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Exchange Rate Effects on Agricultural Trade

David Orden

With sustained appreciation of the U.S. dollar over the past 4 years, the exchange rate has again taken on importance for agriculture. This overview paper revisits the analysis of exchange rate impacts, reviewing the relevant conceptual arguments, summarizing the evidence economists and agricultural economists have marshaled from the 1970s and the 1980s and from several more recent papers, presenting some illustrative recent empirical analysis of exchange rate effects, and briefly examining the detrimental consequences that sustained appreciation of the dollar is having on U.S. farm policy.

Key Words: agricultural policy, agricultural trade, exchange rate

JEL Classifications: F31, Q17, Q18

When the United States abandoned the Bretton Woods agreement on relative fixity of exchange rates in 1973, a new era of international capital mobility was launched, and the rules of the game for macroeconomic interdependence among nations were altered. Twenty years earlier, Milton Friedman had argued in his classic article "The Case for Flexible Exchange Rates" that open markets for currencies were the least disruptive mechanism for managing adjustments to changes affecting international payments. That view seemed to have finally come into its time. Yet, looking back from a vantage point 30 years after the United States gave up its fixed exchange rate, the economic turmoil that followed the initial devaluation and subsequent floating of the dollar against other major currencies was unlikely to have been fully anticipated. The turmoil included, for the United States, substantial inflation through the 1970s, then movements in the real exchange rate—sequential appreciation followed by depreciation during the 1980s—in excess of 40% over periods of several years. Forty percent is a significant realignment in relative prices, and several years is long enough to force economic adjustments.

For agriculture, the "new macroeconomics" of the world economy has had substantial implications. Nominal agricultural prices skyrocketed, along with other primary commodity prices, early in the 1970s, with inflationary monetary policies and dollar flexibility being at least partly responsible. International capital flows expanded after two decades of slow growth. The U.S. trade deficit turned increasingly negative, but agricultural exports, particularly exports through commercial channels (not foreign aid), rose strongly through the 1970s. By the late 1970s, agricultural exports were up, but real agricultural prices were down. Things got much worse when the dollar began to appreciate beginning in 1980. Exports fell in value by nearly one third by 1985, and with high interest rates, land prices could

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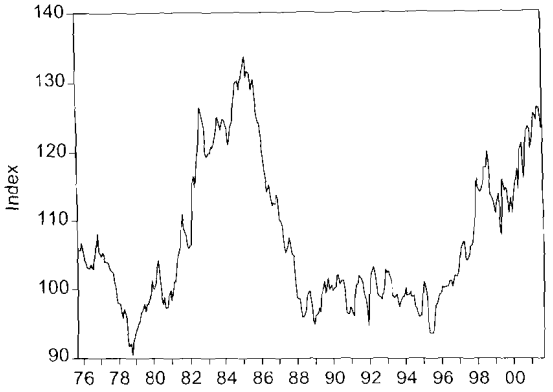

Figure 1. U.S. Agricultural Trade Weighted Real Exchange Rate (October 1975–September 2001)

not be sustained. In the ensuing farm financial crisis, supply control interventions and farm program fiscal costs were driven to record levels.

One view that emerged from this period of turbulence was that macroeconomic policy effects on agriculture, particularly effects delivered through the exchange rate, can swamp those of agricultural policy. Consistent with this view, stability was restored to the U.S. agricultural sector only when an effort to bring down the value of the dollar after 1985 essentially reestablished its pre-1980 real value (see Figure 1). Farm export began to increase again, farm income strengthened, and the portion of that income coming from government transfers declined. The attention of the farm business community and policy establishment turned to other concerns, among them the General Agreement on Tariffs and Trade negotiations and regional integration under the North American Free Trade Agreement. In domestic policy, the 1996 farm bill took steps toward reduced intervention in agricultural production and raised the possibility of, but did not guarantee, reduced future income transfers to the farm sector (Orden, Paarlberg, and Roe).

