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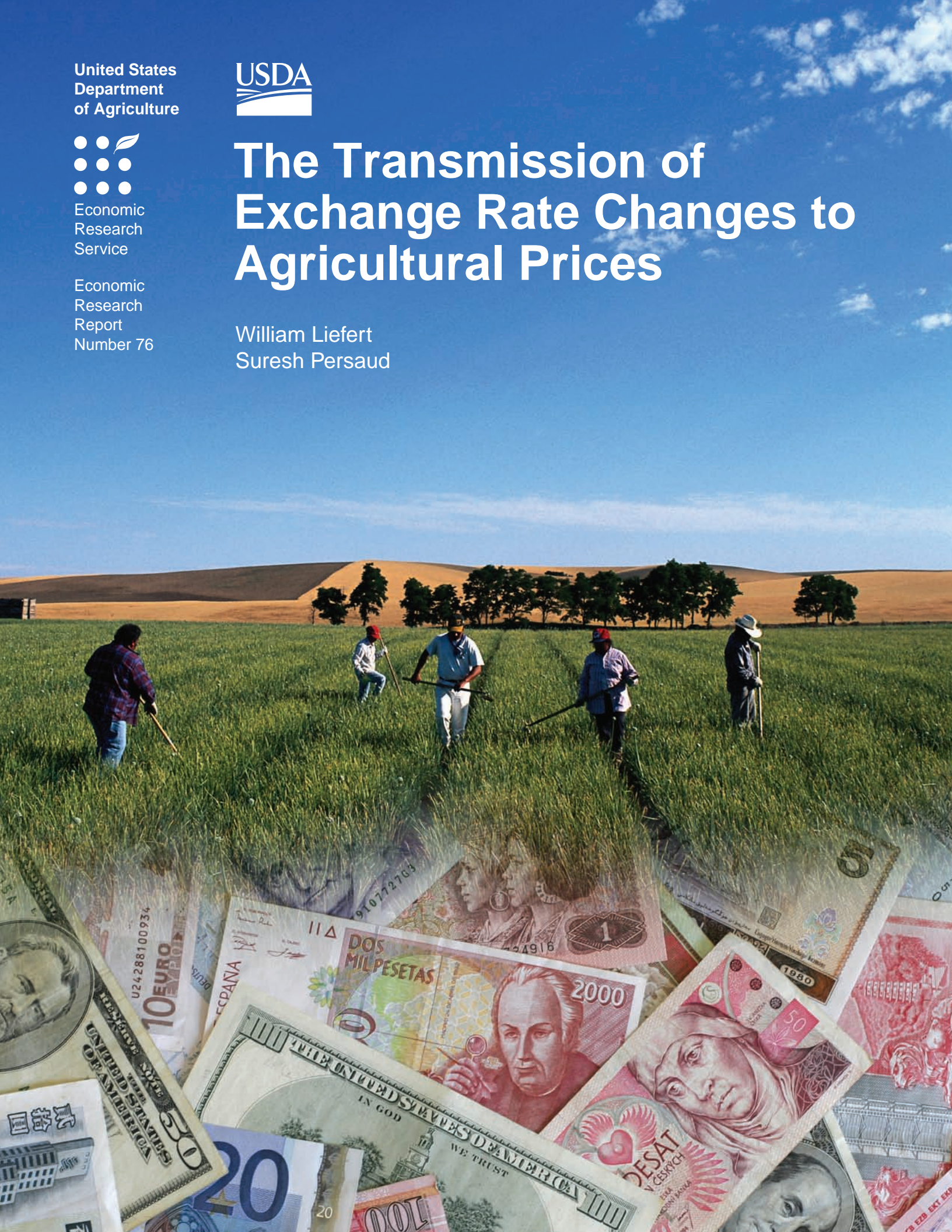


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The Transmission of Exchange Rate Changes to Agricultural Prices

William Liefert
Suresh Persaud



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The Transmission of Exchange Rate Changes to Agricultural Prices

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Abstract

Movements in countries' exchange rates can substantially change the prices of goods faced by producers and consumers and thereby affect incentives to produce, consume, and trade goods. Exchange rate changes, however, might not be completely transmitted (passed through) to domestic prices. Empirical evidence shows that price and exchange rate transmission for agricultural products is low in most developing economies, partly because of trade policies but also because of inadequate infrastructure and other market deficiencies. During the last 20 years, developed and developing countries generally have moved away from support policies that impede price and exchange rate transmission toward trade policies that allow transmission, such as tariffs. The Uruguay Round Agreement on Agriculture of 1994 strongly encouraged this development. Despite these policy changes, market deficiencies remain as a cause of incomplete transmission. Incomplete transmission weakens countries' integration into world agricultural markets and thereby reduces agricultural trade potential. Low transmission in developing countries also decreases their own benefits from trade, including the gains they could realize if there is further global agricultural liberalization.

Keywords: Agricultural infrastructure, agricultural policy, agricultural trade, exchange rates, exchange rate transmission, imperfect markets, institutions, price transmission.

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Summary

Exchange rate movements can change countries' domestic prices, thereby affecting incentives to produce, consume, and trade goods. For example, consider an exporting country that has a depreciating currency. The price domestic producers receive for exporting a good should rise because the trade price converted into domestic currency is now higher. This benefits domestic producers and motivates them to produce and export more of the good.

However, many countries have trade policies or market conditions that prevent or reduce the transmission (or pass through) of changes in exchange rates to domestic prices. This blunts the domestic price and market response to exchange rate changes. In the example above, incomplete transmission could keep the domestic price, production, and export of the good from rising as much as possible. Incomplete transmission thereby can prevent countries from attaining the levels of production, consumption, and trade of goods that would bring them, and their trading partners, the most economic benefit.

What Is the Issue?

The main reason exchange rate transmission is important for U.S. agriculture is because a large share of U.S. agricultural production is exported. Over the last 15 years, about a quarter of U.S. agricultural output has been sold abroad. Incomplete transmission of agricultural prices and exchange rates to domestic prices within countries means, however, that these countries are not fully integrated into world agricultural markets. They are not trading as much as they profitably could. More specifically, as a group they are not importing as many agricultural goods from the United States as is in their, and the United States, economic interests.

What Did the Study Find?

The two main causes of incomplete exchange rate transmission for agricultural products are trade policies and poor market conditions. Trade policies that impede transmission include import quotas and systems of managed (or fixed) agricultural prices. Poor market conditions can involve deficient market infrastructure and the use of market power by large buyers and sellers to set prices. The deficiencies can be in physical infrastructure, such as roads, transport, and storage, or in commercial and institutional infrastructure, such as systems of market information, finance, and law. Poor infrastructure isolates regional markets within countries from each other, as well as cuts them off from the world market, thus weakening transmission.

The United States has been moving away from transmission-impeding agricultural trade and support policies, it has fairly good infrastructure supporting the agro-food economy, and its agricultural markets are reasonably competitive. Thus, price and exchange rate transmission is not a serious problem for the workings of U.S. agriculture. Empirical research shows, however, that price and exchange rate transmission for agricultural products is lower in developing economies than in the United States and other developed countries. Analysis of 56 developing countries over a 30-year period found that

about a third of the countries had almost no transmission of border price changes to domestic prices, even after allowing for an adjustment period of 5-7 years. In 23 other countries, after 5 years, no more than half of the change in border prices was transmitted to domestic prices.

Policies within developing economies certainly account for some of the weak transmission. Yet, during the last 20 years, many developing countries have liberalized their agricultural policies, a process promoted by the 1994 Uruguay Round Agreement on Agriculture, such that price and exchange rate transmission should improve. However, poor market conditions, such as weak infrastructure, continue as a serious impediment to price and exchange rate transmission in many developing economies.

Incomplete transmission has implications for the interpretation and use of standard measures of agricultural protection and support. These measures all involve some sort of gap between the domestic price for a commodity and its border price. This price wedge is typically interpreted as a measure of the degree to which government policies distort domestic prices, and thereby distort market incentives to produce, consume, and trade goods. However, measures of protection and support could be used to misidentify the cause of price gaps. This could happen if a large part of the price wedges were caused not by policies but by incomplete price and exchange rate transmission resulting from market imperfections, such as deficient infrastructure. By misidentifying the cause of price gaps, governments might adopt inappropriate policies intended to eliminate the gaps.

How Was the Study Conducted?

The study uses market and trade analysis to examine how changes in exchange rates affect a country's domestic markets for agricultural commodities. The same conceptual framework is then used to analyze the causes and market effects of incomplete price and exchange rate transmission for agricultural commodities. The study also examines the empirical evidence concerning exchange rate transmission for the United States, other developed countries, and, particularly, developing countries, as well as evidence that market conditions alone can cause incomplete transmission.

