The US Exchange Rate and Agricultural Trade: Effects of Changes in the US Money Supply on the World Coarse Grains Market

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Abstract: This paper measures the impact of US monetary policy on prices and trade in the world coarse grains market. A long-run, nonlinear, nonspatial price equilibrium world model of the coarse grains market was constructed that endogenizes the US exchange rate while implicitly accounting for the pricing policy differences across nations. The results of the analysis show that the effects of an increase in the US money supply are minor in large part because of the inelastic world import demand, elastic US export supply, and inelastic export supplies of other regions. Furthermore, the US competitive position improves in the world market, while its prices change less than those of all other regions in the model.

Introduction

The growing body of research on the macroeconomic linkages to agriculture has considered both real and monetary forces as contributors to volatility in agricultural commodity markets. In particular, the role of the US exchange rate as a monetary factor affecting US agricultural markets has been emphasized. Schuh (1983), for example, has argued that the demise of the Bretton-Woods accord and the consequent shift to a more flexible exchange rate régime in the early 1970s created a more unstable environment for the trade-oriented sectors of the US economy. Becoming increasingly more dependent on exports for growth, US agriculture, therefore, would presumably bear an important share of the adjustment to changes in general economic conditions worldwide.

Schuh (1983) has repeatedly suggested that unstable US monetary policy in a flexible exchange rate environment has been a major source of the volatility of farm exports and prices since the mid-1970s. Leaving aside the more general hypothesis concerning the agricultural share of the adjustment to changes in monetary policy, this paper examines the more limited assertion that monetary policy imposes significant adjustments on exports and prices of US-produced agricultural commodities.

Following a brief discussion of the theoretical relationship among agricultural trade, money growth, and exchange rates, the model used to measure the impact of US monetary policy changes on trade and prices in the US and world coarse grains markets is presented. Coarse grains are the major US agricultural export and, consequently, an appropriate case to examine. The long-run, dynamic effects of a simulated, sustained increase in US money supply growth are discussed. Finally, some implications for policy analysis are drawn.

Agricultural Trade, Money Growth, and the Exchange Rate

Short-term nominal exchange rates are determined by the relative magnitudes of money supply, real income, real interest rates, and price expectations (Frankel, 1979). In the long run, one can show that exchange rates are a function of relative money supplies, real income, and expected inflation differentials (Denbaly, 1985).[2] A nominal exchange rate change as a result of a permanent change in the relative rate of growth of money supplies between an exporting country and an importing country is often viewed as rotating the import demand curves for the exportable commodities. If all goods were storable and traded in perfectly competitive and homogeneous (in their class) markets, then the goods market would behave more like an asset market (such as the exchange rate market) because, when goods are easily stored and resold, they take on the speculative quality of assets. In that case in the absence of policy distortions, a change in the money supply growth rate of the USA alone, for example, would lead to an equal percentage change in the prices of all US commodities and the exchange rate (defined as the foreign currency value of a dollar) contemporaneously because of the neutrality of money and the assumption that goods markets behave like asset markets. US prices and the exchange rate move in opposite directions in the short run but in same direction in the long run. Consequently, in the absence of transport costs, government pricing policies, and structural differences in real economic performance across countries, a relative change in the US money supply would not cause deviations from purchasing power parity (i.e., the equality of currency depreciation and the inflation differential) in the long run. As a result, while the import demand curve for a US-produced commodity rotates, the proportional change in all prices offsets the rotation and any substitution effects.

Most world agricultural markets, however, are characterized by substantial market intervention and other obstacles that tend to prevent frictionless adjustments to changes in the underlying economic structure of the markets. If exchange rates and agricultural markets were perfectly free to adjust, then a change in the US money supply alone, for example, would bring about equiproportional and, therefore, counterbalancing changes in price levels and the exchange rate. However, that is not the case, and government pricing policies and structural differences in real economic performance across countries invoke deviations from purchasing power parity, resulting in a rotation of the import demand curves for exportable agricultural commodities.

The empirical debate on the magnitude of the effects of exchange rate changes on US farm prices and exports naturally has focused, in part, on the question of appropriate values for price elasticities of import demand and export supply functions. A study by Chambers and Just (1982) utilized a two-region (the USA and the rest of the world), multiple-commodity (wheat, maize, and soyabeans) model. The aggregation level in their model, however, largely obscures commodity policy differences among countries and obscures the world demand and supply responses to changes in exchange rate values.

The Model

To measure adequately the world trade and price impacts of changes in the US money supply through their effects on the US exchange rate requires a world commodity market model that accounts for the behaviour of all world market participants (including their domestic and trade policies) and that includes a mechanism by which the US exchange rate is endogenously determined as a function of the US money supply (among other variables) over the period of the flexible exchange rate régime.

