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Decomposing Changes in Agricultural Price Gaps

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Abstract

The paper develops a procedure for decomposing changes in agricultural price gaps, defined as the difference between a commodity's domestic producer and border prices. Two decomposition approaches are presented, depending on whether policy allows transmission from changes in trade prices and exchange rates to domestic prices. The methods allow one to isolate and measure the effect on the price gap of changes in agricultural policy versus non-policy variables. The decomposition procedure is demonstrated in an example involving the price gap for Russian poultry in the late 1990s. The results are consistent with the argument that for developing and transition economies, the main cause of changes in price gaps is incomplete transmission of changes in exchange rates to domestic prices, resulting not from policy intervention, but rather from undeveloped market infrastructure.

Introduction

This paper develops a procedure for decomposing changes in agricultural price gaps. The price gap is defined as the difference between the domestic producer price for a commodity and its border price expressed in domestic currency. Price gaps are important as indicators of the degree to which countries are integrated into world agricultural markets, as well as being the fundamental information revealed by standard measures of trade protection. Price gaps are also a key element in the most widely-used measure of countries' support to agriculture − producer support estimates (PSEs). Identifying and measuring why price gaps change, that is, determining the degree to which changes in specific variables drive movement in price gaps, therefore provides important information for agricultural policy analysis. Our decomposition procedure focuses on separating out and measuring how changes in agriculture-targeted policies (such as import tariff rates), as well as changes in nonpolicy variables (such as border prices and the exchange rate), contribute to changes in price gaps.

Strong concern currently exists in economic development circles for developing countries' capacity to engage profitably in foreign trade. For example, the Global Monitoring Report 2005 put out by the World Bank and IMF highlights the "behind-the-border" problems in developing countries that retard trade, especially in agriculture, and thereby diminish trade's potential to raise incomes and contribute to growth. The trade-constraining problems largely involve undeveloped physical, commercial, and institutional infrastructure which works to isolate regional markets within countries from the world market. The report argues for an aid strategy, called "Aid for trade," whereby assistance focuses on improving countries' trade infrastructure and capacity. A conference held by the Organization for Economic Cooperation and Development in May 2002, "Agricultural Trade Reform, Adjustment, and Poverty," focused on similar problems and issues for developing and transition economies (OECD 2003).

Deficient infrastructure and other behind-the-border obstacles to trade can create gaps between domestic producer prices and border prices. Our procedure for decomposing changes in price gaps provides a mechanism for empirically measuring the magnitude of this problem. The paper in fact argues that the major cause of changes in agricultural price gaps for developing and transition economies is not changes in agriculture-targeted policies. Rather, the main cause appears to be poor transmission from changes in border prices and, especially, exchange rates to domestic producer prices, where the weak transmission is caused not by policy, but rather by undeveloped market infrastructure. If so, strengthening macroeconomic stability and improving domestic infrastructure might do more to reduce price gaps, and their economic effects, than liberalizing agricultural trade policies. Given that PSEs were created to measure the effect of agriculture-targeted policies on agricultural producers and markets, the above argument also raises the question of the appropriate way to compute and interpret PSEs.

The paper is organized as follows. The second section examines the price gap and its main elements. The third and fourth sections present two different methods for decomposing changes in price gaps, with the choice of method depending on the type of trade policy that exists for a given commodity. The key feature behind this dichotomy is whether policy allows any transmission of changes in border prices and exchange rates to domestic producer prices. The fifth section demonstrates the decomposition method when policy allows transmission, by using it to decompose the change in the price gap for Russian poultry over the period 1997-99. The sixth section discusses some limitations of the decomposition procedure, while the conclusion summarizes the paper's main findings.

The Price Gap

This paper focuses on decomposing the *change* in the gap between domestic and border prices. However, before developing the decomposition procedure, it would be useful to examine the price gap itself and its components.

The price gap (G) for an agricultural commodity in a country is calculated as

$$G = P^d - P^w X \quad (1)$$

where G is the price gap;
P^d is the domestic producer (farm gate) price;
P^w is the border price expressed in foreign currency;
X is the exchange rate.

The domestic producer price for an imported commodity can be expressed as

$$P^d = P^w X (1 + t) + C^m - C^d + D^p \quad (2)$$

where t represents policies, expressed as a tariff rate equivalent, that create a gap between the import and domestic price;

C^m is the transport/transaction cost of moving imports from the importation site to the site within the country where imports compete with domestic output;

C^d is the transport/transaction cost of moving domestic output from the farm to the site within the country where domestic output competes with imports;

D^p is a residual between P^d and the other variables in the right side of the equation.

If the commodity is exported rather than imported, P^d is the same as in equation (2), except that C^m drops out and C^d is the transport/transaction cost of moving domestic output from the farm to the exportation site. t now represents policies that create a gap between the export and domestic price, such as an export tax.

Substituting P^d from equation (2) into equation (1) gives

$$G = P^w X t + C^m - C^d + D^p \quad (3)$$

The price gap G consists of three parts. $P^w X t$ results from policy intervention; $C^m - C^d$ gives the difference between internal transport/transaction costs for imported and domestic product; and D^p gives that part of the price gap that cannot be attributed to either policies or transport/transaction costs.

We call D^p the *price disparity*. If the domestic market for a traded commodity is in equilibrium, such that no profitable arbitrage opportunity exists involving the border and domestic price, D^p equals 0. However, for specific country-commodity pairings at any given time, market disequilibrium might exist, such that $D^p \neq 0$. This is especially true for developing and transition economies, which have poor physical, commercial, and institutional infrastructure. 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 and commercial law, the latter failing to enforce contracts and protect property.[1]

Deficient infrastructure can have two main effects. First, it can result in high internal transport/transaction costs for agricultural and food products (as represented in equation (2) by C^m and C^d). Second, it can create the market imperfection of incomplete information. In particular, producers in isolated areas might be unaware of prices (and especially price movements) 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, a likely effect being lags in contracting and transport. Barrett (2001), Barrett and Li (2002), and Fackler and Goodwin (2001) discuss how poor market infrastructure can create imperfect information, and argue that the consequence can be price disequilibrium that lasts for extended periods of time.[2] Barrett and Li describe the situation of $D^p \neq 0$ as imperfect integration.

The method we will develop for decomposing changes in G does not rest on the assumption that price disparities exist. Rather, our method allows their existence, and provides a framework to determine whether they exist. A key element in our decomposition of changes in G is the degree of transmission of changes in border prices and exchange rates to domestic producer prices. A relationship clearly exists between incomplete transmission and price disparities (Colman).

This paper focuses on the *change* in G. The transport/transaction costs C^m and C^d could change for a commodity, such that their change alters G. Nonetheless, we assume that C^m and C^d are fixed, such that they are not included in the decomposition of changes in G.[3] Alternatively we could assume $C^m = C^d$ (when the commodity is imported). The main reason for these assumptions is to simplify the derivation of the decomposition equations. Given that C^m and C^d are simply additive variables in equation (2), including them in the decomposition would be easy analytically and methodologically (though computing their values in empirical work could be challenging). However, including these variables in the derivation of the decomposition equations would create too much clutter. Given that C^m and C^d drop out of our decomposition of the change in G (because of our assumptions), we decompose G consisting of the following elements:

$$G = P^w X t + D^p \qquad (4)$$

Decomposition Without Transmission

We begin deriving the method for decomposing changes in G not with G expressed as in equation (4), but rather with G expressed as in equation (1), that is, with $G = P^d - P^w X$. Work by the Organization for Cooperation and Development (OECD) on PSEs provides a base for developing methods to decompose price gaps. The PSE for a commodity measures the value of monetary transfers to its producers from a given set of agricultural policies in a given year. The PSE consists of two main elements: state budgetary support to producers and market price support (M). M equals the difference between the domestic producer price and border price for the commodity expressed in domestic currency. The latter in turn equals the border price in foreign currency times the exchange rate. For the purpose of determining the decomposition of the change in M, $M = P^d - P^w X$. M in the PSE therefore corresponds to the price gap as given in equation (1).

In addition to computing PSEs for its member, and certain nonmember, countries, OECD decomposes changes in PSEs. OECD's decomposition for M (equation (1) above) is given by

$$\dot{M} = S_{P^d} \dot{P}^d - S_{P^w X} \overset{\bullet}{\overbrace{P^w X}} \tag{5}$$

where a dot above a variable gives the percent change in the variable, and S_{P^d} and $S_{P^w X}$ give the shares of P^d and $(P^w X)$ in M, obtained by dividing both variables by $(P^d - P^w X)$.[4,5]

The OECD decomposition method treats the three right-side variables (P^d, P^w, and X) as being independent. This issue is most relevant for P^d. Under certain government policies, P^d is independent of P^w and X, an example being a managed price policy whereby the government defends a predetermined price through market intervention. For other policies, such as an import tariff, P^d is not independent of P^w and X. However, the OECD decomposition method does not have the objective of generating a decomposition whereby the right-side variables are all independent. OECD also does not use the decomposition to isolate and measure the effects of changes in policy variables versus nonpolicy-determined variables. Rather, the purpose of the decomposition is to determine how M changes in response to a change in these three variables, ignoring the question of any possible relationship between them.

