Agricultural Economics, 7 (1992) 55–64
Elsevier Science Publishers B.V., Amsterdam

A proposal for the reduction of domestic price variability during the phase-in period of trade liberalization

Dermot J. Hayes, Thomas I. Wahl and S.R. Johnson
Department of Economics, Iowa State University, Ames, IA, USA
(Accepted 26 September 1991)

ABSTRACT

Hayes, D.J., Wahl, T.I. and Johnson, S.R., 1992. A proposal for the reduction of domestic price variability during the phase-in period of trade liberalization. *Agric. Econ.*, 7: 55–64.

Countries replacing existing trade barriers with a fixed tariff may find that domestic price variability rises to politically unacceptable levels. This paper shows how the tariff-reduction formula can be modified to delay the transmission of world price variability. The importance of this modification is demonstrated by a simple two-country, one-commodity simulation model.

The simulation results show that tariffication of existing EC variable levies/export subsidies would dramatically increase price variability within the European Community and that the transmission of this variability can be delayed by slightly altering the adjustment formula.

Recent proposals to the General Agreement on Tariffs and Trade (GATT) have called for the conversion of all nontariff trade barriers into their tariff equivalents and for the subsequent reduction of these tariff equivalents over time. The purposes of tariffication are to provide a methodology for quantifying nontariff trade barriers, thereby making them more visible, and to provide a framework within which to reduce them.

Correspondence to: D.J. Hayes, Department of Economics, Iowa State University, 568C Heady Hall, Ames, IA 50011, USA.
Journal Paper No. J-14214 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project No. 2994.

Many nontariff trade barriers are designed to stabilize domestic prices by breaking their link to world prices and thus reducing variability.

Tariffication has the side effect of replacing domestic price-stabilizing policies with a policy that dramatically increases domestic price variability. For example, if a country replaced its nontariff trade barriers with a 100% tariff and world prices then increased from $2 to $4, the domestic price would increase from $4 to $8. This example illustrates that ad valorem import tariffs magnify world price variability and thus affect the political acceptability of tariffication proposals.

This paper examines the transmission of price variability under tariffication. Alternative tariff-reduction formulas are considered, including a proposed modification of an existing formula developed to slowly introduce world price variability into domestic markets while reducing the price wedge. Using existing formulas and the proposed reduction formula, a two-country, one-commodity model, which includes random error terms in the supply and demand equations, demonstrates the effects of tariffication and reducing tariff trade barriers.

First, the advantages and disadvantages of existing tariff-reduction formulas are presented. One of the existing formulas is then modified to slow the transmission of price variability from world to domestic markets. Next, the results of simulating tariffication and reducing the tariff equivalent using the two-country, one-commodity model are presented. Finally, a summary of the important results is presented.

TARIFF EQUIVALENT REDUCTION FORMULAS

Several alternative adjustment formulas for the tariff are available. Perhaps the most intuitive and reasonable formula from a modeling viewpoint is to reduce the tariff by $1/X$ of the *initial* tariff level in each year, where X is the number of years over which the tariff is to fall to zero. Unfortunately, this concept may not appeal to trade negotiators because the measured tariff levels in each year depend on domestic policies and world price levels. Countries are not likely to agree to a tariff adjustment system that makes domestic agricultural policy a function of potentially volatile world prices. Indeed, the motivation for the protectionist policies of many countries is to insulate domestic markets from the frequent wild swings in world prices. Hence, countries will be reluctant to accept a proposal that immediately transfers this volatility to domestic prices and markets, at least until the impact of liberalization has stabilized world prices. The agreed-upon adjustment path, therefore, needs to allow for annual changes in world price levels.

