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DO MEASURES OF MONETARY POLICY IN A VAR MAKE SENSE? A REPLY TO CHRISTOPHER A. SIMS

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1. GENERALITIES

The identified VAR literature has in the past few years begun producing fairly consistent and utterly conventional results (cf. Section 4.4 of my article: Rudebusch, 1998). As summarized in Bernanke et al. (1997, pp. 95–96):

> Using the estimated VAR system, one can trace out... how monetary policy innovations affect the economy. As John Cochrane (1996, p. 1) notes, "this literature has at last produced impulse-response functions that capture common views about monetary policy"; for example, in finding that a positive innovation to monetary policy is followed by increases in output, prices, and money, and by a decline in the short-term nominal interest rate. In addition, despite ongoing debates about precisely how the policy innovation should be identified, the estimated responses of key macroeconomic variables to a policy shock are reasonably similar across a variety of studies and suggest that monetary policy shocks can have significant and persistent real effects.

Sims is wrong to intimate that my critique is motivated by a disagreement with these conclusions. I am instead criticizing their econometric foundation and, in particular, I question the relative roles of econometric evidence and prior belief in obtaining these results.

However, with his four highlighted results, Sims does espouse a rather idiosyncratic perspective on the monetary VAR results—denying, for example, the real effects of monetary policy. His perspective is at odds with the mainstream VAR literature, namely, the opaque interaction of priors and evidence described above, but it is indicative of the underlying methodological weakness of much of the VAR literature so far.[2]

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[1] The views expressed in this paper do not necessarily reflect those of anyone else in the Federal Reserve System.

[2] Similarly, note that Sims states that the VAR literature has "discovered" that most monetary policy is reactive. But of course, the fact that the Federal Reserve isn't predominantly a random policy generator is the point of a several-decade-long research program on the Federal Reserve reaction function (see Section 3.1 of my article).

2. SPECIFICS

2.1. *Quibbles*: *Discussion of Section 3.* Sims completely misunderstands the point of Section 3 of my article. He apparently thinks I am quibbling about the modeling choices that he and other VAR modelers have made regarding structural stability, information sets, time aggregation, and so forth. Instead, I am criticizing the *methodology* by which their modeling choices have been made—that is using ocular judgements on impulse responses instead of statistical tests. A notorious example is the inclusion of an index of commodity prices in VARs not because it has passed a test of statistical significance in the reaction function but because the resulting impulse responses 'look better' to VAR modelers.

Researchers in the VAR literature have discovered that they can eliminate the 'price puzzle,' 'output puzzle,' and 'exchange rate puzzle' using certain sets of variables, but it is not clear that they have moved beyond their priors with regard to these puzzles. Such methodological sloppiness has led to the skepticism implicit in Cochrane's quotation above. Sims is right, "choices are necessary," but they should not be done in a haphazard fashion. Some VAR modelers, under the guise of 'atheoretical econometrics,' have eschewed any responsibility for specification tests. My critique suggests that this is not a tenable position.[3]

As for the specific problems that I raised about VAR reaction functions in Section 3, my four arguments stand:

1. *Time-invariant linear structure.* Sims states: "The best evidence is that nonlinearity and time variation are of modest quantitative significance." This statement is completely out of touch with the literature described in my article. Indeed, I know of *no* research testing the structural stability of the Federal Reserve reaction function over the past few decades that has not rejected the null of structural stability. Bernanke and Mihov (1995) and Clarida et al. (1997) reject this hypothesis, and McCallum and Nelson (1997, p. 7) note,

> ...there has clearly been a major component of Fed behaviour that is *systematic*, as opposed to random, and this component can be expressed in terms of a feedback formula. Of course there can be little doubt but that there have been changes during our 1955–1996 sample in the systematic component's specification, with prominent dates for possible changes including October 1979, late summer 1982, August 1987, and a few others.

In particular, Judd and Rudebusch (1998) demonstrate that monetary policy was insufficiently concerned with nominal quantities during the tenure of Arthur Burns

[3] We need not be econometric saints, but we should not consider our sins to be virtues.

as Chairman of the Federal Reserve, while during the Greenspan sample, monetary policy has anchored the inflation rate.

