measures of monetary policy shocks. All measures displayed high overall correlations and the largest amount of volatility occurred during nonborrowed reserve targeting. This was true for OLS and LDV residuals in the 1996 sample and the OLS, LDV, and PW residuals in the 2003 sample. Each measure was converted to a monthly shock series and the impulse response functions (IRF's) of output and prices from single regressions were computed

using a technique of polynomial division and summation. The responses of output and prices were computed for the both the 1996 and 2003 samples.

The single equation IRF's for output and prices were similar across samples and specifications. A contractionary monetary policy shock produces the expected hump-shaped pattern in output and a permanently significant lower price level in the long-run. Updating the shock measures produced point estimates of the maximum responses in output and prices that were smaller in the 2003 sample compared to the 1996 samples. The responses of output and prices were compared to check for significant differences across samples and methods for dealing with serial correlation. These comparisons showed there were no significant differences at any horizon among any of the single equation responses.

Following RR, to explore the responses of output and prices within a VAR framework, a three-variable VAR was estimated for both samples. The VAR uses a Choleski decomposition to identify structural shocks and orders the variables as follows: output, the price level, monetary policy measure. This ordering assumes that monetary policy only affects output and prices with a lag but that monetary policy responds contemporaneously to movements in output and price.

The residuals from each sample and method for addressing serial correlation were cumulated to form the measure of monetary policy in the VAR. The IRF's of output, prices, and the monetary policy measure were estimated for a one percentage point contractionary shock in the monetary policy measure. The responses of output, prices, and monetary policy were similar across samples and specifications. As found in the single equation IRF's, the maximum responses of output and prices decreased when the sample is extended to 2003. In both samples, the own effect of monetary policy was sustained and significant at all horizons. The VAR responses of output, prices, and monetary policy from the 1996 sample were compared to the responses from the 2003 sample and only slight differences were found. The 2003 sample responses for output, prices, and monetary policy using the OLS measure were compared to the 2003 sample responses using the LDV measure and using the PW measure. The 2003 sample responses for output, prices, and monetary policy using the PW measure were compared to the

2003 responses of output and prices using the LDV measure. No significant differences were found in any of these comparisons.

Comparing the responses from the single equation and VAR methods showed the patterns of the responses were similar. The responses of prices became significant at earlier horizons in the VAR compared to the single equation responses. Looking at the maximum effects showed the magnitudes of the single equation responses of output and prices were much larger than the maximum effects of the VAR responses of output and prices in both samples.

The first step in the quasi-narrative approach of RR is to construct measures of the intended funds rate at each meeting and the change in the intended funds rate that occurred at each meeting. Constructing the intended funds rate through reading Federal Reserve documents is subject to much judgment and interpretation. An alternative independently formulated measure of the intended funds rate has been constructed by Thornton (2005). The level of the intended funds rate and the change in the intended funds rate measures of Thornton were compared to those of RR. The results showed that the alternative independently formulated measure of the intended funds rate by Thornton was similar to that RR. The differences that exist are due to the timing of the changes in the funds rate. While Thornton often shows some changes as taking place in between meetings, RR associate these changes with FOMC meetings. However, the differences are relatively small. The Thornton measures of the level and changes in the intended funds rate were highly correlated with those of RR.

This chapter showed that the quasi-narrative approach to obtaining estimates of monetary policy shocks is robust to updates over time and to corrections for serial correlation. The estimates of the policy equation produced similar magnitudes and significance across samples and serial correlation corrections. The residuals from each sample and specification were highly correlated. All monthly shocks obtained from this approach produced no significant differences in the responses of output, prices, or monetary policy. This chapter also shows that while the RR intended funds rate is subject to degrees of subjectivity, it is very similar to an alternative independently formulated measure.

5.2 Analyzing the Sources of Shocks

Exogenous policy shocks come from a wide variety of sources such as changes in operating procedures, changes in the chairman in power, changes in policymakers' views on monetary policy's effects on the economy, preferences of policymakers towards Federal Reserve goals, information about the economy not included in the Greenbook, and political and private sector pressure on policymakers and the importance of three sources was analyzed in Chapter 3. The three factors that were examined are the effect of the changes in operating regimes, changes in chairmen of the FOMC, and the imposition of the Federal Reserve Board's credit controls at the at the request of President Carter in 1980.

The RR policy equation assumes the FOMC responds in the same manner to Greenbook forecasts throughout all meetings in the sample. However, different operating regimes followed by the FOMC led to differing degrees of emphasis on controlling the federal funds rate throughout the sample. The three regimes that were followed over the sample FOMC meetings were federal funds rate (FFR) targeting, nonborrowed reserves (NBR) targeting, borrowed reserves (BR) targeting, and FFR targeting again. Even during NBR targeting, a target range for the FFR that the Fed believed was consistent with its NBR target was set. However, this target range was wider and adjusted more frequently, compared to other regimes. Consequently, the most variation in the intended funds rate occurred during the NBR targeting period.

Conceptually BR targeting and FFR targeting are very similar, so no distinction was made between these regimes. Thus, it was assumed there were only two regimes in both the 1996 and 2003 samples, and the RR equation was estimated allowing for differential responses to Greenbook forecasts during NBR and FFR targeting meetings (Regimes specification).

The responses of the intended funds rate to forecasted output growth and inflation were more contractionary during the NBR targeting period than during FFR targeting. The sums of coefficients on these variables were much larger during NBR targeting for both samples. However, the sums of coefficients on the change in forecasted output growth and the change in forecasted inflation were negative during the NBR targeting meetings. During the FFR targeting meetings, the sums of coefficients on the change in forecast variables were positive but, compared to the NBR targeting period, smaller in

absolute value. After correcting for serial correlation, the tests of joint significance showed that the response of monetary policy was significantly different during NBR targeting compared to the rest of the FOMC meetings. However, the results from the estimation allowing for a differential response during NBR targeting should be interpreted with caution. The RR policy equation has nineteen coefficients, and there were only twenty-six observations during the NBR targeting period.

The residuals from the Regimes specification were taken as alternative measures of monetary policy shocks for both the 1969-1996 and 1969-2003 samples. The shocks from the Regimes specification were highly correlated with the original RR measures for both samples. However, the magnitudes of the maximum and minimum values of the shock measures from the Regimes specification were much smaller than those of RR.

The responses of output and prices to policy shocks from the Regimes specification were computed for the single equation and VAR methods and compared to those of RR. The Regimes specification shocks produced responses in output that were almost completely insignificant at almost all horizons. The responses of output in the single equation and VAR IRF's were significantly weaker at intermediate horizons compared to RR, though these differences were slight and transitory. In both the single equation and VAR IRF's, the responses of prices displayed significant price puzzles at early horizons for both samples. While the responses of prices were significantly weaker at early and intermediate horizons compared to RR, the differences were small and transitory. The own effects of monetary policy in the VARs also displayed only small transitory differences compared to the original RR results.

The response of the FOMC to the Greenbook forecasts may vary depending on who is chairman of the FOMC. Different chairmen may place different degrees of importance on stabilizing output relative to stabilizing prices, and different chairmen may respond to political pressure differently. Chow tests provided evidence that the responses of monetary policy differed across the terms of chairmen. The response was found to be significantly different during the term of Volcker compared to the pre-Volcker sample and the term of Greenspan.

To analyze the influence of changes in chairmen on the quasi-narrative approach, the policy equation was estimated separately over FOMC meetings prior to Paul Volcker's tenure, meetings during Volcker's term, and FOMC meetings in which Alan Greenspan was chair. The small number meetings where William McChesney Martin and G. William Miller were chairmen led to all pre-Volcker meetings being combined into one term. Serial correlation was found in the residuals from the regression over the sample of pre-Volcker FOMC meetings, and was corrected for by computing Newey-West standard errors.

These results suggested that monetary policy during the Volcker term was quite different from the other terms. The responses of monetary policy to forecasted output growth and forecasted inflation were significant in each chairman's term. The strongest contractionary responses of monetary policy to forecasted output growth and inflation came during Volcker's term as chairman. Given Volcker's determination to reduce inflation, it is not surprising that the sum of the coefficients on forecast inflation was about twice the size of the sum during the Greenspan term and approximately five times larger than the sum in the pre-Volcker term. The responses to forecasted output and inflation also had the highest level of significance during the Volcker period. Interestingly, the only period in which the response of the intended funds rate to unemployment was insignificant was during Volcker's term indicating the Fed did not respond to forecasted increases in unemployment during this time. The response of monetary policy to the change in forecasted output growth variables was significant only in the pre-Volcker and Greenspan – 2003 samples. The response to the change in forecasted inflation variables was only significant in the pre-Volcker sample.

The residuals from the Chairmen regressions were combined to create new measures of policy shocks for the 1996 and 2003 samples. The residuals were highly correlated with the RR results with an overall correlation coefficient of 0.84 for both samples. Once again, the magnitudes of the maximum and minimum values of the shocks were decreased. The maximum and minimum values were found during Volcker's term which includes the period of NBR targeting. The responses of output and prices to the Chairmen specification policy shocks were computed for single equation and VAR methods. Looking at the single equation responses shows the responses of output were insignificant at almost all horizons for

the 1996 sample and completely insignificant in the 2003 sample. The responses of prices were insignificant at all horizons in both samples. When compared to RR, the responses of output from the Chairmen residuals were significantly weaker at intermediate and longer horizons. The responses of prices were stronger at early horizons and weaker at longer horizons.

In the VARs, the responses of output were negative and significant at intermediate horizons. The responses of prices became negative and significant almost immediately. The own effects of monetary policy were insignificant after approximately two years. Compared to RR, there were significant, long-lived differences in the responses of output, prices, and monetary policy. The response of output from the chairmen specification residuals was slightly stronger at earlier horizons and significantly weaker at later horizons. The responses of prices were significantly stronger for approximately thirty months beginning immediately after the shock. The responses of monetary policy were weaker for almost all months.

Allowing the response of the FOMC to differ across the terms of chairmen causes great changes in the monetary policy shocks and in the responses of macroeconomic variables to these shocks. While the policy shocks were still highly correlated with the original measures, the magnitudes of the maximum and minimum values were greatly decreased. The single equation responses of output and prices to the Chairmen specification shocks were completely insignificant at almost all horizons. The responses of output were significantly weaker but the responses of prices were significantly stronger. The own effects of monetary policy were much shorter lived and significantly weaker at almost all horizons. Unlike the Regimes specification, the Chairmen specification shocks produced much more pronounced differences for a longer period of time in the responses of output, prices, and monetary policy. These results show that changes in chairmen are a very significant source of shocks in the quasi-narrative approach.

In March 1980, President Carter invoked the Credit Control Act of 1969 which gave the Board of Governors power to impose restraints on “any or all extensions of credit”. The Federal Reserve Board’s Credit Restraint Program which consisted of six restrictive measures was implemented in this month. In the economy, the response to the Carter credit controls (CCC) was a sharp drop in the amount of credit extended and the demand for credit. At the April FOMC meeting, the FOMC expressed concern about

drop in the growth rate of the money supply and agreed that open market operations should be directed towards the expansion of reserves to be consistent with a somewhat higher growth rate of the money supply. This sharply reduced the intended federal funds rate measure and led to the largest monetary policy shock in magnitude in the RR results.

To investigate the effect of the CCC on the policy shocks, an intercept dummy for meetings in which the CCC were in place was added to the policy equation. The negative coefficient on the dummy was very large in magnitude and significant. One difference from the original RR results was the sum of coefficients on forecasted output growth was insignificant in both samples. The R^2s were higher in each sample compared to RR suggesting that some unexplained variation in the intended funds rate is coming from the CCC. The results also provided suggestive evidence that the serial correlation in the 2003 sample is due to the credit controls. Including the intercept dummy eliminated evidence of serial correlation in the 2003 sample.

The monetary policy shocks obtained from the CCC specification of the policy equation were highly correlated with the RR shocks. The magnitude of the smallest shock was reduced but the magnitude of the largest shock was increased.

These new shocks were used to compute the responses of macoreconomic variables using both the single equation and VAR methods. In both samples, the patterns of the responses of output and prices were similar to those of RR. Both the single equation and VAR response of output displayed significantly weaker transitory differences at intermediate horizons for both samples, though these differences were very small. Compared to the RR results, there were no significant differences in the responses of prices for either sample for the single equation or VAR methods. The own effects of monetary policy were sustained and significant at almost all horizons. The responses of monetary policy displayed only slight, transitory differences, compared to RR, at early horizons.

This chapter finds that changes in chairmen are the most important of the sources of shocks analyzed. Allowing the response of monetary policy to differ across chairmen produced smaller shocks and the responses of output, prices, and monetary policy lost significance. The significant differences from the

RR results were relatively large and lasted for long periods of time. Controlling for changes in regimes or CCC only produced slight transitory differences in the responses.

5.3 Incorporating Alternative Real-Time Data

The RR quasi-narrative shocks assume the Greenbook forecasts are the only data used by policymakers in formulating monetary policy. Chapter 4 examined the role alternative real-time data in the context of obtaining policy shocks. First, three sources of alternative real-time data about the economy beyond the Greenbook were constructed to reflect data available at each FOMC meeting. Data was first used from the Survey of Professional Forecasters (SPF) and the construction of the data source was explained. The second data source used was the Archival Federal Reserve Economic Dataset (ALFRED). Finally, the rates of change in the composite leading, coincident, and lagging indexes of the Business Cycle Indicators (BCI) were considered as an alternative-real time data source and the construction is explained.

5.3.1 Joint Consideration of Alternative Data

Chapter 4 first tested if policymakers respond systematically to information about the economy beyond what is in the Greenbook. If they do, the RR shocks may not be accurate measures of exogenous changes in monetary policy. The Survey of Professional Forecasters (SPF) is an alternative dataset, now compiled by the Philadelphia Fed, which contains private sector forecasts of macroeconomic variables. The composite indexes of the leading, coincident, and lagging indicators from the Business Cycle Indicators (these indexes are jointly referred to as BCI), now compiled by the Conference Board, contain information about past, current, and anticipated economic activity. The SPF and BCI were considered as proxies for the additional information available to the FOMC at each meeting. The specification of the policy equation was changed to include the alternative data. Estimation of this new equation was done over the 1996 and 2003 samples. Tests of joint significance were conducted to determine if alternative data beyond the Greenbook significantly explains variability in the intended funds rate.

When the SPF variables were jointly considered with the Greenbook, evidence of second order serial correlation was found. To correct the standard errors, the regression was first estimated and NW standard

errors with two lags were computed. Further, the regression was also estimated with a lagged dependent variable and with the PW correction for serial correlation. Neither of these regressions produced residuals that exhibited serial correlation. With one exception, the SPF variables were jointly significant in each sample and specification. The one exception occurred when the policy equation was estimated for the 1996 sample incorporating NW standard errors. This regression produced an F-statistic of 1.42 with a p-value of 0.12. When the sample was extended to 2003, the regression with corrected standard errors showed the SPF variables were jointly significant at the 4% level. The LDV and PW specifications produced joint significance for the SPF variables in each sample and each time the p-values were equal to 0.00. Each regression also showed a higher adjusted R^2 compared to the original RR results indicating more variation in the intended funds rate was explained when the SPF is added. The joint significance of the SPF variables and the increases in the goodness of fit in each regression suggests that policymakers respond to information above and beyond that in the Greenbook when formulating policy.

The BCI variables were the next group to be jointly considered with the Greenbook. Estimation of the modified policy equation which included the BCI showed no evidence of serial correlation. Both the 1996 and 2003 sample regressions showed higher R^2s compared to RR and the BCI variables displayed high levels of joint significance. Some of the changes in the intended funds rate can be attributed to policymakers' systematic reaction to information contained in the BCI.

The SPF and BCI data sources were next both jointly considered with the Greenbook. The policy equation was specified to include these two new sources with Greenbook forecasts. There was evidence of first order serial correlation in the equation. The regression was first estimated incorporating NW standard errors with one lag. The regressions were also estimated with a lagged dependent variable and using the PW correction. The SPF variables were jointly significant at the 1% level in both samples and for all methods of correcting for serial correlation. The F-statistics indicated the BCI were jointly significant at the 1% level for each sample and method. Finally, the SPF and BCI variables were tested for joint significance in each regression and sample. Each result showed the variables were jointly significant at the 1% level.

These results provide evidence that policymakers systematically respond to data beyond what is in the Greenbook in formulating monetary policy. This suggests that the quasi-narrative shocks may not be accurate measures of exogenous changes in monetary policy because they still contain systematic responses to other information about the economy. To analyze the effect of alternative real-time data on the quasi-narrative shocks, the residuals from the OLS regressions that included alternative data were taken as new measures of monetary policy shocks and converted to monthly series. Each measure was highly correlated with the original RR series, with correlation coefficients ranging from 0.86 – 0.96.

These shocks were used in the single equation and VAR models to obtain the responses of macroeconomic variables to a one percentage point increase in the new shock measures. The residuals that were obtained from considering just the SPF data with Greenbooks produced only slightly stronger responses in output at early horizons for the 1996 and 2003 samples, compared to RR. This difference was only transitory in the single equation responses. The VAR responses showed that output began to lie above the upper RR CI band in both samples at intermediate and later horizons, but once again this difference was small. In both the single equation and VAR responses of prices, the responses of prices were significantly weaker at early and intermediate horizons for both samples, compared to the original RR results. At longer horizons, the responses of prices displayed no significant differences. In the VARs, the responses of monetary policy showed no significant differences, with the exception of a few slight temporary differences.

Compared to the RR responses, the residuals that were obtained from considering just the BCI data with Greenbooks produced no significant differences in the responses of output for either the single equation or VAR methods. In the single equation responses of prices, the responses of prices were significantly weaker at later horizons for both samples. In the VAR, the response of prices was weaker at later horizons for only the 1996 sample while the 2003 sample response showed no significant differences compared to RR. The responses of monetary policy also showed no significant differences.

The residuals that were obtained from considering both the SPF and BCI data along with the Greenbook data produced responses in output and prices that were very similar to those obtained when

considering only the SPF. In both the single equation and VAR IRFs, the response of output was slightly stronger at early horizons for the 1996 and 2003 samples, compared to RR. This difference was only transitory in the single equation responses. The VAR responses showed that output began to lie above the upper RR CI band in both samples at intermediate and later horizons, but once again this difference was small. In both the single equation and VAR responses of prices, the responses of prices were significantly weaker at early and intermediate horizons for both samples, compared to the original RR results. At longer horizons, the responses of prices displayed no significant differences. In the VARs, the responses of monetary policy showed no significant differences, with the exception of a few slight temporary differences.

While it was shown that policymakers do respond systematically to information not contained in the Greenbooks, the quasi-narrative shocks and the responses of macroeconomic variables do not differ significantly from the RR results when this additional data is considered. The shocks obtained from adding additional macroeconomic data were all highly correlated with the original RR shocks. The responses of output and prices to these alternative shocks generally displayed similar patterns, magnitudes, and times to significance as those of RR. Any significant differences were also generally relatively small and transitory.

5.3.2 Alternative Shocks Using Only Alternative Real-Time Data

The alternative real-time data constructed in the first part of Chapter 4 is released with a very short lag. Since Greenbooks are released five years after they are produced, the possibility exists that new measures of monetary policy shocks can be constructed in a more timely manner from the quasi-narrative approach using only alternative real-time data. New measures were constructed using only alternative real-time data from ALFRED, the SPF, and the BCI for the same samples as before and for a longer period of time that includes more recent data than the Greenbook. To compute new shock measures, five data sets were constructed from the three data sources. The first dataset used only the SPF while the second consisted of ALFRED previous quarter values with the SPF forecasts. The third dataset contained only the rates of change in the BCI. The fourth combined the SPF and BCI while the final dataset

combined the ALFRED previous quarter values with the SPF and BCI. RR-type regressions to obtain shocks using only alternative data were estimated for samples of FOMC meetings beginning in January 1969 and ending in December 1996, December 2003, and March 2007.