Introduction

Foreign exchange markets link a country's domestic economy to world product markets by facilitating the conversion of foreign currencies into domestic currency. The degree to which exchange rate changes impact a country's domestic markets depends on the extent to which the changes are transmitted, or passed through, to domestic prices. When only part of an exchange rate change is transmitted to domestic prices (called incomplete transmission), domestic prices will differ from border prices. Such price differences indicate that countries are not maximizing their total volume of trade, and, thereby, their potential economic gains from trade. This, in turn, means that the countries' total economic welfare is less than it could be.

If countries fail to maximize their trade volumes and gains from trade, not only is their economic welfare reduced, but so, too, are the trade and welfare gains of their trading partners. The United States is the largest agricultural exporter in the world, with 2007 exports equaling \$90 billion (10 percent of the world total; FASonline). About 25 percent of U.S. agricultural output is exported. Incomplete transmission for agricultural products that reduces countries' trade therefore hurts the United States as the world's leading agricultural exporter.

This report examines the possible causes and economic effects of incomplete exchange rate transmission. It looks at the empirical record concerning the magnitude of exchange rate transmission in countries throughout the world, with special focus on developing economies. The report also examines how incomplete transmission can lead to misinterpretation of conventional measures of agricultural protection and support, as the measures might overstate the importance of policies as causes of price gaps. This misidentification could motivate governments to make inappropriate policy changes in an effort to end the price gaps.

Why Are Exchange Rates Important for Agriculture?

Exchange rates are a key variable in determining domestic prices for agricultural commodities, and, thus, the quantities of goods domestically produced, consumed, and traded. For tradable goods, exchange rates link domestic prices to world prices. If a country imposes no transmission-impeding policies and there are no domestic transport or transaction costs for a tradable product, the domestic price for a good (P^d) is determined by the world price (P^w) times the exchange rate (E), that is, $P^d = P^w * E$.

Figure 1 demonstrates how changes in the exchange rate can affect the market for a U.S. agricultural commodity. Assume in the figure that the world price equals 50 euros and the dollar/euro exchange rate equals 2 (which means it takes 2 dollars to buy 1 euro). The commodity's domestic price equals \$100 (P^2). At this price, Q^2 of the commodity is domestically produced, Q^5 purchased, and $Q^2 - Q^5$ imported. Assume now that the exchange rate falls from 2 to 1 (E^2 to E^1), meaning that now only 1 dollar is needed to buy 1 euro. (This means that the dollar has doubled in value vis-à-vis the euro, or alternatively, appreciated by 100 percent.) Because it now takes only half as many dollars as before to buy a given amount of euros, the dollar's appreciation lowers the domestic price of all tradable goods initially priced in euros. In this example, the domestic price is halved from \$100 to \$50 (P^1). At the lower price, domestic production falls to Q^1 , purchases rise to Q^6 , and imports increase to $Q^1 - Q^6$.

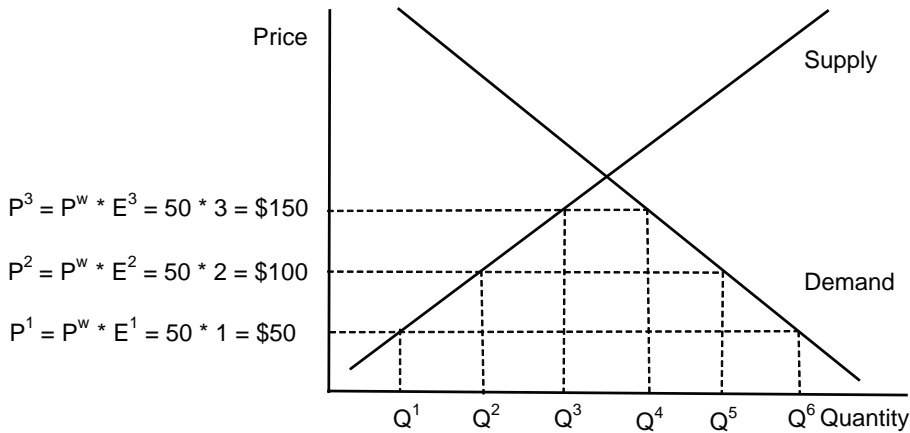
Alternatively, assume that the exchange rate rises from 2 dollars per euro to 3 dollars per euro (a depreciation of 50 percent). Because it now takes 50 percent more dollars to buy a given amount of euros as before, the dollar's depreciation raises the domestic price of all tradable goods initially priced in euros. In this example, the domestic price increases from \$100 to \$150 (P^3). At the higher price, domestic production rises to Q^3 , consumption falls to Q^4 , and imports decrease to $Q^3 - Q^4$.

An increase in the world price of the good in question from \$100 to \$150 would have the same initial market effect as the 50-percent depreciation in the dollar. Exchange rates, however, have more potential than world prices to affect domestic markets. The change in the world price for a specific commodity mainly will impact the domestic price for that good alone (with lesser effects on the prices of a few related goods), while a change in a country's exchange rate can alter domestic prices for all tradable goods.¹ The price changes for other tradable goods can, in turn, affect the market for the good in question (in figure 1, assume this good is beef). The depreciation of the currency as represented by the rise in the domestic beef price from \$100 to \$150 will raise the domestic price of all domestically produced substitutes for beef, such as pork and poultry. The price increases for those goods will boost demand for beef to some degree through a consumer substitution effect, shifting the demand curve for beef to the right. This shift will offset some of the drop in quantity demanded for beef from the initial rise in its price from \$100 to \$150. The currency depreciation will also increase the prices for all tradable inputs used to produce beef. This effect will shift the domestic supply curve for beef to the left, reducing output and increasing imports.

¹One might counter that the currency of a country has no single exchange rate but rather a separate rate vis-à-vis the currency of every other country. Although this is technically correct, countries' exchange rates tend to move together vis-à-vis those of most other foreign currencies. If the rates did not move in such a way, currency traders could make large profits by combining trades in the currencies against which a country's exchange rate did change with trades in the currencies against which the country's currency did not change (called *arbitrage*).

Figure 1

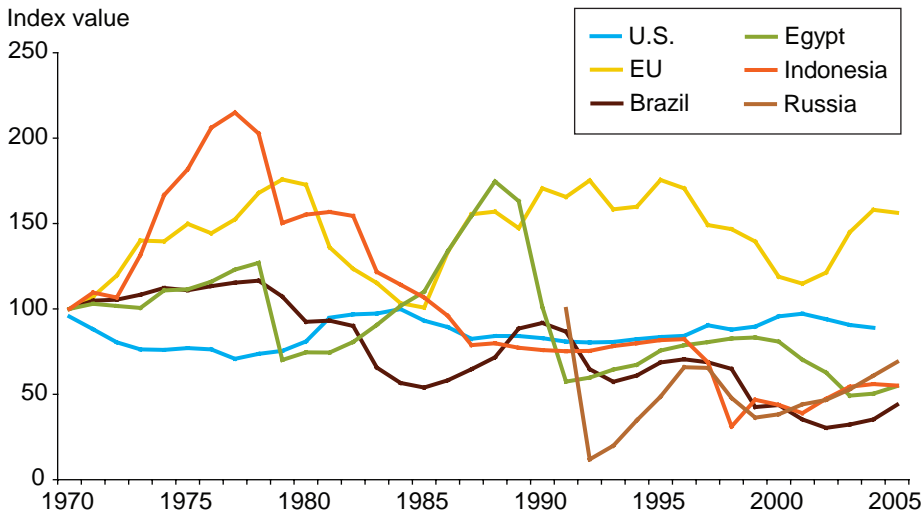
Domestic market effects of exchange rate changes



Source: USDA, Economic Research Service.

Figure 2

Real exchange rates



Note: Real exchange rates are nominal rates adjusted for domestic and foreign inflation. 1970 = 100, except for Russia, for which 1991 = 100. An increase (decrease) in the exchange rate index means currency appreciation (depreciation). For the United States, the exchange rate is trade weighted. For all other countries, the exchange rate is weighted vis-à-vis the U.S. dollar. Source: USDA, Economic Research Service, Agricultural Exchange Rate Data Set and Global Insight.

By affecting prices for all tradable goods, changes in exchange rates have secondary market effects for a single good beyond that identified in figure 1. Thus, exchange rate changes have a more complex effect on the market for an individual good than does a change in the world price for that good alone.