2. *Information sets.* Sims' comment is an example for my argument that VAR modelers have been cavalier about the creation of appropriate information sets. Sims states that other variables that might influence policy behavior "have not proved to be of major importance." My response is: What variables over which samples using which *statistical* tests has this been proved? I know of no such formal investigation in the VAR literature (cf. Section 3.2 of my article).

3. *Use of final revised data.* Sims agrees with my analysis that this is an important area for further research.

4. *Long distributed lags.* Sims misunderstands the argument in Section 3.4 of my article, (confusing the reduced form and structural form of the reaction function). It remains the case that VARs can apparently find information that financial markets cannot.

To summarize the discussion of Section 3, Sims and I are in agreement that a VAR interest rate equation is a structural reaction function that should be subject to standard econometric analysis. Sims has faith that current VARs will pass those tests. I have provided evidence to the contrary; for example, I show that VAR reaction functions should have structural breaks and shorter lags.

2.2. *Let's Look at the Policy Shocks: Discussion of Section* 4. Sims also agrees with the one of the main points of Section 4 of my article; namely, that the historical sequences of monetary policy shocks from various VARs are inconsistent. Indeed, as Sims notes, Sims and Zha estimate several different VARs and implicitly use several *different* historical monetary policy shock time series in a *single* paper. This is more than just inconvenient. It implies that skepticism is warranted about any analysis that uses such shocks.

How models can disagree on policy shocks, while agreeing on their effects. As described in Section 4.4 of my article, the issue is whether one can get the shocks wrong, but the answers to interesting questions right. I think this issue remains unresolved, but I find Sims' comments unhelpful.

For example, can one rely on impulse responses from a VAR, even while disavowing its sequence of shocks? As described quite clearly in Section 4.4 and by Christiano et al. (1996), there is a straightforward connection: the response of a variable to an impulse (or shock) can be measured by the regression of the former on the latter. Sims' simultaneous equations example is murky by comparison. In particular, the assumption that there are "legitimate exogenous variables" renders the example incompatible with monetary VAR analyses.

As for variance decompositions, Sims' optimism is unwarranted. Recall that the correlation between the SZ VAR and the CEE VAR exogenous monetary policy shocks was precisely *zero* (at the end of Section 4.3). As described in footnote 23, if both of these are valid exogenous shocks then the actual variance accounted for by monetary policy shocks is the sum of their individual effects.

Federal funds futures. My article is quite clear on the distinction between one-step-ahead forecast errors (the u's) and the exogenous policy shocks (the e's). It is easy to judge VAR forecast errors against market forecast errors and find them deficient. It is harder to compare VAR and market exogenous policy shocks because of the difficulty in obtaining the latter. However, as noted at the beginning of Section 4, it is hard to imagine that a VAR can get the reduced form model forecast errors wrong but the structural model policy shocks right.

Sims unfortunately confuses forecast errors and shocks. Despite this false start, he raises two not uninteresting issues.

First, consider the timing of the information set. Sims suggests that my results reflect the fact that the end-of-month forward rates have a half-month informational advantage over the VAR right-hand-side variables, which are monthly averages, and so naturally provide "better" forecasts than those emerging from the VAR. This is nonsense. As stressed in Section 3.3 of my article, the actual timing of the information set of a typical VAR is indeterminant. For example, although employment for month $t-1$ (EMP_{t-1}) is on the right-hand side of the VAR reaction functions in Table 1, those data were not available in month $t-1$. In real time, EMP_{t-1} is released in the middle of month t; therefore, if anything, it is the VAR that has a half-month informational advantage over the forward rates. Furthermore, the use of final, revised data, which incorporates revisions made perhaps years later, makes the timing of the VAR's information set completely unclear.