When only the SPF was used, the regressions for all three samples showed evidence of second order serial correlation. To correct the standard errors for serial correlation, the NW correction with two lags was used. The only sum of coefficients that was significant in the regressions was the change in forecasted output growth. The change in forecasted output growth variables were the only group that were jointly significant in the regressions. A puzzling result found was that, while insignificant, the predicted response of the intended funds rate to an increase in forecasted output was negative. This implies the Federal Reserve lowers the intended funds rate in response to forecasted increases in output growth. The R^2s for each sample were also much lower at 0.17, compared to the original R^2s of 0.28 from the RR results. In addition to the NW correction, a nonlinear regression method to correct for second order serial correlation was also estimated for all three samples. While nonlinear regressions do not allow the standard tests of significance to be computed, the results showed that the coefficients and their sums were similar in magnitude and sign to the OLS coefficients.

The regressions were estimated over each sample again; however, the previous quarter values of forecasted output growth and inflation were replaced with values from ALFRED. The response of the intended funds rate to an increase in the forecasted unemployment rate was negative, but insignificant. The R^2 in each regression were lower than just using the SPF. The D-W statistics also increased, compared to using only the SPF, but evidence of second order serial correlation was still found. The regression was estimated with the NW correction for the standard errors and with the nonlinear correction. The sums of coefficients and their significance were similar to what was found using only the SPF. One change from replacing the SPF previous quarter output growth and inflation values with those from ALFRED is that the forecasted inflation variables were jointly significant in all regressions.

The policy equation was also changed from that of RR to only include a constant, the level of the intended target prior to the meeting, and the rates of change in the three composite indicators of the BCI.

The regressions exhibited first order serial correlation in the residuals. The regressions were re-estimated and NW standard errors with one lag were computed. Serial correlation was also corrected for using the LDV and PW correction methods. For all samples and serial correlation corrections, the coefficients on the rate of change in the leading index were positive and significant. The coefficient on the rate of change in the coincident index was positive in all samples and specifications, but was only significant in the regression incorporating NW standard errors. A puzzling result is that the coefficient on the rate of change in the lagging index was negative and significant for all regressions. This implies the FOMC would lower the intended funds rate in response to increases in previous economic activity. The R^2s were lower than those from the RR results, ranging from 0.15 – 0.20.

The correlation between the change in forecast variables from the Greenbook dataset and the SPF dataset were very low. This is explained by the fact that SPF forecasts are often unchanged from one FOMC meeting to another. To eliminate this source of serial correlation, the policy equation was once again re-specified to include only the forecasted output growth, inflation, and unemployment variables from the SPF and the rates of changes in the BCI composite indexes. The SPF and BCI variables acted as proxies for information concerning the future, current, and past states of economic activity. When estimated over the three samples, the policy equation showed first order serial correlation. Serial correlation was adjusted for in the previous three ways. In all specifications, the coefficient on the unemployment rate was negative and generally statistically significant. In each specification and sample, the sums of coefficients on forecasted output growth were negative but insignificant. These variables were not jointly significant in any regression. The sums of coefficients on forecasted inflation were positive and significant in each sample and specification. These variables were also jointly significant. The coefficients on the rates of change in the composite BCI indexes were similar to when these were the only alternative data. The BCI also displayed high levels of joint significance in each sample and specification. Each specification also displayed similar R^2s and standard errors of estimate to the original RR results.

The same specification was used with the ALFRED previous quarter values of output and prices replacing the previous quarter values of the SPF. Once again, there was evidence of first order serial correlation in the residuals and the serial correlation was adjusted for in the same ways as earlier. The results of the policy equation estimations were very similar to those using just the SPF and BCI. The sums of coefficients on forecasted output growth were negative and insignificant for each sample and specification. However, these variables were jointly significant in the 2003 and 2007 samples in the NW and PW corrections for serial correlation. The sums of coefficients on forecasted inflation were positive and significant in all samples and specifications. The forecasted inflation variables were jointly significant in each sample and regression. The coefficients and significance for the rates of change on each composite index were similar compared to using only the BCI and SPF. Once again, the indexes were jointly significant at high levels. Each specification and sample produced R^2s of approximately 0.25 and standard errors of estimates between 0.36 – 0.40, both of which were comparable to the RR results for both the 1996 and 2003 samples.

The residuals from each regression without corrections for serial correlation were used as new measures of monetary policy shocks. Each measure displayed a similar pattern to the RR shocks and had a high correlation. The highest correlation with the RR residuals in both the 1996 and 2003 samples were the residuals from the specification that only used the BCI, with a correlation coefficient of 0.84. The specification that only used the SPF had the lowest correlation with the RR residuals for both samples. The overall correlation was 0.81 in the 1996 sample and 0.80 for the 2003 sample.

These new residuals were used to estimate the responses of macroeconomic variables to contractionary increases in each of the new measures for the 1996 and 2003 samples. The responses of output and prices were first computed using the single equation method. The responses from the alternative measures were plotted with the original RR CI bands to investigate whether there were significant differences. Since there is no method to directly compare the 2007 responses with RR responses for a 2007 sample, the 2007 point estimates were plotted with alternative measure CI bands from earlier samples. Each alternative monetary policy measure was then cumulated and used in the three

variable VAR as the measure of monetary policy. The responses were computed for both samples and compared to those of RR. The 2007 sample responses were compared with earlier samples in the same manner as the single equation responses.

The single equation responses of output from the shocks obtained using only the SPF produce similar maximum effects to RR for the 1996 sample and larger maximum effects than the RR response for the 2003 sample. However, the responses of output were not consistent with economic theory. The responses of output in all three samples were permanently lower at longer horizons. The responses of prices in each sample displayed much smaller maximum effects compared to RR. The responses also took approximately thirty-five months to become significant. When compared to the RR responses, the response of output was significantly weaker at longer horizons for the 2003 sample. The responses of prices were significantly weaker at longer horizons for both samples compared to RR. Updating the sample to 2007 did not produce any significant differences in the responses compared to earlier samples.

IRFs from the VAR were much more in line with economic theory. The responses of output displayed a significant transitory effect and the responses of price became negative and significant relatively quickly. The own effect of monetary policy implied that the central bank reversed its contractionary effect after approximately two years. The maximum effects on output were similar to RR for the 1996 and 2003 samples. The maximum effect on prices was 1.2 percentage points smaller than RR for the 1996 sample but only 0.4 percentage points smaller for the 2003 sample. The responses of output displayed no significant differences compared to RR at any horizon. The responses of prices only displayed significant differences in the 1996 sample. This difference was very small as the response of prices began to lie above the upper RR CI band for the final months. However, as the own effect of monetary policy displayed small and transitory differences in the 1996 sample, the response of monetary policy was significantly weaker at intermediate and longer horizons for the 2003 sample. The differences were quite large. Extending the sample to 2007 only produced slight transitory differences in the response of monetary policy compared to the 2003 sample.

When the ALFRED previous quarter output growth and inflation variables were used in place of the SPF previous quarter values to obtain shocks, the responses were similar to those from only using the SPF. The single equation output responses were permanently lower at longer horizons and the responses of prices took a relatively long period of time to become significant. When compared to RR, the response of output was still significantly lower at longer horizons for the 2003 sample. However, the response of prices showed only slightly stronger transitory differences at early horizons in the 1996 sample. There were no significant differences in the 2003 sample. When the 2007 output and price responses were plotted with the CI bands obtained from the 1996 and 2003 samples, the responses displayed no significant differences.

The responses of output and prices in the VARs were very similar to those of RR. The responses of output and prices displayed no large or prolonged significant differences in either sample. For both samples, the response of monetary policy displayed a pronounced significantly weaker effect at intermediate horizons. Extending the sample to 2007 produced no significant differences with the earlier samples.

Using residuals obtained from using only the BCI produced single equation responses of output that were significant and transitory as the point estimates return towards direction of the origin. However, the responses of prices displayed significant price puzzles at early horizons and the responses of prices were completely insignificant in all months in the 1996 and 2003 samples. The responses of prices took approximately three years to become negative in each of the samples. When compared to the RR responses, the response of output displayed a transitorily weaker effect at intermediate horizons for both samples but these differences were very small. The responses of prices were significantly weaker at intermediate and later horizons beginning approximately two years after the shock.

When these residuals were cumulated for use in a VAR, the maximum effects on output and prices were smaller than those of RR for both samples. The own effect of monetary policy, however, was much longer-lived compared to the responses from the SPF and ALFRED / SPF specifications. Using only the BCI to obtain shocks produced a response of monetary policy that was long-lived and became

insignificant at very long horizons. When the responses were compared to RR, the response of output was significantly weaker at intermediate horizons for the 1996 sample. In the 1996 sample, the point estimates for prices were below the lower RR CI band at early horizons and above the upper CI band at longer horizons. The 2003 sample results showed the significant differences in output were almost completely eliminated and the responses of prices were only significantly weaker at longer horizons. The responses of monetary policy only displayed slight and transitory differences. When extending the sample, the 2007 response of prices was slightly significantly weaker than the 1996 response at early horizons. The response of monetary policy also showed small and transitory weaker effects at early horizons compared to the 1996 responses.

The shocks from the policy equation containing only the SPF forecasts and BCI variables produced responses in the single equation method that were very similar to those of RR. The maximum effects on output were smaller than RR for both samples, but the responses displayed no significant differences from RR in either sample. The responses of prices were significantly weaker at longer horizons, but this difference became smaller as the sample was extended to 2003. The 2007 sample responses displayed no significant differences with the earlier samples.

In the VARs the responses of output displayed a transitory negative significant effect at intermediate horizons. The responses of prices became negative relative quickly and were significant beginning nine months after the shock in the 1996 sample and ten months after the shock in the 2003 and 2007 samples. The own effect of monetary policy was very long lived and significant at all horizons for the 1996 and 2003 samples. When compared to the RR response of output, the BCI / SPF response was significantly weaker at intermediate horizons. However, these differences were very small and transitory and the magnitude of the difference decreased in the 2003 sample. The response of prices showed a slightly stronger effect at early horizons and a slightly weaker effect at longer horizons for the 2003 sample. Compared to RR, the own effects of monetary policy displayed only slight temporary differences.

The policy shocks obtained from replacing the SPF previous quarter values with those from ALFRED and using all three data sources to obtain shocks produced responses similar to those of the BCI / SPF

shocks. In the single equation IRF's, the point estimates of output displayed very minor transitory differences at intermediate horizons. Once again, the response of prices was significantly weaker at longer horizons but the differences became smaller as the sample was extended to 2003. The responses from the 2007 sample displayed no significant differences from obtained in the 1996 and 2003 samples. The VAR responses also displayed similar patterns and significant differences as those found in the BCI / SPF specification. No significant differences with earlier samples were found when extending the sample to 2007.

Using only the SPF or ALFRED and the SPF as replacements for the Greenbook in the quasi-narrative approach does not produce reasonable alternative measures of monetary policy shocks. The policy equation contains second order serial correlation. The estimations using only the SPF showed an increase in the intended funds rate in response to an increase in the forecast of the current quarter unemployment rate. The only group of variables displaying significance was the change in forecasted output measures. When ALFRED previous quarter values replaced those of the SPF, the coefficient on unemployment was negative but insignificant. The forecasted inflation variables became jointly significant in the regression but the sums of coefficients on these variables were not. The single equation IRFs showed that output was permanently lower at longer horizons which is not in line with economic theory. The responses of prices took a relatively long time to become negative and significant. In the VARs, while the responses of output and prices displayed only small transitory differences compared to RR, the response of monetary policy was drastically weaker at intermediate horizons. Each specification also produced smaller R^2 and larger standard errors of estimates in the policy equation compared to RR for each sample.

Using only the BCI does not produce a suitable substitute for the RR measures. The R^2s in the policy equation regressions were much smaller than RR and the standard errors of estimate were much larger. In the single equation IRF's the responses of prices became negative at very long horizons. The responses were completely insignificant for the 1996 and 2003 samples, and only slightly significant in the final two months for the 2007 sample. The responses displayed significant price puzzles at early horizons.

The BCI / SPF and ALFRED / SPF specifications produce acceptable substitutes that were qualitatively and quantitatively very similar to RR. The coefficient on the unemployment rate was negative and generally significant. The sum of coefficients on forecasted inflation was positive and significant for all samples and specifications. The results showed comparable R^2s and standard errors of estimates when compared to RR. The effects of these shocks on output were not significantly different from the effects estimated using the RR measure, except for slight transitory differences. The effects on prices were significantly weaker than those of RR at longer horizons, though the effects were not significantly difference at most horizons. The own effects of monetary policy were long-lived and only displayed minor transitory differences compared to RR. The effects of macroeconomic variables from 2007 sample were quantitatively very similar to estimates for the samples ending in 1996 and 2003.

Chapter 4 showed the quasi-narrative approach can be utilized to produce monetary policy shocks based on alternative real-time data that can be updated with a shorter lag. These new measures do not display permanent significant differences with original RR measures and can incorporate more data in a quicker manner.

5.4 Summary

Identifying exogenous changes in monetary policy is crucial to estimating the effects of monetary policy on the economy. Vector autoregressions, narrative approaches, and quasi-narrative approaches have been used in the literature to estimate shocks to a monetary policy variable and their effects on the economy. This dissertation has primarily focused on the quasi-narrative approach of RR (2004).

Because monetary policy is dependent on forecasts of economic activity, any method of identifying exogenous changes to monetary policy should take this fact into consideration. VARs typically only account for forecasts to the extent that lagged values of the variables in the VAR are used by policymakers in generating forecasts. The quasi-narrative approach of RR incorporates forecasts by the Federal Reserve into the information set making it much more likely to give accurate measures of monetary policy shocks.

The pure narrative approach of RR implicitly incorporates a great deal of information into identifying monetary policy shocks through careful reading of Federal Reserve documents. However, this approach has a large element of subjectivity which may lead to bias in identifying exogenous changes in monetary policy. A researcher may look harder for a negative policy shock preceding a drop in economic activity. Consequently, changes in policy preceding large falls in output are more likely to be identified as exogenous even if they are not. This criticism of subjectivity leading to bias is of a lesser concern in the quasi-narrative approach because it constructs shocks from quantitative methods using FOMC data. The narrative component of the quasi-narrative approach is the construction of an intended funds rate measure, and there is some subjectivity in the construction of this variable. However, this dissertation has shown that comparison of an alternative independently formulated measure of the intended funds rate to the RR intended federal funds rate reveals relatively minor differences between the measures.

Monetary policy shocks are unique to the information set used to construct them. The quasi-narrative shocks are, by construction, orthogonal to the Greenbook forecast data and are accurate measures of exogenous changes only to the degree that economic data beyond the Greenbook does not influence policy decisions. This dissertation has shown that alternative real-time data significantly affects changes in the intended funds rate. However, shocks estimated from specifications jointly considering alternative real-time data with the Greenbook produced responses of macroeconomic variables that were qualitatively and quantitatively very similar to the original RR responses from shocks that were constructed using only the Greenbook.

Finally, new series of monetary policy shocks have been constructed using the quasi-narrative approach. This dissertation has created measures of exogenous changes using only alternative real-time data that can be constructed in a much timelier manner. These series allow a researcher to use the quasi-narrative approach in recent time periods to investigate the effects of monetary policy on economic activity.

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Appendix: Monthly Regression Results

This appendix shows the results for all the monthly regressions used to obtain the impulse response functions for output and prices from single equations.

Tables 1 – 6 show the results of the regressions to obtain single equation IRFs when each shock measure is used from Chapter 3. Using the Regimes specification produced measures of shocks that gave results for the monthly regressions shown in Tables 1 and 2. Table 1 shows the results for the original sample and 2 shows the results for the sample updated until 2003. Shocks from the Chairmen specification shocks gave results for the monthly regressions shown in Tables 3 and 4. Tables 3 and 4 show monthly regression results for the 1996 and 2003 samples, respectively. Using the CCC specification produced measures of shocks that gave results for the monthly regressions shown in Tables 5 and 6. Table 5 shows the results for the original sample and 6 shows the results for the sample updated until 2003.

Tables 7 – 28 show the results of the regressions to obtain single equation IRFs when each shock measure is used from Chapter 4.

Using the RR-SPF specification produced measures of shocks that gave the following results for the monthly regressions shown in Tables 7 and 8. Table 7 shows the results for the 1996 sample and 8 shows the results for the sample updated until 2003. Using the RR-BCI specification produced measures of shocks that gave the following results for the monthly regressions shown in Tables 9 and 10. Table 9 shows the results for the original sample and 10 shows the results for the sample updated until 2003. Using the RR-BCI-SPF specification produced measures of shocks that gave the following results for the monthly regressions shown in Tables 11 and 12. Table 11 shows the results for the original sample and 12 shows the results for the sample updated until 2003.

Using the only the SPF forecasts in place of the Greenbook produces measures of shocks that gave the following results for the monthly regressions shown in Tables 13 – 15. Table 13 shows the results for the original sample, 14 shows the results for the sample updated until 2003, and 15 shows the results for the 2007 sample. Using the only the ALFRED / SPF forecasts in place of the Greenbook produces

measures of shocks that gave the following results for the monthly regressions shown in Tables 16 – 18. Table 16 shows the results for the original sample, 17 shows the results for the sample updated until 2003, and 18 shows the results for the 2007 sample. Using the only the BCI indexes in place of the Greenbook produces measures of shocks that gave the following results for the monthly regressions shown in Tables 19 – 21. Table 19 shows the results for the original sample, 20 shows the results for the sample updated until 2003, and 21 shows the results for the 2007 sample. Using the BCI / SPF specification produced measures of shocks that gave the following results for the monthly regressions shown in Tables 22 – 24. Table 22 shows the results for the original sample, 23 shows the results for the sample updated until 2003, and 24 shows the results for the 2007 sample. Using the ALFRED / BCI / SPF specification produced measures of shocks that gave the following results for the monthly regressions shown in Tables 25 – 27. Table 25 shows the results for the original sample, 26 shows the results for the sample updated until 2003, and 27 shows the results for the 2007 sample.

Table 1

The Impact Regimes of Shocks On Industrial Production

	Shock			Change In Industrial Production	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0015	0.0027	1	0.1221	0.0623
2	0.0002	0.0027	2	0.0110	0.0624
3	-0.0029	0.0027	3	0.0921	0.0627
4	-0.0002	0.0027	4	0.0374	0.0624
5	-0.0021	0.0027	5	-0.0072	0.0625
6	0.0022	0.0027	6	-0.0019	0.0625
7	0.0008	0.0027	7	0.0227	0.0627
8	-0.0055	0.0027	8	0.0275	0.0630
9	-0.0030	0.0027	9	0.0341	0.0628
10	-0.0015	0.0027	10	-0.0182	0.0621
11	-0.0034	0.0027	11	0.0503	0.0601
12	0.0020	0.0027	12	0.2405	0.0612
13	-0.0002	0.0027	13	-0.0278	0.0616
14	0.0016	0.0027	14	-0.1862	0.0613
15	0.0015	0.0027	15	-0.1471	0.0620
16	0.0023	0.0027	16	-0.1111	0.0628
17	0.0009	0.0027	17	0.0803	0.0638
18	-0.0031	0.0027	18	0.0272	0.0634
19	-0.0014	0.0027	19	-0.0096	0.0634
20	-0.0003	0.0027	20	0.0249	0.0631
21	0.0012	0.0027	21	-0.1241	0.0636
22	-0.0073	0.0027	22	-0.0431	0.0642
23	0.0004	0.0027	23	-0.0648	0.0640
24	-0.0014	0.0027	24	0.1337	0.0635

The Impact of Regimes Shocks On the Producer Price Index

	Shock			Change In Producer Price Index	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0007	0.0013	1	0.1940	0.0645
2	0.0012	0.0013	2	-0.0339	0.0655
3	-0.0010	0.0013	3	-0.0649	0.0662
4	0.0015	0.0013	4	-0.0937	0.0662
5	0.0016	0.0013	5	0.0053	0.0663
6	-0.0010	0.0013	6	0.1412	0.0661
7	0.0002	0.0013	7	-0.0575	0.0664
8	0.0001	0.0013	8	0.0573	0.0664
9	-0.0014	0.0013	9	0.0931	0.0664
10	0.0007	0.0013	10	-0.0392	0.0666
11	-0.0016	0.0013	11	0.1294	0.0660
12	-0.0007	0.0013	12	0.0970	0.0666
13	0.0014	0.0013	13	-0.0508	0.0662
14	-0.0002	0.0013	14	-0.0144	0.0658
15	0.0011	0.0013	15	0.0021	0.0655
16	-0.0006	0.0013	16	0.0124	0.0648
17	0.0015	0.0013	17	0.0577	0.0645
18	-0.0001	0.0013	18	0.0593	0.0645
19	0.0010	0.0013	19	0.0201	0.0640
20	-0.0020	0.0013	20	0.1249	0.0638
21	0.0001	0.0013	21	0.0259	0.0642
22	0.0005	0.0013	22	0.0149	0.0640
23	-0.0019	0.0013	23	-0.0251	0.0638
24	-0.0018	0.0013	24	0.0345	0.0629

(table 1 cont.)

