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The Informational Role of Commodity Prices in Formulating Monetary Policy: A Reexamination

Titus Awokuse
University of Delaware

Jian Yang
Prairie View A&M University

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Department of Food and Resource Economics • College of Agriculture and Natural Resources • University of Delaware

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Titus O. Awokuse*

Department of Food and Resource Economics

University of Delaware

Jian Yang

Department of Accounting, Finance and Information Systems

Prairie View A&M University

Abstract: This paper reexamines the issue of whether commodity prices provide useful information for formulating monetary policy through the application of recent development in time series methodology developed by Toda and Yamamoto (1995). We found that commodity prices signals the future direction of the economy.

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*Corresponding author: Titus O. Awokuse, Department of Food and Resource Economics, 213 Townsend Hall, University of Delaware, Newark, Delaware 19717. Tel: 302-831-1323; fax: 302-831-6243; email: kuse@udel.edu

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1. Introduction

Over the last two decades the role of commodity prices in setting monetary policy has been open to debates among economists. It has been argued that commodity prices may be an earlier indicator of the current state of the economy because these prices are usually set in continuous auction markets with efficient information (Olivera, 1970; Garner, 1989; Marquis and Cunningham, 1990; Cody and Mills, 1991). Some key policymakers were early public advocates of using commodity prices as a leading indicator of inflation and endorsed policy proposals using commodity prices as a guide to adjust short run money growth target ranges (Garner, 1989). A rise in commodity prices may indicate to policymakers that the economy is growing too rapidly and hence inflation is inclined to rise. In such a case, the monetary authority may observe the rising commodity prices and respond by raising interest rates to tighten money supply. However, there is a criticism of this argument that commodity prices cannot be used effectively in formulating monetary policy because they are subject to large, market-specific shocks, which may not have macroeconomic implications (Marquis and Cunningham, 1990; Cody and Mills, 1991). More importantly, following the traditional monetarist view, many other researchers (Bessler, 1984; Pindyck and Rotemberg, 1990; Hua, 1998) argue that commodity price movements are (at least to some extent) the result of macroeconomic/monetary factors and that the causality should run from macroeconomic/monetary variables to commodity prices. Obviously, the controversy can only be settled as a matter of empirical testing.

Many empirical studies have been conducted to examine the causal relationship between commodity prices and macroeconomic/monetary variables (particularly the inflation rate or general price levels) and the findings are generally mixed. Earlier studies (e.g., Bessler, 1984) were based on the standard Granger-causality tests performed on macroeconomic/monetary and price variables. More recently, recognizing the nonstationarity of macroeconomic/monetary and price variables, many researchers (Garner, 1989; Sephton, 1991; Marquis and Cunningham, 1990; Cody and Mills, 1991; Hua, 1998) employ cointegration and error correction models to more thoroughly study the economic relationship between these variables, which can make allowance for causal channels through the error correction mechanism (Engle and Granger, 1987). However, as demonstrated in Toda and Phillips (1993), standard Granger causality tests are fraught with many complications when there are stochastic trends and cointegration in the system (p.1388). Unless so-called sufficient cointegration rank conditions are met, the chi-square statistics for weak exogeneity tests regarding the error correction terms may be invalid and thus any causal inference in the Granger sense is unwarranted. In this context, the empirical results of more recent studies might not be reliable.

The objective of this study is to reexamine causality between commodity prices and macroeconomic/monetary variables using the Toda and Yamamoto (1995) methodology. Recently, Toda and Yamamoto (1995) and Dolado and Lutkepohl (1996) proposed an alternative procedure for testing Granger causality in a possibly integrated and cointegrated system (of arbitrary orders), using an augmented level VAR modeling. This procedure conducts Granger causality tests with allowance for the long-run information often ignored in systems that requires first differencing and pre-whitening. Also, this methodology is useful because it bypasses the need for potentially biased pre-tests for unit roots and cointegration, common to other formulations such as the vector error correction model. The rest of this paper is organized as follows. Section 2 presents the data and empirical methodology. Section 3 discusses empirical results. Finally, Section 4 makes concluding remarks.

