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CAUSALITY OF THE U.S. AGRICULTURAL PRICES AND THE
MONEY SUPPLY: FURTHER EMPIRICAL EVIDENCE

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CAUSALITY OF THE U.S. AGRICULTURAL PRICES AND THE MONEY SUPPLY:
FURTHER EMPIRICAL EVIDENCE

by

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In an important paper published in the May 1983 issue of this Journal Barnett, Bessler, and Thompson (BBT) empirically examined the direction of causality between the U.S. money supply and nominal agricultural prices. The authors deployed the direct Granger test of causation between money supply and nominal agricultural prices. Causality implications were derived from standard F-statistics. The results based on F - tests were then used to test the null hypothesis that agricultural prices are not affected by changes in the stock of money.

This method involved an arbitrary lag selection in causality testing. Lag selection refers to the length of autoregressions used to perform causality tests. To complete these tests BBT defined the U.S. money supply with three separate, basic measures: M_1 , M_2 , and reserve money. Nominal agricultural prices were defined as cash prices for No. 2 Kansas City hard red winter wheat and the food component of the consumer price index. The period considered by BBT stretched between 1970 to 1978. The authors found evidence of a unidirectional causal flow from the U.S. money supply (as approximated by M_2) to both measures of agricultural prices. No such evidence was found for either M_1 or the monetary base. Furthermore, BBT found no significant lags of more than sixteen months.

The purpose of this paper is to update the empirical results of BBT's study as well as to provide additional empirical evidence regarding the causality between the farm level agricultural prices and the money supply. This study focuses on the possible effects of the arbitrary lag selection on the causality test results reported by BBT. Additionally, the study addresses the possibility of structural changes in the relationship following a substantial shift in the monetary policy in October 1979. The following sections provide discussions regarding possible modeling problems with BBT's study. The final section provides a summary of the major conclusions based on the findings reported in this study.

Optimal Lag Selection and its Implications to Causality Testing

In addition to BBT's work, numerous studies have provided empirical evidence on the causal relationships and linkages between macro variables, such as the money supply and the U.S. agricultural sector. (Belongia and King; Bessler; Bordo; Chambers; Chambers and Just; and Lombra and Mehra). Most causality tests of the U.S. data, inclusive of the pioneering work of Sims, rely on the arbitrary lag selection in their Granger type causality testing techniques. Recent contributions of Geweke, Meese and Dent, and Guilkey and Salemi, indicate that Granger's causality testing method in finite samples is probably superior to other methods. These authors do not address the question of the lag selection in causality testing. Therefore, the issue of appropriate lag selection for such tests remains unresolved.

There are different criteria used for specifying the lag length. Hsiao (1979, and 1981) states that in cases where arbitrary restrictions are used in causality testing the distributions of test statistics are often sensitive to lag length. Using the minimum final prediction error (FPE) causality testing technique as developed by Hsiao (1979, and 1981), Biswas and Saunders demonstrate that causality test results are influenced by the lag specification. Relying on the standard F tests with varying lag lengths the authors show that the causality implications depend directly on the choice of lags in test equations.

Thornton and Batten examine three different lag selections for the Granger causality testing between money and income; the FPE (final prediction error) method suggested by Hsiao (1981), the Bayesian estimation method outlined by Geweke and Meese, and the technique developed by Pagano and Hartley. Thornton and Batten state that "... the outcome of causality tests between money and income are unquestionably sensitive to the lag specification. Also, they suggest that researchers should not rely on arbitrarily chosen lag lengths, so common in applications of these tests" (p. 169). When compared with other lag selection methods, the FPE criterion, even though

asymptotically less efficient, performed well in selecting an appropriate model.¹

There are two basic ways of determining the lag in causality testing. One way is to rely on a prior knowledge of lag lengths. In this respect the lag selection can be based on theoretical and previously established empirical knowledge of the relationships under examination. However, even if the lags are selected according to existing theoretical and empirical considerations, imposing these restrictions can still influence the test results (Thornton and Batten). Furthermore, if a long lag length is required, then the degrees of freedom tend to become exhausted very quickly. Because of these considerations the choice of the lag length presents a formidable problem.

