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Introduction

Governments continue to play a major role in agricultural markets throughout the world. As argued at some length in Rausser and Farrell (1984), the only market-failure justifications for governmental intervention are excessive uncertainty or unanticipated instability and an incomplete set of risk markets. In the United States prior to 1972, the common explanations for instability were the inelastic nature of aggregate food demand; the low income elasticity of demand; and, on the supply side, weather patterns, rapid technological change, atomistic behavior (and in some treatments naive price expectations), and asset fixity. These characteristics were viewed as existing in a closed, insulated representation of the U. S. agricultural sector. Without governmental intervention, the inherent and unanticipated instability resulting from these characteristics was regarded by many to be unacceptable to all actors in the food and agriculture system: input suppliers, producers, assemblers, processors, distributors, and consumers.

Keynes (1938), Houthakker (1967), and others have argued that, because inherent instability in storable commodity markets would lead to insufficient private stockholding, some government intervention is warranted. Since 1972, however, conventional wisdom has placed increasingly less emphasis on the inherent instability in commodity markets and more emphasis on instability due to external linkages with other markets. During this period, deregulation of the credit and banking system resulted in a greater exposure of agriculture to conditions in domestic money markets. Also, because international capital markets have become increasingly integrated, agricultural commodity markets are more sensitive to international monetary events, capital movements among countries, etc.

Government behavior has also played an important role in commodity market instability. After the Soviet grain deal, the absence of government-held stocks contributed to large price increases. With the Food and Agriculture Act of 1977, changes in commodity programs were introduced which permitted a wider fluctuation in prices. The export embargo in 1980, variations in the rules of the Farmer-Owned Reserve program since 1980, and the payment-in-kind (PIK) program of 1983 suggest that policy uncertainty can be a major contributor to private commodity market instability.

Another source of instability is increased dependence on export markets. In the late 1970s, U. S. agricultural exports accounted for almost 40 percent of total output. This greater dependence on foreign trade has left U. S. agriculture more vulnerable to shocks from foreign markets. In addition, the Soviet Union has emerged as a major importer making the effects of its unstable agriculture felt in the United States.

The linkage of commodity markets with U. S. money markets occurs through both demand and supply effects. Because farming in the United States is extremely capital intensive and debt-to-asset ratios have risen dramatically during the last 10 years, movements in real interest rates have significant

effects on the cost structure facing agricultural production. In addition, grain stocks held and the level of livestock breeding inventories are interest rate sensitive. Finally, the influence of interest rates on the value of the dollar can lead to reduced foreign demand for U. S. grain. Thus, rising interest rates at once increase the cost of grain production and depress demand. Therefore, monetary and fiscal policy changes, through changes in real interest rates, also affect the stability of agricultural markets.

Along with these interest rate effects, there appear to be differential effects of monetary policy between agricultural and nonagricultural markets. If agricultural commodity markets behave as "flex price" while other markets behave as "fixed price," "macroexternalities" will be imposed on the agricultural sector. Different speeds of adjustment in the two types of prices following changes in monetary policy mean that overshooting in agricultural prices will occur even if expectations are formed rationally. This overshooting is analogous to the exchange rate overshooting first studied by Dornbusch (1976) and amounts to either a tax or a subsidy for agriculture through relative price changes. Thus, overshooting can introduce further instabilities into a sector that is already inherently unstable.

Recent U. S. Monetary Effects

The combination of U. S. fiscal and monetary policies has driven real interest rates to all-time highs. The management of money supply in the United States and the relatively high interest rates in this country have reversed the decline of the U. S. dollar that occurred throughout the 1970s. Possibly because of the dominant role of the Federal Reserve in world money markets and the rapid appreciation in the value of the dollar, other central banks also maintained a tight rein on their money supply in an attempt to manage the value of their currency. This has led to a decline in foreign demand for U. S. agricultural exports.

The deflation in agricultural commodity markets over the 1980s, along with the increasing attractiveness of financial assets, has resulted in some rather dramatic decreases in agricultural asset values, particularly land prices. Due to the role of land resources as collateral for agricultural loans and credit lines, the debt-absorption capacity of U. S. agriculture has fallen markedly. This is evidenced by the increased frequency of bankruptcies in the agricultural production sector and by what has come to be called the agricultural financial crisis of 1984.