2. Data and empirical methodology

Following Cody and Mills (1991), the U.S. data used in this study include money stock (M2), the interest rate on federal funds (FF), the consumer price index (CPI), the index of industrial production (IP), and commodity prices (CRB) measured by the Commodity Research Bureau's price index for all commodities. The monthly data covers the period 1975:1 to 2001:12. All data series, except the federal funds rate, are in natural logarithms.

The Toda and Yamamoto (1995) procedure for testing Granger causality is performed directly on the least squares estimators of the coefficients of the levels VAR. Similar to Cody and Mills (1991), we use a five-variable VAR(k) model (where k is the optimal lag length in the system) which includes M2, CPI, FF, IP, and CRB. We examine the dynamic causal relationship between commodity prices and macroeconomic/monetary variables as follows:

$$X_t = \mu + \sum_{i=1}^{p-1} \Gamma_i X_{t-k} + \varepsilon_t \qquad (1)$$

where X_t is an (nx1) column vector of p variables, μ is an (nx1) vector of constant terms, Γ represent coefficient matrices, k denotes the lag length, and ε_t is i.i.d. p-dimensional Gaussian error with mean zero and variance matrix Λ (white noise disturbance term).

Toda and Yamamoto (1995) procedure uses a modified Wald (MWALD) test for restrictions on the parameters of the VAR(k) model. This test has an asymptotic chi-squared distribution with k degrees of freedom in the limit when a VAR[k+d(max)] is estimated (where d(max) is the maximal order of integration for the series in the system). Two steps are involved with implementing the procedure. The first step includes determination of the lag length (k) and the maximum order of integration (d) of the variables in the system. Measures such as the

Schwartz's Bayesian Information Criterion (BIC) and Hannan-Quinn (HQ) Information Criterion can be used to determine the appropriate lag structure of the VAR. Given VAR(k) selected, and the order of integration d(max) is determined, a levels VAR can then be estimated with a total of p = [k+d(max)] lags. The second step is to apply standard Wald tests to the first k VAR coefficient matrix (but not all lagged coefficients) to make Granger causal inference.

3. Empirical results

In order to determine the order of integration, two standard unit root tests were conducted for each of the five series: the augmented Dickey-Fuller tests and the Phillip and Perron tests. Both testing procedures are based on the null hypothesis that a unit root exists in the autoregressive representation of the series. The unit root test results (not reported here but available on request) show that all five variables are non-stationary in levels and are stationary after first differencing. The exception is the variable CPI which requires second differencing to achieve stationarity. Since the order of integration for these macroeconomic variables is usually one or at most two, we can bypass the pre-test for unit roots and report test results for both cases where d(max) could be either one or two. Such an approach can attest to the robustness of the Toda and Yamamoto (1995) procedure against unit roots pre-test bias.

The BIC and HQ information criteria were used to determine the appropriate lag length of the VAR. Both criteria suggest using a lag length of two (which yields white noise residuals). Since all the variables are in levels, the results provide information about the long-run causal relationships among nonstationary variables in the system. Table 1 reports the Granger causality test results using the Toda and Yamamoto's procedure, assuming order of integration d=1. These results suggest that the commodity prices (CRB index) does not respond to lagged changes in any of the other macroeconomic/monetary variables in the system, which is contradictory to the argument that commodity price movements are the results of macroeconomic/monetary factors (Bessler, 1984; Pindyck and Rotemberg, 1990; Hua, 1998). By contrast, commodity prices (CRB) are significant in explaining the future path of the fed fund rate, CPI, and industrial production. The latter result confirms that commodity prices can be used as a leading indicator of inflation (measured as the log of CPI), which is reported in many previous studies (Garner, 1989; Marquis and Cunningham, 1990; Sephton, 1991; Cody and Mills, 1991). The evidence of the usefulness of commodity prices in predicting industrial production has not yet been documented in previous studies, as most previous studies focus on the effectiveness of commodity prices to signal the future inflation rate. However, this new finding provides additional support for the informational role of commodity prices in formulating monetary policy, because industrial production is another important monetary policy target in addition to the inflation rate (See Cody and Mills, 1991). Finally, extending Cody and Mills (1991), the evidence of explanatory power of commodity price in future movements in federal fund rates suggests that during more recent sample period of 1975-2001, the Fed did use the information provided by commodity prices in order to fine-tune monetary policy. By contrast, Cody and Mills (1991) found that during the period of 1959-1987, the historical monetary policy response to commodity prices was insignificant (p. 363).