The OECD method for decomposing changes in M, however, can be used as the starting point for a procedure for decomposing changes in price gaps, whereby the decomposition variables are all independent, and policy-determined variables are distinguishable from nonpolicy variables. In fact, the OECD method for decomposing changes in M can serve as the exact procedure for decomposing changes in price gaps when government policies make P^d independent of P^w and X; that is, when policy precludes any transmission of changes in P^w and X to P^d. This condition holds under the following policies: managed prices, trade quotas, and state trading.

A policy of managed prices by its very nature insulates domestic producer prices from changes in P^w and X.[6] A policy of trade quotas also "fixes" 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 may be tied to official quotas), again insulating P^d from changes in P^w and X.[7]

With all the above policies, the policy essentially determines the domestic producer price for the commodity. The variable P^d therefore can represent the policy that "fixes" the domestic producer price. Similarly, the change in M in equation (5) – or alternatively the change in G – from a change in P^d can measure the effect of the change in the policy (such as the managed price level or import quota volume) on the price gap.

OECD has recently been broadening its analysis of how policy can affect market price support, which is equally relevant to analysis of how policy affects price gaps. Tangermann

(2003) argues that government policies can provide support either explicitly or implicitly. Policies involving managed prices, trade quotas, and state trading support producers explicitly, because as explained above, the policy directly determines P^d; or alternatively, a change in the managed price level or quota volume directly changes P^d, which in turn changes M (or G). With these policies, changes in P^w and X also change M, but not by changing P^d. Rather, changes in P^w and X alter the gap between the domestic price and border price expressed in domestic currency. Tangermann argues that the resulting change in M can nonetheless be attributed to policy, but the effect is implicit rather than explicit. The condition that allows the change in P^w and X to change M (or G) is that a policy exists that "fixes" P^d; or alternatively, a policy is in place which creates a price gap, and the change in P^w or X changes the price gap. The implicit policy effect therefore can occur without a change in the policy.[8]

Decomposition with Transmission

The decomposition method just discussed is appropriate for policies which, by fixing producer prices, allow no transmission from changes in P^w and X to P^d. If, however, policies do allow transmission from P^w and X to P^d, then P^d is not independent of P^w and X. OECD's method for decomposing the change in M therefore will not capture that dependency. Policies that allow transmission from P^w and X to P^d are trade tariffs, tariff rate quotas, technical barriers to trade, and (of course) a policy of free trade.[9]

The method for decomposing changes in price gaps when policy allows transmission is much more relevant to current and future circumstances than the method previously discussed involving policies that preclude transmission from changes in P^w and X to P^d. The Uruguay Round Agreement on Agriculture banned import quotas, non-tariff measures maintained through state trading enterprises, and most other forms of non-tariff barriers to trade, and in general required countries to tariffy border measures. Also, when developing and transition economies support their agriculture, they usually use tariffs as their main support instrument, one reason being that they cannot afford the expensive price and income support policies prevalent in OECD countries in the postwar period.[10]

Reasons Price Gap can Change

When P^d is not an independent variable in the decomposition, we wish to replace it with a variable directly representing the policy (such as a tariff rate). As with policies that do not allow transmission, policies that allow transmission can have both explicit and implicit effects. For example, with an ad valorem tariff, a change in the tariff rate would result in an explicit policy effect on G. On the other hand, a rise in P^w or X would increase the gap between P^d and (P^w X) in absolute value, even if the tariff rate remained unchanged. (With complete transmission from P^w and X to P^d, a given percent rise in P^w or X would increase both P^d and G by that very percent.) In this case, policy changes the price gap because the ΔP^w or ΔX interacts with an existing, but unchanged, tariff. We wish to model the policy variable in a way that allows us to isolate and measure both the explicit and implicit policy effects from changes in variables on G.

When policy allows transmission, price gaps can change not only because of changes involving policy (both the explicit and implicit effects), but also because of undeveloped market infrastructure. This can reduce the transmission of changes in P^w and X to P^d.[11] The change in P^w or X is the active element in the change in G, but this change by itself cannot change G. Rather, the change in P^w or X combines with incomplete transmission, caused by poor infrastructure, to change G. We call this the *incomplete transmission effect* on G. This effect is defined to exist only when agricultural policy *allows* transmission from P^w and X to P^d; undeveloped infrastructure, rather than policy, creates the low transmission. Note that the incomplete transmission effect can occur without a conventional trade or support policy even existing, much less changing. The incomplete transmission creates (or adds to) a price disparity between domestic and border prices (D^p as discussed earlier) − a gap between domestic and border prices not explained by policy or the difference in transaction costs between imports and domestic output.

A feature of developing and transition economies is that they can have highly fluctuating exchange rates.[12] Big changes in exchange rates can combine with poor transmission from deficient infrastructure to become the dominant cause of changes in these countries' price gaps. Harley (1996), Liefert et al. (1996), the OECD country studies on Russian and Ukrainian agriculture (1998, 2004), and Melyukhina (2002) discuss the possibility of an incomplete transmission effect for transition economies, and especially the role played by fluctuating exchange rates. 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). Given the degree to which developing and transition economy exchange rates can swing, as well as the extent to which world commodity prices can vary, a method for decomposing changes in PSEs that can separate out the implicit policy effect and incomplete transmission effect on price gaps, both of which are driven by changes in P^w and X, would appear to be useful.

To summarize, the key empirical features of developing and transition economies that can combine to drive major changes in the price gap are:

(1) import tariffs are the main agricultural support policy, such that policy does not preclude price transmission;

(2) undeveloped physical, commercial, and institutional infrastructure reduces transmission of changes in border prices and exchange rates to domestic producer prices;

(3) exchange rates can fluctuate considerably.

When policy allows transmission from changes in P^w and X to P^d, OECD's method for decomposing changes in market price support (M) is insufficient for decomposing changes in price gaps (as well as M), especially if policy analysis of the decomposition is desired. By not containing the policy variable in the decomposition, the approach cannot measure the isolated effect of a policy change on the price gap. Also, by ignoring any transmission from P^w and X to P^d, the effect of ΔP^w and ΔX on M (G) is overstated, and will usually even have the wrong sign.[13] The method also cannot isolate the effect on M (G) from ΔP^w and ΔX interacting with an existing ad valorem tariff (the implicit policy effect). Nor can it isolate the effect of ΔP^w and ΔX on M (G) which results from incomplete transmission to P^d resulting not from policy, but from undeveloped market infrastructure.

Although OECD's decomposition does not allow one to isolate and measure the incomplete transmission effect on market price support, in its calculation and decomposition of PSEs for all types of economies, OECD includes the entire price gap in market price support, regardless of cause. PSE were created to measure the effect of government *policies* on agricultural producers and markets. The incomplete transmission effect resulting from deficient infrastructure can cause M to change without any change in government support policies, or without any policies even existing. Whether or not this effect should be considered as a reason why M (and thereby the PSE) can change depends on how one defines and interprets PSEs. The counterpart of this issue for the static PSE measured for a specific year is whether the entire price gap should be included in the market price support part of the PSE regardless of cause, or whether market price support should capture only that part of the price gap resulting from "conventional" policy intervention. In terms of equation (4), should M equal only P^w X t or should it include the price disparity D^p? In its country studies on Russia (OECD 1998) and Ukraine (done in collaboration with the World Bank, World Bank and OECD 2004) and Melyukhina (2002), the OECD acknowledges the incomplete transmission effect and in effect accepts the legitimacy of including the entire price gap in the measurement of market price support for transition economies.

Decomposition Method

Ad Valorem Tariff.

This section develops a method for decomposing changes in price gaps when policy allows transmission from changes in P^w and X to P^d. We begin by deriving the decomposition equation when an ad valorem tariff exists, and then examine how the decomposition should be altered when other policies are operative. The derivation begins with the equation that gives the price gap:

$$G = P^d - P^w X \tag{6}$$

$$\Delta G = \Delta Pd - \Delta (P^w X) \tag{7}$$

We then multiply ΔP^d by $1 = \left(\frac{P^d}{P^d}\right)$ and $\Delta (P^w X)$ by $1 = \left(\frac{P^w X}{P^w X}\right)$

$$\Delta G = P^d \dot{P}^d - P^w X \, \overset{\bullet}{\overbrace{P^w X}} \tag{8}$$

We then multiply $P^d \dot{P}^d$ by $1 = \left(\frac{\overset{\bullet}{\overbrace{[P^w X \, (1+t)]}}}{\overset{\bullet}{\overbrace{[P^w X \, (1+t)]}}}\right)$, 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 internal transport/transaction costs for imports are the same as for domestic output, this value should determine the domestic producer price for the commodity (or if the imported good is processed, the value of the primary product embodied in the import should determine the domestic price for the primary product). Introducing the landed price into equation (8) fulfills our objective of inserting the tariff as a policy variable into the decomposition analysis.