Exchange rates can have large swings in magnitude, which also makes them important for agricultural markets (fig. 2). Although the currencies of developing economies are characterized by such swings, developed economies' currencies also can change substantially in value over time, as shown by the fluctuation in the value of the U.S. dollar and euro over the last 35 years.² For most countries, exchange rates fluctuate not so much through annual movements in value up and down but rather through movement over multiyear cycles. The major changes in exchange rates over the course of these multiyear

²The euro did not officially come into existence until 1999 (electronically at first, with notes and coins coming in 2002). The euro exchange rate in figure 2 is calculated by using trade weights to convert earlier currency values for the 12 future member countries to a euro equivalent.

cycles can alter domestic prices substantially. For example, from 1993 to 1999, the dollar appreciated by about 10 percent vis-à-vis all other currencies in trade-weighted terms. Over that time, the U.S. farm gate price for wheat, soybeans, beef cattle, and hogs fell 24, 28, 14, and 33 percent, respectively (USDA, ERS, *Agricultural Outlook*). Although other market conditions probably contributed to these large price drops, the currency appreciation appears to have played a key role.

What Is Exchange Rate Transmission?

As discussed in the previous section, if a country imposes no transmission-impeding policies on a commodity and there are no domestic transport or transaction costs for the product, the domestic price for the good (P^d) will be determined by the world price (P^w) times the exchange rate (E), that is, $P^d = P^w * E$. $P^w * E$ gives the commodity price in domestic currency at the border and therefore is called the *border price* (P^b). If $P^d = P^b = P^w * E$, the border price has been completely transmitted, or passed through, to the domestic price. Alternatively, one could say that both the world price and exchange rate have been completely transmitted to P^d . Although the words *transmission* and *pass through* often are used to describe the process by which changes in border prices affect domestic prices, the rest of this paper will use the word *transmission* exclusively.

Another test of transmission is the degree to which a change in P^b , P^w , or E is transmitted to P^d . The test involves computing transmission elasticities. The transmission elasticity (TE) involving P^b and P^d is defined as the percent change in P^d divided by the percent change in P^b , that is, $\% \Delta P^d / \% \Delta P^b$. If the TE equals 1, there is complete transmission of the change in P^b to P^d . If the TE equals 0, there is no transmission, and if the TE is between 0 and 1, the transmission is incomplete. One can also compute transmission elasticities specifically for the relationships between the world price or exchange rate and the domestic price. The exchange rate transmission elasticity equals $\% \Delta P^d / \% \Delta E$ and also can be between 0 and 1.

In figure 1, assume that, initially, $P^d = P^b = \$50$, such that $P^w * E = 50 * 1$. E then rises from 1 to 3, such that P^b increases from \$50 to \$150. If P^d also were to rise to \$150, the TE involving E and P^d (as well as the TE involving P^b and P^d) would equal $200\% / 200\% = 1$. The transmission of the change in the exchange rate to the domestic price would be complete. If P^d were not to change at all, the TE would equal 0. If P^d were to rise to \$100, the TE would equal $100\% / 200\% = 0.5$.

Because changes in both exchange rates and world prices can be transmitted to domestic prices, many of the issues discussed in this report involving exchange rate transmission apply also to world price transmission. This report focuses on exchange rate transmission because of the high degree to which exchange rates can fluctuate, especially for developing countries, and because a change in the exchange rate for a country's currency can affect domestic prices for all its tradable goods.

What Are the Possible Causes of Incomplete Exchange Rate Transmission?

This section of the report is a conceptual discussion of the two general causes of incomplete exchange rate transmission: government policies and market conditions. Another section of the report, “What Is the Empirical Evidence Concerning Exchange Rate Transmission?” examines more deeply the prevalence of the specific policies and market conditions throughout the world that impede transmission.

Government Policies

During the post-World War II period, governments throughout the world (including in the United States and European Union (EU)) have maintained various policies for agricultural commodities that largely precluded transmission (table 1). These policies usually involved either explicitly fixing prices or defending targeted prices through government intervention into agricultural markets (say, by purchasing output). In the United States, such managed price policies have included the commodity loan program (used for wheat, corn, soybeans, and cotton, among other crops), the sugar price support program, and the dairy support program (see USDA, ERS, Farm and Commodity Policy Briefing Room).

During the same period, the most common EU transmission-impeding policy was intervention prices, combined with variable levies. In 1992, the EU reduced intervention prices, and in 1994, it abolished variable levies as part of the Uruguay Round (UR) Agreement on Agriculture. Nonetheless, the intervention price system combined with border measures still remains for certain commodities, such as milling wheat, barley, sugar, and dairy products, insulating domestic agricultural producer prices from changes in border prices (Agra Europe).

Trade quotas also prevent price or exchange rate transmission. In figure 1, assume that an import quota of Q^3Q^4 exists. The quota volume, combined with the shapes of the domestic demand and supply curves, determines the domestic price (P^3), and, thereby, the quantity of the good domestically produced (Q^3) and consumed (Q^4). Assume that the border price also initially

Table 1
Agricultural commodity policies and their effect on transmission

Policy	Transmission effect
Managed prices	Prevent
Quotas	Prevent
State trading	Prevent
Tariffs	Prevent if trade prohibitive
Tariff rate quotas	Prevent if quota is operative
Technical barriers to trade/ sanitary and phytosanitary	Prevent if take form of trade bans

Source: USDA, Economic Research Service.

equals P^3 but then falls to P^2 . If the quota volume remains unchanged, the domestic price will also remain unchanged at P^3 .³ Consequently, none of the drop in the border price will be transmitted to the domestic price.

Another government policy that can prevent transmission is state trading. State trading exists when a state or parastatal agency determines the volume of a commodity that a country will export or import (see Ackerman and Dixit, 1999). Examples of state trading agencies include the Canadian Wheat Board, AWB of Australia, and Fonterra of New Zealand for agricultural exports, and the Staple Food Department of the Japanese Ministry of Agriculture and Korea Agro-Fishery Trade Corporation for agricultural imports. (AWB formerly was the Australian Wheat Board, whereas Fonterra was formed from the merger of the New Zealand Dairy Board, New Zealand Dairy Group, and Kiwi Cooperative Dairies. Although privatized a few years ago, these agencies operate like state traders.) State trading agencies on the import side determine the volume of a commodity to be imported, and that volume functions like a trade quota. Just as import quotas insulate domestic prices from border prices, so, too, does import state trading in its most typical forms. Consequently, certain state trading practices also can prevent world price and exchange rate transmission to domestic prices.

The trade policy that most allows transmission is tariffs. This is especially true of ad valorem tariffs, where the tariff is calculated as a percentage of the border price. Given that the tariff charge is a proportion of the border price, any percent change in the border price (or more specifically, world price or exchange rate) can result in an identical percent change in the domestic price (assuming no domestic transport or transaction costs for the imported product). Thus, the transmission elasticity potentially is 100 percent. Tariffs, however, can be trade prohibitive, that is, so high that they discourage any trade whatsoever. By effectively cutting off domestic markets from world markets, prohibitive tariffs also prevent world price and exchange rate transmission to domestic prices.⁴

A policy related to tariffs that might or might not impede transmission is tariff rate quotas (TRQs). A TRQ is a two-tiered tariff, where a lower in-quota tariff is applied to a maximum volume of initial imports and a higher over-quota tariff is applied to all additional imports (see Skully, 2001). Because TRQs combine elements of a pure tariff and a pure quota, the degree to which they allow price and exchange rate transmission depends on whether the tariff or quota part of the TRQ is operative.

Another major type of trade restriction is technical barriers to trade (TBTs), defined to include sanitary and phytosanitary (SPS) measures. Roberts et al. (1999) argue that the two most common TBT measures are regulations and testing requirements, both of which increase the cost to foreign suppliers of providing goods for import by the TBT-imposing country. These costs simply increase the price of traded goods and thereby do not retard the transmission of changes in either the world price or the exchange rate to domestic prices. TBTs, however, can take the form of a complete ban on imports, typically because the exporting country suppliers do not satisfy the imposed regulation or testing requirement. By completely preventing trade, trade bans block any transmission between world prices or exchange rates from the banned country to the domestic market of the banning country.

³To see this, assume that the drop in the border price to P^2 also initially results in the domestic price falling to P^2 . At this price, consumers would want to import Q^2Q^5 of the good. The quota, however, restricts imports to only Q^3Q^4 . To eliminate the excess demand for imports, the domestic price must return to P^3 , at which price consumer demand for imports equals the import volume allowed by the quota.