After 9 years of relative exchange rate stability from 1988 to 1996, we are now in the fourth year of a second period of sustained appreciation of the U.S. dollar. The dollar's rise in value since 1997 began with the Asian financial crisis and recession, followed by the devaluation and floating of the Brazilian currency. It continued with the weakening of the euro since its launch as a common currency, the depreciation of the dollars of Canada, Australia, and New Zealand, and, recently, the devaluation of the Argentine peso. The result of these various exchange rate movements has been a broad strengthening of the U.S. dollar relative to the currencies of our competitors and customers in agricultural markets. Short-term exchange rate fluctuations can be hedged against in currency futures markets, and economies should (and can) adjust to their equilibrium long-term exchange rate levels. However, intermediate-length periods of sustained, but not permanent, appreciation or depreciation cause difficulties for economies in which production and trade adjustments are not costless.

With the dollar's appreciation, the exchange rate has again taken on importance for U.S. agriculture. This overview paper revisits the analysis of exchange rate impacts. I take three thrusts: (1) reviewing the relevant conceptual arguments, (2) summarizing the evidence economists marshaled from the 1970s and the 1980s and from several more recent papers, and (3) presenting some recent illustrative empirical analysis of exchange rate effects. This leads me to briefly consider the detrimental impact that sustained appreciation of the dollar is having on U.S. farm policy.

Exchange Rates and Agricultural Trade

The classic modern article on exchange rate impacts on agriculture in the United States was written by G. Edward Schuh and published in the *American Journal of Agricultural Economics* in February 1974. Schuh made the fundamental argument that the exchange rate was an omitted variable in the economic analysis of the U.S. farm sector, and he drew sweeping implications. Throughout the 1950s, the "farm problem" had been described as one of technical change that induced a shift in production toward land-augmenting intermediate and capital inputs, lowered the real prices at which agricultural products could be procured, and put severe adjustment pressure on

the farm sector, particularly farm labor. Agricultural policy interventions of the time (high support prices and land retirements) were perceived to overvalue agricultural resources relative to free markets, leading to welfare costs and the paradox of a country with an advanced agriculture being dependent on export subsidization instead of being competitive in world markets. Schuh argued for a new interpretation of these developments: The U.S. dollar had become overvalued in the early 1950s, which had depressed agricultural prices and exports. This led to a socially inefficient *undervaluation* of agricultural resources. It induced even more technical change, thus aggravating what would have been in any case a serious problem of structural adjustment. It resulted in a larger share of the benefits of technical change going to consumers rather than producers. According to this interpretation, farm policies had served to offset negative exchange rate impacts on the farm production sector. When those farm policies started to shift in the 1960s toward letting prices fall and compensating farmers with direct cash payments instead of high price supports, prices fell toward the disequilibrium levels associated with exchange rate overvaluation. Devaluations in the 1970s restored the dollar to a more nearly equilibrium value, and as a consequence, agriculture experienced a macroeconomic-led boom. As Schuh put it: "If this interpretation is correct, an important share of the rise in agricultural prices in mid-1973 is a result of monetary phenomena which induced an export boom in an economy that was already responding to expansive monetary policies, and in the case of agriculture, increased the foreign demand for U.S. output at the same time that this demand was already rising from temporary bad weather conditions in other countries and a temporary decline in the Peruvian fishmeal industry" (p. 12).

Schuh's initial exposition of the effects of an exchange rate overvaluation on markets was based on a simple partial-equilibrium framework. For a small exporting country facing fixed world prices, an overvalued exchange rate lowers the world price in domestic currency proportionately. The resulting increases in domestic demand and reductions in domestic supply depend on own-price elasticities and export quantity and value fall. In the large-country case, foreign and domestic prices diverge again by the extent of the overvaluation, with elasticities of supply and demand of both trading partners affecting the extent to which the domestic price falls or the foreign price rises. In this framework, focusing on the long run, Schuh made rather modest claims for the sustained price effects from devaluation. In a reply to a comment on his article, he argued that if a devaluation of 13% constituted an equilibrium, the relative price of agricultural products might rise by around 10% "after adjustments have worked themselves out" (Schuh 1975, p. 699).