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

$$e = \frac{\dot{P}^d}{\overbrace{[P^w X\ (1+t)]}^{\bullet}} \tag{9}$$

These manipulations give us

$$\Delta G = P^d\, e\ \overbrace{[P^w X\ (1+t)]}^{\bullet} - P^w X\ \overbrace{P^w X}^{\bullet} \tag{10}$$

The presence of the PTE (e) in the decomposition equation will allow analysis and measurement of the effect on G 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

$$k = 1 - e \tag{11}$$

$$e + k = 1 \tag{12}$$

We can then express the decomposition equation as

$$\Delta G = P^d (e+k) \overbrace{[P^w X (1+t)]}^{\bullet} - P^w X \overbrace{P^w X}^{\bullet} - P^d k \overbrace{[P^w X (1+t)]}^{\bullet} \quad (13)$$

A B C

The letters below the equation identify its three right side terms. If transmission from change in the landed price to domestic price were complete (e = 1, such that k = 0), then term C in the equation drops out. Assume that transmission is incomplete, such that 0 < e, k < 1. The logic of our decomposition approach is that it isolates and measures the effect on G assuming that transmission is complete (as measured by terms A + B), as well as the effect on G from the incomplete transmission that in fact exists (as measured by term C). The sum of the two parts gives the net effect based on the actual value of e.

Term A gives ΔP^d if transmission from $\overbrace{[P^w X (1+t)]}^{\bullet}$ to P^d were complete, while term B gives $\Delta(P^w X)$. Term A minus term B therefore gives ΔG if transmission were complete. Term C measures the degree to which P^d, as well as G, fail 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. Note that the absolute value of the degree to which P^d fails to change by the maximum possible because of incomplete transmission exactly equals the absolute value of the degree to which G also fails to change by the maximum possible. For example, if the maximum possible rise in P^d with full transmission from an increase in $[P^w X (1 + t)]$ is 100, but P^d in fact increases by only 80, then the difference between the maximum possible rise in G and its actual rise will also be 20.

We follow the OECD decomposition practice of decomposing the *percent change* in G ($\dot{G}$), rather than the absolute change in G (ΔG). The next step in deriving the decomposition equation therefore is to divide through by G = $P^d - P^w X$. Although e + k = 1, the term (e + k) is kept in the equation for illustrative purposes.

$$\dot{G} = \underbrace{\frac{P^d (e+k)\ \overbrace{[P^w X(1+t)]}^{\bullet}}{P^d - P^w X}}_{A} - \underbrace{\frac{P^w X\ \overbrace{P^w X}^{\bullet}}{P^d - P^w X}}_{B} - \underbrace{\frac{P^d k\ \overbrace{[P^w X(1+t)]}^{\bullet}}{P^d - P^w X}}_{C} \qquad (14)$$

The purpose of the decomposition equation is to allow us to measure the shares of $\dot{G}$ 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 more than one of these variables expressed as a percent change (with a dot above), and no term exists containing the percent change of either a sum or product of two or more of these variables. In terms A and C, the additive term (1 + t) exists within the larger term $\overbrace{[P^w X\ (1+t)]}^{\bullet}$. We want to break the term $\overbrace{[P^w X\ (1+t)]}^{\bullet}$ 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 of the percent change in each number, weighted by each number's share in their sum. This gives the following:

$$\dot{G} = \underbrace{\frac{P^d (e+k)\ P^w X\ \overbrace{P^w X}^{\bullet}}{(P^d - P^w X)[P^w X(1+t)]}}_{D} + \underbrace{\frac{P^d (e+k) P^w X\ t\ \overbrace{P^w X\ t}^{\bullet}}{(P^d - P^w X)[P^w X(1+t)]}}_{E} - \underbrace{\frac{P^w X\ \overbrace{P^w X}^{\bullet}}{P^d - P^w X}}_{F}$$

$$- \underbrace{\frac{P^d k\, P^w X\ \overbrace{P^w X}^{\bullet}}{(P^d - P^w X)[P^w X(1+t)]}}_{H} - \underbrace{\frac{P^d k\, P^w X\ t\ \overbrace{P^w X\ t}^{\bullet}}{(P^d - P^w X)[P^w X(1+t)]}}_{I} \qquad (15)$$

The letters under each main term once 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 the product of the variables appears to be a problem without a definite mathematical solution. In its decomposition of the change in market price support, OECD confronts the same issue. We therefore use OECD's approach for handling the problem. In each case where the percent change in the product of two or more variables appears in equation (15), say $\overset{\bullet}{\overbrace{P^w X}}$ in term D, the percent change term is preceded by the simple product of the variables in question (in this case ($P^w X$)). This is because in each case the ultimate value being computed is the change in the product of the variables, which can be computed by multiplying the initial product of the variables times the percent change in the product of the variables. In term D, OECD's approach computes the change in $P^w X \overset{\bullet}{\overbrace{P^w X}}$ attributable to $\dot{P}^w$ as $P^w \dot{P}^w \frac{X_1 + X_2}{2}$, where X_1 and X_2 are the values of X in the beginning and end years of the period of measurement. Likewise, OECD computes the change in $P^w X \overset{\bullet}{\overbrace{P^w X}}$ attributable to $\dot{X}$ as $X \dot{X} \frac{P_1^w + P_2^w}{2}$, where P_1^w and P_2^w are the values of P^w in the beginning and end years of measurement. OECD (2002) explains the approach in greater detail, as well as gives the justification for the approach.

Note that because multiplicative terms exist in the decomposition equation, the effects attributable to $\dot{P}^w$, $\dot{X}$, and $\dot{t}$ do not measure the *isolated effect* of a change in each of the variables on G, that is, they do not measure the effect on G assuming that the other variables remain unchanged. Such an approach would result in the deficiency that the sum of the effects of the changes in the variables on G would not give the actual change in G, because it would leave out the changes in G caused by the multiplicative relationships. Rather, the decomposition equation yields effects for the variables based on all three variables changing simultaneously (or at least potentially changing). As such, the effect values generated for the variables yield the *attributable effect* of their change on G.

If PSEs have been computed for commodities, $\dot{G}$ and the initial values of, and changes in, P^w and X needed to do the decomposition in equation (15) are available from the PSE database. If PSEs have not been calculated, these data would have to be collected. The one variable that must be computed is k, or alternatively e (since k = 1 – e). *e* can be calculated directly from the base PSE data, such that

$$e = \frac{\dot{P}^d}{\overset{\bullet}{\overbrace{[P^w X(1+t)]}}} \tag{16}$$

Alternatively, e can be computed from equation (10):

$$e = \frac{\Delta G + P^w X \ \overset{\bullet}{\overbrace{P^w X}}}{P^d \ \overset{\bullet}{\overbrace{[P^w X(1+t)]}}} \tag{17}$$

As discussed before, if a tariff exists for a commodity, there are three possible ways G can change:

(1) a change in the tariff (the explicit policy effect);

(2) a change in P^w or X that interacts with the existing tariff (the implicit policy effect);

(3) a change in P^w or X that interacts with undeveloped infrastructure to create incomplete price transmission to P^d, thereby changing the price gap (the incomplete transmission effect).

The decomposition equation allows us to measure the extent to which changes in G can be attributed to changes in P^w, X, and t, classified according to each of the possible ways G can change listed above. Given that $\dot{G}$ in the decomposition equation is a percent change, the effect of a change in a variable on G is measured in terms of the percent change in G.

In term E in equation (15), the subterm associated with $\dot{t}$ measures the change in G from the explicit policy effect. $\dot{t}$ would change G by a percent equal to

$\frac{P^d t\, \dot{t}\, (P_1^w + P_2^w)(X_1 + X_2)}{(P^d - P^w X)[P^w X(1+t)]*2*2}$. Also in term E, the corresponding subterms associated with

$\dot{P^w}$ and $\dot{X}$ measure the changes in G from the implicit policy effects (resulting from ΔP^w and ΔX interacting with the tariff). The magnitudes of these effects are all based on the assumption of complete transmission of the change in the landed price to P^d.

In terms H and I, the terms associated with $\dot{P^w}$, $\dot{X}$, and $\dot{t}$ measure the change in G from the incomplete transmission effect (resulting from ΔP^w, ΔX, and Δt interacting with undeveloped infrastructure to create incomplete price transmission to P^d). Note that changes in not only P^w and X but also t can contribute to this effect. A change in t will change the commodity's landed price. If only a part of the change in the landed price is transmitted to the domestic price, the change in t becomes the active element in creating the resulting price gap.

How does one interpret the effects on G of $\dot{P^w}$ and $\dot{X}$ in terms D and F? If P^d equals the landed price [P^w X (1 + t)], term D becomes $\frac{P^w X\, \dot{\widehat{P^w X}}}{P^d - P^w X}$. Term D thereby equals term F, and the two terms cancel out. If, however, $P^d \neq$ [P^w X (1 + t)], the two terms do not cancel. ΔP^w and ΔX will now change G for yet another reason, in addition to those previously identified.

Terms D and F can be combined into $\left(\frac{P^d - P^w X\ (1+t)}{P^w X(1+t)}\right)\frac{P^w X\, \dot{\widehat{P^w X}}}{P^d - P^w X}$. The assumption of complete transmission of change in the landed price to the domestic price holds for term D, such that both P^d and $[P^w X (1 + t)]$ will change by the same percentage. If $P^d > [P^w X (1 + t)]$, the domestic price initially exceeds the landed price, such that G is positive. A rise in P^w or X of a given percentage which raises P^d by the same percentage will therefore increase the absolute value of the gap between P^d and $[P^w X (1 + t)]$, simply because initially $P^d > [P^w X (1 + t)]$. This will increase G. Likewise, if $P^d < [P^w X (1 + t)]$, G is initially negative. A rise in P^w or X will again increase the gap between $[P^w X (1 + t)]$ and P^d. The negative value of G will therefore increase. This effect on G from ΔP^w and ΔX is called the *price disparity effect*.

