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Decomposing Changes in Agricultural Producer Prices

by
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Abstract

This paper develops a method for decomposing changes in agricultural producer prices. The method builds on a procedure used by the World Bank, with the key variables in the decomposition being trade prices, exchange rates, and agricultural trade policies. The main ways by which we expand on the World Bank decomposition procedure are by broadening the analysis of policy effects, and by adding the effect from incomplete transmission of changes in border prices and exchange rates to producer prices, and the effect on prices from interactions between variables as they change simultaneously. We demonstrate the decomposition method by using the Russian poultry market in the late 1990s, and find that the dominant factor in changing the producer price was the large depreciation of the ruble. Many developing and transition economies have fluctuating exchange rates. The decomposition method presented in this paper could be used to test the hypothesis that exchange rate movements are the main cause of changes in these countries' agricultural commodity prices. Another hypothesis that the method could help test is that an important factor in affecting countries' agricultural prices is incomplete transmission of changes in trade prices and exchange rates to domestic prices, where the incomplete transmission is mainly caused not by policy, but rather by undeveloped market infrastructure.

Introduction

This paper develops a method for decomposing changes in agricultural producer prices, and then demonstrates the method using an example from Russian agriculture. The decomposition method builds on a procedure used by the World Bank, with the key variables in the decomposition being trade prices, exchange rates, and agricultural trade policies. The main ways by which we expand on the World Bank decomposition procedure are by broadening the analysis of policy effects, and by adding the effect from incomplete transmission of changes in border prices and exchange rates to producer prices, and the effect on prices from interactions between variables as they change simultaneously.

Producer price instability within a country can hurt incentives to produce and invest, as well as create volatility in farm income. Trade liberalization and growing integration into world markets make countries' agriculture increasingly vulnerable to fluctuations in world commodity prices and exchange rates. On the other hand, in order to benefit from trade and integration into the world economy, countries' agricultural economies must be responsive to trade prices (World Bank and IMF 2005). Decomposing why agricultural producer prices change would therefore provide useful information for policymakers.

The procedure for decomposing changes in producer prices developed in this paper is similar to the method for decomposing changes in agricultural price gaps presented in IATRC Working Paper 05-2 (Liefert 2005) by this same author. The reason for the similarity is that the price gap in the latter paper is defined as the producer price minus the border price (trade price times exchange rate). To avoid repetition, certain issues common to both decomposition methods are discussed more tersely in this paper than in the 05-2 paper (with reference for more discussion often made to the latter paper).

The second section of this paper examines the World Bank's procedure for decomposing changes in prices, while the third section presents our decomposition procedure. The fourth section demonstrates our decomposition method by using it to decompose the change in the producer price for Russian poultry over the period 1997-99. The fifth section discusses some limitations of the decomposition procedure, while the conclusion summarizes the paper's main findings.

The World Bank Decomposition Procedure

Method

Quiroz and Valdes (1993), Valdes (1996), Valdes (1999), Valdes, Olsen, and Ocana (1999), and Valdes (2000) present a method for decomposing changes in countries' agricultural producer prices, and use the procedure for decomposition analysis for a number of developing and transition economies. Because this work either appears mainly in World Bank (WB) publications or was done by WB personnel, we call this method the "World Bank decomposition procedure." The decomposition begins with the equation

$$P_t^d = P_t^w X_t \, (1 + t_t^p)\,(1 + g_t) \qquad (1)$$

where P_t^d is a country's real producer price for a commodity in time t, P_t^w the real border (trade) price in foreign currency, X_t the real exchange rate, t_t^p the nominal rate of protection, such that $(1 + t_t^p)$ is the nominal protection coefficient, and g_t a "markup" factor covering domestic transport and transaction costs that equalizes the domestic and border prices. The real values for the domestic and border prices are determined by dividing the nominal prices in time t by domestic and foreign price indices with respect to the base period, while the real exchange rate is determined by multiplying the nominal exchange rate by the ratio of the foreign to domestic price indices.

The next step in the WB decomposition derivation is to put equation (1) into natural logs and then differentiate with respect to time, which yields the decomposition equation

$$\dot{P}^{d} = \dot{P}^{w} + \dot{X} + \overset{\bullet}{\overbrace{(1+t^{p})}} \qquad (2)$$

where a dot above a variable indicates the percent change in the variable. The term $(1 + g_t)$ drops out, because the World Bank decomposition procedure assumes that the transport/transaction costs as represented by g are a *fixed proportion* of $[P^w X\ (1+t^p)]$. We also make this assumption in our decomposition procedure.

Equation (2) decomposes $\dot{P}^{d}$ by attributing its change to the changes in P^w, X, and the nominal protection coefficient $(1+t^p)$, which measures the effect that policy has on P^d. The WB decomposition procedure computes $\overset{\bullet}{\overbrace{(1+t^{p})}}$ as a residual:

$$\overset{\bullet}{\overbrace{(1+t^{p})}} = \dot{P}^{d} - \dot{P}^{w} - \dot{X} \qquad (3)$$

Assessment

Analysis of the decomposition of $\dot{P}^{d}$ depends to a large degree on whether policy allows transmission of changes in P^w and X to P^d. Some policies prevent transmission, because the policies fix P^d independent of P^w and X. Such policies include managed price policies of the type the United States and EU have maintained in the postwar period, but are now moving away from (Normile, Effland, and Young 2004). Trade quotas also “fix” domestic producer prices, in that the quota volume interacts with domestic supply and demand for a commodity to determine the domestic price, independent of the trade price and exchange rate. Likewise, state trading in its most typical form, whereby a government agency determines the volume of a commodity to be exported or imported, can act like a quota (and might be tied to official quotas), again insulating P^d from changes in P^w and X (see Ackerman and Dixit 1999).