We now use a much richer microeconomic framework to assess exchange rates and market equilibrium. Drawing on trade theory, the real exchange rate is viewed as the relative prices of traded to nontraded goods. Real exchange rate movements accommodate changes in technology, income levels, or borrowing from abroad that require either higher or lower relative prices of nontraded goods (appreciation or depreciation, respectively) to clear those markets. This is different from affecting a country's terms of trade: real exchange rate movements affect flexible prices of imports and exports in a symmetric way, and a lot of individual prices are changing (and may need to be accounted for) when the real exchange rate is considered.

The linkage of real exchange rates to international capital flows (with these flows driving goods and services trade more than the other way around) is also well understood, as is the interdependence this creates between countries' macroeconomic polices. There remain disagreements about the effectiveness of monetary and fiscal policies and about how to manage domestic and international constraints, but fewer and fewer countries seem tempted to flaunt the evident linkages. Europe has gone so far as to harmonize monetary and fiscal policies enough to sustain the euro as a unified currency—a rather large step back to a Bretton Woods type of arrangement, and one that might have been unthinkable without the rel-

ative stability in exchange markets from 1988 to 1996.

Empirical Evidence on Exchange Rate Impacts

The earliest attempts to evaluate Schuh's argument empirically were conducted in a partial-equilibrium spatial modeling framework and focused on assessing the elasticities of price transmission and of supply and demand that affected trade of agricultural products. These assessments seemed able to attribute only a small part of the substantial relative price movements in the early 1970s to the exchange rate—results consistent with Schuh's long-run claim but not supportive of the exchange rate being as significant an omitted variable as Schuh described, at least when it came to the inflationary farm sector boom that was occurring. Partial equilibrium spatial modeling subsequently gave way to computable general-equilibrium models—models that offered a more complete linkage of real exchange rate movements to underlying causes, accounted for market equilibrium for multiple traded and nontraded goods, and provided somewhat more support for real exchange rate effects on agriculture.

On another level, the attempt to understand exchange rate impacts on agriculture became redirected, like macroeconomics itself, by the turbulence in the world economy. Exchange rates did not settle down to an equilibrium devaluation of around 13% during the 1970s, and macroeconomic polices seemed to be spinning out of control compared with the relative stability of the preceding period. This situation brought attention to Schuh's broader claim about the importance of monetary policy for agriculture. Did loose monetary policy cause flexible prices (like those for agricultural products) to overshoot their long-run equilibrium levels, rising relative to more slowly adjusting (sticky) prices in other sectors? Did this account for the price boom in agriculture that Schuh had identified with the exchange rate? Later, when inflation was being squeezed out of the U.S. economy and the dollar appreciated in the 1980s, did tight monetary policy cause real agricultural prices to fall?

The argument that monetary policy has nonneutral effects on agricultural prices is hardly a new one (such effects had been argued forcefully by George Warren during the 1920s). With newly floating exchange rates after 1973, this nonneutrality argument was given renewed impetus by the influential model of Rudiger Dornbusch. In the Dornbusch model, monetary expansions that lower domestic interest rates cause exchange rate overshooting so that subsequent appreciation maintains arbitrage conditions equating returns on domestic and foreign assets. Several research efforts, including that of Hughes and Penson and that of Rausser et al., provided a basis for assessing these effects on exchange rates and, by extension, on flexible agricultural prices in traditional macroeconomic econometric models. Rausser et al. used results from such a model to argue that deflationary monetary policy had "taxed" agriculture significantly in the early 1980s.