Alternatively, the "appropriate" lag structure can be based on a statistical criterion. Hsiao (1979, and 1981) outlines this alternative way of handling the lag selection problem in Granger type causality testing. Hsiao's method is based upon Akaike's (1969a,b) final prediction error criterion and on the definition of causality outlined by Granger. This procedure provides a lag choice technique based upon a statistical selection of lags. It involves calculating the minimum final prediction error. Causality implications are derived from the minimum FPEs of several statistical steps. The minimum final prediction error can be computed as $(SEE)^2 \cdot (T + K)/T$, where SEE is the standard error of the regression, K is the number of parameters, and T refers to the number of observations.

The minimum FPE procedure offers several advantages over conventional arbitrary lag selection causality testing methods. First, the minimum FPE procedure allows variables to be tested with different lag lengths. Under an arbitrary lag selection method the variables are tested with identical lag lengths. Therefore, the number of parameters increases with the square of the number of variables and, consequently, the degrees of freedom are rapidly exhausted. Additionally, imposing an identical lag length on all test variables may result in a large number of estimated coefficients

tests, the arbitrary lag selection is applied to the 1972 - 1985 test data. Following BBT, the lags of eight and 16 months are tested. The results so obtained are then compared with the results reported under the FPE procedure.

Hsiao's (1979, and 1981) causality technique method involves several statistical steps. The first step (step 1) in this method consists of treating Y as a one-dimensional autoregressive process. The FPEs are computed by varying the lags from n to m. The specification yielding the minimum FPE is then selected. Once the optimum lag of Y is selected, it is then assumed that X is the manipulated (independent) variable controlling the outcome of Y. The minimum FPE criterion is then used to determine the optimum lag order of X (step 2), while holding the order of lags on Y determined in step 1 constant. The next step involves comparing the smallest FPEs of steps 1 and 2. If the FPE of step 2 is less than the FPE yielded by step 1, then X causes Y. If the opposite is true, then X does not cause Y. Finally, X and Y are statistically independent if neither X causes Y nor Y causes X. In order to obtain the overall causality implications the entire above described procedure must be repeated using X as the initial test variable.

The causality tests are conducted for two different time periods: January 1970 - December 1978, and January 1972 - December 1985. In the reported calculations X represents the money supply while Y refers to agricultural prices. Following BBT's procedure, the money supply is approximated by all three different measures of money, namely the monetary base (BASE), M_1 , and M_2 . As in BBT's study, agricultural prices for the first period are measured by the food component of the consumer price index (FCPI). Agricultural prices for the extended period are measured by the index of prices received by farmers (FPI) for all farm products and by the consumer price index for domestically produced farm food (CPIF).⁷ The obvious advantage of using both CPIF and FPI is that these variables contain only domestically produced farm food prices.⁸ Since the purpose of this study is to examine the causal relationship

between the U.S. money supply and U.S. agricultural prices, and since a partial motivation of this study is to show how farmers are affected by domestic inflation, the above mentioned selection of test variables is reasonable.

As in BBT's study, only monthly data are analyzed. In order to make meaningful comparisons with BBT's study, all equations for the initial test period are estimated in the percentage change form. All equations for the 1972 - 1985 period are estimated in the first differences of logarithms. Mathematically these two specifications are identical. The first differences of logarithms specification is employed because it is generally assumed sufficient to induce the stationarity of test variables. Consequently, this specification is appropriate for the task at hand. The minimum FPEs are calculated by varying the lag structure from one to 24. The impact of monetary changes on other economic variables can be substantially long (Friedman 1961, 1971; Friedman and Schwartz; Gordon). The choice of lag structure from one month to two years should allow sufficient time for all effects of monetary changes on prices to take place.