25	-0.0020	0.0027
26	-0.0064	0.0028
27	-0.0048	0.0028
28	0.0024	0.0028
29	-0.0016	0.0028
30	-0.0008	0.0028
31	0.0000	0.0028
32	-0.0018	0.0028
33	0.0013	0.0028
34	0.0010	0.0027
35	0.0004	0.0027
36	0.0043	0.0027

R^2 = 0.85 S.E.E. = 0.010 D.W. = 2.00
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

25	-0.0023	0.0013
26	-0.0030	0.0014
27	-0.0026	0.0014
28	-0.0023	0.0014
29	-0.0015	0.0014
30	-0.0039	0.0014
31	-0.0029	0.0014
32	-0.0010	0.0015
33	-0.0032	0.0014
34	-0.0019	0.0015
35	-0.0031	0.0015
36	-0.0042	0.0015
37	-0.0017	0.0015
38	-0.0035	0.0015
39	-0.0005	0.0015
40	-0.0034	0.0015
41	-0.0014	0.0014
42	-0.0035	0.0014
43	-0.0012	0.0014
44	-0.0009	0.0014
45	-0.0025	0.0014
46	0.0002	0.0014
47	-0.0004	0.0013
48	-0.0020	0.0013

R^2 = 0.56 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:1 –1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 2

The Impact Regimes of Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0028	0.0024	1	0.0843	0.0534
2	-0.0008	0.0024	2	0.0684	0.0533
3	-0.0028	0.0024	3	0.1118	0.0535
4	0.0009	0.0024	4	0.0069	0.0536
5	-0.0015	0.0024	5	0.0391	0.0535
6	0.0017	0.0024	6	-0.0373	0.0536
7	0.0012	0.0024	7	0.0493	0.0536
8	-0.0051	0.0024	8	0.0274	0.0538
9	-0.0029	0.0024	9	0.0512	0.0542
10	-0.0016	0.0024	10	-0.0210	0.0539
11	-0.0034	0.0024	11	0.0251	0.0520
12	0.0017	0.0024	12	0.2933	0.0525
13	0.0008	0.0024	13	-0.0433	0.0522
14	0.0014	0.0024	14	-0.1770	0.0522
15	0.0011	0.0024	15	-0.1310	0.0528
16	0.0031	0.0024	16	-0.1037	0.0531
17	0.0017	0.0024	17	0.0776	0.0535
18	-0.0027	0.0024	18	0.0311	0.0535
19	-0.0019	0.0024	19	0.0072	0.0536
20	0.0006	0.0024	20	-0.0080	0.0531
21	0.0018	0.0024	21	-0.0964	0.0535
22	-0.0070	0.0024	22	-0.0609	0.0535

The Impact of Regimes Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0010	0.0013	1	0.2146	0.0556
2	0.0019	0.0013	2	-0.0637	0.0567
3	-0.0011	0.0013	3	0.0224	0.0569
4	0.0012	0.0013	4	-0.0205	0.0571
5	0.0034	0.0013	5	0.0395	0.0570
6	-0.0010	0.0013	6	0.0999	0.0569
7	-0.0003	0.0013	7	0.0715	0.0569
8	0.0007	0.0013	8	0.0205	0.0569
9	-0.0013	0.0013	9	0.0947	0.0579
10	0.0007	0.0013	10	-0.0393	0.0586
11	-0.0024	0.0013	11	0.1782	0.0582
12	-0.0012	0.0013	12	0.0873	0.0591
13	0.0018	0.0013	13	-0.1014	0.0588
14	-0.0005	0.0013	14	0.0377	0.0585
15	0.0005	0.0013	15	-0.1061	0.0587
16	-0.0007	0.0013	16	-0.0352	0.0585
17	0.0016	0.0013	17	0.0501	0.0583
18	-0.0001	0.0013	18	0.0874	0.0583
19	0.0000	0.0013	19	-0.0525	0.0578
20	-0.0019	0.0013	20	0.0196	0.0578
21	0.0006	0.0013	21	0.0857	0.0578
22	0.0004	0.0013	22	-0.0191	0.0582

(table 2 cont.)

23	0.0017	0.0024	23	-0.0476	0.0535
24	-0.0010	0.0024	24	0.1713	0.0536
25	-0.0001	0.0024			
26	-0.0058	0.0024			
27	-0.0046	0.0024			
28	0.0031	0.0025			
29	-0.0005	0.0024			
30	-0.0004	0.0024			
31	0.0015	0.0024			
32	-0.0012	0.0024			
33	0.0028	0.0024			
34	0.0024	0.0024			
35	0.0006	0.0024			
36	0.0054	0.0024			

R^2 = 0.85 S.E.E. = 0.009 D.W. = 2.00
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

23	-0.0016	0.0013	23	-0.0546	0.0578
24	-0.0023	0.0013	24	0.0594	0.0569
25	-0.0009	0.0013			
26	-0.0033	0.0013			
27	-0.0018	0.0013			
28	-0.0016	0.0013			
29	-0.0004	0.0013			
30	-0.0019	0.0013			
31	-0.0020	0.0013			
32	0.0004	0.0013			
33	-0.0010	0.0013			
34	0.0003	0.0014			
35	-0.0020	0.0013			
36	-0.0032	0.0013			
37	0.0004	0.0014			
38	-0.0023	0.0013			
39	-0.0002	0.0014			
40	-0.0023	0.0014			
41	-0.0004	0.0013			
42	-0.0027	0.0013			
43	-0.0008	0.0013			
44	-0.0007	0.0013			
45	-0.0015	0.0013			
46	-0.0005	0.0013			
47	0.0005	0.0013			
48	-0.0019	0.0013			

R^2 = 0.49 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 3

The Impact of Chairmen Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0015	0.0022	1	0.1379	0.0629
2	0.0011	0.0022	2	0.0127	0.0626
3	-0.0047	0.0022	3	0.1407	0.0619
4	-0.0011	0.0022	4	0.0847	0.0620
5	-0.0038	0.0022	5	0.0192	0.0624
6	0.0010	0.0022	6	-0.0361	0.0625
7	0.0025	0.0022	7	-0.0278	0.0623
8	-0.0005	0.0022	8	-0.0346	0.0623
9	-0.0007	0.0022	9	0.0258	0.0617
10	-0.0037	0.0022	10	-0.0436	0.0607
11	-0.0033	0.0022	11	0.0882	0.0591
12	-0.0032	0.0022	12	0.2619	0.0611
13	0.0007	0.0022	13	-0.0159	0.0611
14	0.0021	0.0021	14	-0.1895	0.0604
15	0.0001	0.0021	15	-0.1493	0.0615
16	0.0029	0.0021	16	-0.1327	0.0626
17	-0.0010	0.0021	17	0.0760	0.0636
18	-0.0029	0.0021	18	0.1071	0.0634
19	-0.0006	0.0021	19	0.0454	0.0634
20	0.0008	0.0021	20	0.0345	0.0629

The Impact of Chairmen Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0004	0.0011	1	0.2692	0.0646
2	-0.0001	0.0011	2	0.0613	0.0663
3	-0.0010	0.0011	3	0.0161	0.0665
4	0.0007	0.0011	4	-0.0164	0.0666
5	0.0006	0.0011	5	0.0845	0.0664
6	-0.0012	0.0011	6	0.1751	0.0667
7	0.0000	0.0011	7	-0.0330	0.0676
8	0.0001	0.0011	8	0.0802	0.0675
9	-0.0017	0.0011	9	0.1091	0.0676
10	-0.0002	0.0011	10	-0.0236	0.0679
11	-0.0022	0.0011	11	0.1425	0.0680
12	0.0010	0.0011	12	0.1402	0.0683
13	0.0013	0.0011	13	-0.0966	0.0678
14	0.0006	0.0011	14	-0.0132	0.0675
15	0.0015	0.0011	15	-0.0110	0.0672
16	-0.0009	0.0011	16	-0.0214	0.0664
17	0.0009	0.0011	17	0.0638	0.0662
18	-0.0006	0.0011	18	0.0004	0.0663
19	0.0009	0.0011	19	-0.0193	0.0648
20	-0.0005	0.0011	20	0.0435	0.0648

(table 3 cont.)

21	0.0003	0.0021	21	-0.1197	0.0630
22	-0.0030	0.0021	22	-0.0834	0.0633
23	0.0039	0.0021	23	-0.1246	0.0634
24	-0.0001	0.0021	24	0.1033	0.0634
25	0.0000	0.0021			
26	0.0004	0.0021			
27	-0.0022	0.0021			
28	0.0033	0.0021			
29	0.0000	0.0022			
30	0.0019	0.0021			
31	0.0017	0.0021			
32	-0.0006	0.0021			
33	0.0010	0.0021			
34	0.0042	0.0021			
35	-0.0006	0.0021			
36	0.0051	0.0021			

R^2 = 0.85 S.E.E. = 0.010 D.W. = 2.02
The sample period is from 1970:1 –1996:12.
Constant and dummy results are not shown.
There are 324 observations.

21	0.0007	0.0011	21	-0.0243	0.0647
22	0.0005	0.0011	22	-0.0123	0.0646
23	-0.0010	0.0011	23	-0.1221	0.0644
24	-0.0011	0.0011	24	0.0068	0.0635
25	-0.0011	0.0011			
26	-0.0006	0.0011			
27	-0.0011	0.0011			
28	0.0008	0.0011			
29	-0.0010	0.0011			
30	-0.0024	0.0011			
31	-0.0012	0.0011			
32	0.0012	0.0011			
33	-0.0003	0.0012			
34	0.0004	0.0011			
35	0.0001	0.0011			
36	-0.0021	0.0011			
37	0.0000	0.0011			
38	-0.0001	0.0011			
39	0.0015	0.0011			
40	-0.0003	0.0011			
41	0.0011	0.0011			
42	-0.0005	0.0011			
43	0.0002	0.0011			
44	0.0010	0.0011			
45	0.0000	0.0011			
46	0.0013	0.0011			
47	-0.0005	0.0011			
48	0.0003	0.0011			

R^2 = 0.51 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:1 –1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 4

The Impact of Chairmen Shocks On Industrial Production

	Shock			Change In Industrial Production	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0032	0.0020	1	0.0815	0.0541
2	0.0007	0.0020	2	0.0674	0.0535
3	-0.0038	0.0020	3	0.1402	0.0529
4	-0.0004	0.0020	4	0.0342	0.0532
5	-0.0033	0.0020	5	0.0608	0.0534
6	0.0013	0.0020	6	-0.0843	0.0536
7	0.0027	0.0020	7	0.0098	0.0534
8	0.0001	0.0020	8	-0.0224	0.0533
9	-0.0014	0.0020	9	0.0417	0.0533
10	-0.0027	0.0020	10	-0.0496	0.0530
11	-0.0033	0.0020	11	0.0536	0.0515
12	-0.0030	0.0020	12	0.3124	0.0525
13	0.0019	0.0020	13	-0.0364	0.0521
14	0.0021	0.0020	14	-0.1787	0.0520
15	0.0002	0.0020	15	-0.1376	0.0527
16	0.0023	0.0020	16	-0.1247	0.0533
17	-0.0003	0.0020	17	0.0812	0.0537
18	-0.0026	0.0020	18	0.0970	0.0539

The Impact of Chairmen Shocks On the Producer Price Index

	Shock			Change In Producer Price Index	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0003	0.0011	1	0.2457	0.0555
2	0.0000	0.0011	2	-0.0002	0.0568
3	-0.0012	0.0011	3	0.0662	0.0570
4	0.0005	0.0011	4	0.0251	0.0571
5	0.0013	0.0011	5	0.0854	0.0569
6	-0.0015	0.0011	6	0.1065	0.0569
7	-0.0002	0.0011	7	0.0618	0.0572
8	0.0001	0.0011	8	0.0280	0.0571
9	-0.0018	0.0011	9	0.0875	0.0583
10	-0.0005	0.0011	10	-0.0359	0.0589
11	-0.0024	0.0011	11	0.1835	0.0589
12	0.0007	0.0011	12	0.1261	0.0598
13	0.0014	0.0011	13	-0.1243	0.0596
14	0.0008	0.0011	14	0.0510	0.0592
15	0.0011	0.0011	15	-0.1059	0.0594
16	-0.0008	0.0011	16	-0.0394	0.0593
17	0.0005	0.0011	17	0.0726	0.0592
18	-0.0007	0.0011	18	0.0633	0.0594

(table 4 cont.)

19	-0.0002	0.0020	19	0.0505	0.0540
20	0.0017	0.0020	20	-0.0015	0.0534
21	0.0002	0.0020	21	-0.0997	0.0535
22	-0.0023	0.0019	22	-0.0992	0.0534
23	0.0037	0.0019	23	-0.0982	0.0535
24	0.0000	0.0019	24	0.1461	0.0539
25	0.0010	0.0019			
26	0.0007	0.0019			
27	-0.0017	0.0019			
28	0.0030	0.0019			
29	0.0002	0.0020			
30	0.0021	0.0019			
31	0.0021	0.0019			
32	-0.0001	0.0019			
33	0.0011	0.0019			
34	0.0055	0.0019			
35	-0.0004	0.0019			
36	0.0049	0.0019			

R^2 = 0.85 S.E.E. = 0.009 D.W. = 2.01
The sample period is from 1970:1 –2003:12.
Constant and dummy results are not shown.
There are 408 observations.

19	0.0005	0.0011	19	-0.0741	0.0584
20	-0.0005	0.0011	20	-0.0124	0.0586
21	0.0009	0.0011	21	0.0718	0.0586
22	0.0004	0.0011	22	-0.0314	0.0586
23	-0.0012	0.0011	23	-0.1168	0.0585
24	-0.0013	0.0011	24	0.0536	0.0577
25	-0.0006	0.0011			
26	-0.0016	0.0011			
27	-0.0009	0.0011			
28	0.0004	0.0011			
29	-0.0010	0.0011			
30	-0.0022	0.0011			
31	-0.0012	0.0011			
32	0.0013	0.0011			
33	-0.0006	0.0011			
34	0.0010	0.0011			
35	-0.0004	0.0011			
36	-0.0024	0.0011			
37	0.0001	0.0011			
38	-0.0002	0.0011			
39	0.0007	0.0011			
40	-0.0003	0.0011			
41	0.0011	0.0011			
42	-0.0009	0.0011			
43	0.0002	0.0011			
44	0.0010	0.0011			
45	-0.0004	0.0011			
46	0.0005	0.0011			
47	-0.0001	0.0011			
48	0.0000	0.0011			

R^2 = 0.46 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:1 –2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 5

The Impact CCC of Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0027	0.0019	1	0.0835	0.0635
2	0.0017	0.0019	2	-0.0050	0.0634
3	-0.0029	0.0019	3	0.1096	0.0630
4	-0.0002	0.0019	4	0.0417	0.0632
5	-0.0021	0.0019	5	0.0181	0.0633
6	0.0018	0.0019	6	-0.0102	0.0632
7	0.0002	0.0019	7	0.0207	0.0633
8	-0.0021	0.0019	8	0.0113	0.0635
9	-0.0024	0.0019	9	0.0458	0.0629
10	-0.0036	0.0019	10	-0.0320	0.0612
11	-0.0017	0.0019	11	0.0683	0.0593
12	-0.0019	0.0019	12	0.2681	0.0608
13	-0.0011	0.0019	13	0.0036	0.0609
14	-0.0001	0.0019	14	-0.2038	0.0604
15	0.0011	0.0019	15	-0.1633	0.0611
16	0.0032	0.0019	16	-0.1306	0.0626

The Impact of CCC Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0006	0.0009	1	0.2141	0.0645
2	0.0001	0.0009	2	0.0311	0.0654
3	-0.0001	0.0009	3	-0.0148	0.0656
4	0.0014	0.0009	4	-0.0675	0.0659
5	0.0011	0.0009	5	0.0487	0.0658
6	-0.0010	0.0009	6	0.1354	0.0658
7	-0.0004	0.0009	7	-0.0248	0.0661
8	0.0001	0.0009	8	0.0802	0.0660
9	-0.0013	0.0009	9	0.1133	0.0661
10	0.0004	0.0009	10	-0.0253	0.0662
11	-0.0020	0.0009	11	0.1053	0.0661
12	-0.0007	0.0009	12	0.1287	0.0662
13	0.0003	0.0009	13	-0.0817	0.0658
14	0.0000	0.0009	14	-0.0283	0.0655
15	0.0010	0.0009	15	-0.0121	0.0652
16	-0.0001	0.0009	16	-0.0355	0.0644

(table 5 cont.)