Yet a third approach to empirical modeling adopted the methods of time series analysis to seek causal relationships between monetary indicators and agriculture and dynamic impacts of monetary policy on agriculture. In the early 1980s, Christopher Sims, from the University of Minnesota, pioneered the use of small dynamic models without too many a priori restrictions as an alternative to overidentified structures imposed either by traditional Keynesians or by the new neoclassical rational-expectations school. Work on the empirical modeling of monetary effects on agriculture by Bessler, Chambers, and Orden (1986a,b), among others, adopted this approach.

It is appealing to think that monetary effects on agricultural prices and trade can be measured easily with small dynamic models if these effects are important, but such measurement has turned out to be a fairly difficult task. I could detect little effect from the money supply on real U.S. agricultural prices or export values in recursive vector autoregressive (VAR) models (Orden 1986a,b). Shocks to financial market variables, such as a short-term

interest rate or the exchange rate, had larger impacts. These shocks explained 20% of forecast error variance for exports and 10% for real agricultural prices 1 year ahead, and over 50% and 25%, respectively, for a three-year forecast horizon. An increase in the interest rate or the appreciation of the dollar had a depressing effect on agriculture. The dynamic responses to such shocks (which were highly correlated) looked plausible for a monetary contraction. Sims (1980, 1996) has remained skeptical of this interpretation, arguing that interest rate shocks more likely come from real events, but other macroeconomists have adopted the view that monetary policy shocks show up in small dynamic models through interest rates (Lane).

Bradshaw and Orden pursued the modeling of exchange rate effects on agriculture in a narrow sense. We compared the out-of-sample forecasting performance of univariate models of monthly U.S. corn, wheat, and soybean export sales with forecasts from bivariate models that included the exchange rate. The idea was to test Schuh's exchange rate hypothesis in a tightly specified model. If the exchange rate mattered, we hypothesized, it would help predict subsequent export sales. We found that our best bivariate forecasting models outperformed our best univariate models in statistically significant ways, but we would not have found that result if we had limited our search to models specified with a common lag structure, often a standard procedure in dynamic time-series modeling.

Orden and Fackler went in a different direction to develop further evidence on monetary impacts. We specified a nonrecursive structurally identified model of oil prices, supply and demand for aggregate output, money supply and demand, international effects (represented through the exchange rate), and agricultural prices. Short-run responses to the money supply shock looked plausible: money and output rose first, the dollar depreciated, and the price level increased slowly. We concluded that monetary shocks raised real agricultural prices for about 1 year, but our empirical estimates also led us to conclude that monetary policy shocks had not been the dominant source of agricultural price instability.

Within macroeconomics, the magnitude of monetary effects on real exchange rates and trade continue to be assessed. Eichenbaum and Evans found relatively little monetary effect on the exchange rate, while Prasad reported that nominal shocks explain a significant fraction of short-run real exchange rate variability and have short- and long-run effects on the real trade balance. Building on Lane's open-economy model with a sticky-price sector, Fisher and Huh specified VAR models for real output, the real exchange rate, and the real trade balance for each of the G-7 countries. They imposed restrictions identifying a structural model with a supply shock as the only source of long-run output effects, a demand shock with possible contemporaneous and short-run effects on output, and a monetary shock with lagged, but not permanent, output effects. Fisher and Huh found that positive monetary shocks cause depreciation and improvement in the real trade balance and that monetary shocks explain a substantial proportion of the forecast error variance for these real variables.

In terms of monetary impacts on agriculture, Dorfman and Lastrapes and, most recently, Saghaian, Reed, and Marchant have also brought developments in identifying time series models to bear on the measurement of relative price effects. Dorfman and Lastrapes imposed the theory-derived long-run restriction of monetary neutrality to identify policy shocks and used Bayesian techniques to investigate the sensitivity of their results to various aspects of model specification. Their identifying restriction insured that price level, sectoral prices, and money rose equiproportionately in the long run. They found plausible short-run monetary policy impacts on interest rates, output, and price level. Again, monetary shocks raised real agricultural prices in the short run but explained only a small fraction of crop and livestock relative price variability. Saghaian, Reed, and Marchant built on Lai, Hu, and Wang's closed-economy theoretical model of price over- and undershooting to develop a Dornbusch type of model that explic-