The test results of the FPE method for both test periods are reported in Tables 1 and 2. Table 1 summarizes the results of implementing the testing procedure outlined in step 1 whereas Table 2 reports the results of step 2 calculations. Causality implications of the minimum FPE procedure for the test variables are outlined in Table 3. During the 1972 - 1985 test period a unidirectional causal flow is established from both BASE and M_1 to CPIF. These results indicate that both BASE and M_1 play a significant causal role in the determination of agricultural prices at the retail level. Establishing a unidirectional causal flow from BASE and M_1 to prices does not imply that these two variables are the only variables responsible for retail price changes. However, the nature of causality tests does not allow inclusion of other explanatory variables. The reported results do imply that BASE and M_1 have a significant causal effect on retail agricultural prices. Using M_2 as a measure of

TABLE 1
The FPE of Fitting a One-Dimensional Autoregressive Process for
Base, M_1 , M_2 , CPIF, FPI, and FCPI*

The order of Lags	FPE of BASE	FPE of M_1	FPE of M_2	FPE of CPIF	FPE of FPI	FPE of FCPI
1972.01 - 1985.12:						
1	0.1154	0.2513	0.0839	1.0684	10.7110	
2	0.1169	0.2544	0.0822	1.0829	10.5308	
3	0.1187	0.2589	0.0818	1.0969	10.6635	
4	0.1206	0.2596	0.0833	1.1177	10.3421	
5	0.1229	0.2626	0.0839	1.1126	10.4148	
6	0.1244	0.2673	0.0842	1.1117	10.5122	
7	0.1243	0.2718	0.0853	1.1298	10.7087	
8	0.1265	0.2717	0.0853	1.1305	10.8697	
9	0.1273	0.2768	0.0868	1.1367	10.9963	
10	0.1276	0.2810	0.0857	1.1555	11.1708	
11	0.1252	0.2832	0.0870	1.1752	10.8083	
12	0.1241	0.2871	0.0885	1.1628	10.7144	
13	0.1229	0.2909	0.0877	1.1658	10.5627	
14	0.1194	0.2873	0.0872	1.1194	10.4940	
15	0.1223	0.2928	0.0889	1.1283	10.7028	
16	0.1239	0.2980	0.0903	1.1412	10.6677	
17	0.1264	0.3031	0.0923	1.1577	10.2311	
18	0.1279	0.3056	0.0914	1.1722	10.4053	
19	0.1263	0.3076	0.0926	0.7800	7.2472	
20	0.1288	0.3109	0.0922	0.6342	5.6662	
21	0.1312	0.3146	0.0929	0.6390	5.7305	
22	0.1332	0.3201	0.0950	0.6488	5.8794	
23	0.1345	0.3205	0.0966	0.6370	5.8602	
24	0.1370	0.3207	0.0968	0.6420	5.8369	
1970.01 - 1978.12						
1	0.8649	1.1317	0.4909			7.3237
2	0.8324	1.1607	0.4998			7.4371
3	0.8571	1.1913	0.4984			7.6569
4	0.8749	1.2093	0.5043			7.8799
5	0.8934	1.2163	0.5112			8.0398
6	0.9102	1.2435	0.5211			8.0200
7	0.9359	1.2355	0.5274			8.2433
8	0.9583	1.1983	0.5381			8.1716
9	0.9819	1.2192	0.5478			8.3503
10	1.0108	1.2622	0.5637			8.4465
11	1.0262	1.2931	0.5682			8.7158
12	1.0357	1.2931	0.5302			8.9840
13	0.9366	1.3001	0.5465			9.2584
14	0.9338	1.3472	0.5519			9.5010
15	0.9351	1.3827	0.5561			9.5757
16	0.9669	1.3980	0.5769			9.9137

* FPEs reported for the 1972.01 - 1985.12 test period are the numerical values of each FPE multiplied by 10^4 whereas FPEs reported for the 1970.01 - 1978.12 test period are the numerical values of each FPE multiplied by 10^1 .

TABLE 2
The Optimum Lags of the Manipulated Variables and the FPE
of the Controlled Variables^a

Equations	Controlled Variable (Lags)	Manipulated Variables	The Optimum Lag of Manipulated Variables	FPE ^b
1972.01 - 1985.12:				
1	BASE (1)	CPIF	1	0.1166
2	CPIF (20)	BASE	14	0.6162
3	BASE (1)	FPI	1	0.1163
4	FPI (20)	BASE	1	5.7394
5	M ₁ (1)	CPIF	1	0.2524
6	CPIF (20)	M ₁	3	0.6303
7	M ₁ (1)	FPI	3	0.2542
8	FPI (20)	M ₁	1	5.7466
9	M ₂ (3)	CPIF	1	0.0801
10	CPIF (20)	M ₂	1	0.6402
11	M ₂ (3)	FPI	3	0.0811
12	FPI (20)	M ₂	1	5.7327
1970.01 - 1978.12:				
13	BASE (2)	FCPI	1	0.8477
14	FCPI (1)	BASE	1	7.2962
15	M ₁ (1)	FCPI	5	1.1167
16	FCPI (1)	M ₁	1	7.2479
17	M ₂ (1)	FCPI	1	0.4672
18	FCPI (1)	M ₂	1	7.4276

^aNumbers in parentheses indicate optimum lags of controlled variables.

