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Price Transmission Elasticities in the Trade Liberalization (TLIB) Database

John Sullivan

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Abstract

This report documents the price transmission elasticities available in the Trade Liberalization (TLIB) database. The database was constructed using the static world policy simulation (SWOPSIM) framework. Within that framework, linkages across countries and regions take place through domestic-international price equations and world trade. The price transmission elasticities can be used to affect those linkages, and a small model is constructed to illustrate their potential effect on world prices and trade.

Keywords: Price transmission elasticity, trade liberalization, simulation model

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Introduction

The price transmission elasticity (PTE) is an important parameter in some world trade models. It provides a simple way to approximate the impact of domestic policies on prices. The PTE specifies in one number the relationship between a change in a border (or "world") price and the change in a specified domestic price. This paper presents the price transmission elasticities contained in the Trade Liberalization (TLIB) model used by the Economic Research Service (ERS). The TLIB model is a simulation model developed as an analytical tool for evaluating the effects of government policies on U.S. and world agricultural markets.

The model was developed at ERS, U.S. Department of Agriculture, using the Static World Policy Simulation (SWOPSIM) modeling framework (11).[1] The basic components of the TLIB model consists of supply, demand, net trade, policy, and price equations. The policy structure of the model is embedded in equations linking domestic and world prices. Government intervention in agriculture is measured by producer and consumer subsidy equivalents, which are converted into price wedges for modeling purposes. Policies are inserted either as subsidy equivalent price wedges at the producer, consumer, export, or import levels, and as price transmission elasticities that link domestic and world prices. Price transmission elasticities play an important role in the TLIB model for policy analysis.

The subject of price transmission elasticities has received increasing attention in trade policy modeling. It is not an area of consensus. Some of the areas where economists disagree are the need for shortrun and longrun estimates, separate estimates for producers and consumers, separate estimates for importers and exporters, estimates expressed in real or nominal terms, or estimates bounded by 0 and 1. This is in addition to widely varying estimates for what ostensibly is the same commodity in the same region for the same time period.

This report documents the price transmission elasticities available in the TLIB database. To obtain price transmission elasticities for use in the model, we made

[1]Underscored numbers in parentheses refer to items in the References.

estimates for 22 commodities over 36 regions, except in regions where a particular commodity might not be represented. As a result, many sources were consulted to construct the many numbers required. This report first provides a brief history of price transmission elasticities, followed by an overview of the TLIB model, and the sources and criteria for selecting elasticities. Finally, this report presents some model sensitivity analysis with different price transmission elasticities.

History

Price transmission elasticities are used in trade models to link domestic prices with those on world markets. Price transmission elasticities are usually bounded by 0 and 1. A fixed-price policy in a country leads to a 0 price transmission elasticity. In other words, a change in the world price would not cause any change in the domestic price. On the other hand, a free market policy tends to be associated with an elasticity of unity. A change in the world price would be fully transmitted to the domestic market with a comparable change in the domestic price.

Price transmission is a dynamic concept, but is needed even in static models such as those constructed using the SWOPSIM framework. This is because dynamic assumptions must be made about price behavior when static policy measures are changed. Price transmission elasticities should vary with the type of policy being modeled, and vary endogenously as modeled policies are changed. For example, quotas imply a different type of price transmission than variable levies.

Within the SWOPSIM framework, however, policies are not explicitly modeled, but instead proxied by price wedges attributed to the net effect of all government agricultural policies. A policy such as a quota would then need two numbers to represent it, the first being the price wedge which acts as a tariff equivalent, and a price transmission elasticity to represent how much the quota in its tariff equivalent form would change if world prices changed.

The work of Bredahl, Meyers, and Collins (3) is one of the earliest pieces of research on this topic. It was motivated by dissatisfaction with estimates of the elasticity of export demand which did not account for the effect of government policies on domestic producers and consumers. These estimates expressed the elasticity of export demand for a commodity in a form that points out the role of the price transmission elasticity.

$$E_{ef} = SUM_i[E_{di}*E_{pi}*(Q_{di}/Q_{ef}) - E_{si}*E_{pi}*(Q_{si}/Q_{ef})]$$

where E_{ef} = elasticity of export demand
E_{di} = elasticity of domestic demand in country i
E_{pi} = elasticity of price transmission
Q_{di} = level of demand in country i
Q_{ef} = level of U.S. exports
E_{si} = elasticity of domestic supply in country i
Q_{si} = level of supply in country i

In this formulation, the price transmission elasticity is the response of country i to changes in the U.S. price. This can be generalized to include the response within a country to the world price of a commodity.