⁴The other main type of tariff is a fixed charge per unit of good imported or exported. With a per unit tariff, the transmission elasticity between the border and domestic prices will not equal 100 percent. For example, assume that the border price for an import is \$100 and a per unit tariff of \$25 exists. This will produce a domestic price of \$125. Assume now that the border price doubles to \$200, such that the domestic price rises to \$225 (adding on the per unit tariff). The border price has increased by 100 percent, but the domestic price has risen by only 80 percent. The transmission elasticity is therefore 80 percent / 100 percent = 0.8. Note, however, that the full \$100 increase in the border price is passed on to the domestic price, which rises from \$125 to \$225. An ad valorem tariff creates a transmission elasticity of 100 percent because the domestic price changes proportionally with the border price. A fixed per unit tariff, on the other hand, does not produce a transmission elasticity of 100 percent because the fixed tariff precludes a proportional relationship between the border and domestic prices.

During the last 20 years, countries throughout the world have been moving away from trade policies that prevent or lower price and exchange rate transmission toward policies that allow it, especially tariffs. The United States and the EU have been reducing managed price policies that can wholly preclude transmission (USDA, ERS, Farm and Commodity Policy Briefing Room; Agra Europe). These countries have moved to some degree to agricultural support policies based on direct payments to farmers. Under these policies, farmers receive direct monetary payments from the government largely independent of (decoupled from) prices and production decisions. Consequently, the payments should not much affect agricultural markets or prevent or reduce the transmission of border price changes to domestic prices. Yet, both the United States and the EU retain policies that impede price transmission, such as the U.S sugar price support program.

Before the late 1980s, the governments of most developing countries strongly regulated and controlled their agricultural economies, in particular, prices and trade volumes. These policies also largely insulated domestic prices from border prices. In the late 1980s and early 1990s, however, developing countries began to liberalize their agricultural policies so that their domestic agricultural markets became more integrated into world markets (see WTO). The effect has been to strengthen transmission between border and domestic prices. Developed and developing economies were motivated to liberalize their agricultural policies by the 1994 UR Agreement on Agriculture, which banned import quotas, nontariff measures maintained through state trading enterprises, and most other nontariff trade barriers, requiring countries to convert border measures to tariffs.⁵

In the 1980s, the countries with the strictest agricultural trade controls were the planned economies of the Soviet bloc. These economies kept domestic prices almost completely insulated from world prices and exchange rates so that no transmission from the latter to the former was possible. The collapse of the Soviet Union and Soviet bloc and the transition of the former bloc countries from planned to market economies that began in the late 1980s and early 1990s allowed for their expanding integration into world markets so that price and exchange rate transmission for agricultural products now became possible (see Liefert and Swinnen, 2002).

Although there has been a general worldwide move during the last two decades away from transmission-retarding policies—and, especially, such policies as managed prices and quotas that wholly preclude transmission—prohibitive tariffs, TRQs, and TBTs have expanded as trade restrictions during this time. As discussed earlier, these policies can also prevent transmission, which means their growing prevalence has mitigated the move from transmission-retarding trade measures.

Market Conditions

The move from policies that impede transmission enhances the importance of the second main cause of incomplete exchange rate transmission—market conditions, which can be divided into two subcategories: market power and deficient market infrastructure. Market power exists when certain buyers or sellers of a product are so “big” that they are responsible for a large share of the product’s market transactions. Because of their influence on the market,

⁵The actual trade-liberalizing effect of the Uruguay Round Agreement, and, especially, tariffication, was in fact rather limited, at least in the short to medium term. Countries were given the power to determine tariff rate equivalents for their own nontariff measures, with little outside scrutiny or challenge. Many of the new tariffs appear to have been higher than that yielded by a more objective calculation (Josling et al., 1996). Yet, at least the principle of tariffication was accepted and implemented.

these agents do not have to accept the prices at which products are exchanged. Rather, their “market power” gives them the ability to determine to some degree the prices at which they buy and sell, that is, they are “price makers” rather than “price takers.” This power to set prices can interfere with the transmission of changes in world prices and exchange rates to domestic prices.

Market power can impede exchange rate transmission when exporters engage in “pricing to market” behavior. For example, assume that the currency of the exporting country depreciates by 50 percent vis-à-vis the currency of the importing country. If the exchange rate change were fully transmitted, importers would pay 50 percent less for commodities purchased from the exporter, all other things equal. However, the exchange rate change might not be fully transmitted because the exporters might exercise market power to increase their markups in response to the exchange rate depreciation. In this case, importers would receive only some, but not all, of the benefit of the depreciation of the exporter’s currency due to incomplete transmission.

Market power also can affect exchange rate transmission when it is held by economic agents within a country’s domestic agro-food chain. In many countries, food processors and wholesalers have market power vis-à-vis the farms from which they purchase primary output. Assume that a country’s currency depreciates vis-à-vis all foreign currencies, which should increase domestic prices for all tradable agricultural products. Wholesalers and processors might use their market power to reduce the degree to which they pass on the price increases that they receive to their farm suppliers.

The other category of market condition that can reduce world price and exchange rate transmission is deficient physical, commercial, and institutional infrastructure for the agro-food economy. Developing and transition economies, in particular, can suffer from poor agricultural infrastructure. Undeveloped physical infrastructure involves such deficiencies as weak roads, transport, and storage. Poor commercial and institutional infrastructure involves such deficiencies as weak systems of market information, finance, and law, the latter failing to enforce contracts and protect property. Corruption by public officials can also be considered part of weak institutional infrastructure, if the political and legal systems cannot adequately police and discipline such behavior.

Deficient infrastructure can have two main effects, both of which can impact exchange rate transmission. First, it can result in high internal transport and transaction costs for agricultural and food products. As stated earlier, if countries impose no transmission-retarding policies and there are no internal transport or transaction costs for moving goods, border prices will determine domestic prices for tradable goods. Most imported or exported products, however, require some transportation between the domestic site of production or consumption and the border (typically a port). Consequently, even in well-developed market economies, the domestic movement of tradable goods involves some transport and transaction costs. If market infrastructure is weak, however, such costs can be high, especially for perishable products. In some African countries, for example, trucking agricultural goods 100 miles might take almost a week and involve large expenses for documentation, tolls, and other taxes (often indistinguishable from bribes). Domestic transport and transaction costs could in fact be so high for certain goods that they

wholly preclude trade (which will occur if these costs exceed the initial gap between the goods' border and domestic prices).

Fackler and Goodwin (2001) discuss the importance of transport and transaction costs for agricultural markets and trade, while Anderson and van Wincoop (2004) do so for trade in general. Anderson and van Wincoop identify four ways in which trade frictions can create transaction costs: (1) language barriers; (2) currency barriers; (3) information barriers; and (4) contracting costs and insecurity.

For an imported product, domestic transport and transaction costs (TT) increase the price domestic producers receive relative to the border price; that is, $P^d = P^b + TT = P^w * E + TT$ (assuming that no policies raise P^d above P^b , such as a tariff). TT acts as a form of import protection for domestically produced output. For an exported product, TT decreases the price domestic producers can receive relative to the border price, that is, $P^d = P^b - TT = P^w * E - TT$. In this case, TT acts like an export tax, as it cuts into the export price (P^b) that domestic producers would receive.

TT affects the transmission of changes in world prices and the exchange rate to domestic prices because a strictly proportional relationship does not exist between the former and the latter. For imports, the existence of TT results in $P^d > P^b$. Assuming no change in TT, a given percent change in P^b will generate a smaller percent change in P^d . As a result, the transmission elasticity between P^b and P^d (or, alternatively, between either P^w or E and P^d) will be less than one. For exports, the opposite is true. The existence of TT now results in $P^d < P^b$. A given percent change in P^b will therefore result in a larger percent change in P^d . Consequently, the transmission elasticity between P^b and P^d (or between either P^w or E and P^d) will be greater than one.

The second main effect of deficient market infrastructure is that it can create the market imperfection of incomplete information. In particular, producers in isolated areas might be unaware of prices (and, especially, price movements) at the border or in the domestic markets where their output competes with imports. Isolated producers often have to make commercial commitments before the final transaction prices in distant markets are known. Deficient infrastructure also creates market rigidities and holdup problems, such as delayed payments to farms, which reduce prices (especially when inflation is high; see Gow and Swinnen, 1998). Two of the causes of transaction costs in international trade identified by Anderson and van Wincoop—information barriers and contracting costs and insecurity—can also impede the flow of market information and activity. Barrett (2001) and Barrett and Li (2002) discuss how poor infrastructure can create imperfect information and related imperfections for agricultural markets and argue that the consequence can be price disequilibrium that lasts for extended periods of time.

Deficient market information resulting from weak infrastructure can segment regional markets within countries from each other, as well as cut off these regional markets from the world market. Consequently, the transmission of changes in world prices and exchange rates to domestic agricultural producers might be low. If incomplete transmission exists because of imperfect information, then it will be the case for an imported product that $P^d =$

$P^b + TT + G$ (again assuming no market intervention policy), and for an export that $P^d = P^b - TT - G$, where G is a gap between the border and domestic price that does not result from measurable transport and transaction costs. Barrett and Li describe the existence of G as market disequilibrium, or, alternatively, imperfect integration of the domestic market into the world market. This price gap contributes to incomplete exchange rate transmission not simply for the technical reason that the relationship between P^b and P^d is no longer strictly proportional. Rather, the price gap results because deficient infrastructure fundamentally disrupts the flow of information concerning price movements and commercial opportunities between domestic markets and world markets.