With such policies, a "decomposition" of $\dot{P}^d$ using equation (3) could yield some useful information. For example, if with a managed price policy $P^d > P^w X$ and policymakers raise P^d, $(1 + t^p)$ will increase (ceteris paribus), indicating that the price rise has increased the nominal rate of protection. However, an economically meaningful decomposition of $\dot{P}^d$ should require that P^d is a function of the variables used in its decomposition. Policies that fix P^d make the price independent of P^w and X. Consequently, changes in P^w and X will not by themselves change P^d, such that attributing any change in P^d to ΔP^w or ΔX becomes problematic. This point does not mean that when policy largely fixes P^d, the WB decomposition procedure is inadequate and should be replaced by a better method. Rather, it raises the question of how much economic sense there is in decomposing $\dot{P}^d$ when policy determines the value of P^d.

However, in the case of policy not allowing transmission, the WB decomposition procedure does become meaningful if the following assumption is made: if both P^d and either P^w or X change, as much of the change in P^d as possible is attributable to the change in P^w and X. In other words, whatever the change in P^d that actually occurs, it is assumed that policymakers have deliberately changed P^d (or the policy that determines P^d) in response to the change in P^w and X (up to the maximum degree that P^d could change solely in response to a change in P^w and X). The Appendix examines how the WB decomposition procedure can be used given this assumption.

If agricultural price and trade policies that fix prices were dominant in countries throughout the world, one might conclude from the above discussion that decomposition of changes in agricultural producer prices is not a very relevant issue. However, such policies as they exist are diminishing, and the world in general is moving toward policies that allow transmission (tariffs, tariff rate quotas, and technical barriers to trade).[1] The Uruguay Round Agreement on Agriculture banned import quotas, non-tariff measures maintained through state trading enterprises, and most other non-tariff trade barriers, requiring countries to tariffy border measures. Both the United States and EU are replacing price support policies with direct payments to farmers largely decoupled from prices and production (Normile, Effland, and Young 2004). Also, when developing and transition economies support their agriculture, they usually use tariffs as their main support instrument, one reason being that they can not afford the expensive price and income support policies prevalent in OECD countries in the postwar period.

The WB decomposition procedure can serve as a useful first step in decomposing changes in P^d when policy allows transmission. It, however, has certain limitations. One deficiency, which the authors of the cited studies acknowledge, is that the procedure misvalues the contribution to $\dot{P}^d$ of the change in policy, as represented by $\overset{\bullet}{\overbrace{(1+t^p)}}$, for the following reason. Given that P^w, X, and $(1+t^p)$ change simultaneously, equation (2) is incomplete, because it excludes the multiplicative terms that result from $\dot{P}^w$, $\dot{X}$, and $\overset{\bullet}{\overbrace{(1+t^p)}}$ being multiplied by each other. The derivation of equation (2) is based on the assumption that all multiplicative terms are small enough to be ignored. The decomposition equation with the interactive multiplicative terms included is

$$\dot{P}^d = \dot{P}^w + \dot{X} + \overset{\bullet}{\overbrace{(1+t^p)}} + \dot{P}^w\dot{X} + \dot{P}^w\overset{\bullet}{\overbrace{(1+t^p)}} + \dot{X}\overset{\bullet}{\overbrace{(1+t^p)}} + \dot{P}^w\dot{X}\overset{\bullet}{\overbrace{(1+t^p)}} \quad (4)$$

In this case

$$\overset{\bullet}{\overbrace{(1+t^p)}} = \frac{\dot{P}^d - \dot{P}^w - \dot{X} - \dot{P}^w\dot{X}}{1 + \dot{P}^w + \dot{X} + \dot{P}^w\dot{X}} \quad (5)$$

Comparing $\overset{\bullet}{\overbrace{(1+t^p)}}$ in equations (3) and (5), we see that $\overset{\bullet}{\overbrace{(1+t^p)}}$ in equation (3) misvalues the effect of policy changes on $\dot{P}^d$. This happens because equation (3) does not include $-\dot{P}^w \dot{X}$ in the right-side numerator, and also does not include $\dot{P}^w + \dot{X} + \dot{P}^w \dot{X}$ in the denominator (or what should be the denominator). Our decomposition will avoid this misvaluation of policy effects.

Another limitation of the WB decomposition procedure is that a decomposition that provides more information is possible. The following example demonstrates the point. Let $P^w = 50$, $X = 2$, and tariff rate (t) = 0.2, such that $P^d = 120$. If P^w rises to 75, P^d increases by 60 to 180. 50 of the increase results from a direct price effect (25 x 2), while 10 of the increase results from interaction of the rise in P^w with the tariff (25 x 2 x 0.2). The latter can be called an *implicit policy effect*, which occurs when a tariff exists and P^w or X changes. Although the tariff rate need not change, the rise in P^d from this effect occurs because of the existence of the tariff. We can distinguish between an implicit policy effect and an explicit policy effect, which occurs when the tariff rate changes. The implicit and explicit policy effects which can exist with a tariff are similar to the implicit and explicit policy effects which can exist when a managed price policy is in place and policymakers, in setting P^d, respond to some degree to changes in P^w and X (as discussed in the Appendix).