Next, to check the robustness of the estimation procedure for potential unit roots pre-test bias we test causality for the order of integration d=2 (Table 2). Similar to the case where d=1, we find that commodity prices are significant in predicting the future path of the fed fund rate, CPI and industrial production. Overall, the result shown in Table 2 is qualitatively the same as that from Table 1. Yamada (1998) also reported similar robustness for the Toda-Yamamoto's procedure.

Concluding remarks

This paper reexamines the informational role of commodity prices in formulating monetary policy through testing Granger causality among commodity prices (CRB), fed fund rates (FF), inflation (CPI), money stock (M2), and industrial production (IP), using a relatively new method developed by Toda and Yamamoto (1995) and a recent dataset. We test the hypothesis that commodity prices help explain the future path of macroeconomic/monetary variables including the inflation rate. Consistent with the finding of previous studies (e.g., Garner, 1989; Marquis and Cunningham, 1990; Cody and Mills, 1991), commodity prices are found to be useful in predicting the inflation rate. The evidence is also presented that commodity prices are also useful in predicting industrial production, which has not yet been documented in previous studies. Different from Cody and Mills (1991), where the Fed was not found to respond to commodity price innovations in the past (p. 364), the results of this study also indicate that the Fed responded to past commodity price fluctuations. In sum, our findings suggest that commodity prices can help monetary authorities in formulating monetary policy as they may provide signals about the future direction of the economy, including inflation and other macroeconomic activities such as industrial production.

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Table 1. Causality Results from Toda-Yamamoto Procedure (k=2, d=1).

	M2	FF	CPI	IP	CRB
Dep. Variables			MWALD - Statisitics		
M2		19.1927	31.8745	4.2323	0.9104
		(0.0001)	(0.0000)	(0.1205)	(0.4035)
FF	1.3009	-	1.2497	6.0765	13.6745
	(0.5218)		(0.5353)	(0.0479)	(0.0011)
CPI	6.0958	15.5650	-	0.7009	7.8573
	(0.0475)	(0.0007)		(0.7044)	(0.0197)
IP	3.3124	0.1700	1.9976	-	9.3435
	(0.0377)	(0.9185)	(0.3683)		(0.0001)
CRB	0.2307	1.5293	1.2296	2.2288	-
	(0.8911)	(0.4655)	(0.5408)	(0.3281)	

Notes:

The [k+d(max)]th order level VAR was estimated with d(max)=1 for the order of integration equal 1.
Lag length selection of k=2 was based on AIC and HQ information criteria test results.
Reported estimates are asymptotic Wald statistics. Values in parentheses are p-values.

Table 2. Causality Results from Toda-Yamamoto Procedure (k=2, d=2).

	M2	FF	CPI	IP	CRB
Dep. Variables			MWALD - Statisitics		
M2		19.8624	21.8218	6.7507	1.1645
		(0.0002)	(0.0001)	(0.0803)	(0.7615)
FF	1.0760	-	1.2571	5.4299	10.3474
	(0.7829)		(0.7393)	(0.1429)	(0.0158)
CPI	3.5251	12.4210	-	0.6314	7.9667
	(0.3175)	(0.0061)		(0.8892)	(0.0467)
IP	3.4805	4.9816	0.7275	-	6.4700
	(0.3233)	(0.1732)	(0.8667)		(0.0003)
CRB	0.1499	1.2387	2.3281	1.0615	-
	(0.9297)	(0.7437)	(0.5071)	(0.7863)	

Notes:

The [k+d(max)]th order level VAR was estimated with d(max)=1 for the order of integration equal 2.
Lag length selection of k=2 was based on AIC and HQ information criteria test results.
Reported estimates are asymptotic Wald statistics. Values in parentheses are p-values.

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For further information write to:

Dr. Thomas W. Ilvento, Chair
Department of Food and Resource Economics
University of Delaware
Newark, DE 19717-1303

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