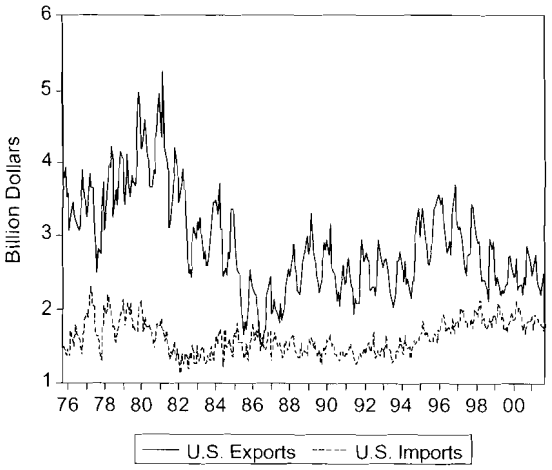

Figure 2. U.S. Real Agricultural Exports and Imports (monthly, October 1975–September 2001)

itly incorporated a flex-price as well as a sticky-price sector. Their theoretical results showed that overshooting in the flex-price sector dampens exchange rate overshooting. The results of their empirical analysis indicate that agricultural commodity prices and industrial prices overshoot their long-run equilibrium in relation to the money supply, with agricultural prices again rising relative to industrial prices in the short run.

Another Direct Look at Exchange Rate Impacts

I now return to the relatively narrow task of evaluating exchange rate effects on agricultural trade and prices directly, without specification of an underlying structural model of monetary shocks. Figure 2 traces monthly movements of the real values of U.S. agricultural exports and imports (in billions of dollars) from October 1975 through September 2001 using time series provided by the Economic Research Service of the U.S. Department of Agriculture. Co-movements of the exchange rate (Figure 1) and the real export value are apparent: turning points in the direction of the export value correspond to those of the exchange rate, and exports rise with depreciation and fall with appreciation. Price and quantity effects reinforce each other for export value (e.g., depreciation raises dollar prices and increases export quantities), whereas for import value these effects work against each other (e.g., depreciation raises dollar prices and lowers import quantities). Thus, it is not surprising that import value shows less co-movement with the exchange rate.

Basic econometric estimates confirm the visual impression from Figures 1 and 2. In a monthly VAR model of the exchange rate and the export value, the exchange rate shocks can be interpreted to convey macroeconomic effects, while agricultural export shocks reflect principally sectoral developments. The exchange rate appears essentially exogenous (shocks to the exchange rate show little contemporaneous correlation with shocks to agricultural export value, and these "own" shocks explain over 98% of exchange rate forecast error variance for a 24-month horizon). Exchange rate shocks also have explanatory power for agricultural export value: they explain nearly 10% of its forecast error variance for a 6-month horizon, nearly 20% for a 12-month horizon, and 35% for a 24-month horizon. The dynamic responses of export value to exchange rate and export shocks are shown in Figure 3. Sectoral shocks show somewhat of a cyclical pattern over 2 years, while an appreciation of the dollar lowers the export value. The exchange rate impacts appear to be significant after a lag of 4 months and then have an increasing cumulative effect through 24 months In a similar model of agricultural import value, the exchange rate again appears essentially exogenous, but exchange rate shocks explain less than 2% of forecast error variance of imports through 24 months ahead. Thus, they have essentially no explanatory power in the model for this side of aggregate U.S. agricultural trade.