In the decade of the 1970s, conditions in the U. S. general economy and the international economy were almost the exact opposite of the conditions that exist in much of the 1980s. In 1972-73, the magnitude of increases in farm product and food prices surprised even the most informed people within the public and private sectors. The move to flexible exchange rates, the rapid expansion of international markets, the emergence of a well-integrated international capital market, and the decreasing barriers between the agricultural economy and other domestic economic sectors all resulted in significant changes in the agricultural sector. During this period, the Federal Reserve expanded the U. S. money supply with the effective objective of

holding the real price of energy at basically the same level; other countries attempted to "inflate their way out" of the energy price shocks by increasing their money supplies. They also attempted to manage their exchange rates with the U. S. dollar by selling their currencies and buying dollars and, thus, indirectly increasing their money supplies even more.

The increases in relative commodity prices which resulted along with the rapid rate of inflation experienced in 1972-1974 and again in 1978-1980 resulted in a dramatic increase in the valuation of the major resource input in agricultural production, namely, land. U. S. agricultural land prices increased at a more rapid rate than the rate of inflation during much of the 1970s. Once again, due to the role of this resource input in agricultural credit markets, viz., its use as collateral for agricultural loans and credit lines, the total absorption capacity of U. S. agriculture for debt appeared to be augmented by leaps and bounds during the decade of the 1970s.

Thus, since the early 1970s, the U. S. agricultural sector has been subjected to a vicious roller coaster ride, the valleys and peaks of which have been defined in part by the external linkages to the U. S. macroeconomy and the international economy. These external linkages have made it crystal clear that timing, in terms of entry and exit from U. S. agricultural production, is indeed critical. More important, they show that, in large part, the inherent instability in the agricultural sector has been augmented by instability caused by factors outside that sector.

Dynamic Market Analysis

The experience in the United States, as well as numerous other countries, makes it clear that the conventional microeconomic analysis of commodity markets is inadequate. The dynamic path of agricultural commodity markets cannot be explained on the basis of private market demand and supply functions alone. In fact, the appropriate characterizations of such dynamics can only be obtained by specifying (1) the real supply and demand forces for a particular market; (2) the influence of governmental intervention; and (3) the linkages between domestic agricultural markets, exchange rates, and domestic as well as international money markets. Most observers would agree with the need for (1) and (2), but few have explicitly recognized the importance of (3).

Any attempt to characterize the dynamic instability of agricultural markets should address at least three major sources of instability: inherent instability emanating from natural supply and demand forces, uncertainties and risk emanating from political or governmental failure (Rausser and Foster, 1984), and overshooting of storable commodity prices resulting from linkages with financial markets. The first two sources of instability are reasonably well known and need not be addressed here. The new source of instability, namely, overshooting is not widely known by agricultural economists and is generally neglected in agricultural price analysis.

As shown in the Appendix, overshooting of flexible prices, such as exchange rates or storable commodity prices, arises because some markets in the general economy are fixed-price markets. This results in short-run nonneutrality of money because relative prices are affected (Stamoulis, Chalfant, and Rausser,

1985). Over time, as fixed prices adjust, relative prices are assumed to return to long-run equilibrium levels; but the interim effects can be thought of as macroexternalities.

As shown in the Appendix, as the share of flex-price markets rises, the extent of overshooting falls. This suggests, of course, that, ceteris paribus, the larger the number of flex-price markets, the less instability in storable commodity markets resulting from overshooting. In the case of the U. S. agricultural sector, the introduction of flexible exchange rates in 1973 and, more recently, the introduction of flexible interest rates in late 1979 imply less overshooting for a given shock. Of course, the amount of observed instability may be greater even though more markets become flex price if the shocks in money markets are larger.

In the case of storable commodity markets, the overshooting phenomenon requires that the economy be a mixture of fixed and flex-price markets. Without this specification, money will not assume nonneutral effects over the short run. In the following section, we present a formal test for the fixed price, flex-price specification of the U. S. economy.

Fixed/Flex Price Specification

We conducted a simple test for the presence of overshooting by examining the sensitivity of prices to anticipated money growth. We estimated money growth using a fairly ad hoc mechanism which we treat as the reaction function of monetary authorities. As in the series of studies by Barro (1977, 1978) and the recent paper by Enders and Falk (1984), predicted values from this regression (MFIT) are treated as anticipated money growth. Fitted residuals are thought of as unanticipated money growth.