Deficient market infrastructure can result in both high TT and the transmission-impeding weak flow of market information, and related market rigidities, within countries. A tradeoff could in fact exist between the two effects for individual commodities. If border prices exceed the prices received by domestic farmers, the farmers have strong incentive to export, even if the transport and transaction costs of moving product from the farm to the border are high. The more product that is exported, the more domestic markets will be integrated into world markets, and the stronger will be the information flow between the world and domestic markets. Yet, the actions taken to strengthen market integration in this way, especially if made quickly, can raise the TT of exporting, which cuts into the price farmers can receive for exporting vis-à-vis the border price.

A relationship also can exist between deficient market infrastructure and market power. Wholesalers and processors, who tend to be larger and more “concentrated” than farmers, probably have better market information than the farmers as well. They can use this superior information in negotiating to gain power over their primary output suppliers.

The degree of transmission for a good also is typically related to how intensively a country trades it. The greater the share of exports in domestic production, or the share of imports in consumption, the closer the relationship between the border and domestic price is likely to be. In addition, many primary agricultural goods are used as inputs by the food processing industry to prepare final products for retail sale. Generally speaking, the greater (lower) the share of a primary good in the total value added of the final product, the higher (lower) the transmission between the border price for the final product and the domestic price for the primary good.

What Are the Economic Effects of Incomplete Transmission?

By weakening the relationship between world prices/exchange rates and domestic prices, incomplete transmission can strongly affect countries' markets for tradable goods. Figure 3 can be used to examine how incomplete transmission impacts agricultural markets, in this specific case, the market for a single imported product. Special focus will be on how the incomplete transmission affects the economic welfare of producers and consumers.

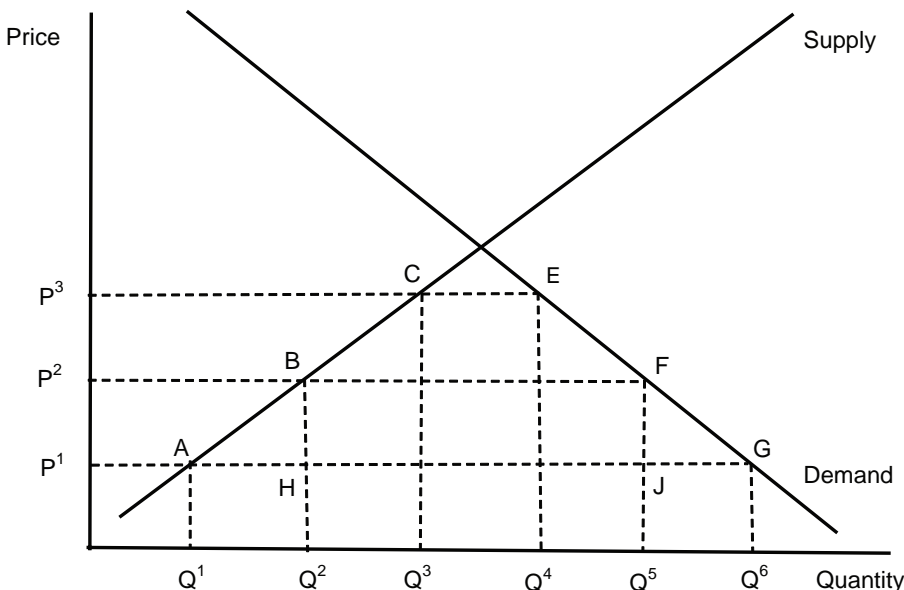
Assume that the domestic and border prices for a commodity are initially equal at P^3 . Q^3 of the good is domestically produced, Q^4 purchased and consumed, and Q^3Q^4 imported. The country's currency then appreciates against the currencies of all countries that export this commodity, such that the border price falls to P^1 . Assume, however, that because of the weak flow of market information resulting from deficient infrastructure, the drop in the border price is incompletely transmitted to the domestic price, so that the latter decreases to only P^2 .

In this example, the incomplete transmission hurts domestic consumers and helps producers. Because of the incomplete transmission, consumers' purchase of the good increases to only Q^5 rather than Q^6 , and they also pay a higher price of P^2 , compared with P^1 . Producers, on the other hand, produce more of the good (Q^2 rather than Q^1) and receive a higher price (P^2 rather than P^1).⁶

Another effect of the incomplete transmission is that only Q^2Q^5 of the good is imported, rather than Q^1Q^6 . The incomplete transmission also has one other welfare effect. Because the border price P^1 now lies below the domestic price P^2 , traders can purchase the import at the border at the lower price and

⁶The price elasticity of supply of the good with respect to the border price will equal the price transmission elasticity between the border and domestic price, times the price elasticity of supply with respect to the domestic price, that is, $\% \Delta Q / \% \Delta P^b = (\% \Delta P^d / \% \Delta P^b) * (\% \Delta Q / \% \Delta P^d)$. In this example, the incomplete transmission between the border and domestic prices results in more of the good being produced (Q^1Q^2) than would be if transmission were complete.

Figure 3
Effect of incomplete transmission on a single market: the import case



Source: USDA, Economic Research Service.

then sell it to consumers at the higher domestic price. The profit from this price arbitrage (buying low and selling high) per unit sold is P^1P^2 , and the total profit (or welfare gain) to the traders equals HBFJ. This gain to the arbitrage traders comes directly at the expense of consumers.

The concepts of consumer and producer surplus can be used to determine the net effect of these welfare changes. Consumer surplus is the difference between the maximum amount consumers are willing to pay to purchase a given quantity of a good and the amount they actually do pay. It therefore is the measure of consumers' net welfare gain from purchasing and consuming goods. Consumer surplus equals the area below the demand curve and above the horizontal line anchored at the domestic market price. If the price fell from P^3 to P^1 , consumer surplus would rise by the area P^1P^3EG . Because of the incomplete transmission, consumer surplus increases by only P^2P^3EF . The incomplete transmission deprives consumers of P^1P^2FG of additional welfare gain from the price drop.

Producer surplus is the difference between the minimum revenue producers are willing to accept to produce a given quantity of output and the amount of revenue they actually do receive. It therefore measures producers' net welfare gain from producing and selling goods. Producer surplus equals the area above the supply curve and below the horizontal line anchored at the market price.⁷ If the price fell from P^3 to P^1 , producer surplus would decline by P^1P^3CA . Because of the incomplete transmission, producer surplus decreases by only P^2P^3CB . The incomplete transmission saves producers from losing an additional P^1P^2BA of revenue, or welfare.

What is the net welfare effect of the incomplete transmission? The incomplete transmission deprives consumers of P^1P^2FG of additional welfare gain, while it saves producers P^1P^2BA of welfare loss. It also allows the arbitrage traders to earn HBFJ of profit. The net effect is therefore a welfare loss to the economy equal to the two triangles ABH and FGJ.

One might wonder why market forces would not eliminate the gap between the border and domestic prices, with the profit earned by the arbitrage traders in particular being a lure to lower the price gap. In a competitive market, as information flows over time, the gap likely would lower (weak infrastructure notwithstanding). For this reason, price and exchange rate transmission for many real-world commodity/country pairings is lower in the short run than in the long run. Incomplete price transmission resulting from weak market infrastructure is therefore a more serious problem for the short- to midterm than for the long run.

It might also appear odd in this example that both the domestic producer and consumer price for an agricultural good would be substantially above the border price throughout the country. If incomplete transmission results from poor market infrastructure, a more likely situation is that the infrastructure would segment the domestic market into regional markets. Those regional markets that are more distant from the border or have poorer infrastructure would be more isolated and have lower transmission and larger price gaps. The situation examined in this example could therefore apply to a regional market for a commodity within a large country.⁸

⁷A benefit of the concepts of consumer and producer surplus is that they allow a single quantitative measure to capture both the price and quantity effects on consumers and producers from market changes.

⁸Supplying regional markets that have poor market infrastructure with imports could involve high transport and transaction costs. The market analysis would have to be adjusted to account for these costs. The arbitrage traders would have to bear these costs, though they might be able to pass them on to consumers by raising the price at which they sell the imports. Probably the best way to adjust the analysis is with the border price, where the adjusted border price equals the arbitrage traders' full per unit cost of supplying the regional market with imports. This full price equals the good's actual border price plus the per unit transport and transaction costs of moving the product from the border to the regional market. The arbitrage traders' per unit profit would therefore equal $P^d - P^b - TT$.