Turning to exchange rate effects on agricultural prices, Xu and Orden provide some microeconomic evidence that is supportive of the dichotomy between flexible commodity prices and sticky industrial prices. Extending an analysis by Carter, Gray, and Furtan, Xu and Orden examined the pass-through of quarterly Canadian/U.S. currency movements to prices of traded agricultural outputs and non–

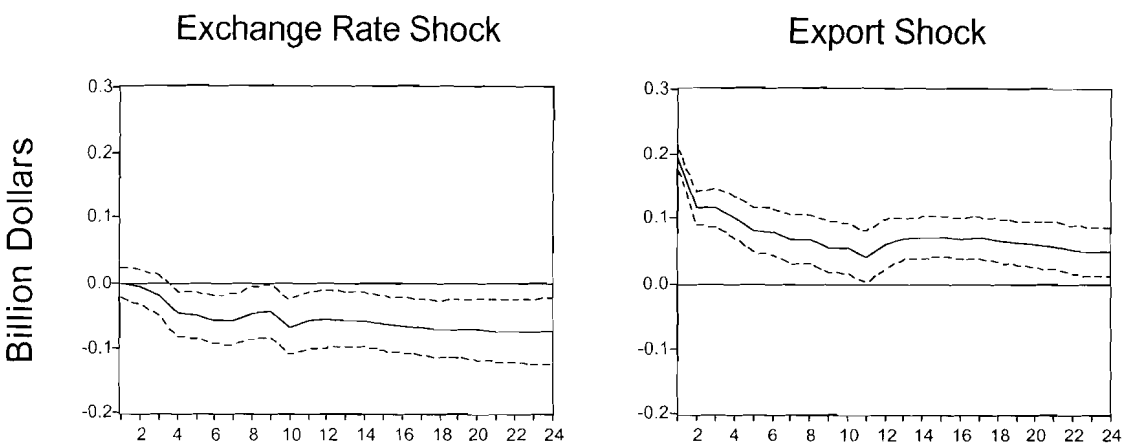

Figure 3. Responses of Agricultural Exports to Exchange Rate and Export Shocks (responses to 1 SD shock ± 2 SE)

farm-produced inputs over the period 1975–1999. Our empirical results confirm that short-run adjustments to the law of one price (LOP) tend to occur quickly for five agricultural outputs (wheat, corn, soybeans, feeder steers, and slaughter steers) and, to a somewhat lesser extent and with longer lags, for three intermediate inputs (fertilizer, petroleum, and pesticides). The LOP is refuted for the capital input farm machinery even after 2 years of adjustment. Cointegration of farm output and input prices with the exchange rate was investigated to determine whether there is convergence of these nonstationary series to the LOP as a stationary long-run equilibrium. The results of the investigation suggest long-run stationarity of the LOP for the five farm outputs but not for the inputs.

Evidence that the LOP holds more strongly for farm outputs than for inputs is consistent with a fixed-price/flex-price conceptual framework with farm commodity prices being more responsive to the exchange rate than industrial prices. For Canada and the United States, the output price increases associated with a devaluation are not completely offset by increases in input prices. Thus, farmers in Canada and the United States are affected by different production incentives when currency revaluations occur.

Consider the effects of the Canadian/U.S. exchange rate on output versus input prices for the 10-year period 1990–1991 to 1999–2000. During this period, the Canadian dollar depreciated by 27.6%, but farm machinery prices in Canada rose relative to those in the United States by only 4.5%. With the LOP holding approximately for farm outputs, Canadian versus U.S. prices of wheat, soybeans, corn, feeder steers, and slaughter steers relative to farm machinery prices rose from 20.9 to 34.9%. Agricultural output prices in Canada and the United States were also subject to substantial common fluctuations over this period, and the depreciation-related higher prices of the farm-produced outputs raised the costs of slaughter steer production in Canada. However, the lack of exchange rate pass-through to farm machinery prices compared with farm outputs means that depreciation provides some positive price incentives in Canada. With nominal and real depreciation tracking closely, farm output prices also rose relative to the costs of nontraded inputs or a broad index of the price level, again providing a positive production incentive.

Exchange Rates and Agricultural Policy

The analyses described above suggest that real exchange rate movements matter to agriculture; they are not always dominant, but they can be. Appreciation of the dollar is observed to create agitation for protection and govern-

ment support for trade sectors across industries and periods. Antidumping complaints from the U.S. steel industry—an industry whose evolution to a capital-intensive competitive sector parallels that of agriculture—are a reminder of the political pressures currency movements engender. Calls for a lower-valued dollar have been echoed recently across many trade-dependent U.S. industries.