The anticipated money growth rate was used to explain the price level response in the fixed- and flex-price sectors of the economy. The rate of change of the nonfood Consumer Price Index (CPINF) is taken as the growth rate of prices in the fixed-price markets, while a calculated growth rate of the U. S. Department of Agriculture, Index of Prices Received by Farmers (FOODINF) was used to measure growth in flex prices. An equation is also estimated for the percentage change in the Consumer Price Index for food and beverages (CPIF).

To explain variation in these rates of change, we used as independent variables our anticipated money growth variable, distributed lags of the gap between potential and actual income (INCGAP), oil price inflation (OILINFL), the differential of wage and productivity growth rates (WPRODIF), and a lagged dependent variable. The following equations were estimated using instrumental variables (standard errors are given in parentheses, and we report only the sums of lag coefficients):

$$\begin{aligned} \text{FOODINF} = {} & \underset{(2.608)}{1.891} + \underset{(0.128)}{0.0319}\ \text{FOODINF} - \underset{(0.380)}{0.188}\ \text{WPRODIF} + \underset{(0.0238)}{0.00003}\ \text{OILINFL} \\ & + \underset{(0.0113)}{0.0286}\ \text{INCGAP} + \underset{(1.319)}{1.641}\ \text{MFIT} \end{aligned}$$

$$\begin{aligned} CPINF = {} & 0.0117 + 0.366\ CPINF + 0.070\ WPRODIF + 0.0115\ OILINFL \\ & (0.321)\quad (0.144)\qquad (0.044)\qquad (0.0039) \\ & + 0.003\ INCGAP + 0.329\ MFIT \\ & (0.0014)\qquad (0.169) \end{aligned}$$

$$\begin{aligned} CPIF = {} & .9826 + .3778 * CPIF_{t-1} + .0018 * WPRODIF \\ & (.588)\quad (.127)\qquad (.074) \\ & + .0052 * OILINFL + .0067 * INCGAP + .2144 * MFIT \\ & (.00597)\qquad (.0028)\qquad (.250) \end{aligned}$$

$\bar{R}^2 = .242$
$DW = 1.91.$

Comparing the coefficients across the equations for FOODINF and CPINF, we see that the lagged dependent variable has a large and significant coefficient in the nonfood inflation equation compared to the food equation. In addition, anticipated money growth causes a much greater response in food inflation than for nonagricultural goods. In fact, the estimated coefficient exceeds one--corresponding to overshooting of food prices following money growth. By contrast, the coefficient in the CPINF equation is significantly less than one, indicating sluggish response to anticipated money growth. Presumably, this is because some of the factors causing stickiness of nonfood prices, say, contracts, were already in place in the preceding quarter. These results support the assumption that prices in the nonfood sectors adjust more sluggishly than food prices to changes in money growth. Coupled with the theoretical model presented in the Appendix, this provides a basis for assuming that there are spillover effects from monetary policy changes in U. S. agriculture.

The results from the CPIF equation strongly indicate that the use of a Consumer Price Index for food is an inappropriate way to represent commodity prices, especially in the context of an asset-market equilibrium. The significance and magnitude of the coefficients of the lagged dependent variable and the income gap suggest an adjustment pattern that strongly resembles the industrial (nonfood) price index adjustment. This is not surprising once we recognize that, from the farm gate to the food store, a lot of "industrial contamination" occurs that increases the degree of "stickiness" of the farm prices.

The test presented above for the fixed/flex-price specification of the U. S. economy will be investigated for a number of other countries as well as worldwide agricultural markets. We are in the process of collecting the data for the three equations presented here for major exporting countries of food and feed grains. We also propose to make the same sorts of tests for worldwide food and nonfood prices. Ultimately, the latter empirical investigation will admit currency substitution; reaction functions on the part of central banks; and, indirectly, the influence of international monetary linkages on storable commodity market prices.

Concluding Remarks

To the extent that money is nonneutral in the short run, analysis of agricultural market dynamics must take into account not only real demand and supply forces and the effects of sectoral governmental intervention but also the macroeconomic policies of the federal government. The fixed/flex price dichotomy of the U. S. economy implies that money is, in fact, nonneutral. Because some goods and services do not respond to changes in demand in the short run, namely, the "customer" goods defined by Okun (1975) or the fixed-price goods defined by Hicks (1974), analysis of commodity markets requires an explicit treatment of monetary factors and the linkages with the macroeconomy. The prices of most other goods are sticky while the prices of agricultural commodities, in the absence of governmental intervention, are free to respond to fluctuations in demand and supply.