17	-0.0004	0.0019	17	0.0721	0.0638
18	-0.0030	0.0019	18	0.0636	0.0635
19	-0.0021	0.0019	19	0.0230	0.0635
20	-0.0016	0.0019	20	0.0512	0.0631
21	-0.0018	0.0019	21	-0.0868	0.0631
22	-0.0045	0.0019	22	-0.0288	0.0633
23	-0.0004	0.0019	23	-0.0571	0.0636
24	-0.0019	0.0019	24	0.0957	0.0636
25	-0.0020	0.0019			
26	-0.0024	0.0019			
27	-0.0028	0.0019			
28	0.0022	0.0019			
29	0.0000	0.0019			
30	0.0024	0.0020			
31	0.0006	0.0020			
32	0.0007	0.0019			
33	0.0012	0.0019			
34	0.0051	0.0019			
35	0.0022	0.0019			
36	0.0022	0.0019			

R^2 = 0.85 S.E.E. = 0.010 D.W. = 2.01
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

17	0.0005	0.0009	17	0.0482	0.0643
18	-0.0007	0.0009	18	0.0077	0.0644
19	0.0008	0.0009	19	-0.0145	0.0631
20	-0.0014	0.0009	20	0.0765	0.0634
21	0.0007	0.0009	21	-0.0125	0.0634
22	0.0003	0.0010	22	0.0004	0.0632
23	-0.0013	0.0010	23	-0.0668	0.0630
24	-0.0021	0.0010	24	0.0363	0.0619
25	-0.0022	0.0010			
26	-0.0019	0.0010			
27	-0.0013	0.0010			
28	0.0002	0.0010			
29	-0.0018	0.0010			
30	-0.0029	0.0010			
31	-0.0020	0.0010			
32	0.0003	0.0010			
33	-0.0002	0.0010			
34	-0.0003	0.0010			
35	-0.0008	0.0010			
36	-0.0028	0.0010			
37	-0.0012	0.0010			
38	-0.0005	0.0010			
39	0.0009	0.0010			
40	-0.0010	0.0010			
41	-0.0005	0.0010			
42	-0.0026	0.0010			
43	-0.0009	0.0010			
44	0.0003	0.0010			
45	-0.0008	0.0010			
46	0.0000	0.0010			
47	-0.0017	0.0010			
48	-0.0008	0.0010			

R^2 = 0.55 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 6

The Impact CCC of Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0032	0.0017	1	0.0482	0.0543
2	0.0011	0.0017	2	0.0516	0.0540
3	-0.0034	0.0017	3	0.1250	0.0535
4	0.0002	0.0017	4	0.0040	0.0538
5	-0.0022	0.0017	5	0.0534	0.0539
6	0.0018	0.0018	6	-0.0544	0.0539
7	0.0004	0.0018	7	0.0433	0.0538
8	-0.0023	0.0017	8	0.0021	0.0538
9	-0.0026	0.0018	9	0.0601	0.0538
10	-0.0030	0.0017	10	-0.0397	0.0531
11	-0.0020	0.0018	11	0.0414	0.0513
12	-0.0018	0.0018	12	0.3157	0.0522
13	-0.0004	0.0018	13	-0.0150	0.0518
14	-0.0002	0.0017	14	-0.1965	0.0516

The Impact of CCC Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0006	0.0009	1	0.1980	0.0554
2	0.0006	0.0009	2	-0.0421	0.0563
3	-0.0004	0.0009	3	0.0361	0.0565
4	0.0010	0.0009	4	-0.0129	0.0566
5	0.0017	0.0009	5	0.0609	0.0565
6	-0.0011	0.0009	6	0.0761	0.0564
7	-0.0004	0.0009	7	0.0811	0.0562
8	0.0004	0.0009	8	0.0313	0.0563
9	-0.0015	0.0009	9	0.0994	0.0572
10	-0.0003	0.0009	10	-0.0270	0.0577
11	-0.0024	0.0009	11	0.1570	0.0577
12	-0.0012	0.0009	12	0.1101	0.0584
13	0.0002	0.0009	13	-0.1130	0.0581
14	0.0002	0.0009	14	0.0261	0.0578

(table 6 cont.)

15	0.0010	0.0017	15	-0.1414	0.0522
16	0.0029	0.0017	16	-0.1190	0.0529
17	0.0001	0.0018	17	0.0781	0.0533
18	-0.0030	0.0018	18	0.0601	0.0532
19	-0.0018	0.0018	19	0.0310	0.0533
20	-0.0005	0.0018	20	0.0204	0.0528
21	-0.0016	0.0018	21	-0.0718	0.0529
22	-0.0041	0.0017	22	-0.0559	0.0529
23	0.0003	0.0018	23	-0.0447	0.0530
24	-0.0018	0.0018	24	0.1327	0.0536
25	-0.0014	0.0017			
26	-0.0017	0.0017			
27	-0.0031	0.0017			
28	0.0021	0.0017			
29	0.0000	0.0017			
30	0.0024	0.0017			
31	0.0009	0.0017			
32	0.0007	0.0017			
33	0.0014	0.0017			
34	0.0059	0.0017			
35	0.0019	0.0017			
36	0.0026	0.0017			

R^2 = 0.85 S.E.E. = 0.009 D.W. = 2.00
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

15	0.0005	0.0009	15	-0.1049	0.0580
16	-0.0002	0.0009	16	-0.0583	0.0578
17	0.0002	0.0009	17	0.0509	0.0577
18	-0.0007	0.0009	18	0.0635	0.0578
19	0.0006	0.0009	19	-0.0827	0.0569
20	-0.0010	0.0009	20	0.0043	0.0572
21	0.0009	0.0009	21	0.0753	0.0572
22	-0.0003	0.0009	22	-0.0151	0.0574
23	-0.0014	0.0009	23	-0.0761	0.0573
24	-0.0021	0.0010	24	0.0656	0.0564
25	-0.0014	0.0010			
26	-0.0023	0.0010			
27	-0.0011	0.0010			
28	-0.0002	0.0010			
29	-0.0017	0.0010			
30	-0.0021	0.0010			
31	-0.0015	0.0010			
32	0.0007	0.0010			
33	0.0002	0.0010			
34	0.0005	0.0010			
35	-0.0010	0.0010			
36	-0.0026	0.0010			
37	-0.0005	0.0010			
38	-0.0002	0.0010			
39	0.0003	0.0010			
40	-0.0011	0.0010			
41	-0.0001	0.0010			
42	-0.0027	0.0010			
43	-0.0007	0.0010			
44	0.0002	0.0009			
45	-0.0011	0.0009			
46	-0.0006	0.0009			
47	-0.0011	0.0009			
48	-0.0010	0.0009			

R^2 = 0.60 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 7

The Impact of RR-SPF Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0022	0.0020	1	0.1074	0.0632
2	0.0013	0.0020	2	0.0059	0.0631
3	-0.0057	0.0020	3	0.1314	0.0629
4	-0.0013	0.0021	4	0.0790	0.0632
5	-0.0045	0.0021	5	0.0306	0.0632
6	0.0003	0.0021	6	-0.0124	0.0631
7	-0.0007	0.0021	7	0.0055	0.0630
8	-0.0027	0.0021	8	-0.0089	0.0628
9	0.0002	0.0021	9	0.0135	0.0621
10	-0.0039	0.0021	10	-0.0464	0.0611
11	-0.0007	0.0021	11	0.0811	0.0597
12	-0.0025	0.0021	12	0.2784	0.0607

The Impact of RR-SPF Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0003	0.0010	1	0.2445	0.0650
2	-0.0004	0.0010	2	0.0609	0.0664
3	-0.0006	0.0010	3	-0.0103	0.0663
4	0.0003	0.0010	4	-0.0306	0.0659
5	0.0014	0.0010	5	0.0701	0.0656
6	-0.0015	0.0010	6	0.1595	0.0658
7	-0.0001	0.0010	7	-0.0174	0.0665
8	-0.0005	0.0010	8	0.0676	0.0666
9	-0.0020	0.0010	9	0.1024	0.0671
10	0.0004	0.0010	10	-0.0413	0.0674
11	-0.0020	0.0010	11	0.1524	0.0673
12	-0.0001	0.0010	12	0.1166	0.0678

(table 7 cont.)

13	-0.0009	0.0021	13	-0.0013	0.0606
14	-0.0004	0.0020	14	-0.1978	0.0602
15	0.0002	0.0020	15	-0.1543	0.0612
16	0.0040	0.0021	16	-0.1255	0.0622
17	-0.0003	0.0021	17	0.0745	0.0632
18	-0.0011	0.0021	18	0.0765	0.0630
19	-0.0019	0.0021	19	0.0473	0.0630
20	-0.0018	0.0021	20	0.0646	0.0629
21	-0.0010	0.0021	21	-0.0980	0.0630
22	-0.0036	0.0021	22	-0.0366	0.0633
23	0.0012	0.0021	23	-0.0970	0.0633
24	0.0000	0.0021	24	0.0589	0.0632
25	-0.0006	0.0021			
26	-0.0002	0.0021			
27	-0.0012	0.0021			
28	0.0043	0.0021			
29	0.0006	0.0021			
30	0.0025	0.0021			
31	0.0007	0.0021			
32	-0.0009	0.0020			
33	0.0014	0.0020			
34	0.0035	0.0020			
35	-0.0005	0.0020			
36	0.0033	0.0020			

R^2 = 0.85 S.E.E. = 0.010 D.W. = 2.00
The sample period is from 1970:3 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

13	0.0002	0.0010	13	-0.0522	0.0676
14	0.0007	0.0010	14	-0.0352	0.0670
15	0.0005	0.0010	15	-0.0317	0.0666
16	-0.0001	0.0010	16	-0.0086	0.0657
17	0.0010	0.0010	17	0.0185	0.0654
18	-0.0009	0.0010	18	0.0248	0.0656
19	0.0009	0.0010	19	-0.0343	0.0641
20	-0.0020	0.0010	20	0.0861	0.0643
21	0.0006	0.0010	21	-0.0322	0.0646
22	0.0007	0.0010	22	-0.0280	0.0645
23	-0.0015	0.0010	23	-0.0857	0.0639
24	-0.0007	0.0011	24	0.0121	0.0626
25	-0.0016	0.0011			
26	-0.0024	0.0011			
27	-0.0009	0.0011			
28	0.0001	0.0011			
29	-0.0010	0.0011			
30	-0.0024	0.0011			
31	-0.0014	0.0011			
32	-0.0001	0.0011			
33	-0.0004	0.0011			
34	0.0004	0.0011			
35	-0.0011	0.0011			
36	-0.0020	0.0011			
37	-0.0007	0.0011			
38	-0.0011	0.0011			
39	0.0009	0.0011			
40	-0.0008	0.0011			
41	0.0001	0.0011			
42	-0.0016	0.0011			
43	0.0000	0.0011			
44	0.0003	0.0010			
45	-0.0020	0.0010			
46	0.0011	0.0010			
47	-0.0007	0.0010			
48	0.0002	0.0010			

R^2 = 0.54 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:2 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 8

The Impact of RR-SPF Shocks
On Industrial Production

	Shock			Change In Industrial Production	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0026	0.0019	1	0.0717	0.0542
2	0.0012	0.0019	2	0.0561	0.0539
3	-0.0057	0.0019	3	0.1354	0.0537
4	-0.0003	0.0019	4	0.0279	0.0540
5	-0.0038	0.0019	5	0.0524	0.0540
6	0.0003	0.0019	6	-0.0520	0.0541
7	-0.0005	0.0019	7	0.0288	0.0539
8	-0.0028	0.0019	8	-0.0102	0.0537
9	0.0000	0.0019	9	0.0369	0.0537
10	-0.0037	0.0019	10	-0.0571	0.0533

The Impact of RR-SPF Shocks On
the Producer Price Index

	Shock			Change In Producer Price Index	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0001	0.0010	1	0.2277	0.0557
2	0.0000	0.0010	2	-0.0115	0.0568
3	-0.0007	0.0010	3	0.0502	0.0568
4	-0.0001	0.0010	4	0.0238	0.0566
5	0.0019	0.0010	5	0.0705	0.0564
6	-0.0017	0.0010	6	0.1031	0.0563
7	-0.0005	0.0010	7	0.0771	0.0567
8	-0.0001	0.0010	8	0.0218	0.0568
9	-0.0022	0.0010	9	0.0913	0.0581
10	0.0002	0.0010	10	-0.0432	0.0586

(table 8 cont.)

11	-0.0010	0.0019	11	0.0502	0.0518
12	-0.0019	0.0019	12	0.3132	0.0521
13	-0.0006	0.0019	13	-0.0228	0.0517
14	-0.0002	0.0019	14	-0.1901	0.0515
15	-0.0001	0.0019	15	-0.1323	0.0523
16	0.0037	0.0019	16	-0.1063	0.0528
17	0.0002	0.0019	17	0.0755	0.0530
18	-0.0012	0.0019	18	0.0683	0.0531
19	-0.0016	0.0019	19	0.0490	0.0532
20	-0.0011	0.0019	20	0.0210	0.0529
21	-0.0006	0.0019	21	-0.0895	0.0530
22	-0.0035	0.0019	22	-0.0565	0.0531
23	0.0012	0.0019	23	-0.0772	0.0531
24	0.0001	0.0019	24	0.1084	0.0532
25	-0.0007	0.0019			
26	0.0004	0.0019			
27	-0.0019	0.0019			
28	0.0042	0.0019			
29	0.0009	0.0019			
30	0.0022	0.0019			
31	0.0013	0.0019			
32	-0.0012	0.0019			
33	0.0016	0.0019			
34	0.0042	0.0019			
35	-0.0008	0.0019			
36	0.0037	0.0019			

R^2 = 0.85 S.E.E. = 0.009 D.W. = 1.99
The sample period is from 1970:3 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

11	-0.0023	0.0010	11	0.1884	0.0586
12	-0.0006	0.0010	12	0.1088	0.0596
13	0.0005	0.0010	13	-0.0911	0.0596
14	0.0005	0.0010	14	0.0224	0.0591
15	0.0008	0.0010	15	-0.1220	0.0591
16	0.0002	0.0010	16	-0.0389	0.0589
17	0.0008	0.0010	17	0.0353	0.0589
18	-0.0006	0.0010	18	0.0851	0.0589
19	0.0004	0.0010	19	-0.0854	0.0581
20	-0.0013	0.0010	20	0.0103	0.0583
21	0.0009	0.0010	21	0.0679	0.0584
22	0.0006	0.0010	22	-0.0383	0.0586
23	-0.0014	0.0010	23	-0.1006	0.0583
24	-0.0009	0.0010	24	0.0570	0.0573
25	-0.0009	0.0010			
26	-0.0026	0.0010			
27	-0.0003	0.0010			
28	-0.0003	0.0010			
29	-0.0005	0.0010			
30	-0.0016	0.0010			
31	-0.0017	0.0010			
32	0.0002	0.0010			
33	0.0000	0.0010			
34	0.0008	0.0010			
35	-0.0012	0.0010			
36	-0.0023	0.0010			
37	-0.0001	0.0010			
38	-0.0011	0.0010			
39	0.0004	0.0010			
40	-0.0008	0.0010			
41	0.0005	0.0010			
42	-0.0017	0.0010			
43	-0.0004	0.0010			
44	0.0004	0.0010			
45	-0.0020	0.0010			
46	0.0004	0.0010			
47	-0.0002	0.0010			
48	-0.0001	0.0010			

R^2 = 0.47 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:3 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 9

The Impact of RR-BCI Shocks
On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0040	0.0019	1	0.0828	0.0636
2	0.0014	0.0019	2	-0.0043	0.0635
3	-0.0032	0.0019	3	0.1171	0.0630
4	-0.0024	0.0019	4	0.0538	0.0633
5	-0.0034	0.0019	5	0.0158	0.0633
6	0.0010	0.0019	6	0.0015	0.0633
7	-0.0010	0.0019	7	0.0387	0.0629
8	-0.0029	0.0019	8	0.0282	0.0628

The Impact of RR-BCI Shocks On
the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0008	0.0009	1	0.2078	0.0644
2	0.0005	0.0009	2	0.0395	0.0655
3	-0.0008	0.0009	3	-0.0187	0.0659
4	0.0013	0.0009	4	-0.0482	0.0660
5	0.0014	0.0009	5	0.0225	0.0660
6	-0.0007	0.0009	6	0.1133	0.0659
7	0.0001	0.0009	7	-0.0101	0.0656
8	0.0004	0.0009	8	0.0640	0.0655

(table 9 cont.)

9	-0.0027	0.0019	9	0.0341	0.0627
10	-0.0037	0.0019	10	-0.0499	0.0608
11	-0.0029	0.0019	11	0.0663	0.0593
12	-0.0020	0.0019	12	0.2787	0.0604
13	-0.0021	0.0019	13	0.0143	0.0608
14	0.0002	0.0019	14	-0.2039	0.0604
15	0.0003	0.0019	15	-0.1576	0.0609
16	0.0024	0.0019	16	-0.1269	0.0624
17	-0.0010	0.0019	17	0.0965	0.0639
18	-0.0023	0.0019	18	0.0687	0.0636
19	-0.0019	0.0019	19	0.0548	0.0635
20	-0.0018	0.0019	20	0.0670	0.0633
21	-0.0001	0.0019	21	-0.0529	0.0633
22	-0.0042	0.0019	22	-0.0060	0.0632
23	0.0013	0.0019	23	-0.0512	0.0632
24	-0.0002	0.0019	24	0.0841	0.0633
25	-0.0002	0.0019			
26	-0.0001	0.0019			
27	-0.0011	0.0019			
28	0.0033	0.0019			
29	0.0015	0.0020			
30	0.0049	0.0019			
31	0.0014	0.0019			
32	0.0012	0.0019			
33	0.0004	0.0019			
34	0.0048	0.0019			
35	0.0020	0.0019			
36	0.0020	0.0019			

R^2 = 0.85 S.E.E. = 0.009 D.W. = 2.01
The sample period is from 1970:3 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

9	-0.0016	0.0009	9	0.1127	0.0657
10	0.0005	0.0009	10	-0.0205	0.0658
11	-0.0012	0.0009	11	0.0790	0.0658
12	-0.0008	0.0009	12	0.1165	0.0657
13	0.0007	0.0009	13	-0.0680	0.0652
14	-0.0002	0.0009	14	-0.0244	0.0649
15	0.0016	0.0009	15	-0.0181	0.0645
16	0.0004	0.0009	16	-0.0403	0.0638
17	0.0004	0.0009	17	0.0510	0.0637
18	-0.0011	0.0009	18	0.0120	0.0637
19	0.0006	0.0009	19	-0.0197	0.0628
20	-0.0010	0.0009	20	0.0896	0.0631
21	0.0007	0.0009	21	-0.0115	0.0629
22	0.0007	0.0009	22	-0.0181	0.0628
23	-0.0013	0.0009	23	-0.0529	0.0623
24	-0.0016	0.0010	24	0.0393	0.0610
25	-0.0021	0.0010			
26	-0.0022	0.0010			
27	-0.0008	0.0010			
28	0.0006	0.0010			
29	-0.0014	0.0010			
30	-0.0025	0.0010			
31	-0.0029	0.0010			
32	-0.0003	0.0010			
33	0.0001	0.0010			
34	-0.0001	0.0010			
35	-0.0009	0.0010			
36	-0.0029	0.0010			
37	-0.0016	0.0010			
38	-0.0011	0.0010			
39	0.0004	0.0010			
40	-0.0009	0.0010			
41	-0.0004	0.0010			
42	-0.0031	0.0010			
43	-0.0012	0.0010			
44	-0.0002	0.0010			
45	-0.0015	0.0010			
46	0.0005	0.0010			
47	-0.0010	0.0010			
48	-0.0011	0.0010			

R^2 = 0.56 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:2 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 10

The Impact of RR-BCI Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0044	0.0017	1	0.0450	0.0543
2	0.0010	0.0017	2	0.0440	0.0541
3	-0.0034	0.0017	3	0.1261	0.0536
4	-0.0017	0.0017	4	0.0080	0.0540
5	-0.0030	0.0017	5	0.0385	0.0541
6	0.0012	0.0017	6	-0.0471	0.0541

The Impact of RR-BCI Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0008	0.0009	1	0.2055	0.0554
2	0.0009	0.0009	2	-0.0331	0.0566
3	-0.0009	0.0009	3	0.0348	0.0568
4	0.0010	0.0009	4	0.0038	0.0568
5	0.0019	0.0009	5	0.0488	0.0567
6	-0.0007	0.0009	6	0.0696	0.0566

(table 10 cont.)