In agriculture, the 1996 Federal Agricultural Improvement and Reform (FAIR) Act has suffered a near-death experience since 1998. The wounds may prove fatal as 4 years of injections of substantial additional support beyond that included in the 1996 legislation gives way to a new farm bill in 2002. Farm bill proposals include new permanent countercyclical support programs providing billions of dollars in subsidies. Loan rates may be raised, and acreage base and/or yield updating in the new bill could further undermine the decoupling of farm support from production decisions. Thus, the strong appreciation of the dollar, which has pushed U.S. prices down and helped to set the stage for the enactment of added support, is proving detrimental to farm policy by undermining reform in the United States.

It may seem unwarranted to conclude from what is happening in the United States that the appreciation of the dollar is having a detrimental effect on agricultural policy worldwide. Appreciation of the U.S. dollar means depreciation of other currencies, so an offsetting lowering of pressures for farm policy interventions elsewhere might lead to something of a net wash. There are offsetting effects of depreciations bringing less pressure for interventions elsewhere, but in my view, a net wash is not the result. Under the FAIR Act, the United States had moved far enough forward along the path of the decoupling of farm support from market interventions that exchange rate movements have had an asymmetric effect on policy evolution internationally. For those countries in which depreciation has favored farm policy liberalization, the effects on policy outcomes have not been as strongly positive as the appreciation of the U.S. dollar has proven detrimental.

Consider the case of the United States and the European Union. Under a strong FAIR Act, the European Union would find itself using acreage controls to sustain its farm policies while the United States pursued market-driven production levels unfettered by annual land use restrictions. This situation would reverse the previous relative effects on the competitiveness of policies in the two blocs, where from 1980 through 1995 the United States used supply controls and the European Union, for the most part, did not. The European Union would be placed at a competitive disadvantage by the new policy mix. Simultaneously, the United States would be positioned to press the European Union in international negotiations to increase market access and discipline domestic and export subsidies. Such action could include giving up the "blue box" of World Trade Organization exemptions for programs with payments tied to production controls, since the United States would no longer be using these exempted policies. The European Union has reasons of its own to move toward decoupling and subsidy reductions as it tries to accommodate expanded membership. Thus, convergent influences might culminate in further movement toward less market intervention in agriculture.

The dollar appreciation that has depressed U.S. farm prices and exports makes such an optimistic reform scenario less likely. While the new U.S. farm bill has yet to be enacted (as of February 2002), it is likely to contain higher support levels and more CRP acreage. With marketing loans, the United States will avoid the stocks accumulation problem whereby appreciation prompted lower loan rates in 1985. However, competitors in world markets will decry the increased support as "unfair" subsidization, and the United States will lose some of its basis for arguing for greater liberalization worldwide (see, e.g., Roberts and Jotzo). Meanwhile, depreciation of other currencies has lessened the cost of foreign farm supports. These are circumstances under which convergent influences are less likely to favor multilateral negotiation of farm policy reforms.

Summing Up

This paper has examined the question of exchange rate effects on agriculture raised forcefully by G. Edward Schuh some 25 years ago, when a new era of flexible exchange rates and international capital mobility emerged worldwide. Exchange rate movements determine the wedge between the domestic and foreign prices of a traded good. More generally, they serve an equilibrating role when markets require a systematic movement in the relative prices of traded and nontraded goods. Exchange rate movements depend on international capital flows and the macroeconomic factors determining these flows, including monetary policy. Monetary shocks have nonneutral effects that explain some of the variability in agricultural prices. Moreover, macroeconomic conditions are often decisive in the determination of domestic agricultural polices and, hence, levels of competitiveness in world markets and tension in trade relations. These structural policy implications of exchange rate movements, along with their direct effects on markets at any given moment in time, are why exchange rates are important to agriculture.

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