Since the general price level is not free to respond fully in the short run, changes in nominal money supply are also changes in the real money supply and, therefore, induce changes in the interest rate which, in turn, induce changes in relative prices. As a result, changes in the money supply will lead to overshooting in flex-price markets. Through much of the 1970s and 1980s, exchange rates have been flexible; hence, changes in the money supply will lead to changes in the value of the dollar that are more than proportionate to the change in money supply. Only when the dollar is "overvalued" ("undervalued") will investors rationally expect a future rate of depreciation (appreciation) that is sufficient to offset the interest rate differential so that the interest rate parity condition holds and investors are willing to hold foreign currency. In the short run, the exchange rate overshoots its long-run equilibrium. This quite obviously happened from 1980 to 1982 when the Federal Reserve adopted a stringent monetary policy. Unlike the 1970s, the resulting higher nominal interest rates did not reflect higher expected inflation but, rather, represented higher real interest rates. As a consequence, the dollar appreciated sharply.

The overshooting is a direct implication of the fixed/flex price framework. This framework was formally tested, and the empirical results corroborate the differential response of nonfood market prices and food market prices to changes in anticipated money growth. Factors affecting commodity price overshooting are shown in the Appendix to be the number of fixed-price markets, the speed of adjustment of those prices, and the interest rate elasticity of money demand.

Nonmonetization of large federal government deficits can be interpreted as a restrictive monetary policy. Such a restrictive monetary policy leads to increases in the real rate of interest and the exchange value of the dollar and to decreases in the long-run equilibrium feed grain and wheat commodity price path. Because of slower adjustment in other segments of the macroeconomy, commodity prices in the short run also overshoot the new long-run equilibrium commodity price. With an expansionary monetary policy, all of these factors run in the opposite direction.

Results reported in Rausser (1985) demonstrate that macroeconomic policies can easily dominate the short-run effects of agricultural policies on the price and income paths for U. S. agriculture. The implicit taxes resulting

from overshooting that are imposed on U. S. agriculture are modified by the current form and shape of U. S. agricultural policy. In particular, price supports imply downward inflexibility of some commodity prices which, in turn, cause the incidence of the macroeconomic policy tax on agriculture to show up as an unexpected increase in the cost of maintaining price supports and the various forms of government stockholding. Overshooting of agricultural commodity prices in the downward direction places some of the implicit tax on the private sector and some on the public sector. Due to the form and shape of current U. S. agricultural policies, the overshooting effects of expansionary monetary policies are asymmetric. Much, if not all, of the subsidy accrues to the private sector.

In the long run, because money is neutral, agricultural sector policies have a more significant influence on resource allocation to the U. S. agricultural sector than do macroeconomic policies. The sector policies that provide incentives for overallocation of resources to agricultural production quite obviously make the sector especially vulnerable to macroeconomic policies that impose implicit taxes via overshooting. Such sector policies, when combined with macroeconomic policies that "subsidize" U. S. agriculture, must, by definition, lead to a financial crisis for both private and public sectors if and when macroeconomic policies begin to impose "taxes" via overshooting on agriculture. The dynamic path composed of a subsidy period followed by a tax period during which sector policies provide incentives for overallocation of resources to agricultural production can be expected to create crises.

Appendix

Overshooting in Commodity and Exchange Rate Markets

Assume that uncovered interest parity holds which requires that

$$i - i^* = x,$$

where i and i* are domestic and foreign nominal interest rates, respectively, and x is the expected depreciation of the domestic currency. This expectation, in turn, is assumed to be a function of the extent to which the exchange rate (domestic currency per foreign currency units) deviates from its long-run equilibrium level,

$$x = \theta(\bar{e} - e),$$

where θ is directly related to the flexibility of nonagricultural prices. It ranges from zero (fixed prices) to one (perfectly flexible prices).

An equilibrium condition in the money market is expressed in natural logarithms:

$$m - q = \phi\, y - \lambda\, i,$$

where m denotes the nominal money supply, q the price level, y income, and i the interest rate. All are measured in logarithms except the interest rate. Purchasing power parity is assumed to hold for the agricultural commodity,

$$e = P_a - P_a^*.$$

If each price P_a is expressed in logarithms, the assumption that the foreign price is one allows this expression to be rewritten as

$$e = P_a.$$

Note that this is simply a choice about the units in which to express the price of the agricultural commodity.