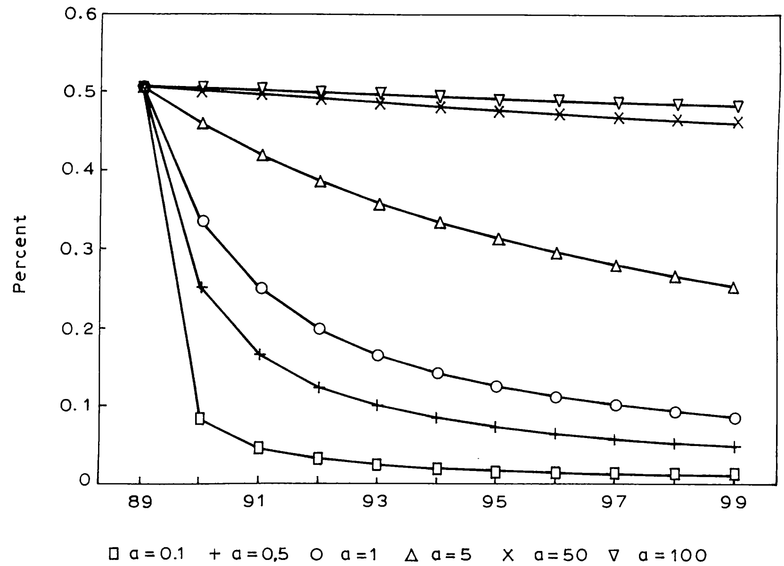

Fig. 1. Alternative Swiss formula adjustment paths.

A second alternative is the Swiss formula considered in the Tokyo Round of the GATT negotiations (Tangermann, et al., 1987). This formula can be written as:

$$t_t = \frac{At_{t-1}}{A + t_{t-1}} \tag{1}$$

where t_t, is the tariff level that must be achieved in a given year, t_{t-1} is the tariff level in the previous year, and A is the negotiated coefficient of adjustment.

The formula allows for a lagged response to changes in world price levels. The tariff adjustment is not instantaneous, however. Tariffs in this formula are determined in advance; consequently, large changes in world prices will have an impact on domestic prices. The tariff will adjust to these world price changes, but the adjustment occurs a full year after the price changes occur. In addition, the nature of the formula guarantees that, for all probable levels of the negotiated coefficient, the brunt of the adjustment will be borne in the early years of the agreement. This concept is demonstrated in Fig. 1, in which the tariff adjustment paths for several values of A (the adjustment coefficient) are presented. The rapid adjustment of tariffs with this formula may be more suited to the industrial trade barriers considered in the Tokyo Round of the GATT negotiations than to agricultural trade barriers. Adjustment costs in agriculture would be rela-

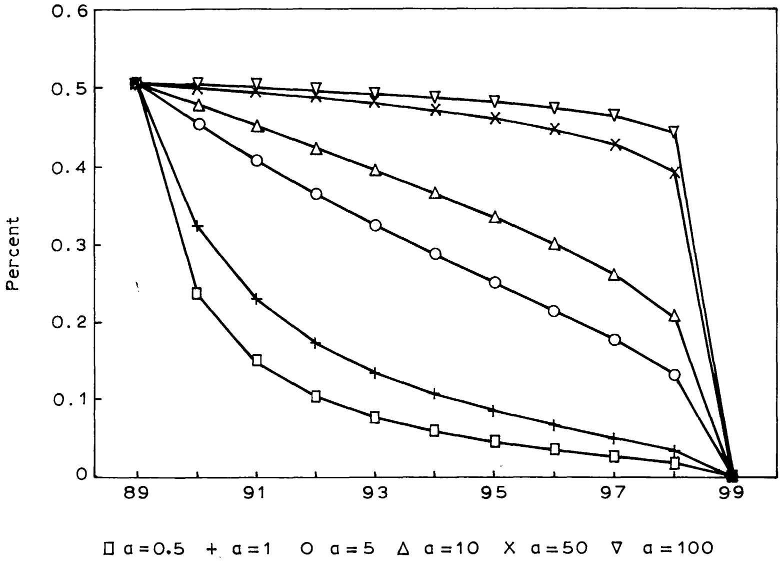

Fig. 2. Alternative modified Swiss formula tariff-reduction adjustment paths.

tively high. At the same time, the level of protectionism in agriculture is higher now than it was during the Tokyo Round. Moreover, the Swiss formula does not allow for the reduction of a given tariff to zero over a given number of years. Unless the value of the adjustment coefficient is zero, the value of the tariff will never reach zero.

The following proposed modification of the Swiss formula addresses the problems inherent in the first two alternatives:

$$t_t = \frac{\left(\frac{r}{n}\right) A t^{a}_{t-1}}{\left(\frac{r}{n}\right) A + t^{a}_{t-1}} \tag{2}$$

$$t^{a}_{t-1} = \frac{(P_{d,t-1} - P_{w,t})}{P_{w,t}} \tag{3}$$

where t^{a}_{t-1} is the ex-ante tariff, n is the negotiated length of the adjustment period, r is the number of years remaining in the agreement, P_d is the domestic price, and P_w is the world price. This formula allows for a wide range of adjustment paths, as shown in Fig. 2. The advantages of the proposed formula are that a target date by which zero trade barriers must be achieved can be stipulated and that the formula automatically adjusts the tariff to allow for world price movements.