Recall that equation (4) gives $G = P^w X t + D^p$, where D^p (the *price disparity*) is the difference between the domestic and border prices that cannot be explained by policy intervention; that is, $D^p = P^d - P^w X (1 + t)$.[14] The price disparity effect therefore measures the effect on G from the initial existence of a price disparity. The most likely reason why P^d might not initially equal the landed price $[P^w X (1 + t)]$ is because of incomplete transmission between the two in an earlier period. In fact, a country with poor price transmission from deficient infrastructure might never have equality between its domestic producer and import landed prices for commodities.

A relationship might exist between the price disparity and incomplete transmission effects, such that they are not wholly independent of each other. For example, if in a given year $P^d > [P^w X (1 + t)]$, a price transmission elasticity of one would seem especially unrealistic. One might expect the actual transmission to be relatively low, such that it would narrow the gap between P^d and $[P^w X (1 + t)]$. Consequently, some of the price disparity effect and incomplete transmission effect might cancel out in the net effect. Nonetheless, identifying the price disparity effect allows us to isolate and measure the policy effects. It also allows a full accounting of decomposition effects under the assumption of complete price transmission.

Assume that initially $D^p = 0$, such that $P^d = P^w X (1 + t)$. In (15), terms D and F would drop out. Assume also that complete transmission between $P^w X (1 + t)$ and P^d exists, such that k = 0. In equation (15), terms H and I would also drop out. This would reduce equation (15) to term E, such that G would change solely because of policy effects (explicit and implicit).

A contribution of our decomposition method is that it gives results based on the extreme assumption of complete transmission. It thereby complements OECD's decomposition of market price support, measured as the entire price gap, which is based on the opposite extreme assumption of absolutely no transmission. Also, adding up the effects on G in our decomposition from the various attributable effects for the variables P^w, X, and t – that is, from all terms D, E, F, G, and H – will give the net effect of the change in each variable on G. The sum of these net effects will in turn give the actual value of $\dot{G}$. This indicates that our method not only provides the complementary extreme measure of decomposition results to OECD's method, but also gives the net (or actual) decomposition effects attributable to the variables, when the assumed complete transmission and the incomplete transmission that actually occur are netted out.

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 $[P^w X + T]$, where T equals the per unit tariff. The only difference in the derivation compared to the ad valorem case is that in equation (8), one multiplies $P^d \dot{P}^d$ by

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

The final decomposition equation is

$$\dot{G} = \frac{P^d (e+k)\, P^w X\, \overbrace{P^w X}^{\bullet}}{(P^d - P^w X)(P^w X + T)} + \frac{P^d (e+k)\, T\, \dot{T}}{(P^d - P^w X)(P^w X + T)} - \frac{P^w X\, \overbrace{P^w X}^{\bullet}}{P^d - P^w X}$$

$$- \frac{P^d k\, P^w X\, \overbrace{P^w X}^{\bullet}}{(P^d - P^w X)(P^w X + T)} - \frac{P^d k\, T\, \dot{T}}{(P^d - P^w X)(P^w X + T)} \qquad (18)$$

With a per unit tariff, e now equals $\dfrac{\dot{P}^d}{\overbrace{P^w X + T}^{\bullet}}$.

The analysis and use of equation (18) in measuring the shares of changes in the key variables in $\dot{G}$ is largely the same as in the case involving an ad valorem tariff. The main difference is that if the per unit tariff T is specified in the importing country's own currency, a change in P^W or X carries no implicit policy effect. Unlike an ad valorem tariff, a per unit tariff makes the value of the tariff paid per unit independent of the import price. A change in P^W or X cannot change the per unit tariff.

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.[15]

Because TRQs combine elements of a pure tariff and pure quota, any decomposition procedure for a TRQ would combine elements of the decomposition methods for these two types of policies. A detailed examination of the decomposition method for a TRQ, with full equations, is beyond the scope of this paper; rather, a general discussion of issues is given.

A TRQ creates a kinked domestic supply curve for the commodity in question, divided into three parts. The first part is a horizontal line anchored at the price which equals the border price plus the low in-quota tariff, with this line extending to the quota volume of imports allowed at the low in-quota tariff; the second part is the upward-sloping domestic supply curve for the commodity lying between the two horizontal parts; and the third part begins where the domestic supply curve intersects the horizontal line anchored at the price equal to the border price plus the above-quota tariff, and continues along this horizontal line indefinitely.[16]

How one handles the decomposition depends on where one initially begins on the kinked supply curve. The analysis becomes complicated if one moves between the three parts of the curve. If one does not move, one uses the analysis specific either to a tariff (if on either of the horizontal parts of the supply curve) or to a quota (if on the upward-sloping part). In the latter case, the OECD decomposition approach would be appropriate.

Skully (2001) shows that empirically, for most country/commodity pairings involving TRQs, the country is on the lower horizontal part of the commodity supply curve, and rarely are countries on the upper horizontal part. The last point indicates that the high above-quota tariffs associated with TRQs are usually trade-prohibitive. Skully also shows that empirically it is uncommon for countries with TRQs to move between the various parts of the supply curve. This evidence indicates that decomposition analysis for countries with TRQs would usually not be difficult, requiring use of the decomposition method for either a pure tariff or pure quota.

Another policy that allows transmission from P^w and X to P^d is technical barriers to trade (TBTs), defined to include the large subcategory of sanitary and phyto-sanitary measures.[17] If a country imposes a TBT on imports of a commodity, the typical consequence is that foreign suppliers must incur costs to satisfy the regulation. If the per unit cost of satisfying the barrier is B, the landed price for the import in the country imposing the barrier is $(P^w + B)X$. The equation for decomposing the change in G is

$$\dot{G} = \frac{P^d (e+k)\, P^w X\, \overset{\bullet}{\overbrace{P^w X}}}{(P^d - P^w X)(P^w + B)X} + \frac{P^d (e+k)\, B X\, \overset{\bullet}{\overbrace{B X}}}{(P^d - P^w X)(P^w + B)X} - \frac{P^w X\, \overset{\bullet}{\overbrace{P^w X}}}{P^d - P^w X}$$

$$- \frac{P^d k\, P^w X\, \overset{\bullet}{\overbrace{P^w X}}}{(P^d - P^w X)(P^w + B)X} - \frac{P^d k\; B X\; \overset{\bullet}{\overbrace{B X}}}{(P^d - P^w X)(P^w + B)X} \qquad (19)$$

The decomposition method presented in this section can also be used if no trade policy exists. Equation (19) can be used as the decomposition equation, but with B and $\dot{B}$ both equal to 0. The decomposition would involve no policy effects, but would measure the price disparity and incomplete transmission effects on G from ΔP^w and ΔX.

<u>Some Qualifications.</u>

The decomposition analysis thus far assumes that the country in question is “small” in world markets – that is, it has no market power. What is the effect on the decomposition if a country has market power in a commodity? If it does, then an initial change in P^w would result in a countervailing change of some lesser degree in P^w in the opposite direction. For example, if a country imports the commodity and P^w falls, the country would import more. Because of its market power, this would raise world demand sufficiently to increase P^w to some degree. This reaction, however, requires no adjustment of our decomposition method. The decomposition equation simply accepts the value of the final adjusted P^w to use in the decomposition.

If a country has significant world market power and the policy variable (say a tariff rate) changes substantially, the change in domestic demand might alter world demand sufficiently to change P^w. The effect for the decomposition analysis is that some of the change in G would be incorrectly attributed to ΔP^w rather than to the change in policy. A more likely interrelationship with market power is between X and P^w, given that exchange rates for developing and transition economies can change so substantially. If a country has market power in a commodity as either an importer or exporter, a major appreciation or depreciation of its currency could substantially affect the world market for the commodity, thereby altering P^w. Once again, the effect for the decomposition is that some of the change in G would be incorrectly attributed to ΔP^w rather than to ΔX. The likelihood that countries have market power in certain commodities reinforces the argument that the exchange rate is the dominant variable in changing price gaps for agricultural products for developing and transition economies.

The decomposition method presented in this section uses changes in only the nominal, rather than real, values of the variables between periods. In this paper, we follow OECD in its decomposition of PSEs, in that OECD decomposes in only nominal terms (though it is considering in future providing decomposition in real as well as nominal terms). Our decomposition could also be done in real as well as nominal terms, though a full explanation and demonstration of the decomposition in real terms is beyond the scope of this paper. The key step would be to adjust G and P^d in the end year of measurement by the change in domestic prices over the period (if there were inflation, to deflate using the domestic price index); adjust P^w in the end year by the appropriate foreign price index; and convert the change in X from nominal to real terms by multiplying the nominal rate in the end year by the foreign price index and dividing by the domestic price index

Empirical Example: The Price Gap for Russian Poultry

This section demonstrates the decomposition method when policy allows transmission, the decomposition example being the change in G 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 of 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 the transition period, Russia's main agricultural trade support policy has been import tariffs. During 1997-99, Russia had in place 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 (or 300 ECUs per metric ton). The tariff rate and minimum per unit tariff did not change over the period (Russian Federation State Customs Committee).