^bFPEs reported for the 1972.01 - 1985.12 test period are the numerical values of each FPE multiplied by 10^4 whereas FPEs reported for the 1970.01 - 1978.12 test period are the numerical values of each FPE multiplied by 10^1 .

TABLE 3

Causality Implications of the FPE Procedure for CPIF, FPI, BASE, M_1 , and M_2

BASE		M_1		M_2	
Process	Implications	Process	Implications	Process	Implications
1972.01 - 1985.12:					
<u>CPIF Process:</u>		<u>CPIF Process:</u>		<u>CPIF Process:</u>	
FPE (Step 1)	0.6342	FPE (Step 1)	0.6342	FPE (Step 1)	0.6342
FPE (Step 2)	0.6162	FPE (Step 2)	0.6303	FPE (Step 2)	0.6402
	$0.6342 > 0.6162$		$0.6342 > 0.6303$		$0.6342 > 0.6402$
	BASE $\Rightarrow$ CPIF		$M_1 \Rightarrow$ CPIF		$M_2 \neq$ CPIF
<u>BASE Process:</u>		<u>M_1 Process:</u>		<u>M_2 Process:</u>	
FPE (Step 1)	0.1154	FPE (Step 1)	0.2513	FPE (Step 1)	0.0818
FPE (Step 2)	0.1166	FPE (Step 2)	0.2524	FPE (Step 2)	0.0801
	$0.1154 < 0.1166$		$0.2513 < 0.2524$		$0.0818 > 0.0801$
	CPIF $\neq$ BASE		CPIF $\neq M_1$		CPIF $\Rightarrow M_2$
<u>FPI Process:</u>		<u>FPI Process:</u>		<u>FPI Process:</u>	
FPE (Step 1)	5.6662	FPE (Step 1)	5.6662	FPE (Step 1)	5.6662
FPE (Step 2)	5.7394	FPE (Step 2)	5.7466	FPE (Step 2)	5.7327
	$5.6662 < 5.7394$		$5.6662 < 5.7466$		$5.6662 < 5.7327$
	BASE $\neq$ FPI		$M_1 \neq$ FPI		$M_2 \neq$ FPI
<u>BASE Process:</u>		<u>M_1 Process:</u>		<u>M_2 Process:</u>	
FPE (Step 1)	0.1154	FPE (Step 1)	0.2513	FPE (Step 1)	0.0818
FPE (Step 2)	0.1163	FPE (Step 2)	0.2542	FPE (Step 2)	0.0811
	$0.1154 < 0.1163$		$0.2513 < 0.2542$		$0.0818 > 0.0811$
	FPI $\neq$ BASE		FPI $\neq M_1$		FPI $\Rightarrow M_2$
1970.01 - 1978.12:					
<u>FCPI Process:</u>		<u>FCPI Process:</u>		<u>FCPI Process:</u>	
FPE (Step 1)	7.3237	FPE (Step 1)	7.3237	FPE (Step 1)	7.3237
FPE (Step 2)	7.2962	FPE (Step 2)	7.2479	FPE (Step 2)	7.4276
	$7.3237 > 7.2962$		$7.3237 > 7.2479$		$7.3237 < 7.4276$
	BASE $\Rightarrow$ FCPI		$M_1 \Rightarrow$ FCPI		$M_2 \neq$ FCPI
<u>BASE Process:</u>		<u>M_1 Process:</u>		<u>M_2 Process:</u>	
FPE (Step 1)	0.8324	FPE (Step 1)	1.1317	FPE (Step 1)	0.4909
FPE (Step 2)	0.8477	FPE (Step 2)	1.1167	FPE (Step 2)	0.4672
	$0.8324 < 0.8477$		$1.1317 > 1.1167$		$0.4909 > 0.4672$
	FCPI $\neq$ BASE		FCPI $\Rightarrow M_1$		FCPI $\Rightarrow M_2$

money, the study indicates an existence of a causal flow from CPIF to M_2 .