When policy allows transmission of changes in P^w and X to P^d, P^d can change not only because of the direct price effect and policy effect, but also because of deficient market infrastructure – physical, commercial, and institutional. Undeveloped physical infrastructure involves deficiencies such as weak transportation and storage, while poor commercial and institutional infrastructure involves deficiencies such as weak systems of market information, credit, and commercial law. Developing and transition economies in particular can suffer from poor infrastructure, which can have a number of effects. First, it can result in high internal transport/transaction costs. Second, it can create the market imperfection of incomplete information (Fackler and Goodwin 2001, Barrett 2001, Barrett and Li 2002). In particular, producers in isolated areas might be unaware of prices (and especially price movements) for their output. Third, weak market infrastructure can create localized market power by processors and distributors and hold-up problems, such as delayed payments to farms which reduce real prices (especially when inflation is high; Gow and Swinnen 1998). The last two effects can reduce the transmission of changes in P^w and X to P^d. The change in P^w or X is the active element in changing P^d, though the change in P^w and X combines with incomplete transmission, caused by undeveloped market infrastructure, to change P^d. We call this the *incomplete transmission effect* on P^d.

A feature of developing and transition economies is that they can have highly fluctuating exchange rates (IMF). Deficient infrastructure could prevent much of the change in exchange rates from being transmitted to domestic prices. Harley (1996), Liefert et al. (1996), the OECD country studies on Russian and Ukrainian agriculture (OECD 1998, World Bank and OECD 2004), and Melyukhina (2002) discuss the possibility of this effect for transition economies. World commodity prices also fluctuate. For example, the average annual change in world prices for wheat, pork and refined sugar over 1986-2002 was 20, 15, and 16 percent, respectively (ERS). A method for decomposing changes in prices that can identify the degree to which prices fail to respond to changes in border prices and exchange rates would be useful to policymakers.

The next section develops an alternative method to that of the WB for decomposing changes in producer prices when policy allows transmission of changes in P^w and X to P^d. The method will allow one to isolate and measure the direct price effect, policy effects (both explicit and implicit), and incomplete transmission effect on P^d.

The Decomposition Method

Derivation

We first derive the decomposition equation when an ad valorem tariff exists, and then examine how the equation should be altered when other transmission-allowing policies are operative. The derivation begins with the identify

$$\dot{P}^d \equiv \dot{P}^d \tag{6}$$

We then multiply the right side $\dot{P}^d$ by $1 = \left(\dfrac{\overset{\bullet}{\overbrace{[P^w X\ (1+t)]}}}{\overset{\bullet}{\overbrace{[P^w X\ (1+t)]}}} \right)$, where t is the tariff rate.

$[P^w X\ (1+t)]$ is the *duty included landed price* (henceforth called simply *landed price*). It gives the value of the imported good immediately after it clears customs, and thereby equals the cif (cost, insurance, freight) value plus the tariff. In a well-functioning market economy, and assuming that the internal transport/transaction costs of moving imports from the border to domestic consumption sites equal the cost of moving domestic output from the farmgate to the domestic consumption sites, this value should determine the domestic producer price for the commodity.

In the right side term $\dfrac{\dot{P}^d\ \overset{\bullet}{\overbrace{[P^w X(1+t)]}}}{\overset{\bullet}{\overbrace{[P^w X\ (1+t)]}}}$, we can isolate the subterm $\dfrac{\dot{P}^d}{\overset{\bullet}{\overbrace{[P^w X\ (1+t)]}}}$. This gives the price transmission elasticity (PTE) between the landed price and domestic producer price. We define *e* as the PTE, such that

$$e = \frac{\dot{P}^d}{\overset{\bullet}{\overbrace{[P^w X\ (1+t)]}}} \tag{7}$$

This gives

$$\dot{P}^d = e\,\overbrace{[P^w X\ (1+t)]}^{\bullet} \qquad (8)$$

The presence of the PTE (e) in the decomposition equation will allow analysis and measurement of the effect on P^d of incomplete transmission from ΔP^w and ΔX to P^d (the incomplete transmission effect). In order to isolate the effect of incomplete transmission, we insert for the PTE not e, but rather ($e + k - k$), where

$$k = 1 - e \qquad (9)$$

$$e + k = 1 \qquad (10)$$

k measures the degree to which the PTE deviates from unity. As such, throughout the derivation and analysis, it will represent and measure any incomplete transmission that exists.

$$\dot{P}^d = (e + k - k)\,\overbrace{[P^w X\ (1+t)]}^{\bullet} \qquad (11)$$

$$\dot{P}^d = \underset{\text{A}}{\overbrace{[P^w X\ (1+t)]}^{\bullet}} - k\,\underset{\text{B}}{\overbrace{[P^w X\ (1+t)]}^{\bullet}} \qquad (12)$$

The letters below the equation identify the two right side terms. If transmission from change in the landed price to P^d were complete ($e = 1$, such that $k = 0$), term B drops out. Assume that transmission is incomplete, such that $e, k < 1$. The logic of our decomposition approach is that it isolates and measures the effect on P^d assuming that transmission is complete (as measured by term A), as well as the effect on P^d from the incomplete transmission that exists (as measured by term B). B measures the degree to which P^d fails to change to the maximum extent possible because of incomplete transmission, or put differently, it measures the degree to which incomplete transmission cuts into this potential change. The sum of the two parts gives the net effect based on the actual value of e.