For all three years 1997, 1998, and 1999, unit values computed for Russian poultry imports show that if an ad valorem tariff were applied, it would yield per kilo tariffs below the minimum requirement of 0.3 ECUs (0.19, 0.19, and 0.18 ECUs for the three years, respectively.) A per unit import tariff policy therefore in effect existed, which means we should use the decomposition equation for a per unit tariff (equation (18)). An important feature of this minimum per unit tariff is that the tariff value was denominated in ECUs, rather than rubles. This means that the imported poultry's landed price should be specified not as $(P^w X + T)$, but rather as $(P^w X + T X)$, or alternatively $(P^w + T) X$, where X is the exchange rate between the ruble and the ECU (which in 1999 became the euro). In deriving the decomposition equation, in equation (8), one now multiplies $P^d \; \dot{P}^d$ by $1 = \left(\dfrac{\overbrace{(P^w + T)X}^{\bullet}}{\overbrace{(P^w + T)X}^{\bullet}} \right)$.

The final decomposition equation is

$$\dot{G} = \frac{P^d (e+k)\, P^w X \; \overbrace{P^w X}^{\bullet}}{(P^d - P^w X)(P^w + T)X} + \frac{P^d (e+k)\, T\, X \; \overbrace{T\, X}^{\bullet}}{(P^d - P^w X)(P^w + T)X} - \frac{P^w X \; \overbrace{P^w X}^{\bullet}}{P^d - P^w X}$$

$$- \frac{P^d k\, P^w X \; \overbrace{P^w X}^{\bullet}}{(P^d - P^w X)(P^w + T)X} - \frac{P^d k\, T\, X \; \overbrace{T\, X}^{\bullet}}{(P^d - P^w X)(P^w + T)X} \qquad (20)$$

The point was made earlier that if a per unit tariff is denominated in domestic currency, a change in P^w or X carries no implicit policy effect, because the per unit tariff makes the tariff independent of the import price. A change in P^w or X therefore can not change the per unit tariff. Specifying the per unit tariff in a foreign currency, however, makes the domestic currency value of the tariff dependent on the exchange rate (through the term (T X)), such that a change in X can change the domestic currency value of the tariff. In this case, a change in X has an implicit policy effect on G, as our empirical example will demonstrate.

Throughout Russia's transition period, agricultural imports from the other NIS countries of the former USSR have not been assigned any tariffs. In our decomposition, however, we assess the tariff on all poultry imports. The empirical harm to our decomposition results from doing so is insignificant, given that Russian poultry imports from other NIS countries have been trivial, in 1997-99 comprising less than 0.5 percent of Russia's total poultry imports in volume terms (Russian Federation State Customs Committee).

In our decomposition approach, the policy variable (T in this example) is intended to represent all state policy that can affect the price gap. $\dot{T}$ would then measure the effect of a change in policy on G (though in our specific example T does not change). During the second half of the 1990s, Russia's sole policy at the federal level that affected the price gap for poultry was the import tariff. However, regional governments throughout the transition period have interfered in local agricultural and food markets, typically in an ad hoc and nontransparent manner, such as by fixing or influencing prices or restricting the movement of agricultural products out of their region.[18] Such policies could affect domestic producer prices, and thereby the price gap for the affected commodities within regions. Yet, these policies have been most strong for grain and dairy products, less so for poultry. Also, determining the aggregate direction of bias of these various ad hoc policies, much less measuring their effect on our decomposition results, would be virtually impossible.

In 1999 and 2000, Russia received food aid from the United States and EU, which was motivated by the country's dismal 1998 grain harvest (48 million metric tons, the lowest in decades) and concern that the economic crisis that struck in 1998 would deprive the country of the financial resources to pay for necessary food imports.[19] Food aid inflows were not assessed tariffs. The nontariffed food aid almost certainly had some downward effect on Russian producer prices for the affected commodities. The Russian government's willingness and desire to accept food aid can be considered a "policy" decision. The food aid's negative effect on domestic producer prices can therefore be viewed as a policy action that changed the price gap. This point complicates our decomposition analysis, as T in our example (unchanged in value, no less) no longer represents all federal government policy that might have affected the price gap.

Given the timing of poultry food aid shipments to Russia, however, this problem is not serious for our decomposition. In 1999, Russian poultry consumption was 1.84 mmt (USDA). As part of the U.S. food aid package, Russia was to receive 50,000 tons of poultry (the EU package did not contain any poultry). Virtually none of the U.S. poultry given to Russia reached domestic markets in 1999. No poultry had reached Russian ports by September 1999, and by the end of October only 11,2000 tons had arrived in ports (Interfax, Oct. 30 – Nov. 5, 1999, p. 4). Given that it took 1-2 months for the poultry to be off-loaded, transported to domestic markets, and made available for retail sale, hardly any poultry food aid was sold in 1999. The poultry therefore did not have time to distort the domestic price data used in our decomposition analysis. However, whatever small downward effect the donated poultry might have had on 1999 prices would have the effect of understating the contribution of "policy" changes to the change in G.

The first step in generating the decomposition results is to compute the PTE (e) between the landed price [$(P^w + T) X$] and the producer price P^d. The value is 46 percent.[20] Table 1 gives the decomposition, which incorporates this transmission value. The column $\dot{V}$ gives the actual percent change in G and the variables that determine G (computed from OECD's database for Russian PSEs, OECD). The column shows that from 1997 to 1999 the price gap for Russian poultry rose 36 percent. The poultry producer price P^d increased 117 percent, the minimum per unit import tariff T remained unchanged, the poultry border price P^w (expressed in ECUs) fell 16 percent, and the ruble/ECU exchange rate X rose 300 percent (largely as a consequence of the 1998 economic crisis).

The other columns measure the degree to which changes in these variables change G, measured by the percent change in G. The three columns under "e + k = 1" give the effects on G based on the assumption that transmission from the change in the landed price to producer price is complete (equal to 1). The column under "policy effect" measures the explicit and implicit effects on G from changes involving the tariff. Because the minimum per unit tariff does not change over the period, there is no explicit policy effect (the value in the column associated with

T equals 0). However, as explained before, because the tariff is expressed in ECUs rather than rubles, the change in X results in an implicit policy effect. X is expressed as rubles per ECU, which means the 300 percent increase in X raises the import tax expressed in rubles. The "attributable" effect is to increase the price gap, by 142 percent.

Recall that the price disparity effect of a change in P^w or X on G occurs when the producer price and landed price for the commodity differ in the beginning year of the period of measurement. In 1997, Russia's average producer price for poultry was 12.4 million rubles per ton, while the landed price for imported poultry was 7.0 million rubles (computed from OECD's database for Russian PSEs, OECD). The fact that the producer price differed so substantially from the landed price is consistent with the price transmission elasticity of 46 percent, in that both results show that Russian internal markets for poultry were imperfectly integrated into the world poultry market. Such a large disparity also supports the arguments of Barrett, Barrett and Li, and Fackler and Goodwin that in developing and transition economies, undeveloped market infrastructure, and in particular the problem of imperfect information, can result in price disequilibrium of some duration whereby gaps between border and domestic producer prices cannot be wholly explained by policy measures and transport/transaction costs.

In our example, P^w falls. With complete transmission, the drop in P^w decreases P^d by more than the landed price (in absolute value). Table 1 shows that the effect is to reduce G by 21 percent. Analogously, the 300 percent rise in X with complete transmission raises P^d more than it raises the landed price. The effect is to increase G by 145 percent. Table 1 shows that the aggregate price disparity effect from the changes in P^w and X is to raise G by 124 percent. The combined effect of the changes in P^w and X given the assumption of complete price transmission is to increase G by 266 percent.

The column "– k" measures the incomplete transmission effect on M which results from changes in variables that affect the domestic producer price interacting with incomplete transmission. The fall in P^w reduces P^d. Because of incomplete transmission, however, P^d falls less than it would with complete transmission. The failure of P^d to drop by its potential maximum has the attributable effect of raising G by 26 percentage points. Likewise, the rise in X increases P^d. Yet, because of incomplete transmission, P^d rises less than it potentially could. The failure of P^d to rise by its potential maximum has the attributable effect of decreasing G by 256 percentage points. The aggregate effect of the changes in P^w and X combining with incomplete transmission (not caused by policies that fix domestic prices) is to decrease G by 230 percent.

The column "e" gives the net effect of changes in the causal variables on G. It equals 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 increase G by 5 percent, while the net attributable effect of the rise in X is to increase G by 31 percent. The total net effect is to raise G 36 percent.

We can also use the results in table 1 to demonstrate the difference between our decomposition of G and OECD's decomposition of the market price support part (M) of the PSE. Recall that in its work on PSEs, OECD includes the entire price gap in M, that is, M = G. This means that in OECD's decomposition, the value of $\dot{M}$ to be decomposed exactly equals the value $\dot{G}$ to be decomposed in our decomposition of the price gap. As discussed before, OECD's method for decomposing the change in M treats all the variables in the decomposition as being independent, and also is not geared to policy analysis. Interpreting the results of the decomposition therefore must be done carefully, especially when policy allows transmission from ΔP^w and ΔX to P^d. The column "OECD decomp" in table 1 gives the decomposition of $\dot{G}$ using OECD's decomposition method. Just as P^d is not a relevant variable for our decomposition approach, T is not a relevant variable for OECD's decomposition. With OECD's decomposition, the rise in P^d increases M (G) by 197 percent, the fall in P^w increases M by 27 percent (because it lowers the border price), and the rise in X decreases M by 188 percent (because it raises the border price).