A price transmission elasticity of one may be termed "perfect price transmission." Note that while perfect price transmission implies the change in the world price equals the change in country i price (in percentage terms), it allows the world price to differ from the price in country i. Within the TLIB context, liberalization has generally meant the price transmission elasticity is set to 1, and each country's price differs from the world price only by marketing margins.

Bredahl and others (3) claim that for many major importing and exporting regions, internal price is largely insulated from U.S. (and/or world market) price. Their study focused on the trade policies of several major importing and exporting regions with respect to cereals, soybeans, and cotton.

The computed export demand elasticities in their study depend on the temporal stability of the elasticities of price transmission. Dynamic price transmission elasticities tend to increase over time, which would increase the export demand elasticities. The choice of static or dynamic price transmission elasticities in trade modeling will obviously have an effect on modeling results.

The price transmission research following Bredahl and others varies in approach and scope (3). Much of the work has focused on a few specific commodities and countries. Elasticities were estimated in some of the research, but numbers were frequently generated from a synthesis of estimates reported by other studies. This latter approach was employed for the elasticities required for the TLIB modeling exercises to date.

Overview of the TLIB Model

The Trade Liberalization (TLIB) database consists of 36 countries and regions and includes 22 major agricultural commodities. The commodities or commodity groups are livestock, dairy, crops, and oilseed products (table 1). The livestock commodities include beef and veal, pork, mutton and lamb, poultry meat, and poultry eggs. The dairy sector consists of milk, butter, cheese, and other dairy powder. The crops include wheat, corn, other coarse grains, rice, soybeans, other oilseeds, cotton, sugar, and tobacco. Oilseed products include soybean meal, soybean oil, other oilseed meal, and other oilseed oils. The country or region coverage is fairly extensive and consists of six major groupings: developed countries, centrally planned economies, Latin America, Africa and Middle East region, Asia, and a rest of world region. Table 2 shows the country composition of regions in the model. Although the standard country models in the TLIB model include 22 commodities or commodity groups, not every country includes all 22 commodities in its model.

When a region's production or trade of a particular commodity is insignificant in a world context, or when data are not available, that commodity is not included in the country or regional model. The quantities of commodities not included in specific country or regional models, but available in the database of the Foreign Agricultural Service (FAS), U.S. Department of Agriculture, are included in an

aggregate rest-of-world model in order to have all-inclusive world commodity coverage. A summary matrix of the TLIB countries/regions and commodities is shown in table 3.

Table 1--Commodities in the TLIB model

Code	Commodity	Code	Commodity	Code	Commodity
	Livestock:		Crops:		Oilseed products:
BF	Beef and veal	CN	Corn	SM	Soybean meal
PK	Pork	WH	Wheat	SO	Soybean oil
ML	Mutton and lamb	CG	Other coarse grains	OM	Other meals
PM	Poultry - meat	RI	Rice	OO	Other oils
PE	Poultry - eggs	SB	Soybeans		
DM	Dairy - milk	OS	Other oilseeds		
DB	Dairy - butter	CT	Cotton		
DC	Dairy - cheese	SU	Sugar		
DO	Dairy - other	TB	Tobacco		

Table 2--Regions in the TLIB model

Code	Region	Code	Region	Code	Region
	Developed countries:		Latin America:		Asia:
US	United States	MX	Mexico	ND	India
CN	Canada	CA	Central America & Caribbean	OS	Other South Asia
EC	European Community			DO	Indonesia
SP	Spain	BZ	Brazil	TH	Thailand
PT	Portugal	AR	Argentina	ML	Malaysia
WE	Other Western Europe	VE	Venezuela	PH	Philippines
JP	Japan	LA	Other Latin America	SA	Other Southeast Asia
AU	Australia			SK	South Korea
NZ	New Zealand			TW	Taiwan
SF	South Africa		Subsaharan Africa & Middle East:	EA	Other East Asia
	Centrally planned countries:	NG	Nigeria	OA	Other Asia
		AF	Other Subsaharan Africa		
EE	Eastern Europe				Other:
SV	Soviet Union	EG	Egypt	RW	Rest of the World
CH	China	MP	Middle East & North Africa Oil Producers		
		MO	Middle East & North Africa - Other		