Because coarse grains represent the major agricultural commodities traded in world markets and exported by the USA, the world coarse grains market was used to measure the price and trade effects of changes in the US money supply. In addition, because coarse grains are used mainly by the developed nations as livestock feed to meet their increasing demand for meats, the number of significant world market participants in the model is limited. To account for the substitution effects among grains, prices of close substitutes were included. Also, because any substitution effects between manufacturing goods and coarse grains (on the demand and supply sides) are likely to be small, prices were deflated to approximate the effects.

The trade model constructed is a multicountry, nonspatial equilibrium type, consisting of internal and external sectors of all participants involved.[3] All regions are then linked through the world balance of total supply and demand, determined simultaneously along with the world prices. The model contains eight components: USA, Argentina, Canada, Australia, Thailand, Japan, USSR, and a rest-of-the-world region. The model includes four simulations blocks: the domestic markets of exporting countries (including excess supply identities), domestic markets of importing countries (including excess demand identities), international price linkages, and international trade flow identities. The first and second blocks explain the behaviour of production, demand, and stocks of individual coarse grains in all trading regions. The markets of all except the US component, however, are expressed in reduced form; i.e., all supply and demand relationships of those components are collapsed into respective net export supply or import demand relationships. The third and fourth blocks link world prices and trade following Williams and Thompson (1984).

The essential feature of the net export or import demand functions is that they reflect the behaviour of the respective exporting or importing countries in the world market as perceived by the other trading countries. Owing to quantitative restrictions on trade or the nature of the trade decision-making process, prices have little effect on the quantity imported or exported by many countries; i.e., for selected countries, export supply or import demand might be exogenously determined, with little regard for world market price. An analysis of the world coarse grains policies (Denbaly, 1984) indicates that only the seven major countries included in the model allow world price fluctuation to be reflected in their domestic markets to some extent. The European Community, for example, is the largest importing entity among developed nations, but effectively insulates its domestic market from world price fluctuations.

The present model includes one recursive block that endogenizes the value of the US dollar vis-à-vis importing countries' currencies as a function of the money supply differential, real income differential, and expected inflation differential. The equation is based on the monetary approach to

exchange rate determination. Given the foreign exchange problems of the USSR and the inconvertibility of the ruble, the USSR commonly exports gold in exchange for commodity imports. Consequently, changes in the dollar-gold exchange rate influences the trading behaviour of the USSR. Therefore, because gold is an investment commodity[4] that reacts to changes in the US dollar, the gold price of the dollar was endogenized as a function of the US exchange rate and the lagged gold price. A grafted polynomial technique was used to estimate the response of exchange rates to changes in money supply over the transitional period from fixed to flexible exchange rates in the 1970s.

A nonlinear, truncated, two-stage least squares procedure was used to estimate the coefficients of the system. The model contains 76 exogenous variables and 41 equations. The estimated behavioural equations had acceptable statistical properties. The estimated directional relationships among variables coincided with *a priori* expectations. The model was validated through historical simulation. The model tracked the turning points well. The Theil statistics were satisfactory. The stability of the model was checked by measuring its response to a one-period exogenous change in the US money supply in 1971. The results were expected; the model converged to equilibrium after the shock, thereby indicating the stability of the model.

Long-Run Dynamic US Money Supply Simulation

To simulate the effects of US monetary policy on the world coarse grains market, we assumed that the US monetary authority increases the money growth target resulting in a once-and-for-all increase in the money supply rather than a single-year increase, which results in a compounding effect; i.e., the consequent changes in the exchange rate, trade, prices, and the other endogenous variables in any period include the dynamic effects of the increase in the money supply of all previous periods. The simulated increase in the money supply assumes that the US monetary authority allows the money supply to grow by $5000 million each year, resulting in a decreasing rate of money growth—from 0.8 in 1971 to less than 0.1 in 1980.[5]

This simulated expansion in the US money supply exacerbated the excess dollar supply problem in international money markets during the 1970s. Consequently, the US dollar depreciated even further, increasing the demand for US coarse grains on the international market. The exchange rate depreciated continually, falling by almost 10 percent between 1971 and 1980. As the US dollar depreciated, US exports and prices rose. The US feed, nonfeed, and inventory demands responded in the opposite direction. During 1971-80, US coarse grains production increased but by less than the increase in the US coarse grains import demand, pushing up the US coarse grains price (on average) over the period.

The increase in US coarse grains exports was absorbed by increases in imports by Japan and the USSR. However, the USSR reacted more dramatically than Japan because of a higher estimated USSR price elasticity of import demand. Because relatively few barriers to trade in gold exist in the world gold market, the gold value of the dollar reacts more dramatically to an increase in the US money supply than most other variables in the model. Consequently, the USSR coarse grains price (denominated in gold) was affected more by the change in US money supply than Japan's price, for example.