7	-0.0005	0.0017	7	0.0494	0.0534
8	-0.0030	0.0017	8	0.0126	0.0532
9	-0.0026	0.0017	9	0.0499	0.0538
10	-0.0031	0.0017	10	-0.0565	0.0529
11	-0.0027	0.0017	11	0.0344	0.0514
12	-0.0017	0.0017	12	0.3251	0.0519
13	-0.0016	0.0017	13	-0.0062	0.0518
14	0.0001	0.0017	14	-0.1970	0.0516
15	-0.0002	0.0017	15	-0.1334	0.0521
16	0.0022	0.0017	16	-0.1117	0.0529
17	-0.0007	0.0017	17	0.0968	0.0534
18	-0.0019	0.0017	18	0.0657	0.0534
19	-0.0019	0.0017	19	0.0527	0.0534
20	-0.0009	0.0017	20	0.0232	0.0530
21	-0.0001	0.0017	21	-0.0471	0.0530
22	-0.0039	0.0017	22	-0.0439	0.0528
23	0.0019	0.0017	23	-0.0401	0.0529
24	-0.0004	0.0017	24	0.1205	0.0533
25	0.0001	0.0017			
26	-0.0001	0.0017			
27	-0.0017	0.0017			
28	0.0027	0.0017			
29	0.0012	0.0017			
30	0.0046	0.0017			
31	0.0018	0.0017			
32	0.0008	0.0017			
33	0.0002	0.0017			
34	0.0055	0.0017			
35	0.0018	0.0017			
36	0.0027	0.0017			

R^2 = 0.86 S.E.E. = 0.009 D.W. = 2.00
The sample period is from 1970:3 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

7	0.0001	0.0009	7	0.0880	0.0563
8	0.0005	0.0009	8	0.0204	0.0563
9	-0.0017	0.0009	9	0.0954	0.0575
10	0.0001	0.0009	10	-0.0255	0.0580
11	-0.0015	0.0009	11	0.1433	0.0580
12	-0.0011	0.0009	12	0.1133	0.0587
13	0.0004	0.0009	13	-0.1016	0.0584
14	-0.0002	0.0009	14	0.0184	0.0582
15	0.0012	0.0009	15	-0.1069	0.0583
16	0.0003	0.0009	16	-0.0593	0.0581
17	0.0001	0.0009	17	0.0540	0.0580
18	-0.0011	0.0009	18	0.0687	0.0580
19	0.0002	0.0009	19	-0.0800	0.0574
20	-0.0008	0.0009	20	0.0074	0.0577
21	0.0008	0.0009	21	0.0743	0.0576
22	0.0002	0.0009	22	-0.0259	0.0577
23	-0.0012	0.0009	23	-0.0688	0.0574
24	-0.0017	0.0009	24	0.0736	0.0563
25	-0.0013	0.0009			
26	-0.0027	0.0009			
27	-0.0006	0.0009			
28	0.0003	0.0009			
29	-0.0013	0.0009			
30	-0.0014	0.0009			
31	-0.0023	0.0009			
32	0.0001	0.0010			
33	0.0005	0.0010			
34	0.0007	0.0010			
35	-0.0007	0.0010			
36	-0.0023	0.0010			
37	-0.0007	0.0010			
38	-0.0007	0.0010			
39	0.0002	0.0010			
40	-0.0009	0.0010			
41	0.0000	0.0010			
42	-0.0026	0.0009			
43	-0.0007	0.0009			
44	0.0000	0.0009			
45	-0.0015	0.0009			
46	-0.0002	0.0009			
47	-0.0002	0.0009			
48	-0.0008	0.0009			

R^2 = 0.49 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:3 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 11

The Impact of RR-BCI-SPF Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0030	0.0021	1	0.1149	0.0631
2	0.0005	0.0021	2	-0.0017	0.0632
3	-0.0046	0.0021	3	0.1322	0.0629

The Impact of RR-BCI-SPF Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0002	0.0010	1	0.2325	0.0649
2	-0.0003	0.0010	2	0.0657	0.0663
3	-0.0013	0.0010	3	-0.0309	0.0664

(table 11 cont.)

4	-0.0020	0.0021	4	0.0750	0.0633
5	-0.0037	0.0021	5	0.0173	0.0633
6	0.0015	0.0021	6	-0.0113	0.0632
7	-0.0008	0.0021	7	0.0258	0.0628
8	-0.0021	0.0022	8	0.0036	0.0626
9	-0.0009	0.0022	9	0.0136	0.0623
10	-0.0023	0.0021	10	-0.0602	0.0608
11	-0.0017	0.0021	11	0.0813	0.0594
12	-0.0018	0.0021	12	0.2678	0.0605
13	-0.0016	0.0021	13	-0.0005	0.0606
14	0.0006	0.0021	14	-0.1936	0.0602
15	0.0004	0.0021	15	-0.1531	0.0608
16	0.0033	0.0021	16	-0.1235	0.0620
17	-0.0008	0.0021	17	0.0873	0.0632
18	-0.0017	0.0021	18	0.0652	0.0629
19	-0.0016	0.0021	19	0.0469	0.0630
20	-0.0040	0.0021	20	0.0535	0.0628
21	0.0002	0.0021	21	-0.0827	0.0628
22	-0.0045	0.0021	22	-0.0260	0.0629
23	0.0009	0.0021	23	-0.0861	0.0629
24	-0.0002	0.0021	24	0.0608	0.0627
25	-0.0004	0.0021			
26	0.0008	0.0021			
27	-0.0018	0.0021			
28	0.0041	0.0022			
29	0.0011	0.0022			
30	0.0042	0.0021			
31	0.0002	0.0022			
32	-0.0002	0.0021			
33	0.0005	0.0021			
34	0.0038	0.0021			
35	0.0003	0.0022			
36	0.0030	0.0021			

R^2 = 0.85 S.E.E. = 0.010 D.W. = 2.00
The sample period is from 1970:3 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

4	0.0006	0.0010	4	-0.0108	0.0660
5	0.0013	0.0010	5	0.0686	0.0658
6	-0.0016	0.0010	6	0.1511	0.0659
7	-0.0004	0.0010	7	0.0161	0.0664
8	-0.0005	0.0011	8	0.0596	0.0664
9	-0.0024	0.0011	9	0.1119	0.0667
10	-0.0002	0.0011	10	-0.0164	0.0671
11	-0.0013	0.0011	11	0.1338	0.0669
12	-0.0006	0.0011	12	0.1124	0.0673
13	0.0010	0.0011	13	-0.0502	0.0671
14	0.0006	0.0011	14	-0.0360	0.0666
15	0.0013	0.0011	15	-0.0273	0.0662
16	0.0006	0.0011	16	-0.0329	0.0651
17	0.0010	0.0011	17	0.0186	0.0649
18	-0.0004	0.0011	18	0.0111	0.0650
19	0.0009	0.0011	19	-0.0443	0.0640
20	-0.0011	0.0011	20	0.0914	0.0642
21	0.0006	0.0011	21	-0.0220	0.0643
22	0.0012	0.0011	22	-0.0364	0.0642
23	-0.0016	0.0011	23	-0.0731	0.0634
24	-0.0006	0.0011	24	0.0244	0.0621
25	-0.0012	0.0011			
26	-0.0027	0.0011			
27	-0.0005	0.0011			
28	0.0001	0.0011			
29	-0.0009	0.0011			
30	-0.0018	0.0011			
31	-0.0020	0.0011			
32	-0.0003	0.0011			
33	0.0001	0.0011			
34	0.0000	0.0011			
35	-0.0014	0.0011			
36	-0.0022	0.0011			
37	-0.0011	0.0011			
38	-0.0016	0.0011			
39	0.0002	0.0011			
40	-0.0008	0.0011			
41	-0.0002	0.0011			
42	-0.0023	0.0011			
43	-0.0003	0.0011			
44	-0.0001	0.0011			
45	-0.0024	0.0011			
46	0.0012	0.0011			
47	-0.0003	0.0011			
48	-0.0003	0.0011			

R^2 = 0.55 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:2 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 12

The Impact of RR- BCI-SPF Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.

The Impact of RR-BCI-SPF Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.

(table 12 cont.)

1	0.0032	0.0019	1	0.0738	0.0541
2	0.0003	0.0019	2	0.0440	0.0539
3	-0.0048	0.0019	3	0.1372	0.0536
4	-0.0010	0.0020	4	0.0267	0.0540
5	-0.0031	0.0019	5	0.0364	0.0540
6	0.0013	0.0019	6	-0.0519	0.0540
7	-0.0003	0.0019	7	0.0410	0.0536
8	-0.0028	0.0019	8	-0.0025	0.0534
9	-0.0009	0.0019	9	0.0370	0.0537
10	-0.0026	0.0019	10	-0.0669	0.0529
11	-0.0017	0.0019	11	0.0493	0.0516
12	-0.0012	0.0019	12	0.3066	0.0520
13	-0.0017	0.0019	13	-0.0208	0.0516
14	0.0009	0.0019	14	-0.1856	0.0514
15	-0.0002	0.0019	15	-0.1288	0.0519
16	0.0032	0.0019	16	-0.1095	0.0526
17	-0.0004	0.0019	17	0.0871	0.0529
18	-0.0012	0.0019	18	0.0645	0.0530
19	-0.0014	0.0019	19	0.0461	0.0531
20	-0.0030	0.0019	20	0.0111	0.0529
21	0.0004	0.0019	21	-0.0743	0.0529
22	-0.0045	0.0019	22	-0.0519	0.0528
23	0.0013	0.0019	23	-0.0681	0.0529
24	-0.0003	0.0019	24	0.1109	0.0529
25	-0.0002	0.0019			
26	0.0013	0.0019			
27	-0.0023	0.0019			
28	0.0037	0.0019			
29	0.0015	0.0019			
30	0.0036	0.0019			
31	0.0012	0.0019			
32	-0.0005	0.0019			
33	0.0007	0.0019			
34	0.0045	0.0019			
35	-0.0001	0.0019			
36	0.0041	0.0019			

R^2 = 0.85 S.E.E. = 0.009 D.W. = 1.99
The sample period is from 1970:3 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

1	0.0001	0.0010	1	0.2252	0.0556
2	0.0003	0.0010	2	-0.0023	0.0567
3	-0.0014	0.0010	3	0.0368	0.0568
4	0.0003	0.0010	4	0.0391	0.0566
5	0.0021	0.0010	5	0.0728	0.0565
6	-0.0018	0.0010	6	0.1045	0.0565
7	-0.0005	0.0010	7	0.0979	0.0567
8	-0.0003	0.0010	8	0.0180	0.0569
9	-0.0022	0.0010	9	0.0994	0.0582
10	-0.0003	0.0010	10	-0.0235	0.0588
11	-0.0018	0.0010	11	0.1672	0.0588
12	-0.0009	0.0010	12	0.1086	0.0596
13	0.0009	0.0010	13	-0.0883	0.0596
14	0.0004	0.0010	14	0.0041	0.0592
15	0.0014	0.0010	15	-0.1104	0.0592
16	0.0009	0.0010	16	-0.0572	0.0588
17	0.0005	0.0010	17	0.0335	0.0588
18	-0.0003	0.0010	18	0.0713	0.0587
19	0.0005	0.0010	19	-0.0910	0.0580
20	-0.0009	0.0010	20	0.0120	0.0583
21	0.0007	0.0010	21	0.0759	0.0583
22	0.0010	0.0010	22	-0.0435	0.0586
23	-0.0014	0.0010	23	-0.0882	0.0580
24	-0.0009	0.0010	24	0.0711	0.0570
25	-0.0007	0.0010			
26	-0.0029	0.0010			
27	0.0001	0.0010			
28	0.0000	0.0010			
29	-0.0003	0.0010			
30	-0.0008	0.0010			
31	-0.0020	0.0010			
32	0.0001	0.0010			
33	0.0008	0.0011			
34	0.0006	0.0011			
35	-0.0011	0.0011			
36	-0.0019	0.0010			
37	-0.0004	0.0011			
38	-0.0013	0.0011			
39	0.0000	0.0011			
40	-0.0004	0.0011			
41	0.0003	0.0011			
42	-0.0020	0.0010			
43	-0.0003	0.0010			
44	0.0002	0.0010			
45	-0.0022	0.0010			
46	0.0003	0.0010			
47	0.0005	0.0010			
48	-0.0001	0.0010			

R^2 = 0.48 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:3 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 13

The Impact of SPF Shocks On Industrial Production

	Shock			Change In Industrial Production	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0043	0.0018	1	0.0828	0.0637
2	0.0009	0.0018	2	-0.0131	0.0637
3	-0.0045	0.0018	3	0.0754	0.0634
4	0.0009	0.0018	4	0.0421	0.0634
5	-0.0025	0.0018	5	0.0187	0.0635
6	0.0009	0.0018	6	-0.0371	0.0634
7	-0.0022	0.0018	7	0.0159	0.0636
8	-0.0018	0.0018	8	-0.0343	0.0634
9	0.0002	0.0018	9	0.0144	0.0633
10	-0.0024	0.0018	10	-0.0427	0.0621
11	-0.0033	0.0018	11	0.0805	0.0610
12	-0.0008	0.0018	12	0.2598	0.0615
13	-0.0018	0.0018	13	0.0195	0.0617
14	-0.0023	0.0018	14	-0.1854	0.0610
15	-0.0013	0.0018	15	-0.1026	0.0616
16	0.0010	0.0018	16	-0.1059	0.0619
17	-0.0009	0.0018	17	0.0831	0.0627
18	-0.0009	0.0018	18	0.0585	0.0624
19	-0.0040	0.0018	19	0.0568	0.0625
20	-0.0021	0.0018	20	0.0750	0.0621
21	-0.0018	0.0018	21	-0.0716	0.0622
22	-0.0021	0.0018	22	-0.0228	0.0621
23	-0.0001	0.0018	23	-0.0622	0.0623
24	-0.0022	0.0018	24	0.0633	0.0618
25	-0.0004	0.0018			
26	-0.0013	0.0018			
27	-0.0025	0.0018			
28	0.0025	0.0018			
29	0.0005	0.0018			
30	0.0011	0.0018			
31	-0.0001	0.0018			
32	-0.0009	0.0018			
33	-0.0010	0.0018			
34	0.0055	0.0018			
35	-0.0012	0.0018			
36	0.0012	0.0018			

R^2 = 0.85   S.E.E. = 0.009   D.W. = 2.00
The sample period is from 1970:3 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

The Impact of SPF Shocks On the Producer Price Index

	Shock			Change In Producer Price Index	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0007	0.0009	1	0.2355	0.0647
2	-0.0001	0.0009	2	0.0454	0.0660
3	-0.0008	0.0009	3	-0.0233	0.0661
4	0.0011	0.0009	4	-0.0450	0.0657
5	0.0016	0.0009	5	0.0845	0.0653
6	-0.0017	0.0009	6	0.1413	0.0655
7	0.0001	0.0009	7	0.0078	0.0661
8	0.0001	0.0009	8	0.0656	0.0660
9	-0.0017	0.0009	9	0.1259	0.0661
10	0.0003	0.0009	10	-0.0246	0.0663
11	-0.0004	0.0009	11	0.1636	0.0664
12	-0.0005	0.0009	12	0.1053	0.0671
13	0.0004	0.0009	13	-0.0419	0.0668
14	0.0000	0.0009	14	-0.0133	0.0661
15	0.0008	0.0009	15	-0.0291	0.0658
16	0.0004	0.0009	16	-0.0149	0.0650
17	0.0005	0.0009	17	0.0509	0.0648
18	-0.0005	0.0009	18	0.0198	0.0650
19	-0.0001	0.0009	19	-0.0129	0.0637
20	-0.0007	0.0009	20	0.1013	0.0636
21	0.0006	0.0009	21	-0.0496	0.0644
22	0.0000	0.0009	22	0.0132	0.0644
23	-0.0009	0.0009	23	-0.0882	0.0639
24	-0.0013	0.0009	24	-0.0100	0.0626
25	-0.0011	0.0009			
26	-0.0022	0.0009			
27	-0.0006	0.0009			
28	-0.0005	0.0009			
29	0.0000	0.0009			
30	-0.0026	0.0009			
31	-0.0008	0.0009			
32	0.0001	0.0009			
33	0.0001	0.0009			
34	0.0003	0.0009			
35	-0.0008	0.0009			
36	-0.0018	0.0009			
37	0.0007	0.0009			
38	-0.0007	0.0009			
39	0.0006	0.0009			
40	0.0004	0.0009			
41	-0.0005	0.0009			
42	-0.0018	0.0009			
43	0.0007	0.0009			
44	0.0000	0.0009			
45	-0.0016	0.0009			
46	0.0005	0.0009			
47	-0.0009	0.0009			
48	0.0000	0.0009			

R^2 = 0.54   S.E.E. = 0.005   D.W. = 2.00
The sample period is from 1970:2 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 14

The Impact of SPF Shocks Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0049	0.0016	1	0.0283	0.0547
2	0.0004	0.0016	2	0.0423	0.0544
3	-0.0041	0.0016	3	0.0875	0.0543
4	0.0007	0.0017	4	-0.0059	0.0545
5	-0.0020	0.0016	5	0.0533	0.0545
6	0.0004	0.0016	6	-0.0667	0.0544
7	-0.0021	0.0016	7	0.0367	0.0544
8	-0.0018	0.0016	8	-0.0356	0.0541
9	-0.0005	0.0016	9	0.0396	0.0545
10	-0.0019	0.0016	10	-0.0412	0.0540
11	-0.0042	0.0016	11	0.0563	0.0528
12	-0.0010	0.0016	12	0.3158	0.0530
13	-0.0017	0.0016	13	-0.0005	0.0529
14	-0.0026	0.0016	14	-0.1615	0.0524
15	-0.0016	0.0016	15	-0.0860	0.0528
16	0.0007	0.0017	16	-0.0982	0.0528
17	-0.0004	0.0017	17	0.0867	0.0531
18	-0.0014	0.0017	18	0.0556	0.0532
19	-0.0037	0.0017	19	0.0718	0.0532
20	-0.0016	0.0017	20	0.0459	0.0527
21	-0.0020	0.0017	21	-0.0522	0.0528
22	-0.0018	0.0016	22	-0.0524	0.0526
23	-0.0003	0.0016	23	-0.0422	0.0528
24	-0.0022	0.0016	24	0.1140	0.0529
25	-0.0006	0.0016			
26	-0.0006	0.0016			
27	-0.0023	0.0016			
28	0.0021	0.0016			
29	0.0011	0.0016			
30	0.0009	0.0016			
31	0.0001	0.0016			
32	-0.0009	0.0016			
33	-0.0008	0.0016			
34	0.0060	0.0016			
35	-0.0015	0.0016			
36	0.0017	0.0016			

R^2 = 0.86 S.E.E. = 0.009 D.W. = 1.99
The sample period is from 1970:3 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

The Impact of SPF Shocks On the Producer On Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0008	0.0008	1	0.2239	0.0556
2	0.0003	0.0009	2	-0.0291	0.0567
3	-0.0010	0.0009	3	0.0514	0.0568
4	0.0008	0.0009	4	-0.0005	0.0566
5	0.0022	0.0009	5	0.0703	0.0564
6	-0.0013	0.0009	6	0.0790	0.0565
7	-0.0001	0.0009	7	0.0901	0.0566
8	0.0000	0.0009	8	0.0399	0.0567
9	-0.0014	0.0009	9	0.1000	0.0576
10	0.0003	0.0009	10	-0.0440	0.0579
11	-0.0006	0.0009	11	0.1921	0.0579
12	-0.0004	0.0009	12	0.0936	0.0590
13	0.0004	0.0009	13	-0.0886	0.0588
14	-0.0001	0.0009	14	0.0339	0.0581
15	0.0008	0.0009	15	-0.1138	0.0583
16	0.0002	0.0009	16	-0.0401	0.0582
17	0.0002	0.0009	17	0.0695	0.0582
18	0.0001	0.0009	18	0.0645	0.0583
19	-0.0006	0.0009	19	-0.0489	0.0575
20	-0.0010	0.0009	20	0.0445	0.0575
21	0.0004	0.0009	21	0.0461	0.0579
22	-0.0001	0.0009	22	0.0049	0.0581
23	-0.0005	0.0009	23	-0.1027	0.0577
24	-0.0021	0.0009	24	0.0626	0.0566
25	-0.0007	0.0009			
26	-0.0027	0.0009			
27	-0.0001	0.0009			
28	-0.0003	0.0009			
29	-0.0002	0.0009			
30	-0.0022	0.0009			
31	-0.0009	0.0009			
32	0.0001	0.0009			
33	0.0001	0.0009			
34	0.0010	0.0009			
35	-0.0009	0.0009			
36	-0.0023	0.0009			
37	0.0008	0.0009			
38	-0.0011	0.0009			
39	0.0008	0.0009			
40	-0.0001	0.0009			
41	-0.0004	0.0009			
42	-0.0021	0.0009			
43	0.0000	0.0009			
44	0.0002	0.0009			
45	-0.0018	0.0009			
46	0.0001	0.0009			
47	-0.0007	0.0009			
48	-0.0004	0.0009			

R^2 = 0.49 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:3 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 15

The Impact of SPF Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0052	0.0015	1	0.0197	0.0518
2	0.0010	0.0016	2	0.0329	0.0517
3	-0.0042	0.0016	3	0.0754	0.0514
4	0.0010	0.0016	4	-0.0032	0.0515
5	-0.0019	0.0016	5	0.0637	0.0516
6	0.0007	0.0016	6	-0.0734	0.0516
7	-0.0020	0.0016	7	0.0509	0.0517
8	-0.0015	0.0016	8	-0.0322	0.0515
9	-0.0004	0.0016	9	0.0404	0.0513
10	-0.0018	0.0016	10	-0.0637	0.0509
11	-0.0040	0.0016	11	0.0600	0.0501
12	-0.0006	0.0016	12	0.3307	0.0503
13	-0.0018	0.0016	13	-0.0025	0.0503
14	-0.0020	0.0016	14	-0.1620	0.0499
15	-0.0013	0.0016	15	-0.0968	0.0503
16	0.0011	0.0016	16	-0.0910	0.0503
17	-0.0004	0.0016	17	0.0812	0.0506
18	-0.0011	0.0016	18	0.0368	0.0506
19	-0.0031	0.0016	19	0.0714	0.0511
20	-0.0014	0.0016	20	0.0343	0.0506
21	-0.0018	0.0016	21	-0.0533	0.0507
22	-0.0014	0.0016	22	-0.0558	0.0504
23	-0.0003	0.0016	23	-0.0314	0.0505
24	-0.0020	0.0016	24	0.1029	0.0506
25	-0.0007	0.0016			
26	-0.0003	0.0016			
27	-0.0020	0.0015			
28	0.0022	0.0016			
29	0.0009	0.0016			
30	0.0009	0.0016			
31	0.0004	0.0016			
32	-0.0005	0.0015			
33	-0.0013	0.0015			
34	0.0067	0.0015			
35	-0.0015	0.0016			
36	0.0015	0.0015			

R^2 = 0.85 S.E.E. = 0.009 D.W. = 1.99
The sample period is from 1970:3 – 2007:3.
Constant and dummy results are not shown.
There are 447 observations.