The purpose of the decomposition equation is to allow us to measure the shares of $\dot{P}^d$ which are caused by, and therefore can be attributed to, $\dot{P}^w$, $\dot{X}$, and $\dot{t}$. This requires that in the final form of the decomposition equation, no term contains the percent change of either a sum or product of two or more of these variables. In terms A and B, the additive term (1 + t) exists within the larger term $[\overbrace{P^w X\ (1+t)}^{\bullet}]$. We want to break $[\overbrace{P^w X\ (1+t)}^{\bullet}]$ into its two additive parts. This is done by using the result that the percent change of a sum of two numbers equals the sum of the percent change in each number, weighted by each number's share in their sum. This gives the following:

$$\dot{P}^d = \underset{C}{\frac{P^w X\ \overbrace{P^w X}^{\bullet}}{P^w X\ (1+t)}} + \underset{D}{\frac{P^w X\ t\ \overbrace{P^w X\ t}^{\bullet}}{P^w X\ (1+t)}} - \underset{E}{\frac{k\ P^w X\ \overbrace{P^w X}^{\bullet}}{P^w X\ (1+t)}} - \underset{F}{\frac{k\ P^w X\ t\ \overbrace{P^w X\ t}^{\bullet}}{P^w X\ (1+t)}} \qquad (13)$$

The letters under each term again identify that term. The next step is to deal with the percent change of a product of two or more variables. Attributing the share of individual variables to the change in their product appears to be a problem without a definite mathematical solution. In its decomposition of the change in the market price support part of PSEs, OECD confronts the same issue. OECD (2002) employs a procedure that yields subterms that contain changes in only single variables, with no changes in the product of two or more variables. We therefore use OECD's approach for handling the problem. This issue is also discussed at greater length in Liefert (2005), IATRC Working Paper 05-2, pp. 18-19.

In term C in equation (13), the subterms associated with $\dot{P}^w$ and $\dot{X}$ (obtained after employing OECD's method) measure the change in P^d from the direct price effect that occurs from ΔP^w and ΔX. In term D, the subterm associated with $\dot{t}$ measures the change in P^d from the explicit policy effect, while the subterms associated with $\dot{P}^w$ and $\dot{X}$ measure the change in P^d from the implicit policy effects (resulting from ΔP^w and ΔX interacting with the tariff). The magnitudes of all the effects in terms C and D are based on the assumption of complete transmission of change in the landed price to P^d. In terms E and F, the subterms associated with $\dot{P}^w$, $\dot{X}$, and $\dot{t}$ measure the change in P^d from the incomplete transmission effect (resulting from ΔP^w, ΔX, and Δt interacting with undeveloped infrastructure to create incomplete price transmission to P^d).

The decomposition analysis thus far assumes that the country in question is "small" in world markets and thereby lacks market power. Liefert (2005, IATRC Working Paper 05-2, pp. 26-27) examines the consequences of market power for decomposing changes in agricultural price gaps, and the discussion applies equally well to decomposition of changes in producer prices. The main effect of a country having market power in a commodity is that a major depreciation or appreciation in its currency could substantially affect the world market for the commodity, thereby altering P^w. This would enhance the importance of exchange rates in determining domestic prices.

Other Policies Allowing Transmission

The derivation of the decomposition equation when the tariff is a fixed per unit tax is similar to the derivation when the tariff is ad valorem. The landed price of the imported good now equals $[P^wX + T]$, where T is the per unit tariff. The only difference in the derivation compared to the ad valorem case is that in equation (6), one multiplies $\dot{P}^d$ in the right side by $1 = \left(\dfrac{\overbrace{P^w X + T}^{\bullet}}{\overbrace{P^w X + T}^{\bullet}} \right)$.

How would our decomposition method handle a tariff rate quota (TRQ) for a commodity? A TRQ is a two-tiered tariff, where a lower in-quota tariff is applied to a fixed volume of initial imports and a higher over-quota tariff is applied to all additional imports. TRQs are becoming increasingly common policy support instruments for countries (see Skully 2001). Because TRQs combine elements of a pure tariff and pure quota, the decomposition procedure for a TRQ combines elements of the decomposition methods for these two types of policies. A deeper examination of the decomposition method for a TRQ is given in Liefert (2005), IATRC Working Paper 05-2, pp. 24-25.

Another policy that can allow transmission from ΔP^w and ΔX to P^d is technical barriers to trade (TBTs), defined to include sanitary and phytosanitary (SPS) measures. Roberts, Josling, and Orden (1999) argue that the two most common TBT measures are regulations and testing, both of which increase the cost to foreign suppliers of providing goods for import by the TBT-imposing country. If the per unit cost of satisfying the regulation or meeting the testing requirement is B, the landed price for the import in the TBT-imposing country is $(P^w + B)X$. In deriving the decomposition equation, in equation (6) one now multiplies $\dot{P}^d$ on the right side by

$$1 = \left(\frac{\overbrace{(P^w + B)X}^{\bullet}}{\overbrace{(P^w + B)X}^{\bullet}} \right).$$

Empirical Example: The Producer Price for Russian Poultry

The example we use to demonstrate the decomposition method is the change in P^d for Russian poultry producers over the period 1997-99. Since the mid 1990's, poultry has been Russia's biggest agricultural import commodity (in value terms). The period 1997-99 is chosen because it spans Russia's economic crisis that hit in 1998. One effect of the crisis was a severe depreciation in the ruble, which gives the example the interesting feature of major change in the exchange rate. The two year period 1997-99 is used because the crisis hit in August 1998, such that much of the crisis' economic effects (on domestic prices and exchange rates, among other variables) did not play out until 1999.