In addition, under the proposed formula, the tariff adjusts instantaneously to compensate for changes in world prices. This adjustment serves to isolate the domestic market from changes in world prices without transmitting domestic price variability to the world market.

A second alternative is to replace $P_{d,t-1}$ with $P_{d,t}$ in (3). This substitution is feasible but would allow the tariff to adjust for domestic disturbances and would allow importing countries to export domestic price variance to the world market. This version of the formula would be unacceptable to exporting countries.

The practical implications of these alternatives can best be understood with a simplistic example. Consider an importing country that uses a variable export levy to maintain domestic price stability. Such a policy essentially exports the effects of domestic disturbances to world markets. Should this country shift to an ad valorem tariff, disturbances in world markets would be transmitted to domestic markets. The modified Swiss formula shown in (2) and (3) would at first isolate the effects of domestic and world disturbances; i.e., prices in the importing country would reflect disturbances in that country, whereas prices in world markets would reflect disturbances in world markets. As world and domestic prices moved together, so too would the variances of world and domestic prices. In the last year of the agreement, the two disturbances would be identical. (Presumably, world price variance would be lower after trade barriers were removed.)

AN EMPIRICAL EXAMPLE

To demonstrate the claims made in this paper, we have constructed a simple empirical model. For realism, we have used actual prices and elasticities. The model is too simplistic to provide real-world predictions, however, and these results are presented only to demonstrate the concepts underlying the proposed formula. Any attempt to introduce more realism (such as introducing other countries and commodities) would unduly complicate the model and disguise the more relevant results.

This model contains two countries (the United States and the European Community). The United States begins as a net importer and the European Community as a net exporter; however, this situation is reversed as markets are liberalized. We assume in the base instance that the European Community replaces its variable import levy when liberalization occurs. Table 1 presents the base year data and assumed elasticities.

The supply and demand specifications for each country take the general form:

$$ES_1 = QS_1 - QD_1 \tag{4}$$

TABLE 1

Base year supply and demand elasticities for beef in the United States and the European Community [a]

	United States (Country 1)	European Community (Country 2)
Elasticities		
Supply	0.65	0.55
Demand	−0.70	−0.70
1986 Data		
Supply	11.292	7.445
Demand	12.031	6.991
Net imports	0.739	−0.454
Price	1.878	3.221
Coefficients		
f_{i1}	3.952	3.350
f_{i2}	3.908	1.271
τ_i	1.271 [b]	0.596 [b]
g_{i1}	20.453	11.885
g_{i2}	−4.484	−1.519
ν_i	0.352 [c]	0.444 [c]

[a] The base year is 1986. The data and elasticities are taken from Roningen and Dixit (1988).
[b] Variance of the random term in the supply equation for country i.
[c] Variance of the random term in the demand equation for country i.

and

$$ED_2 = QD_2 - QS_2 \tag{5}$$

$$QS_i = f_i(P_i, \alpha_i, \tau_i) \qquad i = 1, 2 \tag{6}$$

$$QD_i = g_i(P_i, \beta_i, \nu_i) \tag{7}$$

where QS_i is the quantity supplied in country i, QD_i is the quantity demanded in country i, ES_1 is the excess supply in country 1, ED_2 is the excess demand in country 2, P_i is the price in country i, α_i is a supply shifter in country i, β_i is a demand shifter in country i, and τ_i and ν_i are randomly distributed mean zero-error terms with variances σ_i and ω_i, respectively.

The world market is represented by:

$$ES_1 = ED_2 \tag{8}$$

$$P_2 = EZ_1P_1 + Z_2 \tag{9}$$

$$Z_1 = E(1 - s_1)(1 - s_2)(1 + t_1)(1 + t_2) \tag{10}$$

and

$$Z_2 = E(T_1 - S_1 + C) + T_2 + S_2 \quad (11)$$

where E is the exchange rate, s_1 is an ad valorem export subsidy, S_1 is a specific export subsidy, s_2 is an ad valorem import subsidy, S_2 is a specific import subsidy, t_1 is an ad valorem export tariff, T_1 is a specific export tariff, t_2 is an ad valorem import tariff, T_2 is a specific import tariff, and C is the transportation cost between country 1 and country 2.