The Impact of SPF Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0008	0.0009	1	0.2302	0.0523
2	0.0004	0.0009	2	-0.1048	0.0533
3	-0.0011	0.0009	3	0.0928	0.0536
4	0.0007	0.0009	4	-0.0384	0.0535
5	0.0020	0.0009	5	0.0472	0.0535
6	-0.0013	0.0009	6	0.1018	0.0538
7	0.0002	0.0009	7	0.0991	0.0547
8	-0.0003	0.0009	8	0.0306	0.0549
9	-0.0015	0.0009	9	0.0960	0.0549
10	0.0005	0.0009	10	-0.0135	0.0546
11	-0.0010	0.0009	11	0.2352	0.0543
12	-0.0004	0.0009	12	0.0339	0.0551
13	0.0005	0.0009	13	-0.1273	0.0544
14	-0.0003	0.0009	14	0.0921	0.0545
15	0.0007	0.0009	15	-0.1279	0.0546
16	-0.0001	0.0009	16	-0.0326	0.0545
17	0.0005	0.0009	17	0.0677	0.0551
18	0.0003	0.0009	18	0.0325	0.0552
19	-0.0009	0.0009	19	0.0068	0.0549
20	-0.0006	0.0009	20	0.0487	0.0547
21	0.0003	0.0009	21	0.0270	0.0552
22	-0.0004	0.0009	22	-0.0109	0.0553
23	-0.0004	0.0009	23	-0.1321	0.0551
24	-0.0022	0.0009	24	0.1234	0.0541
25	-0.0009	0.0009			
26	-0.0026	0.0009			
27	-0.0001	0.0009			
28	-0.0005	0.0009			
29	-0.0002	0.0009			
30	-0.0022	0.0009			
31	-0.0008	0.0009			
32	-0.0001	0.0009			
33	0.0003	0.0009			
34	0.0008	0.0009			
35	-0.0013	0.0009			
36	-0.0021	0.0009			
37	0.0011	0.0009			
38	-0.0014	0.0009			
39	0.0010	0.0009			
40	-0.0002	0.0009			
41	-0.0006	0.0009			
42	-0.0017	0.0009			
43	-0.0002	0.0009			
44	0.0003	0.0009			
45	-0.0020	0.0009			
46	0.0001	0.0009			
47	-0.0006	0.0009			
48	-0.0003	0.0009			

R^2 = 0.46 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:3 – 2007:3.
Constant and dummy results are not shown.
There are 447 observations.

Table 16

The Impact of ALFRED/SPF Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0040	0.0017	1	0.0904	0.0634
2	0.0007	0.0017	2	-0.0062	0.0634
3	-0.0048	0.0017	3	0.0836	0.0628
4	0.0005	0.0017	4	0.0392	0.0627
5	-0.0025	0.0017	5	0.0139	0.0628
6	0.0011	0.0017	6	-0.0368	0.0627
7	-0.0018	0.0017	7	0.0075	0.0629
8	-0.0016	0.0017	8	-0.0450	0.0627
9	0.0004	0.0017	9	0.0103	0.0625
10	-0.0026	0.0017	10	-0.0466	0.0614
11	-0.0028	0.0017	11	0.0686	0.0603
12	-0.0004	0.0017	12	0.2599	0.0609
13	-0.0014	0.0017	13	0.0134	0.0611
14	-0.0020	0.0017	14	-0.1951	0.0606
15	-0.0017	0.0017	15	-0.0973	0.0613
16	0.0005	0.0017	16	-0.1078	0.0616
17	-0.0003	0.0017	17	0.0872	0.0622
18	-0.0011	0.0017	18	0.0612	0.0619
19	-0.0043	0.0017	19	0.0534	0.0620
20	-0.0021	0.0018	20	0.0774	0.0616
21	-0.0020	0.0017	21	-0.0769	0.0617
22	-0.0024	0.0017	22	-0.0189	0.0616
23	0.0003	0.0017	23	-0.0618	0.0617
24	-0.0023	0.0017	24	0.0673	0.0614
25	-0.0004	0.0017			
26	-0.0017	0.0017			
27	-0.0025	0.0017			
28	0.0027	0.0017			
29	0.0002	0.0017			
30	0.0013	0.0017			
31	-0.0004	0.0017			
32	-0.0010	0.0017			
33	-0.0009	0.0017			
34	0.0057	0.0017			
35	-0.0011	0.0018			
36	0.0007	0.0017			

R^2 = 0.86 S.E.E. = 0.009 D.W. = 2.00
The sample period is from 1970:3 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

The Impact of ALFRED/SPF Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0003	0.0008	1	0.2383	0.0647
2	0.0000	0.0009	2	0.0340	0.0660
3	-0.0009	0.0009	3	-0.0139	0.0661
4	0.0011	0.0009	4	-0.0464	0.0656
5	0.0012	0.0009	5	0.0734	0.0654
6	-0.0018	0.0009	6	0.1433	0.0656
7	0.0001	0.0009	7	0.0027	0.0663
8	-0.0002	0.0009	8	0.0586	0.0662
9	-0.0014	0.0009	9	0.1243	0.0662
10	0.0003	0.0009	10	-0.0311	0.0664
11	-0.0008	0.0009	11	0.1627	0.0665
12	-0.0005	0.0009	12	0.1146	0.0672
13	0.0004	0.0009	13	-0.0482	0.0668
14	-0.0001	0.0009	14	-0.0099	0.0661
15	0.0010	0.0009	15	-0.0176	0.0658
16	0.0001	0.0009	16	-0.0038	0.0651
17	0.0002	0.0009	17	0.0629	0.0649
18	-0.0006	0.0009	18	0.0194	0.0650
19	0.0000	0.0009	19	-0.0101	0.0638
20	-0.0010	0.0009	20	0.0938	0.0639
21	0.0006	0.0009	21	-0.0337	0.0648
22	-0.0002	0.0009	22	0.0053	0.0647
23	-0.0010	0.0009	23	-0.0877	0.0645
24	-0.0014	0.0009	24	-0.0057	0.0630
25	-0.0015	0.0009			
26	-0.0018	0.0009			
27	-0.0009	0.0009			
28	-0.0007	0.0009			
29	-0.0003	0.0009			
30	-0.0026	0.0009			
31	-0.0010	0.0009			
32	-0.0001	0.0009			
33	0.0002	0.0009			
34	-0.0002	0.0009			
35	-0.0006	0.0009			
36	-0.0020	0.0009			
37	0.0006	0.0009			
38	-0.0007	0.0009			
39	0.0007	0.0009			
40	0.0001	0.0009			
41	-0.0005	0.0009			
42	-0.0014	0.0009			
43	0.0003	0.0009			
44	0.0002	0.0009			
45	-0.0016	0.0009			
46	0.0004	0.0009			
47	-0.0010	0.0009			
48	0.0000	0.0009			

R^2 = 0.54 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:3 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 17

The Impact of ALFRED/SPF Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0047	0.0016	1	0.0388	0.0546
2	0.0004	0.0016	2	0.0507	0.0543
3	-0.0043	0.0016	3	0.0972	0.0538
4	0.0004	0.0016	4	-0.0019	0.0540
5	-0.0020	0.0016	5	0.0539	0.0539
6	0.0006	0.0016	6	-0.0664	0.0539
7	-0.0015	0.0016	7	0.0315	0.0539
8	-0.0014	0.0016	8	-0.0403	0.0536
9	-0.0002	0.0016	9	0.0351	0.0539
10	-0.0021	0.0016	10	-0.0437	0.0534
11	-0.0033	0.0016	11	0.0490	0.0523
12	-0.0007	0.0016	12	0.3174	0.0526
13	-0.0011	0.0016	13	-0.0067	0.0525
14	-0.0022	0.0016	14	-0.1688	0.0521
15	-0.0019	0.0016	15	-0.0824	0.0526
16	0.0003	0.0016	16	-0.0971	0.0526
17	0.0002	0.0016	17	0.0903	0.0528
18	-0.0013	0.0016	18	0.0578	0.0529
19	-0.0038	0.0016	19	0.0719	0.0529
20	-0.0013	0.0016	20	0.0464	0.0524
21	-0.0021	0.0016	21	-0.0551	0.0525
22	-0.0020	0.0016	22	-0.0502	0.0524
23	0.0003	0.0016	23	-0.0400	0.0525
24	-0.0020	0.0016	24	0.1182	0.0528
25	-0.0004	0.0016			
26	-0.0010	0.0015			
27	-0.0020	0.0015			
28	0.0025	0.0015			
29	0.0009	0.0016			
30	0.0013	0.0016			
31	0.0001	0.0016			
32	-0.0008	0.0015			
33	-0.0005	0.0015			
34	0.0064	0.0015			
35	-0.0013	0.0016			
36	0.0013	0.0016			

R^2 = 0.86 S.E.E. = 0.009 D.W. = 1.99
The sample period is from 1970:3 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

The Impact of ALFRED/SPF Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0005	0.0008	1	0.2268	0.0556
2	0.0006	0.0008	2	-0.0339	0.0567
3	-0.0011	0.0008	3	0.0566	0.0568
4	0.0007	0.0008	4	0.0004	0.0566
5	0.0020	0.0008	5	0.0615	0.0564
6	-0.0014	0.0008	6	0.0793	0.0565
7	-0.0001	0.0009	7	0.0897	0.0567
8	-0.0001	0.0009	8	0.0273	0.0567
9	-0.0013	0.0008	9	0.1042	0.0577
10	0.0004	0.0008	10	-0.0499	0.0581
11	-0.0010	0.0008	11	0.1918	0.0581
12	-0.0005	0.0008	12	0.1006	0.0592
13	0.0004	0.0008	13	-0.0962	0.0589
14	-0.0002	0.0009	14	0.0370	0.0583
15	0.0010	0.0009	15	-0.1038	0.0586
16	-0.0001	0.0009	16	-0.0308	0.0583
17	0.0000	0.0009	17	0.0799	0.0583
18	0.0000	0.0009	18	0.0615	0.0585
19	-0.0005	0.0009	19	-0.0500	0.0577
20	-0.0013	0.0008	20	0.0370	0.0578
21	0.0005	0.0009	21	0.0592	0.0582
22	-0.0003	0.0008	22	-0.0036	0.0585
23	-0.0007	0.0009	23	-0.1002	0.0583
24	-0.0020	0.0009	24	0.0654	0.0569
25	-0.0012	0.0009			
26	-0.0023	0.0009			
27	-0.0003	0.0009			
28	-0.0006	0.0009			
29	-0.0003	0.0009			
30	-0.0021	0.0009			
31	-0.0011	0.0009			
32	0.0001	0.0009			
33	0.0002	0.0009			
34	0.0006	0.0009			
35	-0.0007	0.0009			
36	-0.0025	0.0009			
37	0.0006	0.0009			
38	-0.0010	0.0009			
39	0.0008	0.0009			
40	-0.0003	0.0009			
41	-0.0004	0.0009			
42	-0.0019	0.0009			
43	-0.0002	0.0009			
44	0.0003	0.0009			
45	-0.0017	0.0009			
46	0.0000	0.0009			
47	-0.0008	0.0009			
48	-0.0004	0.0008			

R^2 = 0.48 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:3 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 18

The Impact of ALFRED/SPF Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0051	0.0015	1	0.0279	0.0517
2	0.0009	0.0015	2	0.0393	0.0515
3	-0.0042	0.0015	3	0.0847	0.0509
4	0.0006	0.0015	4	0.0003	0.0510
5	-0.0019	0.0015	5	0.0632	0.0511
6	0.0009	0.0015	6	-0.0740	0.0511
7	-0.0014	0.0015	7	0.0443	0.0512
8	-0.0012	0.0015	8	-0.0364	0.0509
9	-0.0001	0.0015	9	0.0371	0.0507
10	-0.0020	0.0015	10	-0.0673	0.0503
11	-0.0032	0.0015	11	0.0517	0.0495
12	-0.0003	0.0015	12	0.3332	0.0498
13	-0.0013	0.0015	13	-0.0066	0.0499
14	-0.0017	0.0015	14	-0.1668	0.0496
15	-0.0017	0.0015	15	-0.0931	0.0500
16	0.0006	0.0015	16	-0.0880	0.0501
17	0.0002	0.0015	17	0.0851	0.0503
18	-0.0010	0.0015	18	0.0404	0.0503
19	-0.0032	0.0015	19	0.0725	0.0508
20	-0.0012	0.0015	20	0.0361	0.0503
21	-0.0020	0.0015	21	-0.0564	0.0503
22	-0.0017	0.0015	22	-0.0515	0.0501
23	0.0003	0.0015	23	-0.0279	0.0501
24	-0.0018	0.0015	24	0.1082	0.0504
25	-0.0006	0.0015			
26	-0.0008	0.0015			
27	-0.0017	0.0015			
28	0.0025	0.0015			
29	0.0008	0.0015			
30	0.0013	0.0015			
31	0.0003	0.0015			
32	-0.0004	0.0015			
33	-0.0011	0.0015			
34	0.0070	0.0015			
35	-0.0012	0.0015			
36	0.0012	0.0015			

R^2 = 0.85 S.E.E. = 0.009 D.W. = 1.99
The sample period is from 1970:3 – 2007:3.
Constant and dummy results are not shown.
There are 447 observations.

The Impact of ALFRED/SPF Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0005	0.0008	1	0.2334	0.0523
2	0.0006	0.0009	2	-0.1098	0.0533
3	-0.0013	0.0009	3	0.0984	0.0536
4	0.0006	0.0009	4	-0.0374	0.0536
5	0.0019	0.0009	5	0.0352	0.0536
6	-0.0015	0.0009	6	0.1015	0.0538
7	0.0001	0.0009	7	0.0944	0.0547
8	-0.0004	0.0009	8	0.0244	0.0549
9	-0.0013	0.0009	9	0.0990	0.0549
10	0.0006	0.0008	10	-0.0201	0.0546
11	-0.0013	0.0008	11	0.2349	0.0543
12	-0.0004	0.0009	12	0.0358	0.0551
13	0.0004	0.0009	13	-0.1297	0.0543
14	-0.0004	0.0009	14	0.0954	0.0545
15	0.0011	0.0009	15	-0.1188	0.0545
16	-0.0004	0.0009	16	-0.0262	0.0544
17	0.0003	0.0009	17	0.0781	0.0549
18	0.0001	0.0009	18	0.0301	0.0551
19	-0.0009	0.0009	19	0.0083	0.0548
20	-0.0008	0.0009	20	0.0420	0.0547
21	0.0004	0.0009	21	0.0369	0.0553
22	-0.0004	0.0009	22	-0.0137	0.0554
23	-0.0005	0.0009	23	-0.1290	0.0552
24	-0.0022	0.0009	24	0.1277	0.0541
25	-0.0014	0.0009			
26	-0.0021	0.0009			
27	-0.0003	0.0009			
28	-0.0006	0.0009			
29	-0.0003	0.0009			
30	-0.0022	0.0009			
31	-0.0010	0.0009			
32	0.0000	0.0009			
33	0.0004	0.0009			
34	0.0005	0.0009			
35	-0.0011	0.0009			
36	-0.0023	0.0009			
37	0.0009	0.0009			
38	-0.0013	0.0009			
39	0.0010	0.0009			
40	-0.0005	0.0009			
41	-0.0006	0.0009			
42	-0.0015	0.0009			
43	-0.0004	0.0009			
44	0.0005	0.0009			
45	-0.0019	0.0009			
46	-0.0001	0.0009			
47	-0.0008	0.0009			
48	-0.0003	0.0008			

R^2 = 0.46 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:3 – 2007:3.
Constant and dummy results are not shown.
There are 447 observations.