However, even if taken at face value, the argument does not hold up. Essentially identical results to those in the text are obtained by using federal funds futures rates that are measured at the middle of the month. For example, construct the federal funds futures (FFF) market one-month-ahead unanticipated policy shocks using $FFF15_{t-1}$, which is the FFF market's one-month-ahead expected funds rate as of the middle of period $t-1$ (Sims' notation), as $\hat{u}_t^{FFF15} \equiv FFR_t - FFF15_{t-1}$. The regression of the VAR shocks on these shocks yields a familiar,

$$\underset{\quad}{\hat{u}_t^{VAR}} = \underset{(0.03)}{0.05} + \underset{(0.17)}{0.58}\hat{u}_t^{FFF15} \qquad R^2 = 0.12; \qquad 1988{:}11\text{–}1995{:}3.$$

A second issue is the efficiency of the FFF market. The results in my article are not meant to be a definitive analysis in this regard because of space constraints and because the efficiency of short-term interest rate futures markets is a well-established result in the literature (see the many references in Krueger and Kuttner 1996).

In any case, I do not find Sims' multivariate regressions in levels persuasive. A superior method is to simply regress the forecast error for period t on the

TABLE 1
TESTS OF FEDERAL FUNDS FUTURES EFFICIENCY

	p-value: $\beta = 0$	
X_{t-1}	$\hat{u}_t^{FFF}$	$\hat{u}_t^{FFF15}$
Funds rate (ffr)	0.08	0.59
T-Bill rate (tbr)	0.14	0.63

information set of time $t-1$, X_{t-1}, (as was done at the end of Section 4.1 in my article):

$$\hat{u}_t^{FFF} = \alpha + \beta X_{t-1}.$$

Table 1 gives the relevant p-values of $\beta = 0$ for both end-of-month and middle-of-month FFF forecast errors. All are insignificant, which supports efficiency.

3. CONCLUSION: CONSTRUCTIVE CRITICISM

Sims concedes my two most important points. First, a VAR interest rate equation is a structural reaction function and should be subject to the same statistical tests and econometric analysis the profession applies to other structural econometric methods. Given that, it is pretty easy to show that many common VARs fail such tests, and that, notably in the full six-equation VAR estimated for Figure 3 of my article, there are possible "sharp changes in results" as a consequence of my criticisms. Second, Sims concedes that monetary shocks are interesting objects of study and can be usefully compared across VARs and with financial market stocks. Again, it is easy to show that a typical VAR's monetary policy shocks are contradicted by other VARs and by financial markets.

Thus, my critique stands. Do measures of monetary policy in commonly estimated VARs make sense? No. Neither VAR Federal Reserve reaction functions nor VAR monetary shocks look appealing.

Let me be clear that I think there is interesting research being done using VARs, some of which acknowledges and builds on my critique. Sims' comment is, in contrast, a defensive, even obstructionist response.

My own views on how the VAR literature can progress are obvious throughout my article. VARs should be improved with a more careful attention to economic structure, in particular, to sample period, structural breaks, variable selection, lag length, and information sets. Some of these problems are easy to correct, while others are more subtle.

REFERENCES

BERNANKE, B.S., M. GERTLER, AND M. WATSON, "Systematic Monetary Policy and the Effects of Oil Price Shocks," *Brookings Papers on Economic Activity* 1 (1997), 91–157.

——— AND I. MIHOV, "Measuring Monetary Policy," Federal Reserve Bank of San Francisco, Working Paper 95-09, 1995.

CHRISTIANO, L.J., M. EICHENBAUM AND C.L. EVANS, "The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds," *Review of Economics and Statistics* 78 (1996a), 16–34.

CLARIDA, R., J. GALI, AND M. GERTLER, "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory," manuscript, New York University, 1997.

COCHRANE, J.H., "What Do the VARs Mean? Measuring the Output Effects of Monetary Policy," manuscript, University of Chicago, 1996.

JUDD, J. AND G.D. RUDEBUSCH, "Taylor's Rule and the Fed: 1970–1997," *Economic Review* 3, Federal Reserve Bank of San Francisco (1998), 3–20.

KRUEGER, J.T. AND K.N. KUTTNER, "The Fed Funds Futures Rate as a Predictor of Federal Reserve Policy," *Journal of Futures Markets* 16 (1996), 865–879.

MCCALLUM, B. AND E. NELSON, "Performance of Operational Policy Rules in an Estimated Semi-Classical Structural Model," manuscript, Carnegie Mellon University, 1997.

RUDEBUSCH, G.D., "Do Measures of Monetary Policy in a VAR Make Sense?" *International Economic Review*, this issue, pp. 907–931.