Several alternative policies can be represented by (10) and (11). For example, to examine the effects of changes in the import tariff on the importer's price, (10) reduces to $E(1 + t_2)\ P_1$, and (11) reduces to EC.

Under a variable levy, the link between the importer's price and world prices, (10), is replaced by a constant import price, $\bar{P}_2$. The effect is to prevent the transmission of world price variability into the importer's markets.

To analyze the transmission of variability under various trade policies, the model was simulated for 100 iterations by using the program @RISK. The program solves for the equilibrium prices and quantities for a given set of disturbance terms. A new set of disturbance terms is then generated, and new equilibrium values are found. This process is repeated 100 times to generate a price distribution for each policy and/or year. The parameters of the resulting price distributions can then be used as proxies for those of the true distributions.

The policies include no trade, free trade, ad valorem import and export subsidies and tariffs, and a variable levy. The resulting means, variances, and coefficients of variation (covs) of the endogenous variables are presented in Table 2.

TABLE 2

Mean prices, variances, and coefficients of variation under various trade policies

Policy	Protection level (%)	U.S. price			EC price		
		Mean (%)	Variance ($/kg)	cov [a]	Mean (%)	Variance (ECU/kg)	cov
No trade	NA	1.97	0.0261	0.0820	3.05	0.0682	0.0856
Free trade	0.00	2.18	0.0214	0.0671	2.53	0.0242	0.0614
U.S. export subsidy	0.50	2.50	0.0242	0.0622	1.55	0.0069	0.0536
U.S. export tariff	0.50	1.93	0.0264	0.0841	3.28	0.2597	0.1553
EC import subsidy	0.50	2.50	0.0215	0.0586	1.55	0.0061	0.0504
EC import tariff	0.50	1.93	0.0258	0.0832	3.29	0.2469	0.1510
EC variable levy	0.75	1.87	0.0320	0.0957	3.44	0	0

[a] cov, coefficients of variation.

In the no-trade scenario, the EC price is much higher than the U.S. price. Under free trade, prices differ only by transportation costs, and the variances are similar. Under an EC import or U.S. export subsidy, U.S. prices rise and EC prices fall relative to free-trade levels, and the variance of EC prices falls. Under a U.S. export or EC import tariff, U.S. prices fall and EC prices rise relative to free-trade levels, and the variability of EC prices increases by a factor of 10. Under an EC variable levy, U.S. prices fall and variability increases relative to free trade, whereas the EC prices are much higher than the free-trade results. The variability of the EC prices under the variable levy is zero because the prices are set exogenously. The implication for tariffication is that U.S. prices increase as their variability decreases, whereas EC prices decrease as their variability increases. The extent of the increase in variability of EC prices will depend on the formula chosen to decrease the tariff equivalent over time.

TARIFFICATION OF THE EC VARIABLE LEVY

The tariff equivalent of the variable levy can be found in this two-country, one-commodity model by driving a wedge between the prices until prices and quantities under the tariff are exactly equivalent to those under the variable levy. The calculated tariff equivalent of the variable levy is 0.64. The tariff equivalent is then reduced over time by using the modified Swiss and Swiss formulas. *

The results of simulating the reduction of the tariff equivalent over 10 years are presented in Figs. 3a through 5b. The modified Swiss formula is used in Figs. 3a, 4a, and 5a, and the Swiss formula is used in Figs. 3b, 4b, and 5b. The results presented are for year 1 (Figs. 3a and 3b), year 5 (Figs. 4a and 4b), and year 10 (Figs. 5a and 5b). As shown in Figs. 3a and 3b, the variability of the EC prices in year 1 is less than those in the other years under the modified Swiss formula because the formula adjusts the tariff as the world price changes, and therefore world price variability is not transmitted into the domestic market. Domestic price variability is attributed only to domestic disturbances and not to variability in world markets.

Tariffication of a variable levy results in domestic producers being subjected to price variability that previously did not exist. This new variability would occur with tariffication of all nontariff trade barriers designed to set price levels. Other nontariff trade barriers allowing some degree of

[1] A small-country assumption was necessary because the degree of simultaneity in the large-country version caused convergence problems.

