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The Post–War U.S. Phillips Curve: A Comment

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The Post-War U.S. Phillips Curve. A Comment

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1. Introduction

Robert King and Mark Watson's paper provides a fascinating account of the correlations between inflation and unemployment at various horizons from three different econometric perspectives: Keynesian, Monetarist, and real business cycle (RBC). The empirical results cast considerable doubt on their identified Keynesian and RBC supply and demand shocks as plausible explanations for post-war U.S. economic fluctuations.[1] By contrast, the Monetarist identification yields results which are so reasonable *a priori* that Robert J. Gordon has suggested the label "mainstream" for this case.[2] Nevertheless, I found it surprising that the neoclassical monetarist case contained a statistically significant long-run trade-off between inflation and unemployment. Indeed, King and Watson conclude that it would be hard for a neoclassical monetarist to argue with this finding. Because of the important policy implications, I will attempt to argue the opposing side empirically (but not nearly as exhaustively as their paper does)— namely, according to the neoclassical monetarist perspective, there is no long-run, exploitable Phillips curve trade-off.

Given the extensive nature of King and Watson's paper, I feel slightly negligent in addressing such a narrow question. Nevertheless, I think it is of primary importance. If a trade-off exists, politically-inclined decision-makers will invariably be drawn to exploit it. However, the trade-off that I have in mind is slightly different from the one that King and Watson focus on. My guess is that, for a trade-off to be viewed as exploitable, a decision-maker must have confidence that unemployment can be reduced by engineering a higher rate of inflation (to take just one example). It would

*This comment is based upon remarks which I delivered at the Carnegie-Rochester Conference on Public Policy, Carnegie-Mellon University, November 1993. I have benefitted from helpful conversations with Robert King and Mark Watson. The views expressed in this comment do not necessarily reflect the views of the Federal Reserve Bank of Chicago or the Federal Reserve System.

[1]Of course, it is unclear whether this failure reflects badly on the theories or the identification strategy.

[2]See King and Watson's footnote #14.

be of little comfort to many politicians if the Phillips curve trade-off simply implied that if unemployment instead turned higher, at least inflation would be lower. For this reason, I will focus more of my attention on the effect of demand shocks on unemployment.

King and Watson do not tell us how to exploit the trade-off explicitly, but the paper contains numerous comments suggesting that the monetarist demand shocks are monetary. Consequently, after briefly discussing the shortcomings of the Keynesian and RBC identifications, my comments will focus on two issues: (1) do the monetarist demand shocks look like monetary policy shocks? and (2) is the long-run trade-off obviously non-zero?

2. Identification

King and Watson (hereafter KW) consider a bivariate VAR for inflation and unemployment of the following form (their equations (17) and (18)):

$$\Delta u_t = \lambda \Delta \pi_t + \phi_{u\pi}(L)\Delta \pi_{t-1} + \phi_{uu}(L)\Delta u_{t-1} + \epsilon_{st} \tag{2.1}$$

$$\Delta \pi_t = \delta \Delta u_t + \phi_{\pi\pi}(L)\Delta \pi_{t-1} + \phi_{\pi u}(L)\Delta u_{t-1} + \epsilon_{dt} \tag{2.2}$$

Identification of the supply and demand shocks is achieved by imposing a value for λ *a priori* in the empirical analysis. The paper's discussion of how the λ's were selected and the implications of those choices is extremely complete. Since the Keynesian, Monetarist, and RBC models are each just-identified, the models can only be evaluated critically by considering more information than is imposed on the estimation. The paper suggests an intriguing method of assessing these identified shocks, namely, to investigate specific episodes in the post-war period.