Table 19

The Impact of BCI Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0038	0.0017	1	0.0978	0.0642
2	0.0004	0.0017	2	-0.0064	0.0644
3	-0.0023	0.0017	3	0.0997	0.0633
4	-0.0006	0.0017	4	0.0586	0.0632
5	-0.0029	0.0017	5	-0.0026	0.0633
6	0.0015	0.0017	6	-0.0464	0.0632
7	-0.0009	0.0017	7	0.0073	0.0633
8	-0.0027	0.0017	8	-0.0002	0.0633
9	0.0003	0.0017	9	0.0162	0.0629
10	-0.0007	0.0017	10	-0.0336	0.0612
11	-0.0036	0.0017	11	0.0603	0.0601
12	-0.0004	0.0017	12	0.2660	0.0613
13	-0.0023	0.0017	13	0.0092	0.0614
14	-0.0015	0.0016	14	-0.1764	0.0610
15	-0.0001	0.0017	15	-0.1063	0.0612
16	0.0022	0.0017	16	-0.1159	0.0619
17	-0.0003	0.0017	17	0.1145	0.0634
18	-0.0020	0.0017	18	0.0748	0.0632
19	-0.0030	0.0017	19	0.0530	0.0630
20	-0.0028	0.0017	20	0.0756	0.0625
21	-0.0005	0.0017	21	-0.0504	0.0625
22	-0.0021	0.0017	22	-0.0407	0.0622
23	0.0027	0.0017	23	-0.0365	0.0622
24	-0.0022	0.0017	24	0.0854	0.0624
25	-0.0009	0.0017			
26	-0.0009	0.0017			
27	-0.0025	0.0017			
28	0.0028	0.0017			
29	0.0014	0.0017			
30	0.0029	0.0017			
31	-0.0003	0.0017			
32	-0.0003	0.0017			
33	-0.0014	0.0017			
34	0.0051	0.0017			
35	0.0014	0.0017			
36	0.0018	0.0017			

$R^2 = 0.86$ S.E.E. = 0.009 D.W. = 2.00
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

The Impact of BCI Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0009	0.0008	1	0.2346	0.0645
2	0.0005	0.0008	2	0.0786	0.0659
3	-0.0014	0.0008	3	-0.0058	0.0662
4	0.0012	0.0008	4	-0.0313	0.0663
5	0.0015	0.0008	5	0.0855	0.0661
6	-0.0008	0.0008	6	0.1463	0.0664
7	-0.0001	0.0008	7	-0.0003	0.0665
8	0.0006	0.0008	8	0.0790	0.0665
9	-0.0018	0.0008	9	0.1403	0.0666
10	-0.0003	0.0008	10	-0.0214	0.0668
11	-0.0002	0.0008	11	0.1230	0.0669
12	-0.0005	0.0008	12	0.1168	0.0672
13	0.0007	0.0008	13	-0.0680	0.0671
14	0.0002	0.0008	14	-0.0255	0.0666
15	0.0015	0.0008	15	-0.0109	0.0662
16	0.0005	0.0009	16	-0.0353	0.0651
17	0.0004	0.0008	17	0.0591	0.0651
18	-0.0001	0.0008	18	0.0042	0.0652
19	0.0002	0.0008	19	-0.0329	0.0641
20	-0.0003	0.0008	20	0.0853	0.0642
21	0.0008	0.0008	21	-0.0211	0.0645
22	0.0004	0.0008	22	-0.0071	0.0643
23	-0.0008	0.0008	23	-0.0869	0.0641
24	-0.0012	0.0008	24	0.0198	0.0628
25	-0.0014	0.0008			
26	-0.0015	0.0009			
27	-0.0001	0.0009			
28	0.0005	0.0009			
29	-0.0003	0.0009			
30	-0.0018	0.0009			
31	-0.0013	0.0009			
32	0.0002	0.0009			
33	0.0013	0.0009			
34	0.0008	0.0009			
35	-0.0002	0.0009			
36	-0.0014	0.0009			
37	0.0002	0.0009			
38	0.0002	0.0009			
39	0.0010	0.0009			
40	0.0004	0.0009			
41	-0.0001	0.0008			
42	-0.0020	0.0008			
43	-0.0001	0.0009			
44	0.0007	0.0008			
45	-0.0009	0.0008			
46	0.0003	0.0008			
47	-0.0003	0.0008			
48	-0.0006	0.0008			

$R^2 = 0.54$ S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 20

The Impact of BCI Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0047	0.0015	1	0.0488	0.0549
2	-0.0002	0.0015	2	0.0488	0.0548
3	-0.0022	0.0015	3	0.1088	0.0538
4	-0.0005	0.0015	4	0.0117	0.0540
5	-0.0025	0.0015	5	0.0350	0.0539
6	0.0011	0.0015	6	-0.0782	0.0539
7	-0.0005	0.0015	7	0.0307	0.0538
8	-0.0031	0.0015	8	-0.0052	0.0536
9	-0.0001	0.0015	9	0.0384	0.0539
10	-0.0003	0.0015	10	-0.0337	0.0531
11	-0.0039	0.0015	11	0.0277	0.0519
12	-0.0006	0.0015	12	0.3294	0.0527
13	-0.0020	0.0015	13	-0.0105	0.0526
14	-0.0018	0.0015	14	-0.1634	0.0523
15	-0.0006	0.0015	15	-0.0796	0.0526
16	0.0022	0.0015	16	-0.1042	0.0530
17	0.0001	0.0015	17	0.1050	0.0536
18	-0.0017	0.0015	18	0.0752	0.0538
19	-0.0032	0.0015	19	0.0632	0.0536
20	-0.0019	0.0016	20	0.0420	0.0531
21	-0.0009	0.0016	21	-0.0258	0.0531
22	-0.0016	0.0015	22	-0.0700	0.0529
23	0.0029	0.0015	23	-0.0223	0.0530
24	-0.0024	0.0015	24	0.1268	0.0535
25	-0.0007	0.0015			
26	-0.0008	0.0015			
27	-0.0020	0.0015			
28	0.0020	0.0015			
29	0.0016	0.0015			
30	0.0026	0.0015			
31	-0.0001	0.0015			
32	-0.0004	0.0015			
33	-0.0011	0.0015			
34	0.0058	0.0015			
35	0.0009	0.0016			
36	0.0022	0.0015			

R^2 = 0.86 S.E.E. = 0.009 D.W. = 1.98
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

The Impact of BCI Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0011	0.0008	1	0.2214	0.0554
2	0.0007	0.0008	2	-0.0028	0.0566
3	-0.0014	0.0008	3	0.0513	0.0567
4	0.0010	0.0008	4	0.0099	0.0569
5	0.0020	0.0008	5	0.0815	0.0567
6	-0.0006	0.0008	6	0.0832	0.0569
7	0.0001	0.0008	7	0.0828	0.0567
8	0.0007	0.0008	8	0.0389	0.0568
9	-0.0017	0.0008	9	0.1127	0.0579
10	-0.0003	0.0008	10	-0.0339	0.0585
11	-0.0006	0.0008	11	0.1626	0.0586
12	-0.0006	0.0008	12	0.1021	0.0594
13	0.0005	0.0008	13	-0.1054	0.0593
14	0.0003	0.0008	14	0.0227	0.0589
15	0.0013	0.0008	15	-0.0961	0.0591
16	0.0004	0.0008	16	-0.0538	0.0587
17	0.0002	0.0008	17	0.0696	0.0586
18	0.0000	0.0008	18	0.0617	0.0587
19	-0.0002	0.0008	19	-0.0760	0.0580
20	-0.0003	0.0008	20	0.0227	0.0582
21	0.0009	0.0008	21	0.0705	0.0583
22	0.0001	0.0008	22	-0.0072	0.0585
23	-0.0007	0.0008	23	-0.0902	0.0583
24	-0.0015	0.0008	24	0.0759	0.0572
25	-0.0008	0.0008			
26	-0.0020	0.0008			
27	0.0002	0.0008			
28	0.0006	0.0008			
29	-0.0005	0.0008			
30	-0.0013	0.0008			
31	-0.0010	0.0008			
32	0.0002	0.0008			
33	0.0013	0.0008			
34	0.0013	0.0008			
35	-0.0005	0.0008			
36	-0.0015	0.0008			
37	0.0003	0.0008			
38	0.0000	0.0008			
39	0.0007	0.0008			
40	0.0001	0.0008			
41	-0.0002	0.0008			
42	-0.0021	0.0008			
43	-0.0003	0.0008			
44	0.0006	0.0008			
45	-0.0010	0.0008			
46	-0.0001	0.0008			
47	-0.0001	0.0008			
48	-0.0007	0.0008			

R^2 = 0.48 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 21

The Impact of BCI Shocks On Industrial Production

Lag	Shock Coefficient	Shock S.E.	Lag	Change In Industrial Production Coefficient	Change In Industrial Production S.E.
1	0.0050	0.0015	1	0.0352	0.0520
2	0.0004	0.0015	2	0.0342	0.0520
3	-0.0022	0.0015	3	0.0897	0.0508
4	-0.0004	0.0015	4	0.0050	0.0510
5	-0.0024	0.0015	5	0.0428	0.0510
6	0.0013	0.0015	6	-0.0790	0.0511
7	-0.0008	0.0015	7	0.0431	0.0511
8	-0.0029	0.0015	8	-0.0113	0.0509
9	0.0000	0.0015	9	0.0318	0.0507
10	-0.0003	0.0015	10	-0.0553	0.0501
11	-0.0039	0.0015	11	0.0292	0.0492
12	-0.0005	0.0015	12	0.3398	0.0499
13	-0.0021	0.0015	13	-0.0106	0.0499
14	-0.0016	0.0015	14	-0.1610	0.0497
15	-0.0004	0.0015	15	-0.0928	0.0500
16	0.0022	0.0015	16	-0.0948	0.0503
17	-0.0001	0.0015	17	0.0992	0.0508
18	-0.0015	0.0015	18	0.0476	0.0509
19	-0.0029	0.0015	19	0.0617	0.0514
20	-0.0016	0.0015	20	0.0347	0.0509
21	-0.0006	0.0015	21	-0.0271	0.0509
22	-0.0015	0.0015	22	-0.0699	0.0506
23	0.0024	0.0015	23	-0.0099	0.0505
24	-0.0026	0.0015	24	0.1169	0.0510
25	-0.0008	0.0015			
26	-0.0008	0.0015			
27	-0.0016	0.0015			
28	0.0019	0.0015			
29	0.0012	0.0015			
30	0.0023	0.0015			
31	-0.0001	0.0015			
32	-0.0002	0.0015			
33	-0.0014	0.0015			
34	0.0065	0.0015			
35	0.0002	0.0015			
36	0.0017	0.0015			

R^2 = 0.86 S.E.E. = 0.009 D.W. = 1.98
The sample period is from 1970:1 – 2007:3.
Constant and dummy results are not shown.
There are 447 observations.

The Impact of BCI Shocks On the Producer Price Index

Lag	Shock Coefficient	Shock S.E.	Lag	Change In Producer Price Index Coefficient	Change In Producer Price Index S.E.
1	0.0010	0.0008	1	0.2302	0.0522
2	0.0007	0.0008	2	-0.0884	0.0533
3	-0.0014	0.0008	3	0.0940	0.0535
4	0.0009	0.0008	4	-0.0249	0.0539
5	0.0017	0.0008	5	0.0606	0.0539
6	-0.0007	0.0008	6	0.1045	0.0543
7	0.0003	0.0008	7	0.0949	0.0550
8	0.0006	0.0008	8	0.0349	0.0552
9	-0.0018	0.0008	9	0.1001	0.0552
10	0.0000	0.0008	10	0.0034	0.0551
11	-0.0010	0.0008	11	0.2167	0.0549
12	-0.0009	0.0008	12	0.0417	0.0556
13	0.0007	0.0009	13	-0.1441	0.0550
14	0.0000	0.0009	14	0.0852	0.0554
15	0.0011	0.0009	15	-0.1085	0.0554
16	-0.0001	0.0009	16	-0.0541	0.0552
17	0.0004	0.0009	17	0.0766	0.0557
18	0.0002	0.0009	18	0.0264	0.0559
19	-0.0004	0.0009	19	-0.0137	0.0557
20	0.0001	0.0009	20	0.0358	0.0556
21	0.0008	0.0009	21	0.0388	0.0559
22	-0.0003	0.0009	22	-0.0235	0.0560
23	-0.0006	0.0009	23	-0.1221	0.0558
24	-0.0016	0.0009	24	0.1274	0.0549
25	-0.0011	0.0009			
26	-0.0018	0.0009			
27	0.0001	0.0009			
28	0.0003	0.0009			
29	-0.0005	0.0009			
30	-0.0013	0.0009			
31	-0.0009	0.0009			
32	0.0002	0.0009			
33	0.0011	0.0009			
34	0.0010	0.0009			
35	-0.0006	0.0009			
36	-0.0013	0.0009			
37	0.0006	0.0009			
38	-0.0004	0.0009			
39	0.0009	0.0009			
40	0.0000	0.0009			
41	-0.0003	0.0008			
42	-0.0018	0.0008			
43	-0.0004	0.0008			
44	0.0005	0.0008			
45	-0.0012	0.0008			
46	0.0001	0.0008			
47	0.0000	0.0008			
48	-0.0008	0.0008			

R^2 = 0.45 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:1 – 2007:3.
Constant and dummy results are not shown.
There are 447 observations.

Table 22

The Impact of BCI/SPF Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0035	0.0018	1	0.1132	0.0636
2	-0.0007	0.0018	2	-0.0042	0.0638
3	-0.0021	0.0017	3	0.1178	0.0630
4	-0.0009	0.0017	4	0.0697	0.0630
5	-0.0033	0.0017	5	0.0080	0.0631
6	0.0013	0.0017	6	-0.0293	0.0631
7	-0.0009	0.0017	7	0.0124	0.0630
8	-0.0025	0.0017	8	0.0217	0.0628
9	-0.0002	0.0017	9	0.0115	0.0625
10	-0.0014	0.0017	10	-0.0137	0.0607
11	-0.0035	0.0017	11	0.0673	0.0598
12	-0.0003	0.0017	12	0.2667	0.0613
13	-0.0022	0.0017	13	-0.0046	0.0613
14	-0.0005	0.0017	14	-0.1724	0.0607
15	-0.0005	0.0017	15	-0.1129	0.0611
16	0.0023	0.0017	16	-0.1258	0.0620
17	0.0001	0.0017	17	0.1107	0.0635
18	-0.0015	0.0017	18	0.0555	0.0633
19	-0.0020	0.0017	19	0.0433	0.0631
20	-0.0029	0.0017	20	0.0521	0.0626
21	-0.0002	0.0017	21	-0.0622	0.0625
22	-0.0018	0.0017	22	-0.0439	0.0621
23	0.0024	0.0017	23	-0.0478	0.0622
24	-0.0017	0.0017	24	0.0749	0.0619
25	-0.0002	0.0017			
26	-0.0014	0.0017			
27	-0.0029	0.0017			
28	0.0033	0.0017			
29	0.0011	0.0018			
30	0.0029	0.0017			
31	-0.0005	0.0017			
32	0.0001	0.0017			
33	-0.0014	0.0017			
34	0.0048	0.0017			
35	0.0020	0.0018			
36	0.0023	0.0018			

R^2 = 0.85 S.E.E. = 0.010 D.W. = 2.00
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

The Impact of BCI/SPF Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0009	0.0008	1	0.2375	0.0645
2	0.0005	0.0009	2	0.0535	0.0660
3	-0.0018	0.0009	3	-0.0091	0.0662
4	0.0011	0.0009	4	-0.0249	0.0660
5	0.0009	0.0009	5	0.0842	0.0658
6	-0.0008	0.0009	6	0.1475	0.0662
7	0.0002	0.0009	7	-0.0021	0.0662
8	0.0003	0.0009	8	0.0897	0.0662
9	-0.0019	0.0009	9	0.1301	0.0664
10	-0.0007	0.0009	10	-0.0138	0.0664
11	-0.0004	0.0009	11	0.1261	0.0665
12	-0.0005	0.0009	12	0.1151	0.0669
13	0.0010	0.0009	13	-0.0718	0.0667
14	0.0000	0.0009	14	-0.0276	0.0662
15	0.0013	0.0009	15	-0.0100	0.0659
16	0.0001	0.0009	16	-0.0394	0.0647
17	0.0002	0.0009	17	0.0423	0.0646
18	-0.0001	0.0009	18	-0.0164	0.0646
19	0.0005	0.0008	19	-0.0324	0.0635
20	-0.0004	0.0008	20	0.0776	0.0637
21	0.0006	0.0008	21	-0.0228	0.0640
22	0.0001	0.0008	22	-0.0072	0.0640
23	-0.0010	0.0008	23	-0.0751	0.0639
24	-0.0010	0.0009	24	0.0032	0.0624
25	-0.0016	0.0009			
26	-0.0012	0.0009			
27	-0.0007	0.0009			
28	-0.0002	0.0009			
29	-0.0004	0.0009			
30	-0.0017	0.0009			
31	-0.0011	0.0009			
32	-0.0002	0.0009			
33	0.0010	0.0009			
34	0.0004	0.0009			
35	-0.0005	0.0009			
36	-0.0018	0.0009			
37	0.0002	0.0009			
38	-0.0003	0.0009			
39	0.0008	0.0009			
40	0.0003	0.0009			
41	-0.0002	0.0009			
42	-0.0025	0.0009			
43	-0.0002	0.0009			
44	0.0003	0.0009			
45	-0.0015	0.0009			
46	0.0006	0.0009			
47	-0.0007	0.0009			
48	-0.0007	0.0009			

R^2 = 0.54 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 23

The Impact of BCI/SPF Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0046	0.0016	1	0.0608	0.0545
2	-0.0013	0.0016	2	0.0449	0.0543
3	-0.0019	0.0016	3	0.1235	0.0536
4	-0.0007	0.0016	4	0.0224	0.0539
5	-0.0029	0.0016	5	0.0442	0.0539
6	0.0010	0.0016	6	-0.0647	0.0540
7	-0.0006	0.0016	7	0.0391	0.0537
8	-0.0027	0.0016	8	0.0079	0.0535
9	-0.0005	0.0016	9	0.0330	0.0537
10	-0.0011	0.0016	10	-0.0191	0.0528
11	-0.0035	0.0016	11	0.0347	0.0517
12	-0.0004	0.0016	12	0.3279	0.0525
13	-0.0019	0.0016	13	-0.0272	0.0523
14	-0.0007	0.0015	14	-0.1609	0.0520
15	-0.0009	0.0015	15	-0.0952	0.0524
16	0.0024	0.0015	16	-0.1199	0.0528
17	0.0005	0.0016	17	0.0941	0.0537
18	-0.0010	0.0016	18	0.0573	0.0538
19	-0.0022	0.0016	19	0.0498	0.0537
20	-0.0018	0.0016	20	0.0175	0.0532
21	-0.0005	0.0016	21	-0.0385	0.0531
22	-0.0014	0.0016	22	-0.0779	0.0529
23	0.0024	0.0016	23	-0.0336	0.0531
24	-0.0021	0.0016	24	0.1149	0.0533
25	0.0001	0.0016			
26	-0.0013	0.0015			
27	-0.0025	0.0015			
28	0.0024	0.0015			
29	0.0012	0.0016			
30	0.0027	0.0015			
31	-0.0004	0.0016			
32	0.0001	0.0016			
33	-0.0011	0.0016			
34	0.0053	0.0016			
35	0.0011	0.0016			
36	0.0029	0.0016			

R^2 = 0.85 S.E.E. = 0.009 D.W. = 1.99
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

The Impact of BCI/SPF Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0009	0.0008	1	0.2165	0.0554
2	0.0007	0.0008	2	-0.0167	0.0566
3	-0.0017	0.0008	3	0.0513	0.0568
4	0.0009	0.0008	4	0.0129	0.0567
5	0.0017	0.0008	5	0.0828	0.0566
6	-0.0007	0.0008	6	0.0862	0.0568
7	0.0001	0.0008	7	0.0875	0.0565
8	0.0003	0.0008	8	0.0458	0.0567
9	-0.0019	0.0008	9	0.1099	0.0579
10	-0.0006	0.0008	10	-0.0297	0.0584
11	-0.0008	0.0008	11	0.1618	0.0585
12	-0.0006	0.0008	12	0.0969	0.0593
13	0.0007	0.0008	13	-0.1066	0.0591
14	-0.0001	0.0008	14	0.0183	0.0588
15	0.0011	0.0008	15	-0.1038	0.0589
16	0.0000	0.0008	16	-0.0593	0.0585
17	0.0001	0.0008	17	0.0549	0.0584
18	-0.0002	0.0008	18	0.0400	0.0585
19	0.0000	0.0008	19	-0.0732	0.0576
20	-0.0005	0.0008	20	0.0180	0.0579
21	0.0007	0.0008	21	0.0678	0.0580
22	-0.0001	0.0008	22	-0.0113	0.0581
23	-0.0009	0.0008	23	-0.0787	0.0580
24	-0.0016	0.0008	24	0.0606	0.0567
25	-0.0011	0.0008			
26	-0.0019	0.0008			
27	-0.0003	0.0008			
28	0.0000	0.0008			
29	-0.0006	0.0008			
30	-0.0012	0.0008			
31	-0.0010	0.0008			
32	0.0000	0.0009			
33	0.0012	0.0009			
34	0.0010	0.0009			
35	-0.0007	0.0009			
36	-0.0019	0.0009			
37	0.0004	0.0009			
38	-0.0006	0.0009			
39	0.0007	0.0009			
40	0.0001	0.0009			
41	-0.0003	0.0009			
42	-0.0027	0.0009			
43	-0.0004	0.0009			
44	0.0003	0.0009			
45	-0.0016	0.0009			
46	0.0002	0.0009			
47	-0.0004	0.0009			
48	-0.0008	0.0009			

R^2 = 0.48 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 24

The Impact of BCI/SPF Shocks On Industrial Production

	Shock			Change In Industrial Production	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0051	0.0015	1	0.0480	0.0517
2	-0.0006	0.0015	2	0.0301	0.0516
3	-0.0020	0.0015	3	0.1028	0.0507
4	-0.0005	0.0015	4	0.0194	0.0510
5	-0.0027	0.0015	5	0.0534	0.0510
6	0.0013	0.0015	6	-0.0625	0.0512
7	-0.0007	0.0015	7	0.0549	0.0511
8	-0.0024	0.0015	8	0.0028	0.0508
9	-0.0003	0.0015	9	0.0276	0.0507
10	-0.0012	0.0015	10	-0.0420	0.0500
11	-0.0035	0.0015	11	0.0398	0.0491
12	-0.0002	0.0015	12	0.3433	0.0499
13	-0.0022	0.0015	13	-0.0261	0.0498
14	-0.0003	0.0015	14	-0.1597	0.0495
15	-0.0006	0.0015	15	-0.1069	0.0500
16	0.0024	0.0015	16	-0.1102	0.0504
17	0.0003	0.0015	17	0.0874	0.0511
18	-0.0007	0.0015	18	0.0311	0.0511
19	-0.0019	0.0015	19	0.0495	0.0516
20	-0.0014	0.0015	20	0.0105	0.0511
21	-0.0002	0.0015	21	-0.0376	0.0510
22	-0.0014	0.0015	22	-0.0771	0.0507
23	0.0020	0.0015	23	-0.0227	0.0508
24	-0.0023	0.0015	24	0.1028	0.0510
25	0.0000	0.0015			
26	-0.0011	0.0015			
27	-0.0020	0.0015			
28	0.0022	0.0015			
29	0.0007	0.0015			
30	0.0024	0.0015			
31	-0.0003	0.0015			
32	0.0002	0.0015			
33	-0.0014	0.0015			
34	0.0062	0.0015			
35	0.0003	0.0015			
36	0.0022	0.0015			

R^2 = 0.85 S.E.E. = 0.009 D.W. = 1.99
The sample period is from 1970:1 – 2007:3.
Constant and dummy results are not shown.
There are 447 observations.