The analysis of the market and welfare effects from incomplete transmission when a good is exported is similar to that for an imported good. Assume that the domestic and border prices for an export are initially equal, the border price then rises, but, because of incomplete transmission, the domestic producer and consumer price increases less. The incomplete transmission now hurts producers because the price rises less than the maximum possible and they produce less than they would at the higher price. Consumers benefit, however, because they pay less and purchase more of the good than they would if the price rose as high as the border price. As in the import case, arbitrage traders will also gain from the incomplete transmission. They can purchase the good from domestic producers at the low domestic price and then export it at the higher border price. The arbitrage profit per unit bought and sold will again equal the difference between the domestic and border price.

As opposed to the import case, in the export case the quantity domestically produced is greater than the quantity domestically consumed. As a result, the producers' loss exceeds not only the consumers' gain but the gain to the consumers and arbitrage traders combined. As in the import case, however, the incomplete transmission again results in a net welfare loss to the economy.

Another possibility is that a change in the trade price for a good or the exchange rate is asymmetrically transmitted to a country's domestic producers and consumers of the product. For example, a country imports a good and its trade price rises. The price increase is fully transmitted to the price faced by domestic consumers of the product, but little if any is transmitted to the price faced by domestic producers. This effect might stem from consumers being concentrated in large cities, which typically have good physical and commercial infrastructure for bringing in imported goods. Many countries' big cities are in fact coastal ports, such that the transmission of border prices for imports to consumer prices is very high (or more specifically, transmission is high for that share of the total value of final retail products contributed by the imports). On the other hand, many domestic producers of imported agricultural goods might be in the remote hinterland, which has poor infrastructure, such that transmission of border prices to the prices they face is low. In the example above, the country's consumers of the imported product would suffer from the price increase, while the low transmission to the producers' price provides little countervailing benefit to domestic producers from the price increase.

This analysis shows that the specific market and welfare effects for producers, consumers, and traders from incomplete transmission depend on whether a good is imported or exported, whether its price increases or decreases, and whether the transmission to domestic producer and consumer prices is symmetric. Yet, in most cases, incomplete transmission will result in a net welfare loss for a country.

What Is the Empirical Evidence Concerning Exchange Rate Transmission?

Although a substantial amount of empirical work has been done estimating the transmission between agricultural world prices and countries' domestic prices, only a few studies have isolated the impact of exchange rates on domestic prices. Consequently, this section presents results from work on world price transmission to gauge the magnitude of exchange rate transmission. In general, this is legitimate. As discussed earlier, the world price for a good and exchange rate together determine the good's border price in domestic currency, which is then transmitted to domestic prices. Thus, the transmission of change in either the world price or exchange rate affects domestic prices through the same policies, market institutions, and distribution systems. World prices and exchange rates in most cases should therefore have fairly equal transmission elasticities.⁹ Some studies, in fact, compute transmission between border prices, which cover both world prices and exchange rates, and domestic prices. In discussing specific empirical studies, this report will identify whether transmission is computed for world prices, exchange rates, or border prices.

Another issue is how one assesses the magnitude of transmission estimates from specific studies. What constitutes high, low, or moderate transmission? A complicating factor is that studies can differ in their country coverage, time coverage, methodology of estimation, and data used. Even if two works cover the same countries and time period, they can use different methods and data in their estimation. Disparities in the transmission estimates between studies might therefore reflect these differences, rather than the underlying conditions (policies, market power, quality of infrastructure) that can affect transmission.

Most individual studies that estimate transmission elasticities for multiple countries use the same methodology and period of estimation, and often the same data source. To control for these factors, the main approach here in assessing the magnitude (and especially relative magnitude) of transmission elasticities is to compare results for different countries within the same study. Yet, a certain transmission elasticity estimate, say 0.5, might be judged relatively high within one study and relatively low within another.

Two other more technical points also should be considered in assessing the transmission elasticities. First, if transport and transaction costs (TT) exist that are fixed rather than proportional to the border price, the transmission elasticity between the border and domestic price for a good will not equal unity. This will be the case even if there are no policy or market impediments to transmission. If the good in question is imported, the fixed nature of TT will result in a transmission elasticity less than one; if the good is exported, the transmission elasticity will be greater than one. Some studies try to adjust for this problem by measuring and deducting TT, such that any difference between the border and domestic price does not reflect TT. Even so, error in measuring TT might not wholly eliminate this problem.

⁹The main exception to transmission equivalence for world prices and exchange rates stems from the role of expectations about the duration of changes in these values. For example, if the markets believe that the change in a price for a certain good or exchange rate will be very short run, and that the price or exchange rate will soon revert to its previous value, domestic prices might not react much to the change.

Second, if the gap between the border and domestic price for a good is less than TT, the (relatively) high TT will preclude any trade (Balcombe et al., 2007). Another consequence is that if the border price changes but the change is small enough such that the price gap is still less than TT, the domestic price will not change in response to the change in the border price. The transmission elasticity between the two prices will therefore be zero.

Empirical Studies

Tyers and Anderson (1992) compute transmission elasticities for changes in border prices (covering both world prices and exchange rates) to domestic producer prices for 30 countries/regions and 7 agricultural commodities (or commodity groups) over 1961-83, for both the short and long run. The weighted average of the transmission elasticity for U.S. agriculture is 0.7 in the short run and 0.78 in the long run. Compared with results for other countries in the study, the U.S. transmission is strong. The weighted average of the transmission elasticity calculated for the 10 member countries of the European Community (later called the European Union, or EU) is 0.17 in the short run and 0.38 in the long run. The short- and long-run transmission elasticities for Japan are 0.24 and 0.47. For developing countries, Tyers and Anderson find that in the short run, most commodity/country transmission pairings have a price transmission elasticity less than 50 percent, and in many cases the elasticity is less than 25 percent. Although the transmission performance for these countries is better in the long run, the elasticity values are still far below unity.

Quiroz and Soto (1995) compute an aggregate transmission elasticity for changes in agricultural world prices to domestic producer prices for 78 countries over 1966-91. They find that for the United States, 50 percent of world price changes are transmitted to domestic prices within 2 years. Although this result is not high in an absolute sense and is much lower than the transmission estimates for the United States from Tyers and Anderson, for the Quiroz and Soto study the U.S. transmission elasticity is relatively high. Only 4 of the 78 countries in the study—Australia, Canada, New Zealand, and Uruguay—have a better transmission record than does the United States, with half or more of a world price shock transmitted to domestic prices within 1 year.

Quiroz and Soto find that most European countries show no transmission between trade and domestic prices, even in the long run. The best European performers are the United Kingdom, Italy, and Spain, which take 5-7 years to transmit 50 percent of a change in world prices to domestic prices. Quiroz and Soto find no evidence of transmission for Japan, even in the long run. For developing countries, Quiroz and Soto calculate that about one-third show no transmission even in the long run, while for the rest, the majority take at least 5-7 years to transmit 50 percent of a world price shock to domestic prices.

Mundlak and Larson (1992) compute transmission elasticities for world prices and exchange rates separately for 58 countries over 1968-78. They find that not only the United States but also most countries (including developing countries) have high transmission, in most cases close to one. Yet, Quiroz and Soto argue that the high transmission found by Mundlak and Larson

might be a spurious result due to a serious methodological problem, which they correct in their own study.

Even if one discounts the results by Mundlak and Larson, the findings by Tyers and Anderson and Quiroz and Soto show that price and exchange rate transmission for U.S. agriculture has been relatively high. This result stems in part from the United States having good supporting agricultural infrastructure—physical, commercial, and institutional. Transmission would be even higher if not for the effects of the various agricultural support policies that have existed in the postwar period (discussed earlier), some of which insulate domestic prices from changes in world prices and exchange rates.

Of the three works examined, Quiroz and Soto come closest in their period of coverage (1966-91) to the present, and their study ends in 1991. During the last 15 years, the United States has been liberalizing its agricultural policies. The main change has been a move toward support policies decoupled from both prices and production decisions by farmers. The main new type of support policy involves direct payments by the Government to farmers independent of prices and farmers' production decisions on what and how much to produce (USDA, ERS, Farm and Commodity Policy Briefing Room). By not being linked to or affecting farmers' market decisions, these payments do not impede price or exchange rate transmission. Thus, although certain policies have been retained that retard price transmission, such as the sugar program, if studies of the type done by Tyers and Anderson and Quiroz and Soto were done for the last 15 years, they would probably show higher transmission for the United States than these works reveal.