2.1. RBC identification ($\lambda = 0$)

KW label this the RBC identification: the idea is that unemployment is contemporaneously unaffected by *nominal* demand shocks. In principle, $\phi_{u\pi}(L) = 0$ also; but for convenience, KW do not impose this restriction in the empirical analysis. Of course, other potential demand shocks are permanent and transitory fiscal policy shocks which would likely affect the short-run dynamics of an RBC economy and even the steady state. KW recognize the approximate nature of this restriction, but indicate that the estimated dynamic response patterns have clear RBC characteristics, justifying the label RBC. Their Figure 5 displays the empirical difficulties of this identification scheme: RBC demand shocks accounted for no part of the 1981-82 recession which many economists would argue was associated (in some part) with a restrictive monetary policy at the time. This inconvenient finding suggests that King and Watson's so-called RBC identification does not provide a reasonable account of

post-war economic fluctuations. This is not to say that supply shocks or technology shocks are unimportant. They may be unimportant, but it may also be the case that this identification scheme doesn't adequately capture the principal driving processes of these theories.

2.2. Keynesian identification

Several observations on this case are in order. First, King and Watson's Keynesian identification restriction is to assume that contemporaneous fluctuations in the unemployment rate are completely driven by demand shocks. This assumption allows λ to be estimated in equation (17) with the unemployment rate used as an instrument for the inflation rate. Unfortunately, this leads to imprecise estimates of $\widehat{\lambda}$. The t-statistic for testing the null hypothesis that $\lambda = 0$ (the RBC identification) is -0.97.[3] Second, the standard errors on the impulse response functions in Table 4 are extremely large. KW compute these standard errors using the delta method with λ fixed. In my analysis, I computed standard errors using Monte Carlo methods holding λ fixed as well; but in that case the standard errors were much smaller, and the impulse response functions were significantly different from zero. Apparently, the delta method calculations face the same difficulties that the $\widehat{\lambda}$ estimation faces.[4] Third, according to Figure 7, the Keynesian identification seems about as problematic as the RBC one: the problem here is that the 1973-75 recession is almost exclusively a demand shock phenomenon. Conventional accounts of this recession implicate the oil price shock as at least a co-conspirator. Consequently, one can argue that King and Watson's Keynesian identification does not provide a plausible account of post-war fluctuations either.

3. Monetarist identification

The monetarist identification of demand shocks seems to pass the episode diagnostic of Figure 6: much of the 1973-75 increase in unemployment is not explained by the demand shock, while much of the 1981-82 recession is accounted for by these shocks. This analysis is intriguing, but it does not establish that the monetarist demand shocks are indeed monetary shocks. Such a demonstration would seem to be important for King and Watson's conclusion that "it is hard for a neoclassical monetarist economist to argue that the [long-run] Phillips correlations are absent from the U.S.data..." For example, one counterargument might proceed as follows. Suppose that the KW monetarist demand shocks are in part fiscal policy shocks with permanent components; then unemployment might be affected at the empirical

[3] A wide range of $\widehat{\lambda}$ are possible depending upon the sample period. Some examples that I stumbled across are (sample period, $\widehat{\lambda}$): 54-92, -1.54; 55-92, -2.46; 70-92, -0.71; 54-69, 2.16 (!); 55-69, 0.89 (!); and 50-69, -10.32.

[4] This is the only case where my recreations differed perceptibly from King and Watson's analysis.

horizons considered here. But if inflation is a purely monetary phenomenon (according to a monetarist), this would conditionally imply an arbitrarily large inflation-unemployment trade-off ($\partial u/\partial \pi$). Perhaps this contamination of fiscal and monetary shocks is what accounts for the estimated monetarist trade-offs. In fact, once the estimation allows for more than the two simple shocks considered in the King and Watson paper, the monetarist long-run effect on unemployment can be driven to zero.