During 1997-99, Russia had a 30 percent tariff on imported poultry, though with the condition that a minimum tariff be applied of 0.3 European Currency Units (ECUs) per kilo of imports. Another qualification is that in 1999, Russia received food aid from the United States and EU, including some poultry. Russia's receipt of food aid can be viewed as a policy decision, which affected domestic prices. As explained in Liefert (2005, IATRC Working Paper 05-2), uncertainty concerning the effects and interplay of the minimum per unit tariff and food aid is such that one could represent the net policy effect two different ways: (1) by applying the minimum per unit tariff to all poultry imports; and (2) by applying the ad valorem rate to all imports, but cut the tariff rate from 30 to 15 percent. The halving of the tariff captures the downward effect that food aid had on Russian domestic producer prices. In decomposing the change in the price gap between the domestic and border price using this specific example (Russian poultry over 1997-99), Liefert (2005, IATRC Working Paper 05-2) presents decomposition results for both policy representations. In this paper (dealing with decomposition of changes in producer prices rather than price gaps), we present results for the case of applying the ad valorem tariff (with a drop in the tariff from 30 to 15 percent), mainly because it gives a more interesting illustration of the decomposition procedure.

The OECD database for Russian PSEs (OECD) provides the data required by our decomposition procedure. The first step in generating the decomposition results is, using equation (7), to compute the PTE (e) between the landed price [$P^w X (1 + t)$] and the producer price P^d. The value is 37 percent. Equation (9) is then used to compute k, yielding a value of 63 percent. Table 1 gives the decomposition results, which incorporate the values for e and k. The column $\dot{V}$ gives the actual percent change in P^d and the variables that determine P^d. The column shows that from 1997 to 1999, the real P^d for Russian poultry rose 27 percent. The real border price P^w (expressed in ECUs) fell 17 percent, and the real ruble/ECU exchange rate X rose 137 percent. The 50 percent drop in *t* results from the decline in the tariff rate from 30 to 15 percent as discussed in the previous paragraph.

The other columns measure the degree to which changes in these variables change P^d, measured by the percent change in P^d. Equation (13) is used to compute the results. The three columns under "$e + k = 1$" give the effects on P^d based on the assumption that transmission of the change in the landed price to producer price is complete. Through the direct price effect, the drop in P^w decreases P^d by 22 percent, while the rise in X increases P^d by 97 percent.[2] The aggregate direct price effect is to raise P^d 75 percent.

The fall in the tariff rate has the explicit policy effect of reducing P^d 18 percent. The drop in P^w has the implicit policy effect of reducing P^d 5 percent, while the rise in X has the implicit policy effect of increasing P^d 22 percent. The aggregate policy effect is a decline in P^d of 1 percent. The combined effect of changes in all variables if transmission were complete is to increase P^d 74 percent.

The column "$-k$" measures the incomplete transmission effect on P^d which results from changes in variables that affect P^d interacting with incomplete transmission. The fall in P^w reduces P^d. Because of incomplete transmission, P^d declines less than it would with complete transmission. The failure of P^d to drop by the potential maximum has the attributable effect of raising P^d by 17 percent. Likewise, the rise in X increases P^d. Yet, because of incomplete transmission, P^d rises less than it could. The failure of P^d to increase by its potential maximum has the attributable effect of reducing P^d by 75 percent. The halving of the tariff rate t decreases P^d. However, because of incomplete transmission, 11 percentage points of the potential drop in P^d also does not materialize. The aggregate effect of the changes in P^w, X, and t combining with incomplete transmission (not caused by any policies that fix domestic prices) is to lower P^d by 47 percent.

The column "*e*" gives the net effect of changes in the causal variables on P^d. Figures in this column equal the values in the column "combined effect" under "$e + k = 1$" and the column "$-k$." The results show that the net attributable effect of the drop in P^w is to decrease P^d by 10 percent; the net attributable effect of the rise in X is to increase P^d 44 percent; while the net attributable effect of the decline in t is to decrease P^d 7 percent. The total net effect is to raise P^d 27 percent.

Table 1 also gives decomposition results for $\dot{P}^d$ using the WB decomposition procedure, which we can compare to results using our method. The WB decomposition results attributable to $\dot{P}^w$ and $\dot{X}$ conceptually are most similar to our results from the direct price effect, and the actual decomposition calculations from these two columns are somewhat close. The main reason our decomposition net results for $\dot{P}^w$ and $\dot{X}$ are lower than those from the WB procedure is because our decomposition has the incomplete transmission effect attributable to the changes in P^w and X.

The result in the table for "*t*" in the WB decomposition gives the effect on P^d from change in the nominal protection coefficient $(1+t^p)$. The WB result attributed to $\overset{\bullet}{\overbrace{(1+t^p)}}$ of -93 percent differs substantially from our result for $\dot{t}$ (the tariff rate) of -7 percent. One might think that this difference occurs mainly because the WB procedure computes the effect on P^d from $\overset{\bullet}{\overbrace{(1+t^p)}}$ while our approach computes the effect from just $\dot{t}$. This, however, is not the case. Equation (13) gives the effect on P^d attributable to $\dot{t}$ in the form of the effect from $\overset{\bullet}{\overbrace{(1+t)}}$. The easiest way to demonstrate this is as follows. $\overbrace{(1+t)}^{\bullet} = \frac{t\,\dot{t}}{1+t}$. Assume in equation (13) that only t changes, and that transmission is complete such that $k = 0$. This results in terms C, E, and F dropping out. The sole remaining term D reduces to $\frac{t\,\dot{t}}{1+t}$.

There are two main reasons for the large difference between the WB's calculation of the effect on P^d from $\overbrace{(1+t^p)}^{\bullet}$ and our calculation of the effect on P^d from $\dot{t}$. First, the WB approach misstates the value of $\overbrace{(1+t^p)}^{\bullet}$ because it calculates the term as a residual and thereby attributes to the term all the interactive multiplicative relationships between the variables (as discussed previously). The changes in the variables in our Russian poultry example are large such that the multiplicative terms are also substantial in size. Second, the WB approach includes in $\overbrace{(1+t^p)}^{\bullet}$ the incomplete transmission effect, which we attribute largely to deficient market infrastructure. If in the WB decomposition procedure, the effect on P^d from $\overbrace{(1+t^p)}^{\bullet}$ is intended to measure the effect of changes in agriculture-targeted policies alone, such as those involving market intervention, the procedure could misvalue the effect on P^d (and perhaps strongly so).