The increase in the growth rate of the US money supply adversely affected the markets of countries exporting coarse grains in competition with the USA. Both their exports and prices decreased. However, the share of the adjustment accounted for by each country depended upon the relative sizes of their elasticities of price transmission and the price elasticities of their export supplies. In any event, the overall share of world coarse grains exports by these countries as well as their export revenues declined.

Table 1 (page 282) presents the long-run or dynamic multipliers from the US money supply increase, in percentage terms. In essence, these are long-run elasticities because they indicate the percentage change in price, exports, and imports from the given percentage change in money supply over the period.

The long-run elasticities in Table 1 indicate that an expansionary US monetary policy leads to inelastic responses of prices, imports, and exports in the world coarse grains market. Nevertheless, the US coarse grains price responds much less than the prices in other countries to the US money supply expansion, while world trade (exports and imports) responds by less than prices in non-US

Table 1—Dynamic Elasticities of the Sustained $5000 Million Increase in the US Money Supply

	Price Impact*	Trade Impact*	Base Market Share†	Simulation Market Share†
USA	0.0924	0.2055	71.57	72.89
Argentina			11.27	10.62
Maize	-0.7371	-0.3225		
Sorghum	-0.7448	-0.3189		
Canada	-0.4938	-0.3720	5.13	4.77
Australia	-0.5487	-0.2416	3.99	3.82
Thailand	-0.5194	-0.1015	3.18	3.02
Japan	-0.4743	0.1086	20.67	20.67
USSR	-0.9699	0.6088	8.89	9.06

[*Calculated at the same mean over the 1971-80 period. †Share as a percentage of the six largest exports.]

regions. This phenomenon can best be explained by an examination of the price elasticities of the export supplies and import demands of the world coarse grains market participants.

The world net excess coarse grains demand is fairly price inelastic (to see this divide the second column by the first column in Table 1 for Japan and the USSR). This is, of course, expected because the major coarse grains importing nations of the world are highly protective of their markets. Therefore, a shift in the US coarse grains supply curve, for example, induces a small change in the quantity of coarse grains traded in world markets and a relatively larger change in the prices of importing regions. The relatively small change in world grain trade together with a long-run US export supply elasticity of 2.2 (divide column two by column one), results in a relatively small price and export increase from a sustained increase in the US money supply. The price responses of the other exporting regions were comparatively larger than that of the USA because their export supplies are much less price elastic.

Chambers and Just (1982) and Schuh (1983) claim that the currently restrictive US monetary policy has particularly dramatic and adverse effects on US agricultural exports and prices. However, such a large effect on exports is most likely when the net import demand facing the USA is price elastic. In contrast, this study indicates that the import demand for coarse grains facing the USA is inelastic (rather than elastic) and that the US coarse grains export supply is quite elastic (rather than inelastic). As a consequence, monetary policy has a relatively small effect on both US prices and exports of coarse grains over the long run.

Conclusions

The major objective of this study was to evaluate the world market impacts of US monetary policy. Consequently, the effects of a $5000 million sustained increase in the US money supply was simulated dynamically. The associated increase in world demand for US coarse grains led to only a small increase in the domestic US price and exports from the USA. This occurred because of the high US export supply elasticity and the inelasticity of the net import demand facing the USA. World market prices decreased by relatively more than the US price increased. However, because of the simulated dollar depreciation, the US competitive position in the world market improved slightly.

These results are particularly interesting in the light of recent attempts to tighten the US money supply. Apparently, such a policy does not have dramatically adverse effects on US coarse grains exports. In addition, the response of the domestic US coarse grains market is also fairly minor. Therefore, contractionary monetary policy has only a small effect on the domestic US coarse grains market. Furthermore, because of a fairly inelastic world import demand facing the USA, even if the world price falls below the loan rates, US exports will not be severely affected.

Notes

[1]Economic Research Service (USDA) and Iowa State University, respectively.

[2]This follows from the equality of currency depreciation and the interest rate differential (interest rate parity) on the one hand and the equality of currency depreciation and the inflation differential (purchasing power parity) on the other. Alternatively, in the absence of fixed capital, one can argue that the long-run equality of the real interest rate and, therefore, the nominal interest rate and expected inflation differentials is ensured by international investment flows.

[3]Only two multiregional coarse grains trade models exist (Bjarnason, 1967; and Collins, 1977), both of which assume fixed exchange rates and deal with trade flows, making them unsuitable for the general purpose of this study.

[4]For example, if the US money supply were expected to grow faster, then portfolio assets would shift from dollars into gold, which would increase the gold price.

[5]This amounts to 0.3 percent annual compound growth rate during 1971-80.

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