Note that our decomposition approach yields not only substantially different results for the effect of the changes in P^w and X on G than does OECD's decomposition, but even produces a different sign for the net effect of the change in X on G. Clearly a relationship exists between the large negative value for the effect of the change in X on G from our incomplete transmission effect and from OECD's decomposition approach. The OECD approach yields a negative value for the effect of the change in X on M (G) because it assumes no transmission from the change in X to P^d. In OECD's approach, the big increase in the border price measured in rubles that results from the large change in X (the ruble depreciation) has the attributable effect of substantially reducing G, but without any consideration for the fact that much of the change in X is transmitted to P^d (given that e = 46 percent). Because our approach allows transmission from the change in X to P^d, we get a positive net effect for the change in X on G.

As discussed earlier, the annual unit values for poultry imports computed from the official Russian trade data for 1997, 1998, and 1999 result in values too low for the ad valorem tariff of 30 percent to have been assessed. Rather, such values would have triggered the minimum per unit tariff for poultry of 0.3 ECUs per kilo. However, for either seasonal reasons or because some of the imported poultry might have been of higher quality and therefore had a higher unit value (Russian poultry imports not being completely homogeneous), some of the imported poultry might have been assessed the ad valorem rather than per unit tariff.

We also discussed earlier that Russia's acceptance of Western food aid would complicate our decomposition analysis. The food aid would affect the price gap for a commodity by lowering the domestic producer price, and could therefore be interpreted as a state policy which should be integrated into the decomposition analysis. As discussed earlier, very little of the Western poultry food aid that Russia received in 1999 arrived early enough to be available for sale within the country in that year. The food aid's effect on domestic prices in 1999 was therefore slight. However, to capture the effects of both the possible use of the ad valorem tariff for some of the imported poultry, and the negative effect that food aid might have had on domestic prices in 1999, we again decompose the price gap for Russian poultry imports over 1997-99, but this time using an ad valorem import tariff (table 2).

We also lower the tariff rate below that which actually existed in 1999. The negative effect on the domestic producer price of our lowering the tariff represents the fall in P^d from the poultry food aid. The Russian ad valorem poultry import tariff of 30 percent did not change over our period of measurement. To capture the negative effect on P^d from food aid, we cut the 1999 tariff rate by half, reducing it to 15 percent. Thus, in column $\dot{V}$ in table 2, t declines by 50 percent.

These decomposition results therefore give the opposite extreme measure of the possible decomposition compared to the results from the other example, given the special policy and trade conditions that existed during the period covered. The extremity of the example is reinforced by the fact that we assume the ad valorem tariff is applied to all the poultry imports. This decomposition example also has the benefit of demonstrating how the decomposition works in the case of an ad valorem tariff.

The landed price in this case equals [P^w X (1 + t)], where t is the tariff rate. The transmission from the change in the landed price to P^d now equals 0.59, compared to 0.46 when the minimum per unit tariff was used. This lower value for e occurs because the halving of the tariff rate reduces the calculated change in the landed price. Given that this example uses the same change in P^d as in the previous example, a smaller change in the landed price will generate higher transmission.

In table 2, the column $\dot{V}$ is unchanged from table 1, except that the tariff rate t replaces the per unit tariff T as the policy variable. The column "policy effect" when transmission is complete (e + k = 1) shows that the tariff cut has the explicit policy effect of reducing G by 44 percent. As examined earlier, with an ad valorem tariff, a change in both P^w and X creates an implicit policy effect on G, because it changes the value of the import to be assessed the tariff rate. The implicit policy effect of the drop in P^w is to lower G by 12 percent, while the implicit effect of the rise in X is to raise G by 80 percent. The aggregate result of these various policy effects is to increase G 24 percent.

The changes in P^w and X also have price disparity effects that result from the fact that P^d exceeds the landed price, now measured as [P^w X (1 + t)]. The fall in P^w decreases G by 24 percent, while the rise in X increases G by 169 percent, with the aggregate price disparity effect being a rise in G of 145 percent. The combined effect of changes in all variables if transmission were complete would be to increase G 169 percent.

The column "– k" shows that only part of the potential rise in G that would occur with complete transmission is realized. Each figure in this column for a specific variable understandably has a different sign than the corresponding figure in the column "total effect" under "e + k = 1" (as was also the case in table 1). For example, 18 percentage points of the potential 44 percent fall in G that would result from the halving of the tariff rate does not materialize because incomplete transmission prevents P^d from falling to the maximum extent possible. The net effect of incomplete transmission is to result in G falling (or put differently, failing to rise) by 133 percent.

The column "e" once again gives the net effect of the change in each variable on G − that is, the results based on the actual price transmission embodied in the data. Because t and P^w fall, the net effect of the change in these variables is to reduce G, while the rise in X generates an increase in G. The large change in X dominates the changes in the two other variables, such that the final impact is to raise G 36 percent.

Comparing the results in column "e" in table 2 with those in table 1 when the per unit tariff holds shows that the change in the ad valorem tariff adds an explicit policy effect; the fall in P^w has a negative rather than positive net attributable effect on G, because the drop in P^w combines with the ad valorem tariff to create a negative implicit policy effect; and the change in X remains the dominant factor in changing G.

The column "OECD decomp" again presents the results using OECD's approach for decomposing $\dot{M}$, unchanged from the previous example. Comparison of the results in column "e" and OECD's results again shows that not only do the two approaches yield substantially different results for the net effect of the changes in P^d and X on G, but that the signs for the effects are different. The main explanation again is that the OECD approach assumes no transmission from changes in P^w, X, and t to P^d, while our approach is based on the actual transmission that occurs.

Our decomposition method strongly complements and fills out the OECD approach. OECD's approach yields decomposition results based on the assumption of no transmission, while our approach yields results based on the opposite extreme assumption of complete transmission, as well as results based on the actual transmission that occurs.

The empirical point we wish to demonstrate in these examples involving Russian agriculture is that the dominant factor in changing the price gap was the large depreciation in the exchange rate, acting in combination with poor transmission which resulted from undeveloped market infrastructure. In the example using the per unit tariff, if complete transmission had existed, the rise in X would have increased G by 287 percent. Incomplete transmission, however, prevented 256 percentage points of this potential rise, such that the net attributable effect of the rise in X was to increase G by only 31 percent. The example using the ad valorem tariff shows that if complete transmission had existed, the rise in X would have increased G by 249 percent. Incomplete transmission prevented 177 percentage points of this potential rise, such that the actual effect of the rise in X was to increase G by 72 percent. A more general demonstration of the importance of the exchange rate in the decomposition is that in every column in tables 1 and 2, the change in X dominates the aggregate effect of the changes in all variables on G.

These decomposition examples are based on the assumption that Russia did not have market power in the world poultry market in the late 1990s. 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, 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 16 percent in the decomposition examples. 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 price gap is even greater than that indicated by the decomposition results.

Our two empirical examples are limited to Russian poultry over 1997-99. Admittedly, during this period the exchange rate depreciated substantially. Nonetheless, we can argue that changes in the exchange rate combined with poor transmission have been the dominant factor driving changes in price gaps for Russian agricultural commodities during transition. From 1992 to 2003, the average annual percent change in Russia's nominal exchange rate (ruble to the U.S. dollar) was 36 percent (PlanEcon). This calculation in fact excludes the huge depreciation in the exchange rate from 1991 to 1992 (the first year of economic reform). Exchange rate changes of course affect the price gap for all commodities.

Limitations of the Decomposition Procedure

Given that an objective of our procedure is to isolate and measure the effect on the price gap 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. However, Russia's experience illustrates a special policy measurement problem, common to NIS countries, which is that regional governments can pursue their own agricultural price and market policies within their jurisdictions. Such market interference is often nontransparent, and therefore might not be “captureable” by the policy variable in our decomposition.

Nontransparent regional policies (as well as any other nontransparent agricultural policies) would most likely affect the price gap through P^d. If not captured by the policy effect in our decomposition, the effects on P^d would be attributed to incomplete price transmission resulting from deficient market infrastructure. This problem notwithstanding, results generated by our decomposition methods which at minimum isolate and measure the effects of countries’ transparent national trade policies would be useful. Also, even if one cannot wholly separate out the effects of policy as opposed to deficient market infrastructure (or any other possible cause) on price transmission, our procedure has the merit of measuring the effect of incomplete transmission on the price gap, regardless of cause. Likewise, 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 G (as presented in tables 1 and 2).

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.[21] 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 tables 1 and 2 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 examples for Russia, changes in P^w or X in 1996) carry over to the period of measurement, this carry-over transmission will affect the decomposition for the column "– k." The results for this column will measure not only effects of changes in variables that have occurred since the base year of measurement, but also effects on P^d (and therefore on G) from changes in variables before the base year. The carry-over effects in column "– k" for a specific variable (say X) will 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" will also affect the net results 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. This means that the base year in the decomposition analysis will be one of relative price 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 countries' 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.

In our Russian poultry examples, 1996 and 1997 were also years of relative stability in the nominal exchange rate, the average annual change in 1996-97 being 13 percent compared to 138 percent over 1993-95. Russia during the transition period has also been a good example of a country whose exchange rate moves in 2-4 year cycles.

Conclusion

This paper presents two different methods for decomposing changes in price gaps for agricultural commodities. One method is appropriate when policy precludes any transmission from changes in border prices or exchange rates to domestic producer prices, as in the case of managed prices, trade quotas, and state trading. The other decomposition method is appropriate when policy allows transmission, as in the case of tariffs, tariff rate quotas, and technical barriers to trade.