3.1. How monetary is the KW Monetarist demand shock?

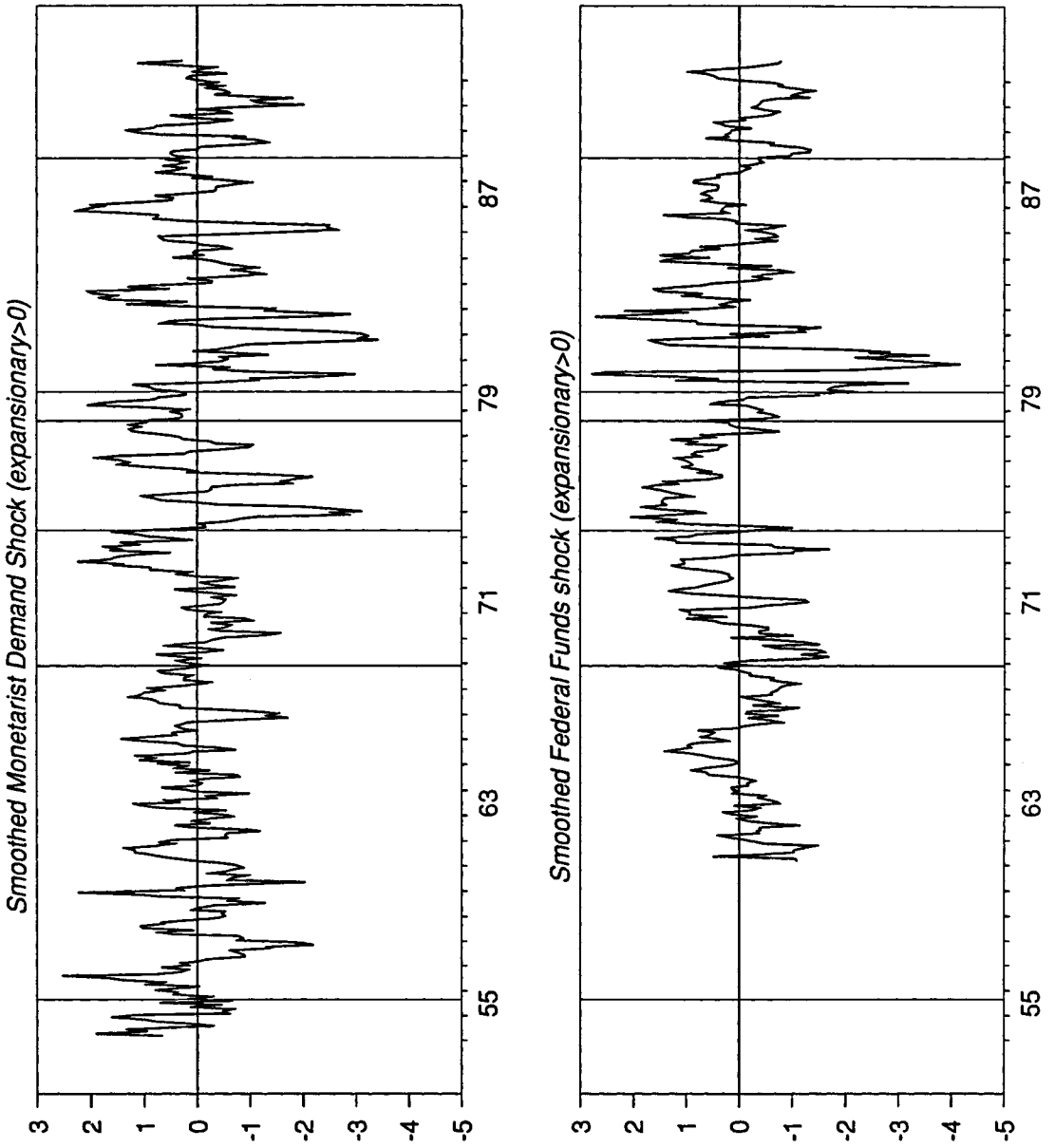
Figure 1 (top panel) plots my recreation of the King and Watson Monetarist demand shock. The shock series is smoothed, being a centered, 5-month moving average of the monthly demand shocks. Positive values indicate expansionary demand shocks. The vertical lines are the Romer and Romer (1989, 1990) dates indicating their assessment of the Federal Reserve's intention to induce a monetary contraction. The bottom panel plots a measure of expansionary monetary policy shocks identified in Christiano, Eichenbaum, and Evans (1994) (hereafter CEE). The policy shocks are orthogonalized innovations to the Federal Funds rate from a six-variable VAR which includes aggregate employment, the implicit consumption deflator, an index of commodity prices, the Federal Funds rate, nonborrowed reserves, and total reserves.[5] The FF shock series plotted in Figure 1 is also a centered, 5-month moving average of the monthly shocks. The shocks in both panels have been standardized to have equal variance.