The decomposition results show that the dominant factor driving change in the producer price was the large depreciation of the ruble. However, most of the potential change in the price did not materialize because of poor transmission. If complete transmission had existed, the rise in X would have increased P^d by 119 percent. Incomplete transmission, however, prevented 75 percentage points of this potential rise, such that the net attributable effect of the rise in X was to increase P^d by only 44 percent.

Our empirical example involves Russian poultry over 1997-99, a period we deliberately chose because the exchange rate changed dramatically. However, during the transition period the ruble's exchange rate has fluctuated considerably. From 1992 to 2004, the average annual percent change in the nominal exchange rate (vis-a-vis the U.S. dollar) was 70 percent, and the corresponding figure for the real exchange rate was 32 percent (PlanEcon). This supports the argument that during transition, changes in the exchange rate combined with poor transmission have been the dominant factor affecting prices for Russian agricultural commodities.

The decomposition example is based on the assumption that Russia did not have market power in the world poultry market in the late 1990's. The evidence, however, suggests otherwise. In 1997, Russia accounted for about a third of world poultry imports (USDA), enough to give it market power. Russia's exchange rate depreciated substantially in 1997-99. The plunge in the ruble's value significantly raised Russian domestic poultry prices (Interfax), thereby reducing demand. Given Russia's world market power, the drop in its demand for poultry could by itself have reduced the price at which it imported poultry. This could account for part of the actual drop in P^w for poultry of 22 percent in the decomposition example. Given that the depreciation in the exchange rate probably caused some of the fall in P^w, the effect of the change in the exchange rate on the producer price is even greater than that indicated by the decomposition results.

A final issue is whether most of the incomplete transmission between the landed and producer price for poultry results from nontransparent policies or deficient market infrastructure. The results that our decomposition procedure can provide admittedly do not identify the cause of the incomplete transmission; to determine causality, other evidence must be brought to bear. Some relevant evidence is that no Russian federal policies existed in the second half of the 1990s which could explain most of the incomplete transmission (OECD 1998 and OECD 2001). Throughout transition, regional governments have engaged in various nontransparent policies that affect prices and transmission, the most common being restrictions on agricultural outflows (Interfax).[3] These controls, however, have usually been used for grain, not for poultry or other meats. On the other hand, Wehrheim et al. (2000) argue that undeveloped agricultural infrastructure (mainly institutional) has not only been weak during the transition period, but the most serious problem facing the sector. It therefore appears that most of the incomplete transmission in this example can be attributed to deficient infrastructure rather than policies.

Limitations of the Decomposition Procedure

Given that an objective of our procedure is to isolate and measure the effect on domestic prices of changes in government policies targeted to agriculture (both the explicit and implicit effects), versus the effect of changes in nonpolicy variables, our approach has the burden of identifying and integrating into the decomposition all such policies. It appears this is a manageable challenge for handling conventional national trade support policies, such as tariffs, quotas, tariff rate quotas, and managed prices (which typically involve variable tariffs), and perhaps state trading and technical barriers to trade as well.

Given that the Uruguay Round Agreement on Agriculture banned import quotas and other non-tariff trade barriers, there is strong concern that countries will try to protect domestic producers by imposing TBT and SPS measures. Being able to capture the effect of these measures in the price decomposition methodology is therefore important. As examined earlier in the paper, the effect of most TBT/SPS measures is to increase a good's import price. If such a measure is enacted, the policy effect in our decomposition will be understated, and the direct price effect overstated. This is because some of the change in P^w from the direct price effect will result from the TBT/SPS measure.

Policies less transparent than those identified two paragraphs above might not be as easy to identify and capture within the decomposition. Policies enacted by regional and local governments within a country, as have existed in Russia during its transition, would be particularly challenging to identify and account for. Nontransparent policies would most likely affect the price gap through P^d. The resulting effects on P^d would be attributed to incomplete price transmission. One of the ways we would like the decomposition procedure to be useful is in measuring the effect of deficient market infrastructure on price changes. This would be possible if no government policies impeding transmission existed. However, the inclusion of effects from any nontransparent policies in the incomplete transmission effect would compromise the latter as a measure of the effect on P^d from poor infrastructure alone. (As discussed above, though, TBT/SPS measures not captured in the decomposition would muddy the interpretation not of the incomplete transmission effect, but rather of the direct price and policy effects.)

The problem of nontransparent policies notwithstanding, our decomposition method has the merit of measuring the effect of incomplete transmission on producer prices, regardless of cause. More than that, the method can isolate and measure the effect of countries' transparent national trade policies. Given the move toward tariffication of agricultural trade policies in both the Uruguay and Doha Rounds of WTO trade negotiations, the ability of the decomposition method to separate out the effect of changes in tariffs versus the effects from changes in all other factors and variables that could affect farm prices should be useful. Lastly, any inability to distinguish between the effects of policy and deficient infrastructure on transmission does not tarnish the calculations that give the effects of changes in P^w and X on P^d.

Another limitation of our procedure is that transmission from a major change in P^w or X to

P^d might take not just one year to play out fully, but rather a number of years. If the decomposition is used to compute annual changes, then the effect attributed to a change in a variable over a single year of measurement might contain effects from changes in variables in previous years. This problem would not mar the decomposition effects based on the assumption of complete transmission − that is, in table 1 it would not tarnish the decomposition results in the columns under "$e + k = 1$". This is because these results are based on the strict assumption that whatever values exist in the base year of the measurement period, complete transmission occurs over the period.