The decomposition methods allow one to identify and measure the following reasons why price gaps can change: (1) an explicit policy effect whereby the change in a policy variable directly alters the price gap; (2) an implicit policy effect, whereby a change in the border price or exchange rate combines with an existing policy to change the gap; and (3) the incomplete transmission effect, whereby a change in policy, border price, or exchange rate combines with incomplete transmission to alter the price gap, and where deficient market infrastructure rather than policy interference is responsible for the incomplete transmission. The last effect exists only when policy allows transmission from changes in border prices and exchange rates to domestic prices, and is especially relevant for developing and transition economies.

We apply the methods to decompose the change in the price gap for Russian poultry producers over the period 1997-99. We find that the dominant factor in changing the price gap was the large depreciation in Russia's exchange rate, acting in combination with poor transmission which resulted from undeveloped market infrastructure. Russia's exchange rate has fluctuated throughout the transition period (though in cycles). This supports the argument that the oscillating exchange rate, through the incomplete transmission effect, has been the driving force in changing price gaps for Russian agricultural commodities during transition. Fluctuating exchange rates and poor market infrastructure are key features of developing and transition economies in general. This suggests that the combination of these two features through the incomplete transmission effect could be the main cause of changes in their agricultural price gaps.

The decomposition methods allow one to determine the degree to which changes in agriculture-targeted trade policies affect the price gap, as opposed to changes in border prices and the exchange rate. The methods are therefore relevant to the current debate concerning what policies countries should adopt, especially in the developing and transition worlds, in order to reduce differences between world commodity prices and their domestic prices, expand foreign trade to capture more of the potential gains from trade, and integrate more strongly into world markets. Much attention focuses on the high tariffs and other trade restrictions imposed by many developing countries. However, the analysis and results presented in this paper are consistent with the argument that the main cause of changes in agricultural price gaps in developing and transition economies is fluctuating exchange rates combined with undeveloped infrastructure that weakens transmission, and the paper presents methods for testing this hypothesis for specific countries. If this argument holds, the policy implication would be that strengthening macroeconomic stability and improving domestic market infrastructure might do more to reduce price gaps, and their economic effects, than liberalizing agricultural trade policies.

Endnotes

[1] For discussion of deficient infrastructure in developing countries, see FAO, and in transition economies World Bank (2004). Wehrheim et al. (2000) argues that poor institutional infrastructure is the biggest problem facing Russian agriculture, which could also be the case for other New Independent States (NIS) of the former USSR.

[2] These authors acknowledge that empirical work involving trade policy and market integration (both between foreign and domestic markets and between regional markets within countries) often makes the simplifying assumption that market equilibrium exists (that is, $D^p = 0$). This allows one to attribute price gaps largely to policy intervention.

[3] Just as empirical work often assumes that market equilibrium exists, work involving trade protection, market integration, and price transmission also typically assumes that transport/transaction costs are constant, either in absolute terms or as a proportion of border prices (see Fackler and Goodwin (2001) for discussion of the issue). This obviates the often empirically difficult task of computing these costs. The two assumptions together also allow one in empirical work to attribute changes in price gaps to changes in policy.

[4] Although OECD begins its decomposition of change in M with M as $P^d - P^w X$, if domestic transport/transaction costs exist, M for an import should equal $P^d + C^d - P^w X - C^m$, and for an export $P^d + C^d - P^w X$. OECD usually assumes that either C^d and C^m are fixed, or in the case when the commodity is imported, that $C^d = C^m$ (assumptions that we also make in this paper). With either assumption (fixed or equal costs), C^d and C^m would drop out of the decomposition of the change in M. An example of OECD's approach is that, in computing M for non-OECD countries, OECD assumes for an imported commodity that the cost, insurance, freight (cif) value for the import plus C^m equals C^d plus an adjustment for the inferior quality of

the domestic product compared to the import (Melyukhina 2002).

[5] The only major qualification to the equivalence between our definition of G and OECD's definition of M is that the latter also involves a feed adjustment coefficient. This comes into existence when the animal feed used in producing livestock products is itself supported or taxed through market price policies. For example, if a country supports its feed producers such that domestic feed prices lay above border prices, domestic livestock producers are taxed because they have to pay higher prices for feed. This tax should be subtracted from M for livestock producers to give an "adjusted" value of their market price support. Because we are interested in measuring a commodity's price gap rather than the support that the commodity's producers receive, we do not include any feed adjustment for livestock products. For a brief description of OECD's method for decomposing the change in M, see OECD (2005). For a more detailed description, see OECD (2002).

[6] Throughout the postwar period, the United States, EU, and other OECD countries have administered a variety of managed price policies that in effect fixed domestic producer prices. The most common agricultural price support policy for the EU has been the intervention purchasing program, and for the United States the commodity loan program. In recent years, however, the United States and EU have been moving away from price support to direct income support for farmers (decoupled from production). For a discussion of EU and U.S. farm policies, see Normile, Effland, and Young (2004) and Kelch and Normile (2004).

[7] For discussion and analysis of state trading, see Ackerman and Dixit (1999).

[8] For example, assume that a country has a managed price policy which keeps the domestic producer price for a commodity (P^d) fixed at $400. The border price ($P^w$ X) initially is $300, which results in per unit market price support of $100. P^w then increases such that the

border price rises to $350. Per unit support falls to $50. The drop in support has been implicit rather than explicit, because the policy variable (the managed price of $400) has not changed.

[9] 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 allow transmission from 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 are the variable tariffs maintained by the EU.

[10] For discussion of agricultural trade policy in transition economies see World Bank (2004), as well as the various agricultural country reports on transition economies by OECD (such as OECD 1998). For discussion of agricultural trade policy in developing countries, as well as in transition economies that are WTO members, see WTO.

[11] Tyers and Anderson (1992) and Quiroz and Soto (1995) find that price transmission elasticities for most country-commodity pairings for developing and transition economies are below 50 percent, and for many pairings below 25 percent. Mundlak and Larson (1992) find that transmission for most countries is much higher than that found in other work. Yet, Quiroz and Soto argue that the high transmission results of Mundlak and Larson stem mainly from a serious problem of positive autocorrelation, a problem that the former avoid in their own study by using a dynamic error correction model. Although the low transmission found by Tyers and Anderson and Quiroz and Soto could result in part from policy interference, it also is consistent with poor infrastructure.

[12] During their early transition years, all the countries of the former Soviet bloc

experienced huge changes in their exchange rate. The rates then began to stabilize, though Russia's economic crisis of 1998 destabilized not only its own exchange rate but also that of most other NIS countries. From 1992 to 2003, the average annual change in Russia's and Ukraine's nominal exchange rate with the U.S. dollar was 36 and 183 percent, respectively (these figures exclude the tremendous depreciation in both currencies during the initial transition year of 1992; PlanEcon). Developing country exchange rates have become somewhat more stable in recent years, as a number of countries have pegged their currencies to the U.S. dollar. Yet, as Argentina's recent experience shows, currency pegging does not preclude financial crisis, which usually brings extreme currency depreciation. For discussion of exchange rate market and policy developments in developing and transition economies, see United Nations (1998) and Braga de Macedo, Cohen, and Reisen (2001).

[13] For example, let $P^w = 50$, $X = 2$, and tariff rate $(t) = 0.2$, such that $P^d = 120$ and $M = 20$. If X increases by 50% to 3, $(P^w X)$ increases by 50% to 150, P^d by 50% to 180, and M by 50% to 30. By assuming no transmission, the OECD decomposition method would misvalue the effect of the change in X on M. The OECD method would calculate that the effect of ΔX on M is –50, the negative of $(P^w = 50) * (\Delta X = 1) = 50$, and that the effect of ΔP^d on M is 60. The net effect on M is an increase of 10. What has in fact happened is that the full 50% rise in X has been transmitted as a 50% rise in P^d, such that P^d increases by 60 to 180. With a tariff of 20 percent, 10 of the increase in P^d of 60 results from the tariff policy. The tariff has not changed, but its existence combined with the rise in X increases M by 10. This measures the net effect of ΔX on M, which incorporates the combined effects of the rise in X, the transmission of ΔX to M, and the existence of the tariff. From the point of view of Tangermann's discussion of explicit versus implicit policy effects, the rise in M is an implicit policy effect of the tariff, in that the rise in X

could not increase M without the tariff. Note that the OECD method would not only severely overstate the effect of ΔX on M in absolute value, but also get the direction of change in M wrong (-50 versus +10).

[14] Recall also that equation (4) rests on the assumption that internal transport/transaction costs for imported and domestic products are equal.

[15] For analysis of how TRQs affect the domestic market for a commodity, as well as empirical examination of the nature and prevalence of TRQs in world agricultural trade, see Skully (2001).

[16] This analysis is based on the "small-country" assumption, whereby a country's trade volumes are too small to affect the prices at which it trades. This accounts for the horizontal parts of the supply curve.

[17] For examination of the market effects of TBTs, see Roberts, Josling and Orden (1999).

[18] Regional governments have restricted product *outflows* rather than inflows, typically when poor harvests have raised concerns over local food security. Such restrictions violate federal law, though enforcement has been difficult (Interfax).