Several comparisons are in order. First, the construction of these shocks is quite different. The KW monetarist demand shock is inferred from *policy outcomes* relating to unemployment and inflation. The CEE Fed Funds shock is inferred from exogenous changes in the assumed *policy instrument* relative to a large information set. Second, each shock has limited success matching the Romer index of monetary contractions: the KW monetarist shock seems to capture the 1974, 1979, and 1988 Romer dates, while the CEE Fed Funds shock captures the 1968, 1979, and 1988 Romer dates. In the case of the 1973-75 recession, the Fed Funds shock is small in 1974, implying that later increases in the Funds rate reflected systematic policy responses rather than exogenous shocks. According to the KW monetarist shock, however, there is a large negative demand shock during this period; presumably this identification scheme attributes a smaller portion of the changes in monetary policy instruments to systematic responses. This latter interpretation is also the one given by the Romer index. Third, large, contractionary FF shocks precede the 1980 and 1982 recessions more than the KW shock; for the latter case, the demand shocks begin after the onset of these recessions which are often thought of as monetary induced recessions. This really isn't very surprising. Since inflation and unemployment are extremely persistent processes, it is probably difficult to infer policy actions quickly from their

[5]The data is monthly, and the orthogonalization of the VAR residuals assumes that employment, the price level, and commodity prices are Wold causally prior to the Fed Funds rate.

movements. On the other hand, the Fed Funds shock identified by CEE leads to movements in unemployment and inflation with a delay. Fourth, the FF shock is expansionary following the 1975 recession for sometime. Christiano, Eichenbaum, and Evans (1994) discuss this and attribute the resolution of the price puzzle, in some part, to this inference. In sum, the King and Watson monetarist shock is at least partly monetary since it agrees with the Romer index and the FF shock during several episodes. But there are discrepancies and it would be interesting know if these discrepancies are systematic.

Figure 1: Monetarist Demand Shock v. Federal Funds Shock



The monetarist demand shock is from King-Watson's bivariate system, and the Federal Funds rate shock is from a six-variable VAR estimated in Christiano-Eichenbaum-Evans (1994). Both series are centered, 5-month moving averages of the serially uncorrelated shocks. The vertical lines are the dates identified by Romer and Romer (1989) as monetary contractions.

3.2. Is there a confounding of multiple shocks?

The KW identification in a bivariate system assumes that there are only two important shocks. But suppose that there is a third shock; then the identified supply and demand shocks from a bivariate VAR will be linear combinations of the three shocks. It is in this sense that the monetarist demand shock may be contaminated by some other shock. One way around this criticism, potentially, is to add a third variable (say x_t) to the VAR. Obviously, it is important that x_t contains some information about the third shock; alternatively, x_t could contain different information about the supply and demand shocks which allows the third shock to be identified from the unemployment or inflation equations. In either event, it is still feasible to maintain the King and Watson identifying restrictions for the demand and supply shocks; this amounts to assuming that the supply and demand shocks are Wold causally prior to the third shock.[6]

I considered four candidates for the x_t variable: the change in the Federal Funds rate (FF), the ratio of (real) nondurables plus services consumption expenditures to industrial production (C/Y), the growth rate of nominal M2 (dM2), and the growth rate of labor productivity (dZ) (industrial production divided by an index of aggregate labor hours from the establishment employment survey).[7] The first column of Figure 2 plots the estimated response of unemployment and inflation to the demand shocks identified in these trivariate systems. The unemployment rate response is centered between 2-standard error bands on either side (an approximately 95% confidence interval). The responses are graphed for 48 months.[8]