If, however, transmission from changes in variables earlier than the base year of measurement (say in our example for Russia, changes in P^w or X in 1996) carry over to the period of measurement, this carry-over transmission would affect the decomposition for the column "$-k$". The results for this column would then measure not only effects of changes in variables that have occurred since the base year of measurement, but also effects on P^d from changes in variables before the base year. The carry-over effects in column "$-k$" for a specific variable (say X) would not necessarily be confined to the earlier change in that variable alone, but could contain effects from earlier changes in other variables as well. Any marring of the results in column "$-k$" for a specific variable would also affect the net results for that variable in column "e".

A point that mitigates the harm caused by this problem is that the decomposition results are the most interesting and important when either policy, or the variables P^w and X, change substantially. In such instances, the base year in the decomposition analysis would usually be one of relative price, exchange rate, and policy stability. If so, there would be little inherited transmission from changes in variables in the years preceding the base year of calculation. In computing the decomposition effects after major changes in variables, the most informative and least distorting approach would be to compute results always using the same base year (which should be the year of relative stability preceding the year of major change). In our example, we could compute changes from 1997 to 1998, 1997 to 1999, and 1997 to 2000. This would give a year-by-year record of how the decomposition effects materialize, as transmission plays out over time. An empirical point which supports this approach is that exchange rates tend not to fluctuate severely in opposite direction from year to year, but rather move cyclically, with the trough to peak (or peak to trough) period typically lasting a number of years (IMF).

In our Russian poultry example, 1996 and 1997 were years of relative stability in the ruble nominal exchange rate, the average annual change in the two years being 13 percent, compared to 138 percent during 1993-95. Russia during transition has also been a good example of a country whose exchange rate moves in multi-year cycles (PlanEcon).

Conclusion

This paper presents a method for decomposing changes in agricultural producer prices, the key variables in the decomposition analysis being trade prices, exchange rates, and trade policies. The decomposition methods allow one to identify and measure the following reasons why producer prices can change: (1) the direct price effect, whereby changes in trade prices and exchange rates are transmitted to domestic prices; (2) an explicit policy effect, whereby a change in a policy variable directly alters prices; (3) an implicit policy effect, whereby a change in the trade price or exchange rate combines with an existing policy to change prices; and (4) the incomplete transmission effect, whereby a change in the trade price or exchange rate combines with incomplete transmission to affect the price, and where deficient market infrastructure rather than policy intervention could be largely responsible for the incomplete transmission. The last effect exists only when policy allows some transmission of changes in trade prices and exchange rates to domestic prices, and is especially relevant for developing and transition economies.

Demonstration of the method using the Russian poultry price over 1997-99 shows that the main cause of change in the price was the large depreciation in the ruble, a consequence of the severe economic crisis that hit the country in 1998. The results also show, however, that much of the potential change in the producer price did not materialize, the main reason apparently being incomplete price transmission resulting from deficient market infrastructure. This supports the argument that fluctuating exchange rates, combined with incomplete transmission, have been key factors affecting Russian agricultural producer prices during the transition.

Many developing and transition economies have highly fluctuating exchange rates. The decomposition method presented in this paper could be used to test the hypothesis that the main cause of changes in these countries' agricultural commodity prices is exchange rate volatility. Another hypothesis the decomposition method could help test is that an important factor in affecting countries' prices is incomplete transmission of changes in trade prices and exchange rates to domestic prices, where the incomplete transmission is caused not by policy, but rather by undeveloped market infrastructure.

Endnotes

[1] Managed price policies also can, and in fact often do, involve tariffs. If the managed price for a commodity exceeds the world price, a tariff equal to the difference is often used to “defend” the domestic price. The tariffs are reactive, in that they are set in response to the managed prices, and must be altered in response to changes in P^w and X. The tariffs, therefore, do not automatically allow transmission of changes in P^w and X to P^d, but rather are part of the policy instrument set that maintains the managed prices. A prime example is the variable tariffs used by the EU.

[2] Because the variables that determine P^d change simultaneously, the results in table 1 give the *attributable effects* of a change in a variable on P^d, not the isolated effects that would occur if the variable in question were the only causal variable to change. The attributable effects therefore capture the multiplicative relationships that occur when variables, whose functional relationship involves multiplication by each other, change simultaneously.

[3] One motive for the outflow controls could be the desire of government officials, especially during poor harvests, to maintain an adequate level of local food supplies. Another possible motive could be the officials' wish to gain from the price arbitrage opportunities between regions that the restrictions create.

Appendix: Decomposition of Change in Producer Price when Policy does not Automatically Allow Transmission

As explained in the text, in the case when policy precludes automatic transmission, the WB decomposition procedure becomes meaningful if one assumes that any change in P^d results from policymakers' deliberate decision to change P^d in response to the change in P^w and X (up to the maximum possible change in P^d in response solely to changes in P^w and X). The change in P^d that occurs for this reason is called the *desired transmission effect*.

The decomposition procedure can involve two other effects. Any change in P^w or X that policymakers do not choose to pass on to P^d is called the *implicit policy effect* on P^d. In this case, P^d does not change because, first, policy does not allow automatic transmission, and, second, policymakers decide that their determination of P^d should not respond to changes in P^w and X (at least not in full). The implicit policy effect measures the degree to which P^d could potentially change but does not given that policymakers prevent transmission. The inability of P^d to respond to the change in P^w and X is a passive effect, implicit in the policy. A third possible effect is the *explicit policy effect*. This occurs when policymakers change P^d without any change in P^w or X; that is, they decide to change P^d independent of its relationship to the border price. The implicit and explicit policy effects that can be identified in this decomposition analysis are similar to the implicit and explicit policy effects that Tangermann (2003) identifies in analyzing changes in the market price support part of producer support estimates (PSEs).