An important result is reported in the second section of Table 3. Using the same data, time period and specification as BBT, the present study relying on a statistical lag selection finds no evidence of a causal flow from M_2 to FCPI. In fact, a unidirectional causal flow from the FCPI to M_2 is established while feedback exists between M_1 and FCPI. At the same time, a unidirectional causal flow is established from the monetary base to FCPI. These results are in direct contrast to the results reported by BBT. They indicate that it is the monetary base which is truly exogenous in the money - retail level agricultural prices (prices approximated by FCPI) relationship and not M_2 , as reported by BBT.

The results reported for the monetary base and nominal retail level agricultural prices for both test periods indicate that the monetary base plays an important causal role in this relationship. As such these results are consistent with existing economic theory. The monetary base, due to its definition, can indeed be regarded exogenous. Both components of the monetary base - currency and reserves - are under the Fed's control. Therefore, the variations in it are expected to affect economic activity (Andersen and Jordan).

For the farm level prices no causal flow is established from any measure of money to FPI. The existence of a statistical independence is found between BASE, M_1 , and FPI. This indicates that farm level prices are determined independently of changes in the money supply. This result is not altogether unexpected as typically the farm level prices are influenced by factors other than changes in the money supply, such as the government commodity programs.

Table 2 also indicates that the optimal lag selection of the test variables for the overall test period is considerably longer than the eight or 16 lags chosen by BBT. In fact, a lag of 20 months appears appropriate for both CPIF and FPI. Again, this result is in contrast to BBT's claim that no lag lengths of more than 16 months

were significant. Longer price adjustments are consistent with many existing studies (Gordon).

In order to gather further empirical evidence on the influence of the lag selection on causality test results, the arbitrary lag selection method is applied to the overall test period data. Following BBT, lags of eight and 16 months are examined. The results of the estimations for all test variables are reported in Table 4. Given the arbitrary lag selection of eight months, all three measures of the money supply and the two measures of agricultural prices are found to be statistically independent at both levels of statistical significance. However, when the 16 month lag is used for the same data, a unidirectional causal flow is established from CPIF to BASE, FPI to BASE, FPI to M_1 , and FPI to M_2 at the 5 percent level of significance. In the rest of the cases under investigation the test variables are statistically independent. Clearly, these results are contrary to the results reported under the FPE procedure using the same test data and specification. The plausible explanation of these differences lies in the lag structure used in causality testing procedures. As previously outlined, models selected by different statistical criteria often yield contradictory conclusions concerning the Granger causality implications (Biswas and Saunders; Hsiao 1979 and 1981; Thornton and Batten).

A complete empirical investigation must address the possibility of structural changes during the sample period. In order to investigate this possibility, equation (2) was subjected to the Chow test (Chow; Kmenta, pp. 420-22). The overall sample period was divided into two parts: 1972.01 - 1979.10, and 1979.11 - 1985.12. The reason for this particular division of the test period was to capture the effects of an October 1979 change in the monetary policy on the causal relationships under investigation. An F statistic of 0.94 (critical F = 1.50 at the 5% level of significance) was obtained. This statistic implies that the null hypothesis of no