The domestic price level is Q, and its natural logarithm q appears in the money market equilibrium condition. Initially, let Q be a Cobb-Douglas price index so that

$$q = \alpha P_n + (1 - \alpha) P_a$$

or

$$q = \alpha P_n + (1 - \alpha) e,$$

where P_n is the natural logarithm of the fixed-price good. The money market equilibrium condition can therefore be expressed as

$$m - \alpha P_n - (1 - \alpha) e = \phi y - \lambda i.$$

Combining the uncovered interest parity assumption and the expected depreciation of the currency, the money market equilibrium condition becomes

$$m - \alpha P_n - (1 - \alpha) e = \phi y - \lambda[\theta(\bar{e} - e) + i^*].$$

This expression summarizes equilibrium in financial asset markets.

A long-run version of the expression for asset market equilibrium, one in which money supply is taken to be at its long-run equilibrium level, is

$$\bar{m} - \alpha \bar{P}_n - (1 - \alpha) \bar{e} = \phi y - \lambda i^*.$$

Note that the expected depreciation of the currency is now zero.

Combining the last two expressions and expressing the nominal interest rate differential $(i - i^*)$ as expected depreciation or appreciation of the home currency,

$$m - \alpha P_n - (1 - \alpha) e = -\lambda \theta(\bar{e} - e) + \bar{m} - \alpha \bar{P}_n - (1 - \alpha) \bar{e},$$

where $y = \bar{y}$ is assumed for convenience. By taking $m = \bar{m}$ as well, we find that

$$e - \bar{e} = -\alpha[(1 - \alpha) + \lambda \theta]^{-1} (P_n - \bar{P}_n).$$

The equilibrium exchange rate deviates from its long-run equilibrium rate $(\bar{e})$ by an amount proportional to the deviation of the price in the fixed-price sector from its long-run equilibrium level. The proportion is increasing in α and decreasing in λ and θ.

The persistence of expected appreciation or depreciation does not mean that unexploited profits exist. The expected capital gain or loss on bonds denominated in the home currency will be consistent with both the uncovered interest parity assumption and the rate of return available through storing commodities. For instance, when the domestic interest rate falls below the foreign rate following an increase in money growth, the currency depreciates instantly as the prices of foreign assets are bid up. The more the interest rate falls, the greater this immediate overshooting response of the exchange rate must be. Depreciation continues until the expected revaluation plus the (lower) nominal interest rate just equals i*, the rest-of-world interest rate. Then expected depreciation falls over time as the fixed-price P_n moves toward its long-run equilibrium and i returns to i*.

In addition, there is no advantage to holding commmodities instead of currencies. Frankel (1984) and Frankel and Hardouvelis (1983) develop this latter point in more detail, but a brief summary is in order. To compensate the holders of grain inventories for foregoing present consumption, the grain price must rise at the interest rate in between harvests once convenience yields, storage costs, and a risk premium are taken into account. If an unanticipated growth in the money supply occurs so that the liquidity effect causes a fall in the interest rate, a better return is available for storing grain than dollars and investors compete to hold grain inventories. This causes an immediate jump in the price of grain so that an asset market equilibrium of equal rates of return is restored. All commodity prices are, therefore, expected to rise at the now lower interest rate.

Recall that we took P_a to be equal to the exchange rate by normalizing the rest-of-world price of agricultural output. This means that there is an equivalent amount of overshooting in the agricultural goods markets. Also, note that the proportion by which e deviates from e is increasing in α or decreasing in $(1 - \alpha)$, so this illustrates the importance of the number of fixed-price markets. As the share of fixed-price markets rises, the extent of deviation of e from e is greater; and, as that share falls, it is less.

Both e and P_a overshoot their long-run equilibrium levels in the manner directly related to deviation of P_n from its long-run equilibrium level. The upshot is that there are relative price changes during the adjustment period. This is a source of macroexternalities. In the short run, relative price changes occur so that, after monetary growth, there is a period in which agriculture is subsidized; conversely, after a contraction, the change in relative prices acts as a tax on agriculture until the fixed-price has fully adjusted.

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