The low transmission of European agriculture results mainly from policies (within the EU, but also followed by non-EU members, such as Norway and Switzerland) that strongly insulate domestic prices from world price and exchange rate fluctuations. Like the United States, the EU also has been liberalizing its agricultural support policies during the last 15 years. As mentioned earlier, in the mid-1990s, the EU began reducing intervention prices and eliminated variable levies, which are transmission precluding. Yet, intervention prices remain for various commodities, as do high tariffs, which continue to impede transmission strongly (Agra Europe). Quiroz and Soto find that the developed countries with the highest transmission (even exceeding that of the United States) are Canada, Australia, and New Zealand (as discussed earlier). These countries appear to combine infrastructure equal to that in the United States with policies that are less transmission retarding than U.S. policies.

In addition to Tyers and Anderson, Quiroz and Soto, and Mundlak and Larson, a number of other studies calculate transmission elasticities for developing countries and also find generally low transmission. Hazell et al. (1990) compute the transmission of changes in world prices for 22 developing countries and 15 commodities over 1961-87. They find that transmission of world price changes to the prices at which countries export goods is generally high, but transmission to domestic producer prices is quite low. Baffes and Gardner (2003) compute transmission between world and domestic prices for 8 developing countries and 10 commodities from 1970 to the 1990s (the end year of the calculation varies by country). The results for Mexico, Chile, and Argentina show strong transmission, while those for

Columbia, Egypt, Ghana, Madagascar, and Indonesia show little or no transmission. All the countries covered undertook major agricultural liberalization reforms during the mid-1980s to early 1990s, and the study calculates the change in transmission after reform begins. In some cases, transmission improves after a reform effort is made, but for most commodity/country pairings, transmission does not increase. The authors conclude that despite apparent reforms, protectionist policies continue (though in less overt form). Even if policy allows more transmission, poor infrastructure could also impede it.

Sharma (2003) computes transmission between world and domestic prices for eight Asian countries for wheat, maize, and rice over 1990-99. Like Baffes and Gardner, Sharma examines transmission over a period of time when the countries considered were beginning to liberalize their agricultural support and trade policies. Yet, he also finds transmission not to be high in the short run. For his statistically significant results, the simple average of all shortrun transmission elasticities is 0.27. The simple average of all statistically significant longrun elasticities is considerably higher at 0.65.

During the last 20 years, many developing countries have liberalized their agricultural support and trade policies, to varying degrees. The studies by Tyers and Anderson, Quiroz and Soto, and Hazell, Jaramillo, and Williamson capture little or none of that reform effort. Although the work by Baffes and Gardner and Sharma cover some of the reform period for certain countries, they find little evidence of improved transmission. Nonetheless, as with transmission for the United States, one would expect transmission during the last 15-20 years for many developing countries to be higher to some degree than that during the years before the mid-1980s. At a minimum, one would expect the negative effect of policy on transmission to be reduced. Countries also might have made improvement in infrastructure. Yet, most developing countries continue to have weak agricultural market infrastructure, which is a major transmission impediment.

The Cause of Low Transmission for Developing Countries

Is low transmission for developing countries the result of mainly government policies or market conditions, in particular weak infrastructure? The empirical studies on transmission presented earlier do not provide an answer, as they do not allow one to apportion the calculated levels of incomplete transmission by cause. It would be useful at least to determine empirically whether market conditions (especially weak infrastructure) can also contribute substantially to incomplete transmission.

Evidence regarding the impact of market conditions on price transmission is rather general but nonetheless revealing. Fackler and Goodwin (2001) and Barrett (2001) acknowledge that most empirical tests for agricultural markets reject the “law of one price.” This “law” states that if one adjusts for the effects of market intervention policies and transport and transaction costs, then a product should have the same price everywhere within a country (or however one defines a market area). For traded goods, border prices should equal domestic prices. The failure of empirical tests to support the law of one price may stem from problems with measurement, especially of transport and

transaction costs, which usually are quite challenging to gauge (see the experience of Barrett concerning agricultural trade among Pacific Rim countries, 2001, p. 21-22). Yet, the empirical results suggest that in addition to policies and transport and transaction costs, nonpolicy-related incomplete transmission could create gaps between border and domestic prices.

Work by the Organisation for Economic Co-operation and Development (OECD) in computing producer support estimates (PSEs) can be used to provide more specific evidence of the effect of market conditions. The PSEs consist of two elements: budgetary transfers to producers and market price support (MPS), which results from policies that create a gap between border and domestic prices. In computing MPS for developing and transition economies, the OECD sets MPS equal to zero for a specific commodity/country pairing in the following situations, even if a gap exists between the border and domestic prices: (1) the good is exported, the domestic producer price is below the border price (in domestic currency), and no taxing policies can be identified (such as an export tax); and (2) the good is imported, the producer price is again below the border price, and some type of protection policy either can or cannot be identified (OECD, 2007). In the second case, even if a protection policy can be ascertained, because the domestic price is less than the border price, the negative price gap is not attributed to any policy.

In computing MPS, OECD adjusts for observable domestic transport and transaction costs. This means that if a price gap exists for a commodity that is given an MPS of zero, the price gap cannot be attributable to policies or observable transport and transaction costs. One can argue that by default, market conditions should be largely responsible for most of the gap. Some measurement error (especially concerning transport and transaction costs, product quality, and nonhomogeneity) could occur in OECD's price gap calculations (as OECD admits). Nonetheless, the OECD-observed price gaps can serve at least as a rough measure of the degree to which market conditions, including deficient infrastructure, maintain disparities between border and domestic prices, or alternatively, the degree to which market conditions impede transmission of changes in border prices (world prices or exchange rates) to domestic prices.

OECD has calculated PSEs for Brazil (OECD, 2005a) over the period 1995-2004, China (OECD, 2005b) over 1993-2003, and South Africa (OECD, 2006) over 1994-2003. The products for which OECD judges the MPS to be zero, in all or most years, are beef, pork, poultry, eggs, apples, and peanuts for China; beef, pork, poultry, sugarcane, and cotton for Brazil; and beef, pork, poultry, yellow maize, sunflowerseed, and groundnuts for South Africa. Given that for all three countries, the zero MPS commodities include the major meats (beef, pork, and poultry), the zero MPS commodities constitute a substantial fraction of the total value of these countries' agricultural output.

Based on OECD's MPS data for these commodities, domestic producer prices deviated from border prices for nonpolicy reasons on average by 24 percent in Brazil, by 15 percent in China, and by 21 percent in South Africa. For each country, the figure is derived from a weighted average of the price gap for specific commodities (for which MPS = 0) computed within years, and is an unweighted average of the annual aggregate price gap over the period for which OECD computes PSEs. The results suggest that market

conditions can create gaps between border and domestic prices, which occur because transmission between the two prices is incomplete.¹⁰ China, Brazil, and South Africa are hardly the least developed countries in the developing world, and their agricultural infrastructures are probably superior to those in many other countries, especially in sub-Saharan Africa. In the least developed economies, price gaps could be higher, and price and exchange rate transmission correspondingly lower, than in these countries.

OECD acknowledges that weak infrastructure and other market conditions in developing and transition economies can cause incomplete transmission and price gaps. In its 2007 review (Annex A, p. 166) of agricultural policies in nonmember countries, OECD states

. . . markets are characterized by various imperfections, while it takes time and cost for agents to react to new market signals. Therefore, market inertia creates price differentials independently of government price interventions. The degree of such non-policy “noise” increases in the case of non-OECD economies. Markets in these economies are characterized by underdeveloped physical infrastructure, poor information and weak market institutions, which impede price arbitrage. These deficiencies are even more pronounced in the countries with large territories, like Brazil, China, or Russia, where natural vastness exacerbates the effects of weak market organization.

These results also support the argument that fluctuating exchange rates often combine with market conditions to create enduring gaps that poor infrastructure and other market imperfections prevent from quickly closing. Of these three countries, Brazil has the largest price gap and also a volatile exchange rate. China, on the other hand, has the smallest price gap. Because of its policy of pegging its currency (the yuan) to the U.S. dollar (followed throughout the period for which OECD computes PSEs), China has had the least potential for currency movements to cause price gaps. OECD (2007, Annex A, p. 166) also acknowledges the major role fluctuating exchange rates can play in creating price gaps:

The majority of non-OECD economies went through periods of serious macroeconomic adjustments. Such adjustments—whether controlled or crisis—brought about shocks to relative prices. For example, macroeconomic reforms in Brazil, South Africa, and Russia were associated with massive exchange rate devaluations. Following the major reforms, all these countries saw additional currency shocks of varying intensity. The exchange rate devaluations pushed world prices, expressed in local currencies, above domestic price levels, and opened wide price gaps. Such abrupt and strong price disparities, emerging due to factors not related to agricultural policies, take time to dissipate and inevitably affect the measured price gaps.