Table 4

Granger Causality Test Results for

CPIF, FPI, BASE, M_1 , and M_2 : 1972.01 - 1985.12

Levels of Significance	Eight-months Lag:		Implications:	Sixteen-months Lag:		Implications:
	F^a :	F^b :		F^a :	F^b :	
	----	----		----	----	
CPIF and BASE at the 5% level of significance	0.72	1.94	CPIF $\nrightarrow$ BASE	1.88	1.67	CPIF $\Rightarrow$ BASE
BASE and CPIF at the 5% level of significance	1.12	1.94	BASE $\nrightarrow$ CPIF	1.35	1.67	BASE $\nrightarrow$ CPIF
CPIF and BASE at the 1% level of significance	0.72	2.51	CPIF $\nrightarrow$ BASE	1.88	2.04	CPIF $\nrightarrow$ BASE
BASE and CPIF at the 1% level of significance	1.12	2.51	BASE $\nrightarrow$ CPIF	1.35	2.04	BASE $\nrightarrow$ CPIF
CPIF and M_1 at the 5% level of significance	1.48	1.94	CPIF $\nrightarrow$ M_1	1.60	1.67	CPIF $\nrightarrow$ M_1
M_1 and CPIF at the 5% level of significance	0.50	1.94	M_1 $\nrightarrow$ CPIF	0.76	1.67	M_1 $\nrightarrow$ CPIF
CPIF and M_1 at the 1% level of significance	1.48	2.51	CPIF $\nrightarrow$ M_1	1.60	2.04	CPIF $\nrightarrow$ M_1
M_1 and CPIF at the 1% level of significance	0.50	2.51	M_1 $\nrightarrow$ CPIF	0.76	2.04	M_1 $\nrightarrow$ CPIF
CPIF and M_2 at the 5% level of significance	1.51	1.94	CPIF $\nrightarrow$ M_2	1.40	1.67	CPIF $\nrightarrow$ M_2
M_2 and CPIF at the 5% level of significance	0.59	1.94	M_2 $\nrightarrow$ CPIF	0.77	1.67	M_2 $\nrightarrow$ CPIF
CPIF and M_2 at the 1% level of significance	1.51	2.51	CPIF $\nrightarrow$ M_2	1.40	2.04	CPIF $\nrightarrow$ M_2
M_2 and CPIF at the 1% level of significance	0.59	2.51	M_2 $\nrightarrow$ CPIF	0.77	2.04	M_2 $\nrightarrow$ CPIF
FPI and BASE at the 5% level of significance	0.14	1.94	FPI $\nrightarrow$ BASE	2.72	1.67	FPI $\Rightarrow$ BASE
BASE and FPI at the 5% level of significance	1.03	1.94	BASE $\nrightarrow$ FPI	0.74	1.67	BASE $\nrightarrow$ FPI
FPI and BASE at the 1% level of significance	0.14	2.51	FPI $\nrightarrow$ BASE	2.72	2.04	FPI $\Rightarrow$ BASE
BASE and FPI at the 1% level of significance	1.03	2.51	BASE $\nrightarrow$ FPI	0.74	2.04	BASE $\nrightarrow$ FPI
FPI and M_1 at the 5% level of significance	1.42	1.94	FPI $\nrightarrow$ M_1	1.80	1.67	FPI $\Rightarrow$ M_1
M_1 and FPI at the 5% level of significance	0.43	1.94	M_1 $\nrightarrow$ FPI	0.80	1.67	M_1 $\nrightarrow$ FPI
FPI and M_1 at the 1% level of significance	1.42	2.51	FPI $\nrightarrow$ M_1	1.80	2.04	FPI $\nrightarrow$ M_1
M_1 and FPI at the 1% level of significance	0.43	2.51	M_1 $\nrightarrow$ FPI	0.80	2.04	M_1 $\nrightarrow$ FPI
FPI and M_2 at the 5% level of significance	1.61	1.94	FPI $\nrightarrow$ M_2	1.79	1.67	FPI $\Rightarrow$ M_2
M_2 and FPI at the 5% level of significance	0.69	1.94	M_2 $\nrightarrow$ FPI	0.73	1.67	M_2 $\nrightarrow$ FPI
FPI and M_2 at the 1% level of significance	1.42	2.51	FPI $\nrightarrow$ M_2	1.79	2.04	FPI $\nrightarrow$ M_2
M_2 and FPI at the 1% level of significance	0.43	2.51	M_2 $\nrightarrow$ FPI	0.73	2.04	M_2 $\nrightarrow$ FPI

F^a is the F statistic for testing the null hypothesis that past values of the causal variable do not significantly affect current values of the tested variable.

F^b is the critical F statistic for the null hypothesis test.

structural change cannot be rejected at the 5% level of significance.⁹ This result indicates that the parameters have remained stable over the entire test period.