The Impact of BCI/SPF Shocks On the Producer Price Index

	Shock			Change In Producer Price Index	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0008	0.0008	1	0.2232	0.0522
2	0.0007	0.0009	2	-0.1028	0.0533
3	-0.0017	0.0009	3	0.0881	0.0537
4	0.0009	0.0009	4	-0.0281	0.0538
5	0.0015	0.0009	5	0.0590	0.0539
6	-0.0008	0.0009	6	0.1067	0.0543
7	0.0004	0.0009	7	0.0967	0.0548
8	0.0001	0.0009	8	0.0390	0.0551
9	-0.0019	0.0009	9	0.0983	0.0551
10	-0.0002	0.0009	10	0.0025	0.0548
11	-0.0011	0.0009	11	0.2150	0.0547
12	-0.0007	0.0009	12	0.0380	0.0552
13	0.0008	0.0009	13	-0.1443	0.0547
14	-0.0003	0.0009	14	0.0798	0.0551
15	0.0010	0.0009	15	-0.1171	0.0551
16	-0.0005	0.0009	16	-0.0633	0.0548
17	0.0005	0.0009	17	0.0626	0.0553
18	0.0002	0.0009	18	0.0094	0.0555
19	-0.0002	0.0009	19	-0.0078	0.0552
20	-0.0002	0.0009	20	0.0307	0.0551
21	0.0005	0.0009	21	0.0374	0.0553
22	-0.0005	0.0009	22	-0.0243	0.0554
23	-0.0007	0.0009	23	-0.1138	0.0554
24	-0.0016	0.0009	24	0.1186	0.0543
25	-0.0012	0.0009			
26	-0.0019	0.0009			
27	-0.0005	0.0009			
28	-0.0002	0.0009			
29	-0.0005	0.0009			
30	-0.0012	0.0009			
31	-0.0008	0.0009			
32	-0.0001	0.0009			
33	0.0009	0.0009			
34	0.0007	0.0009			
35	-0.0008	0.0009			
36	-0.0017	0.0009			
37	0.0006	0.0009			
38	-0.0009	0.0009			
39	0.0010	0.0009			
40	-0.0001	0.0009			
41	-0.0004	0.0009			
42	-0.0022	0.0009			
43	-0.0005	0.0009			
44	0.0002	0.0009			
45	-0.0018	0.0009			
46	0.0003	0.0009			
47	-0.0003	0.0009			
48	-0.0009	0.0009			

R^2 = 0.46 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:1 – 2007:3.
Constant and dummy results are not shown.
There are 447 observations.

Table 25

The Impact of ALFRED/ BCI/SPF Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0038	0.0018	1	0.1158	0.0636
2	-0.0005	0.0018	2	-0.0085	0.0638
3	-0.0024	0.0018	3	0.1200	0.0631
4	-0.0008	0.0017	4	0.0698	0.0631
5	-0.0031	0.0017	5	0.0047	0.0632
6	0.0017	0.0018	6	-0.0277	0.0632
7	-0.0005	0.0017	7	0.0168	0.0631
8	-0.0026	0.0017	8	0.0219	0.0629
9	-0.0006	0.0017	9	0.0150	0.0627
10	-0.0015	0.0017	10	-0.0174	0.0609
11	-0.0030	0.0017	11	0.0638	0.0599
12	-0.0002	0.0017	12	0.2680	0.0612
13	-0.0022	0.0017	13	-0.0060	0.0614
14	-0.0002	0.0017	14	-0.1783	0.0608
15	-0.0005	0.0017	15	-0.1146	0.0612
16	0.0018	0.0017	16	-0.1258	0.0621
17	0.0004	0.0017	17	0.1098	0.0635
18	-0.0013	0.0017	18	0.0599	0.0633
19	-0.0022	0.0017	19	0.0402	0.0631
20	-0.0026	0.0017	20	0.0532	0.0627
21	-0.0003	0.0017	21	-0.0627	0.0626
22	-0.0019	0.0017	22	-0.0372	0.0623
23	0.0022	0.0017	23	-0.0433	0.0623
24	-0.0020	0.0017	24	0.0743	0.0620
25	-0.0003	0.0017			
26	-0.0015	0.0017			
27	-0.0029	0.0017			
28	0.0035	0.0017			
29	0.0008	0.0018			
30	0.0031	0.0017			
31	-0.0005	0.0018			
32	-0.0001	0.0018			
33	-0.0013	0.0017			
34	0.0049	0.0018			
35	0.0017	0.0018			
36	0.0022	0.0018			

R^2 = 0.85 S.E.E. = 0.010 D.W. = 2.00
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

The Impact of ALFRED/BCI/SPF Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0008	0.0008	1	0.2308	0.0645
2	0.0005	0.0009	2	0.0582	0.0659
3	-0.0018	0.0009	3	-0.0106	0.0662
4	0.0012	0.0009	4	-0.0251	0.0661
5	0.0010	0.0009	5	0.0786	0.0659
6	-0.0008	0.0009	6	0.1499	0.0662
7	0.0001	0.0009	7	0.0040	0.0663
8	0.0003	0.0009	8	0.0819	0.0662
9	-0.0018	0.0009	9	0.1314	0.0663
10	-0.0005	0.0009	10	-0.0149	0.0664
11	-0.0004	0.0009	11	0.1172	0.0666
12	-0.0004	0.0009	12	0.1160	0.0668
13	0.0010	0.0009	13	-0.0709	0.0666
14	-0.0001	0.0009	14	-0.0328	0.0662
15	0.0014	0.0009	15	-0.0133	0.0659
16	0.0004	0.0009	16	-0.0383	0.0647
17	0.0000	0.0009	17	0.0439	0.0646
18	-0.0002	0.0009	18	-0.0162	0.0646
19	0.0005	0.0008	19	-0.0354	0.0635
20	-0.0005	0.0008	20	0.0833	0.0638
21	0.0008	0.0008	21	-0.0175	0.0641
22	0.0000	0.0008	22	-0.0068	0.0640
23	-0.0009	0.0008	23	-0.0710	0.0639
24	-0.0011	0.0009	24	0.0045	0.0624
25	-0.0016	0.0009			
26	-0.0012	0.0009			
27	-0.0007	0.0009			
28	-0.0001	0.0009			
29	-0.0003	0.0009			
30	-0.0017	0.0009			
31	-0.0013	0.0009			
32	0.0000	0.0009			
33	0.0012	0.0009			
34	0.0003	0.0009			
35	-0.0006	0.0009			
36	-0.0019	0.0009			
37	0.0001	0.0009			
38	-0.0003	0.0009			
39	0.0008	0.0009			
40	0.0002	0.0009			
41	-0.0004	0.0009			
42	-0.0024	0.0009			
43	-0.0002	0.0009			
44	0.0003	0.0009			
45	-0.0015	0.0009			
46	0.0002	0.0009			
47	-0.0007	0.0009			
48	-0.0007	0.0009			

R^2 = 0.55 S.E.E. = 0.005 D.W. = 2.00
The sample period is from 1970:1 – 1996:12.
Constant and dummy results are not shown.
There are 324 observations.

Table 26

The Impact of ALFRED/BCI/SPF Shocks On Industrial Production

	Shock			Change In Industrial Production	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0047	0.0016	1	0.0650	0.0545
2	-0.0010	0.0016	2	0.0413	0.0544
3	-0.0023	0.0016	3	0.1252	0.0536
4	-0.0007	0.0016	4	0.0224	0.0539
5	-0.0026	0.0016	5	0.0430	0.0539
6	0.0013	0.0016	6	-0.0626	0.0540
7	-0.0002	0.0016	7	0.0456	0.0538
8	-0.0027	0.0016	8	0.0088	0.0535
9	-0.0009	0.0016	9	0.0357	0.0538
10	-0.0012	0.0016	10	-0.0232	0.0529
11	-0.0030	0.0016	11	0.0311	0.0518
12	-0.0003	0.0016	12	0.3269	0.0525
13	-0.0019	0.0016	13	-0.0288	0.0524
14	-0.0004	0.0016	14	-0.1657	0.0521
15	-0.0008	0.0016	15	-0.0986	0.0525
16	0.0018	0.0016	16	-0.1195	0.0529
17	0.0008	0.0016	17	0.0951	0.0536
18	-0.0008	0.0016	18	0.0591	0.0537
19	-0.0024	0.0016	19	0.0470	0.0537
20	-0.0015	0.0016	20	0.0179	0.0532
21	-0.0005	0.0016	21	-0.0396	0.0532
22	-0.0016	0.0016	22	-0.0694	0.0530
23	0.0022	0.0016	23	-0.0288	0.0532
24	-0.0022	0.0016	24	0.1166	0.0533
25	-0.0001	0.0016			
26	-0.0013	0.0015			
27	-0.0025	0.0015			
28	0.0026	0.0015			
29	0.0010	0.0016			
30	0.0027	0.0015			
31	-0.0004	0.0016			
32	0.0000	0.0016			
33	-0.0011	0.0016			
34	0.0056	0.0016			
35	0.0008	0.0016			
36	0.0027	0.0016			

$R^2 = 0.85$ S.E.E. = 0.009 D.W. = 1.99
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

The Impact of ALFRED/BCI/SPF Shocks On the Producer Price Index

	Shock			Change In Producer Price Index	
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0008	0.0008	1	0.2117	0.0554
2	0.0008	0.0008	2	-0.0144	0.0565
3	-0.0018	0.0008	3	0.0533	0.0567
4	0.0010	0.0008	4	0.0147	0.0568
5	0.0018	0.0008	5	0.0748	0.0566
6	-0.0007	0.0008	6	0.0869	0.0568
7	0.0002	0.0008	7	0.0906	0.0565
8	0.0002	0.0008	8	0.0415	0.0567
9	-0.0017	0.0008	9	0.1136	0.0579
10	-0.0004	0.0008	10	-0.0304	0.0585
11	-0.0008	0.0008	11	0.1513	0.0586
12	-0.0004	0.0008	12	0.0991	0.0593
13	0.0006	0.0008	13	-0.1044	0.0591
14	-0.0002	0.0008	14	0.0132	0.0588
15	0.0012	0.0008	15	-0.1033	0.0590
16	0.0003	0.0008	16	-0.0576	0.0585
17	0.0000	0.0008	17	0.0535	0.0585
18	-0.0002	0.0008	18	0.0416	0.0585
19	0.0000	0.0008	19	-0.0775	0.0576
20	-0.0007	0.0008	20	0.0192	0.0579
21	0.0010	0.0008	21	0.0729	0.0580
22	-0.0001	0.0008	22	-0.0120	0.0581
23	-0.0007	0.0008	23	-0.0769	0.0581
24	-0.0017	0.0008	24	0.0619	0.0567
25	-0.0012	0.0008			
26	-0.0018	0.0008			
27	-0.0003	0.0008			
28	0.0000	0.0008			
29	-0.0004	0.0008			
30	-0.0012	0.0008			
31	-0.0012	0.0008			
32	0.0001	0.0009			
33	0.0014	0.0009			
34	0.0009	0.0009			
35	-0.0007	0.0009			
36	-0.0020	0.0009			
37	0.0000	0.0009			
38	-0.0005	0.0009			
39	0.0008	0.0009			
40	0.0000	0.0009			
41	-0.0003	0.0009			
42	-0.0026	0.0009			
43	-0.0004	0.0009			
44	0.0003	0.0009			
45	-0.0015	0.0009			
46	-0.0001	0.0009			
47	-0.0005	0.0009			
48	-0.0008	0.0009			

$R^2 = 0.49$ S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:1 – 2003:12.
Constant and dummy results are not shown.
There are 408 observations.

Table 27

The Impact of ALFRED/BCI/SPF Shocks On Industrial Production

Shock			Change In Industrial Production		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0052	0.0015	1	0.0523	0.0517
2	-0.0004	0.0016	2	0.0280	0.0516
3	-0.0024	0.0016	3	0.1056	0.0507
4	-0.0006	0.0015	4	0.0195	0.0510
5	-0.0025	0.0015	5	0.0535	0.0510
6	0.0016	0.0015	6	-0.0612	0.0512
7	-0.0004	0.0015	7	0.0596	0.0511
8	-0.0024	0.0015	8	0.0043	0.0508
9	-0.0007	0.0015	9	0.0294	0.0507
10	-0.0013	0.0015	10	-0.0453	0.0500
11	-0.0031	0.0015	11	0.0357	0.0492
12	-0.0001	0.0015	12	0.3416	0.0498
13	-0.0020	0.0015	13	-0.0302	0.0498
14	0.0000	0.0015	14	-0.1644	0.0495
15	-0.0007	0.0015	15	-0.1099	0.0499
16	0.0018	0.0015	16	-0.1104	0.0504
17	0.0006	0.0015	17	0.0882	0.0510
18	-0.0006	0.0015	18	0.0354	0.0510
19	-0.0021	0.0015	19	0.0484	0.0516
20	-0.0013	0.0015	20	0.0107	0.0511
21	-0.0002	0.0015	21	-0.0386	0.0510
22	-0.0016	0.0015	22	-0.0681	0.0507
23	0.0018	0.0015	23	-0.0185	0.0508
24	-0.0024	0.0015	24	0.1055	0.0510
25	-0.0002	0.0015			
26	-0.0011	0.0015			
27	-0.0020	0.0015			
28	0.0024	0.0015			
29	0.0005	0.0015			
30	0.0024	0.0015			
31	-0.0002	0.0015			
32	0.0002	0.0015			
33	-0.0014	0.0015			
34	0.0064	0.0015			
35	0.0002	0.0015			
36	0.0021	0.0015			

R^2 = 0.85 S.E.E. = 0.009 D.W. = 1.99
The sample period is from 1970:1 – 2007:3.
Constant and dummy results are not shown.
There are 447 observations.

The Impact of ALFRED/BCI/SPF Shocks On the Producer Price Index

Shock			Change In Producer Price Index		
Lag	Coefficient	S.E.	Lag	Coefficient	S.E.
1	0.0006	0.0008	1	0.2213	0.0522
2	0.0008	0.0009	2	-0.1021	0.0533
3	-0.0018	0.0009	3	0.0889	0.0537
4	0.0010	0.0009	4	-0.0232	0.0539
5	0.0016	0.0009	5	0.0522	0.0539
6	-0.0008	0.0009	6	0.1086	0.0543
7	0.0004	0.0009	7	0.0997	0.0549
8	0.0000	0.0009	8	0.0334	0.0551
9	-0.0018	0.0009	9	0.0995	0.0551
10	0.0000	0.0009	10	0.0018	0.0549
11	-0.0012	0.0009	11	0.2077	0.0548
12	-0.0006	0.0009	12	0.0411	0.0553
13	0.0008	0.0009	13	-0.1449	0.0547
14	-0.0004	0.0009	14	0.0772	0.0551
15	0.0011	0.0009	15	-0.1178	0.0551
16	-0.0002	0.0009	16	-0.0626	0.0548
17	0.0003	0.0009	17	0.0613	0.0553
18	0.0002	0.0009	18	0.0088	0.0554
19	-0.0003	0.0009	19	-0.0083	0.0552
20	-0.0004	0.0009	20	0.0307	0.0551
21	0.0008	0.0009	21	0.0391	0.0553
22	-0.0005	0.0009	22	-0.0243	0.0554
23	-0.0006	0.0009	23	-0.1147	0.0554
24	-0.0017	0.0009	24	0.1203	0.0543
25	-0.0013	0.0009			
26	-0.0017	0.0009			
27	-0.0005	0.0009			
28	-0.0001	0.0009			
29	-0.0004	0.0009			
30	-0.0012	0.0009			
31	-0.0010	0.0009			
32	0.0000	0.0009			
33	0.0011	0.0009			
34	0.0006	0.0009			
35	-0.0009	0.0009			
36	-0.0018	0.0009			
37	0.0004	0.0009			
38	-0.0008	0.0009			
39	0.0011	0.0009			
40	-0.0003	0.0009			
41	-0.0004	0.0009			
42	-0.0021	0.0009			
43	-0.0005	0.0009			
44	0.0002	0.0009			
45	-0.0017	0.0009			
46	0.0000	0.0009			
47	-0.0004	0.0009			
48	-0.0009	0.0009			

R^2 = 0.46 S.E.E. = 0.005 D.W. = 1.99
The sample period is from 1970:1 – 2007:3.
Constant and dummy results are not shown.
There are 447 observations.

Vita

Daniel Matthew Groft was born in Lafayette, Louisiana. He holds a Bachelor of Science degree in economics from Northern Kentucky University, Highland Heights, Kentucky. He began to pursue his Doctor of Philosophy in economics at Louisiana State University in August 2003, earning a Master of Science degree in May, 2006 in the process. In August 2010, Daniel accepted a tenure-track Instructor position at St. Norbert College, De Pere, Wisconsin. In August 2011, he will begin as an Assistant Professor at McNeese State University, Lake Charles, Louisiana.

At Louisiana State University, Dan has taught Principles of Microeconomics, Principles of Macroeconomics, and Money and Banking. He received the Excellence in Teaching Award – Teaching Assistant Category in the Department of Economics in 2008 and 2009. He also received the Excellence in Teaching Award, Teaching Assistant Category, in the E.J. Ourso College of Business in 2009. At St. Norbert College, he has taught Principles of Macroeconomics, Monetary Theory and Policy, and Intermediate Macroeconomics. At McNeese State University he will begin teaching Principles of Macroeconomics and International Economics. His research interests are in the areas of Macroeconomics, Monetary Policy, Monetary Economics, and Central Banking. Currently, Daniel is a candidate for the degree of Doctor of Philosophy in economics at Louisiana State University to be awarded at the December 2011commencement.