¹⁰As discussed earlier, a situation could exist whereby the domestic transport and transaction costs for a good exceed the initial gap between the good’s border and domestic prices. The high transport and transaction costs would preclude any foreign trade. In addition, the price gap for such goods computed from OECD price data should be attributable to these costs, rather than to market conditions that impede price transmission. Yet, this point does not mar ERS’s calculations and interpretation of the price gaps for the zero MPS commodities for Brazil, China, and South Africa. For all the commodities and years for which OECD sets MPS equal to zero for these countries, the commodities were traded. This means that for each commodity in the aggregate in each year, the condition that domestic transport and transaction costs exceeded the initial price gap did not hold.

How Does Incomplete Transmission Affect Measures of Protection and Support?

Incomplete transmission of changes in world prices and exchange rates to domestic prices has implications for the interpretation of conventional measures of protection and support to agricultural producers and consumers. These measures include the nominal protection coefficient, nominal assistance coefficient, and producer support estimate (see box, “Measures of Protection and Support”). The measures were created mainly to gauge the effect of policies on markets and producers and consumers, with the producer support estimate being conceived specifically to measure support to *agricultural producers*. The measures all involve some sort of gap between the domestic price or value for a commodity and its border price or value. The price wedge is interpreted as a measure of the degree to which policies distort domestic prices, and thereby distort market incentives to produce, consume, and trade goods, as well as the degree to which producers and consumers are affected by the distortion.

Measures of Protection and Support

The simplest measure is the *nominal protection coefficient*, which equals the domestic producer price for a good divided by the border price. (The Organisation for Economic Development and Co-operation (OECD), however, calculates this coefficient as the producer price plus per unit output subsidies, divided by the border price.) The nominal rate of protection is the protection coefficient, but with the border price subtracted from the domestic price in the numerator. Another measure is the *nominal assistance coefficient*. This equals the domestic producer price plus per unit budget subsidies to producers, divided by the border price. This measure gives the full “incentive price” received by producers relative to the per unit revenue they would receive in the absence of any government support policies (the latter being simply the border price). The nominal rate of assistance is the assistance coefficient, but with the border price again subtracted from the domestic price in the numerator.

The *producer support estimate* (PSE) for a country’s agriculture measures the monetary value of gross transfers from consumers and taxpayers to producers from policy measures that support agriculture. It equals the value of output measured in domestic producer prices minus the value measured in border prices (the aggregate price gap), plus budget transfers (subsidies). The percent PSE is the value of the producer support estimate divided by the sum of the value of output measured in domestic producer prices and budget transfers. This measure gives the support producers receive from government policies, relative to the full revenue received by producers. All these measures make an adjustment between the domestic and border price for domestic transport and transaction costs.

Before 2007, OECD computed not only the aggregate PSE for countries’ agricultural producers, but also commodity-specific PSEs. In 2007, however, it discontinued calculating commodity-specific PSEs. The move toward noncommodity-specific direct payments by many countries, such as the United States and the EU region, made it conceptually inappropriate to attribute budget subsidies to specific products. OECD, however, continues to compute commodity-specific market price support, which is the difference between a good’s domestic and border prices.

Deficient market conditions, and especially weak infrastructure, that impede price and exchange rate transmission can make it difficult for policymakers to interpret these measures. As discussed earlier, poor infrastructure can have two main effects—high transport and transaction costs and incomplete transmission between border and domestic prices. In computing and interpreting these measures of support, however, the convention has been to assume that weak infrastructure has only the first effect—transport and transaction costs.¹¹ Under this assumption, any difference between domestic and border prices not attributable to policies is attributed to these costs, such that markets are always in equilibrium. The convenience of the assumption is that if transport and transaction costs are deducted, any remaining gap between border and domestic prices can be attributed exclusively to policies.

Implicit in the assumption is that market conditions alone (independent of policy) cannot impede transmission between border and domestic prices, such that no gap can exist between the two prices that cannot be attributed to either policies or transport and transaction costs. Yet, the previous section of the report provided evidence (based on work by OECD) that deficient market conditions in Brazil, China, and South Africa can cause incomplete transmission between border and domestic prices. If true for these countries, it is probably even more true for those developing economies with weaker agricultural infrastructure. The conclusion would be that nontrivial price gaps can exist for periods of time that cannot be attributed to either market intervention policies or transport/transaction costs. This means that conventional measures of agricultural protection and support for developing economies must be interpreted with care, given that the interpretations could overstate the effects of policies in creating price gaps and distorting market incentives.¹² If governments misidentify the cause of price gaps as revealed by the measures, they might adopt inappropriate policies intended to eliminate the gaps.

¹¹An example of this attitude and approach is the guide by Tsakok (1990) on computing and using measures of agricultural protection, support, and comparative advantage. In the methods described for computing these measures, Tsakok assumes that the sole effect of deficient infrastructure is transport and transaction costs.

¹²OECD's work in computing producer support estimates (PSEs) is in fact a major exception to the convention of assuming that weak infrastructure cannot cause any incomplete transmission. In its calculation of PSEs for the transition economies of the former Soviet bloc, and, more recently, developing economies, the OECD has consistently acknowledged that sizeable price gaps could result from incomplete transmission of changes in world prices, and especially exchange rates, to domestic prices, and where deficient infrastructure could be a major cause of the incomplete transmission, such that domestic markets are not in equilibrium (OECD 1998, p. 144; Melyukhina 2003, pp. 125-126; World Bank and OECD 2004, pp. 77-78). As discussed earlier, when OECD computes the market price support (MPS) part of PSEs and a gap (adjusted for domestic transport/transaction costs) exists between the domestic and border price for a good that cannot be attributed to any identifiable policy, OECD sets the good's MPS equal to zero. Yet, if any policy can be found, OECD includes the entire calculated gap in the MPS.

Conclusion

One of the main features of the globalization of the world economy during the last 20 years has been the move toward freer trade and greater integration of countries' domestic markets into world markets, in agriculture as well as in other sectors. In the late 1980s, many developing countries liberalized their agricultural production and trade policies, while the collapse of the Soviet bloc resulted in those countries moving from closed planned economies to generally open market systems. The Uruguay Round Agreement on Agriculture contributed to the liberalization of agricultural trade and support policies, as it banned quotas and other quantitative trade restrictions and pushed for converting trade measures into tariffs.

For countries to maximize their volume of trade and the resulting welfare gains from trade, changes in the world prices for goods and exchange rates must be transmitted to the domestic prices faced by the countries' producers and consumers. Trade liberalization eliminated many systemic and policy constraints to agricultural trade and market integration, and, more specifically, ended or reduced systemic and policy impediments to price and exchange rate transmission. However, many developing and transition economies suffer from a different type of impediment to transmission and market integration—deficient market conditions, such as weak market infrastructure and market power held by large domestic producers. These conditions cause gaps between domestic and world prices, and in so doing reduce these countries' trade volumes and economic gains from trade.

The current Doha Round of multilateral trade negotiations has been called the “development round” because a major goal is to help developing economies reap more of the gains from trade and integration into world markets, especially in agriculture. Within the round, developing countries have been pushing for developed countries to end policies that reduce world agricultural prices. Yet, for agricultural producers in developing countries to benefit from such policy changes, the rise in world prices must be transmitted to their domestic markets. If market conditions within developing countries inhibit the transmission of higher world prices to their domestic prices, they lower the gains the developing economies can receive from trade liberalization.

The surge in world agricultural and food prices from mid-2006 to mid-2008 also demonstrates how developing countries might suffer if market conditions impede price transmission. During this time, food prices faced by urban consumers in many developing countries rose substantially, indicating fairly strong transmission of world prices to *consumer food prices*. This effect stems from cities having good infrastructure for the flow of food and other goods and for economic activity in general. Although consumers suffered from the price increases, agricultural producers within developing countries, many of whom are poor small plotters, had an opportunity to benefit from the rising prices. Yet, weak and undeveloped rural and agricultural infrastructure within these countries might have reduced the price transmission and thereby the benefit these poor farmers actually received. The price

surge likely affected developing countries asymmetrically, in that their food consumers were hit hard, with little offsetting advantage of higher prices to farmers.

If market intervention policies are the main cause of incomplete transmission, governments have it within their power to improve transmission through policy reform. If the main cause of incomplete transmission is market imperfections such as market power or weak infrastructure, governments can adopt corrective policies, but progress can take long and be expensive. Weak infrastructure is largely a problem of economic development, for which there is no quick solution. Yet, for many developing countries, improving market infrastructure and other market conditions may have more potential to improve price and exchange rate transmission and expand trade than reducing existing agricultural market intervention policies.

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