Concluding Remarks

The purpose of this study has been to highlight some theoretical and empirical issues involved in causality testing of the U.S. money supply and nominal agricultural prices. In particular, attention is focused on the recent study of BBT. Using the minimum FPE causality testing technique the present study finds the existence of a unidirectional causal flow from BASE to the food component of the consumer price index in both test periods. No such flow is established from M_2 to CPIF. When the farm level agricultural prices are investigated, no causal flow is found to exist from any of the three measures of the money supply and FPI.

An important contribution of this study lies in the results reported for the January 1970 to December 1978 test period. The earlier study of BBT analyzing this period and making use of an arbitrary lag selection method found evidence of a causal flow from M_2 to FCPI. The present study using the same data and specification, but relying on the minimum FPE causality testing technique, reports striking differences from BBT's study. Not only is the unidirectional causal flow established from BASE to FCPI, but furthermore, there exists no evidence of such a flow from M_2 to FCPI. These results are in contrast to the evidence reported by BBT. However, they are supported by theoretical considerations involving the issues of the exogeneity of the monetary base.

Further evidence of the effect of an arbitrary lag selection on causality implications is reported in Table 4. Using an arbitrary lag selection of eight and 16 lags in the overall test period, the causality implications are markedly different from those obtained under the minimum FPE causality testing method. In this case, as in BBT's sample period, the only difference in the method of investigation is the lag selection technique used in causality tests.

On the whole, the test results show that the outcomes of causality tests between agricultural prices and the money supply are unquestionably sensitive to the lag selection. This conclusion is consistent with results reported by other studies for the U.S. money and income data (Biswas and Saunders; Hsiao 1981; Thornton and Batten). Since the causality implications are directly affected by the choice of the lag length, the validity of the arbitrary lag selection causality tests is questionable.

The minimum FPE technique offers an alternative lag selection method to the arbitrary selection of lag lengths. The extent of the arbitrariness is reduced since a statistical selection criterion is adopted. The only arbitrariness remains in the selection of this criterion. When compared with other estimation procedures, this method performs well in selecting an appropriate model (Thornton and Batten). A further considerable advantage of this technique lies in the fact that it yields consistent results when used by different researchers for the same type of data. Consequently, a strong case can be made for using this method when examining the money - price relationship in the subsectors of the U.S. economy, such as in the agricultural sector.

Footnotes

1. Asymptotic efficiency refers to the dispersion of the asymptotic distribution of an estimator.
2. For a more detailed explanation of these issues, see Hsiao (1979, pp. 553-54).
3. The definition of causality used under the minimum FPE procedure is the same as the one given by Granger. In the Granger sense, given two variables X and Y , X causes Y if and only if Y is better predicted by using the past values of X than by not doing so. Under the minimum FPE procedure, "better predicted" implies a smaller FPE. Consequently, causality implications are based upon a comparison of the minimum FPEs of several statistical steps (Hsiao, 1979, and 1981).
4. One drawback of the FPE procedure lies in the fact that this method may result in either overfitting or underfitting of test variables, i.e., in selecting too high or too low a lag order of test variables. However, the probability of selecting too low an order diminishes rapidly with increased sample size. For a further analysis of the asymptotic distributions and statistical risks associated with the original Akaike's (1969a,b) FPE procedure, see Shibata.
5. Additionally, there exists a possibility of an instantaneous causality. Testing for instantaneous causality requires an inclusion of the current value of an explanatory variable as well as its past values in test equations. This case is not considered in this study.
6. For a more detailed discussion of causality implications, see Hsiao (1981).
7. The monetary data are reported in various issues of H - 6 publication published by the Federal Reserve System, Board of Governors. The price data are compiled by the U.S. Department of Labor, Bureau of Labor Statistics, Wholesale Prices and Price Indexes, and by the U.S. Department of Agriculture, Prices Received and Paid by Farmers.
8. The main differences between CPIF and FCPI consist of the exclusion of certain items from CPIF and assigning different weights to others. For example, the prices of imported foods, fishery and sea foods as well as those of prepared meals are excluded from CPIF. Similarly, weights for items such as sugar, seasonings, condiments, and some selected beef cuts are altered to represent the portion of these items which are produced domestically. The main purpose of these adjustments is to exclude the effects of imported food prices on domestic agricultural prices.
9. Equation (6) was subjected to the same test of structural change. In this case, too, the null hypothesis of no structural change could not be rejected.

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