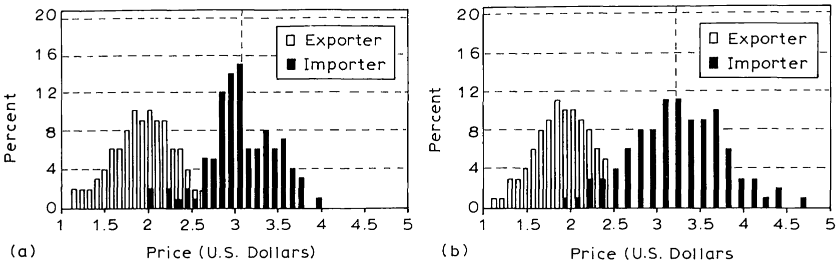

Fig. 3. Exporter and importer price distributions for year 1 of tariff reduction using (a) modified Swiss formula, (b) Swiss formula.

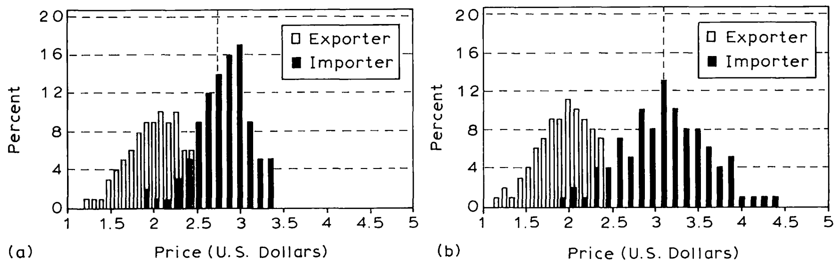

Fig. 4. Exporter and importer price distributions for year 5 of tariff reduction using (a) modified Swiss formula, (b) Swiss formula.

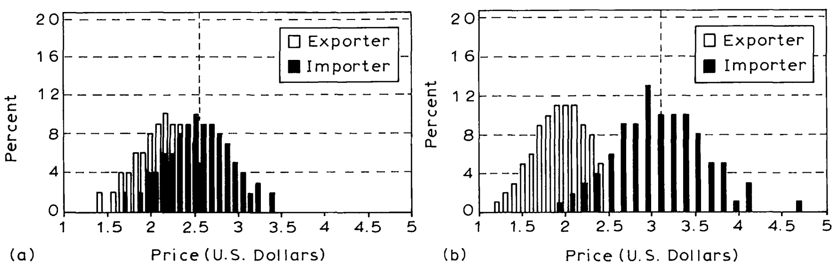

Fig. 5. Exporter and importer price distributions for year 10 of tariff reduction using (a) modified Swiss formula, (b) Swiss formula.

domestic price variability, such as quotas, would cause a modest increase in domestic price variability under tariffication using the modified Swiss formula but a much greater increase when the Swiss formula is used.

In the 5th year of the reduction, the means of the distributions for the exporter and the importer converge as the tariff is reduced (Figs. 4a and 4b). However, the variance of prices under the modified Swiss formula continues to decrease, whereas the Swiss formula maintains a larger variance.

By the last year of the reduction, the price distributions under the modified Swiss formula are separated only by transportation costs, whereas the price distributions under the Swiss formula remain widely separated because the Swiss formula does not force the tariff equivalent to reach zero by the end of the agreement (Figs. 5a and 5b).

SUMMARY AND CONCLUSIONS

The tariffication proposals to the GATT promise to provide a framework for reducing barriers to trade. A drawback of such proposals, however, is that ad valorem tariffs cause domestic price variance to be greater than world price variability. Given that many trade barriers are implemented to reduce price variability, a policy that dramatically increases price variability would likely be politically unacceptable.

A proposed tariff-reduction formula that gradually transmits world price variability to domestic markets is presented. Simulation results using a two-country, one-commodity trade model support the claims made for the new formula.

REFERENCES

Roningen, V. and Dixit, P., 1988. Economic implications of agricultural policy reforms in industrial market economies. Staff Rep. AGES 89-36, Agriculture and Trade Analysis Division, Economic Research Service, U.S. Department of Agriculture, Washington, DC.

Tangermann, S., Josling, T. and Pearson, S., 1987. International negotiations on farm support levels: the role of PSEs. IATRC Work. Pap. No. 87-3, International Agricultural Trade Research Consortium, Stanford University, Stanford, CA.