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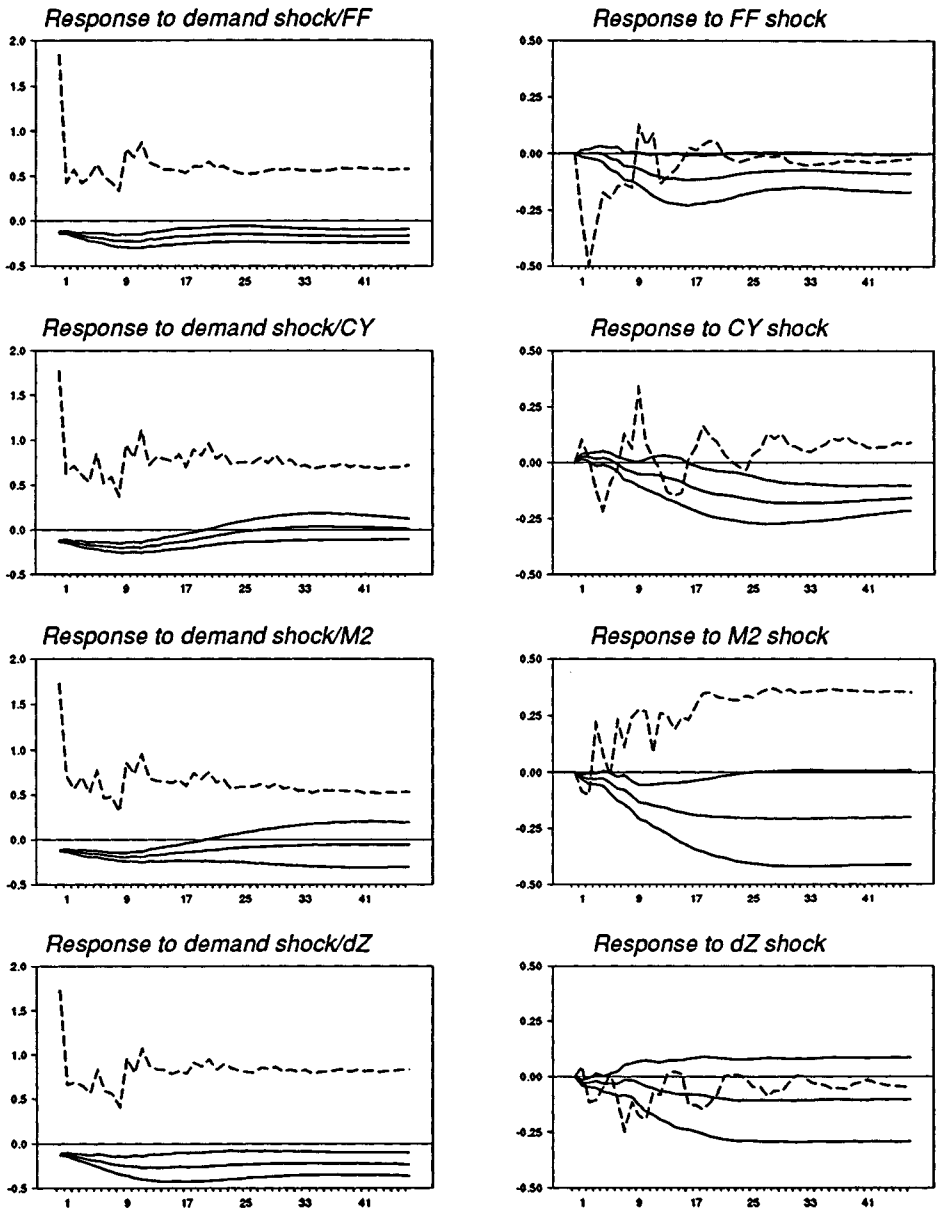
[6]In terms of the bivariate VAR system (17) and (18), this amounts to: (a) adding lagged values of x_t to (17) and (18); and (b) adding a third autoregression to the system for x_t which includes contemporaneous values of Δu_t and $\Delta \pi_t$, as well as lags of all three variables.