[19] Russia received over 3 million metric tons (mmt) of commodities from the United States, worth about $1.1 billion, and around 1.8 mmt from the EU, worth almost $0.5 billion (Liefert and Liefert 1999).

[20] Such a low transmission value is consistent with the findings of empirical work that estimates transmission between border prices and exchange rates and Russian food prices (Osborne and Liefert 2004) and the transmission of changes in food prices between regions within Russia (DeMasi and Koen 1996, Goodwin, Grennes and McCurdy 1999, and Loy and Wehrheim 1999).

[21] The decomposition examples for Russian poultry can be used to illustrate the point. If the per unit poultry tariff is operative, the transmission elasticity from the change in the landed price to domestic producer price over 1997-99 is 46 percent. The transmission elasticity computed from 1997 to 1998 is lower at 33 percent, while the elasticity computed from 1997 to 2000 is higher at 66 percent. The change in P^d for poultry from the big ruble depreciation caused by the 1998 economic crisis clearly took a few years to play out.

References

Ackerman, K. and P. Dixit. *An Introduction to State Trading in Agriculture*. Agricultural Economic Report No. 783, Economic Research Service, USDA, Washington, DC, October 1999.

Barrett, C.B. "Measuring Integration and Efficiency in International Agricultural Markets." *Review of Agricultural Economics* 23, 1:19-32 (Spring 2001).

Barrett, C.B. and Jau Rong Li. "Distinguishing Between Equilibrium and Integration in Spatial Price Analysis." *American Journal of Agricultural Economics* 84, 2: 292-307 (May 2002).

Braga de Macedo, J., D. Cohen and H. Reisen, editors. *Don't Fix, Don't Float: The Exchange Rate in Emerging Markets, Transition Economies and Developing Countries*. OECD, Paris, 2001.

Colman, D. "Problems of Measuring Price Distortion and Price Transmission: A Framework for Analysis." *Oxford Agrarian Studies* 23, 1:3-13 (1995).

DeMasi, P. and V. Koen. "Relative Price Convergence in Russia." *IMF Staff Papers* 43, 1:97-122 (March 1996).

Economic Research Service (ERS), USDA. *Agricultural Outlook*, various issues.

Fackler, P.L. and B.K. Goodwin. "Spatial Price Analysis." In *Handbook of Agricultural Economics*, pp. 971-1024, edited by B.L. Gardner and G.C. Rausser. Amsterdam: Elsevier, 2001.

Food and Agriculture Organization (FAO). *The State of Food and Agriculture*. Rome, annual.

Goodwin, B. K., T .J. Grennes and C. McCurdy. "Spatial Price Dynamics and Integration in Russian Food Markets." *Policy Reform* 3, 2:157-193 (1999).

Harley, M. "Use of the Producer Subsidy Equivalent as a Measure of Support to Agriculture in Transition Economies." *American Journal of AgriculturalEconomics* 78, 3:799-804 (August 1996).

Interfax. *Food and Agriculture Report*. Moscow, various issues.

Kelch, D. and M.A. Normile. "CAP Reform of 2003-04." Electronic Outlook Report WRS-04-07, Economic Research Service, USDA, Washington, DC, August 2004. www.ers.usda.gov

Liefert, W.M., D.J. Sedik, R.B. Koopman, E. Serova and O. Melyukhina. "Producer Subsidy Equivalents for Russian Agriculture: Estimation and Interpretation." *American Journal of Agricultural Economics* 78, 3:792-798 (August 1996).

Liefert,W.M. and O. Liefert. "Russia's Economic Crisis: Effects on Agriculture." *Agricultural Outlook*, Economic Research Service, USDA, Washington, DC, June 1999, pp. 15-18.

Loy, J. P. and P. Wehrheim. "Spatial Food Market Integration in Russia." *Food Security, Diversification and Resource Management: Refocusing the Role of Agriculture,* pp. 421-431. Proceedings of the Twenty-third International Conference of Agricultural Economists, Aldershot, UK: Ashgate, 1999.

Melyukhina, O. "The Measurement of the Level of Support in Selected Non-OECD Countries." *China in the Global Economy: Agricultural Policies in China after WTO Accession*. OECD, 2002.

Mundlak, Y. and D.F. Larson. "On the Transmission of World Agricultural Prices." *The World Bank Economic Review* 6, 3:399-422 (September 1992).

Normile, M.A., A.B.W. Effland and C.E. Young. "U.S. and EU Farm Policy – How Similar?" *U.S.-EU Food and Agriculture Comparison*. Agriculture and Trade Reports WRS-04-04, Economic Research Service, USDA, Washington, DC, January 2004, pp. 14-27.

OECD. "Producer and Consumer Support Estimates, OECD Database, 1986-2003," Russia. www.oecd.org

OECD. *Russian Federation: Review of Agricultural Policies*. Paris, 1998.

OECD. "Decomposition of Country-Specific Commodity Trees." OECD internal working document, Paris, 2002.

OECD. *Agricultural Trade and Poverty: Making Policy Analysis Count*. Paris, 2003.

OECD. *Agricultual Policies in OECD Countries: Monitoring and Evaluation 2005*. Paris, 2005.

Osborne, S.R. and W.M. Liefert. "Price and Exchange Rate Transmission in Russian Meat Markets." *Comparative Economic Studies* 46, 2:221-244 (June 2004).

PlanEcon. *Review and Outlook for the Former Soviet Republics*. Washington, DC, annual.

Quiroz, J. and R. Soto. "International Price Signals in Agricultural Prices: Do Governments Care?" GERENS and ILADES/Georgetown University, 1995.

Roberts, D., T.E. Josling and D. Orden. *A Framework for Analyzing Technical Trade Barriers in Agricultural Markets*. Technical Bulletin No. 1876, Economic Research Service, USDA, Washington, DC, March 1999.

Russian Federation State Customs Committee. *Tamozhennaia Statistika Vneshnei Torgovli Rossiiskoi Federatsii (Customs Statistics for Foreign Trade of the Russian Federation).* Moscow, annual.

Skully, D.W. *Economics of Tariff-Rate Quota Administration*. Technical Bulletin No. 1893, Economic Research Service, USDA, Washington, DC, April 2001.

Tangermann, S. “Agricultural Policies in OECD Countries 10 Years After the Uruguay Round: How Much Progress.” Paper presented at the Meeting of the International Agricultural Trade Research Consortium, “Agricultural Policy Reform and the WTO: Where are We Heading?” Capri, Italy, June 23-26, 2003.

Tyers, R. and K. Anderson. *Disarray in World Food Markets: A Quantitative Assessment*. Cambridge University Press: Cambridge, UK, 1992.

United Nations. *Trade and Development Report 1998*. New York, 1998.

U.S. Dept. of Agriculture (USDA). *Production, Supply, and Distribution (PS&D)*. www.fas.usda.gov/psd/

Wehrheim, P., K. Frohberg, E. Serova and J. von Braun, editors. *Russia’s Agro-food Sector: Towards Truly Functioning Markets*. Dordrecht, Netherlands: Kluwer Academic Publishers, 2000.

World Bank. *The Agrarian Economies of Central-Eastern Europe and the Commonwealth of Independent States*, edited by C. Csaki and A. Zuschlag. ECSSD Environmentally and Socially Sustainable Development Working Paper No. 38, World Bank, Washington, DC, June 25, 2004.

World Bank and OECD. *Achieving Ukraine’s Agricultural Potential*. Washington, DC, 2004.

World Bank and IMF. *Global Monitoring Report 2005*. Washington, DC, 2005.

World Trade Organization (WTO). *Trade Policy Reviews*. Geneva, periodical by country.

Table 1: Decomposition of Change in Price Gap for Russian Poultry, 1997-99: Per Unit Tariff

Variable (V)	$\dot{V}$	Contribution of $\dot{V}$ to $\dot{G}$					
		$e+k=1$			$-k$ (incomplete transmission effect)	e (net effect)	OECD decomp
		policy effect	price disparity effect	combined effect			
	Percent						
P^d	117	na	na	na	na	na	197
T	0	0	0	0	0	0	na
P^w	-16	0	-21	-21	26	5	27
X	300	142	145	287	-256	31	-188
G	36	142	124	266	-230	36	36

Note: P^d is a relevant variable for only OECD's decomposition method, and *T* is relevant for only our method. "na" means not applicable.

Source: For $\dot{V}$, database for Russian PSEs (OECD). For contribution of $\dot{V}$ to $\dot{G}$, own calculations.

Table 2: Decomposition of Change in Price Gap for Russian Poultry, 1997-99: Ad Valorem Tariff

Variable (V)	$\dot{V}$	Contribution of $\dot{V}$ to $\dot{G}$					
		$e+k=1$			$-k$	e	OECD decomp
		policy effect	price disparity effect	combined effect	(incomplete trans-mission effect)	(net effect)	
	percent						
P^d	117	na	na	na	na	na	197
t	-50	-44	0	-44	18	-26	na
P^w	-16	-12	-24	-36	26	-10	27
X	300	80	169	249	-177	72	-188
G	36	24	145	169	-133	36	36

Note: P^d is a relevant variable for only OECD's decomposition method, and t is relevant for only our method. "na" means not applicable.

Source: For $\dot{V}$, database for Russian PSEs (OECD). For contribution of $\dot{V}$ to $\dot{G}$, own calculations.