The appendix table demonstrates how the decomposition procedure could be used, given 6 possible scenarios involving the relationship between the changes in P^d, P^w, and X. For each scenario, the table gives hypothetical values for the percent change in P^d and P^wX. The values in the "policy" column give the effect on P^d from policy, computed, using the WB decomposition procedure, as the percent change in P^d minus the percent change in P^wX. For simplicity, P^w and X are combined into the single "variable" P^wX (the border price in domestic currency), such that we deal with the change in this single variable rather than changes in P^w and X separately. The decomposition procedure , however, could easily handle separating out the changes in P^w and X.

In scenario (1), P^d does not change while P^wX does change (rising by 50 percent). The change in P^wX is not passed on to P^d, which reflects both that policy precludes any automatic transmission and policymakers choose not to pass any of the change in P^wX on to P^d. The failure of P^d to rise in response to the increase in P^wX results in an implicit policy effect of – 50 percent.

In scenario (2), P^d and P^wX both change in the same direction (it could be positive or negative), but the absolute value of the percent change in P^wX exceeds that of P^d. P^wX rises 50 percent, while P^d rises only 30 percent. The 30 percent increase in P^d measures the desired transmission effect, because policymakers decide to let P^d rise by this amount in response to the growth in P^wX. Policymakers, however, choose not to pass on to P^d 20 percent of the rise in P^wX, which results in an implicit policy effect of – 20 percent.

In scenario (3), P^d and P^wX change by the same percent (rising again by 50 percent). Since all of the change in P^wX is passed on to P^d, the 50 percent rise in P^d measures the desired transmission effect from the change in P^wX. There is no policy effect.

In scenario (4), P^d and P^wX again change in the same direction, but the absolute value of the change in P^d (90 percent) exceeds that of P^wX (50 percent). The 50 percent rise in P^wX passed on to P^d measures the desired transmission effect. The percent rise in P^d exceeds that of P^wX by 40 percent. This measures the explicit policy effect on P^d, in that it reflects policymakers' decision to increase P^d independent of any motivating change in P^wX.

In scenario (5), P^d changes (up 60 percent), while P^wX remains unchanged. Because P^d rises without any motivating change in P^wX, the 60 percent rise in P^d is an explicit policy effect.

In scenario (6), P^d and P^w X both change, but in opposite directions (P^d falling 30 percent and P^wX rising 50 percent). In decreasing P^d, policymakers clearly have not responded to the 50 percent rise in P^wX. The 50 percent value in column $\overset{\bullet}{\overbrace{P^w X}}$ therefore measures the implicit policy effect of the change in P^wX. Policymakers' decision to decrease P^d 30 percent despite P^wX moving in the opposite direction measures the explicit policy effect. The difference in the effect on P^d from the actions taken by policymakers and from what would occur if they allowed the change in P^wX wholly to determine the change in P^d equals 80 percent. This measures the full policy effect (implicit and explicit effects) from the policymakers' actions.

In this decomposition analysis, values in the specific columns will not always measure the same effect. Values in the policy column, however, will always give the full policy effect on P^d, in that the values will reflect the combined implicit and explicit policy effects (if any).

Appendix Table: Decomposition of Change in Producer Price when Policy does not Automatically Allow Transmission

Scenario	P^d	$P^w X$	Policy
		percent change	
(1) $\dot{P}^d = 0,\ \dot{\overbrace{P^w X}} \neq 0$	0	50	− 50
(2) $\dot{P}^d * \dot{\overbrace{P^w X}} > 0$,[1] $\lvert \dot{P}^d \rvert < \lvert \dot{\overbrace{P^w X}} \rvert$	30	50	− 20
(3) $\dot{P}^d = \dot{\overbrace{P^w X}} \neq 0$	50	50	0
(4) $\dot{P}^d * \dot{\overbrace{P^w X}} > 0$,[1] $\lvert \dot{P}^d \rvert > \lvert \dot{\overbrace{P^w X}} \rvert$	90	50	40
(5) $\dot{P}^d \neq 0,\ \dot{\overbrace{P^w X}} = 0$	60	0	60
(6) $\dot{P}^d * \dot{\overbrace{P^w X}} < 0$ [2]	− 30	50	− 80

[1] Means P^d and $P^w X$ change in same direction, either positively or negatively.

[2] Means P^d and $P^w X$ change in opposite directions.

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Table 1: Decomposition of Change in Producer Price for Russian Poultry, 1997-99

Variable (V)	$\dot{V}$	Contribution of $\dot{V}$ to $\dot{P}^d$					
		$e+k=1$			$-k$ (incomplete trans-mission effect)	e (net effect)	WB decomp
		direct price effect	policy effect	combined effect			
	percent						
P^w	-17	-22	-5	-27	17	-10	-17
X	137	97	22	119	-75	44	137
t	-50	na	-18	-18	11	-7	-93
P^d	27	75	-1	74	-47	27	27

Note: The WB decomp column gives results based on the World Bank decomposition method. The figure associated with t in this column gives the effect of change in the nominal protection coefficient, as measured by $(1+t^p)$. "na" means not applicable.

Source: For $\dot{V}$, database for Russian PSEs (OECD), and PlanEcon and Bureau of Labor Statistics for the Russian and foreign (U.S.) producer price indices used to move from nominal prices and exchange rate to real values. For contribution of $\dot{V}$ to $\dot{P}^d$, own calculations.