[7]King and Watson are careful to check the unemployment and inflation data for unit roots and cointegrating relationships; I have ignored this issue here. Considering Cochrane's (1994) paper on "Shocks" in this conference volume, these four variables seemed like obvious candidates. I have also experimented with replacing the monthly CPI data with the monthly implicit deflator for personal consumption expenditures. The results were quite similar; so apparently the choppiness in the monthly CPI inflation data does not seriously affect the estimated impulse response functions.

[8]As I stated earlier, I am focusing on $\partial u_{t+k}/\partial \epsilon_{dt}$ since policymakers care about the individual components of the Phillips curve trade-off at least as much as the $[\partial u_{t+k}/\partial \epsilon_{dt}]/[\partial \pi_{t+k}/\partial \epsilon_{dt}]$.

Figure 2: Impulse Response Functions from 3-variable VARs



The dashed line is the inflation response; the solid lines are the response of unemployment and a 95% confidence interval. The 3-variable VARs include $\Delta u_t, \Delta \pi_t$, and x_t, where x_t is the change in the Federal Funds rate (FF), the consumption-output ratio (C/Y), and the growth rates of M2 ($M2$) and labor productivity (dZ). The sample period runs from 1959-1992, due to data availability constraints.

The long-run effect of the monetarist demand shock on unemployment is uncertain across these larger trivariate systems. For systems which include FF and dZ, unemployment continues to be significantly negative at the 48-month horizon. But when C/Y or dM2 are included, the long-run effect is insignificantly different from zero; furthermore, for the C/Y system, the unemployment response point estimate is about zero at the 48-month horizon. Recall that King and Watson report that the monetarist demand shock accounts for 42% of the variance decomposition of unemployment at the 48-month horizon (Table 4). In the M2 VAR system, the demand shock now accounts for only 13% of the unemployment variance, while the M2 shock accounts for 30%. Evidently, the addition of M2 reduced the explanatory power of the demand shock without substantially affecting the supply shock's contribution. Since the M2 and demand shock responses are similar, but less precisely estimated separately, omitting M2 may be justified. In the C/Y system, however, the demand shock now accounts for only 25% of the unemployment variance, while the C/Y shock accounts for 39%. Apparently, adding C/Y to the system reduces the explanatory power of the demand and supply shocks about equally at the 48-month horizon.

A final check of these trivariate systems is to ask what effect the third shock has? Maybe these systems can be viewed as implausible on this account. The second column displays the response of unemployment and inflation to the third shock in the system; the shocks have been normalized so that they generate expansions in real activity.[9] The responses of unemployment and inflation to the third shocks seem representative of most researchers' findings. A negative FF shock leads to a fall in unemployment, and, somewhat perversely, the inflation rate falls. This has been referred to as the "price puzzle": however, in this monthly data, it seems to be largely due to the use of the CPI in this system. If the implicit deflator for consumption expenditures is used instead, there is essentially no puzzle.[10] An increase in the consumption-output ratio leads to significant reductions in unemployment, apparently signaling more prosperous times ahead. Expansions in M2 lead to a fall in unemployment and also an increase in inflation; while increases in productivity lead to reductions in inflation with a fall in unemployment (but the latter is imprecisely estimated).

To sum up, this paper usefully lays out three simple ways to identify aggregate supply and demand shocks which capture many features of Keynesian, Monetarist and RBC views of the postwar U.S. economy. With respect to the Monetarist identification, the long-run implications of expansionary aggregate demand shocks seem to be more in doubt than King and Watson's conclusion indicates. Finally, it would be interesting to know how well these econometric methods actually recover the funda-

[9]Specifically, the FF shock represents a *reduction* in the Funds rate, while the CY, dM2, and dZ shocks represent *increases* in those variables.

[10]Christiano, Eichenbaum, and Evans (1994) discuss this phenomena in larger VAR systems and the contribution of commodity prices to resolving the puzzle.

mental driving processes of an economy. For example, in general equilibrium models with technology shocks, monetary policy shocks, and fiscal shocks, what do these bivariate identifications actually recover from simulated data?

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