Table 3--Summary matrix of the TLIB model countries and commodities

	US	CN	EC	SP	PT	WE	JP	AU	NZ	SF	EE	SV	CH	MX	CA	BZ	AR	VE	LA	NG	AF	EG	MP	MO	ND	OS	DO	TH	ML	PH	SA	SK	TW	EA	OA	RW
BF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	1	1	1	1	.	.	.	.	1	.	1	1	1	.	1
PK	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	.	.	1	1	.	.	.	.	1	.	1	1	1	.	1
ML	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	1	1	1	1	.	.	.	.	1	.	1	1	1	.	1
PM	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	1	1	1	1	.	.	1	.	1	.	1	1	1	.	1
PE	1	1	1	1	1	1	1	1	.	1	1	1	.	1	1	1	1	1	1	.	.	1	1	1	1	.	.	.	.	.	.	1	1	1	.	1
DM	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.	1
DB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	1	1	1	1	.	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.	1
DC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	1	1	1	1	.	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.	1
DP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	1	1	1	1	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	1
WH	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CN	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CG	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	.	1
RI	1	1	1	1	1	1	1	1	.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SM	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SO	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OM	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OO	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CT	1	1	1	1	1	1	1	1	.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SU	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.	1
TB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Note: Cells containing "1"'s indicate model equations are created for that commodity and region.

The basic components of the TLIB model structure consists of supply, demand, net trade, policy, and price equations for each commodity in each country model. The standard equations for supply and demand are specified as functions of own- and cross-product prices. Structural equations are specified as nonlinear equations with constant elasticities over all prices. Supply and demand elasticities are major elements of the model. These elasticities in the TLIB model are discussed in (8). The policy structure of the TLIB model is embedded in equations linking domestic and world prices. The standard policy structure is designed to allow flexibility in characterizing policies that might affect production, consumption, and trade. The price linkage equations are specified as follows (where ^ denotes exponentiation):

Production price linkage: PP = MA + CT*(PW^TW)
Consumption price linkage: PC = MD + PP

where MA = marketing margin for either exports or imports
MD = domestic margin
CT = trade price linkage constant, either export price linkage or import price linkage constant
PP = producer price
PC = consumer price
PW = world price
TW = world price transmission elasticity

These price linkage equations are specified at the observed equilibrium situation which includes the effect of any agricultural support policies in place. For prices that would operate if policy interventions were removed (liberalized equilibrium prices), the following definitions apply:

$$PPL = PP - (SP + SE - SI)$$
$$= -SP - SE + SI + MA + CT*(PW\hat{}TW)$$
$$PCL = PC + (SC - SE + SI)$$
$$= SC - SE + SI + MD + PPL = MD + SC + SP + PPL$$

where PPL = liberalized production price
PCL = liberalized consumption price
SP = subsidy equivalent price wedge (production)
SC = subsidy equivalent price wedge (consumption)
SE = subsidy equivalent price wedge (export)
SI = subsidy equivalent price wedge (import)

These two equations constitute the full price-policy linkage equations included in the TLIB/SWOPSIM models. When parameterized for an existing equilibrium situation, the insertion of subsidy measures allows us to recalculate quantities and prices that would result if the subsidies were removed. Removing the subsidy in the model serves to move supply and demand quantities toward trade liberalization positions. Price transmission elasticities in the model are used to characterize the degree of connection of domestic and world prices. Model simulations to date limit the values of transmission elasticities within the range of zero and one. A value of zero for a transmission elasticity means no transmission, while a value of one implies full transmission of world price changes to the domestic market.

Three Main Sources for Elasticities

The International Institute for Applied Systems Analysis (IIASA) model (7) is one of the three major sources for price transmission elasticities in this report. Commodities included are wheat, coarse grains, protein feed, ruminant meat, dairy products, and other animal products. Data are published for 2- and 10-year elasticities, as well as some distinctions between producer and consumer effects.

According to Seeley (12), the transmission of the world price to the domestic price is a function of the historical short- and longrun world-to-domestic price transmission of the country. Price transmission may also be affected by government policies reflecting the country's attitude toward self-sufficiency.

As noted, the IIASA model documents both demand and supply price transmission elasticities for both years 2 and 10. In many cases, however, the demand and supply numbers are equal, and frequently the 10-year value is the same as the 2-year figure. The price transmission equations include lagged prices, which should cause gradual rises in elasticities over time.

There are more elasticities in the IIASA model than are available in published form. Countries are only included in the documentation if their price response can cause a significant change in trade of a commodity, as determined by IIASA system results. The coefficients in the IIASA model that imply elasticities were estimated for the May 1984 version of the model.

Besides differentiating between producer and consumer price transmission elasticities, which not all studies do, IIASA also reports many transmission elasticities greater than 1, which is outside the original theoretical boundary of (3). This probably represents evidence of taxation, although it may also be indicative of exchange rate fluctuations.

For the FAO World Food Model (13), elasticities were obtained mainly from existing studies and analyses such as the USDA GOL model, supplemented by estimates prepared by FAO. This is the most comprehensive source for elasticities for this report, since the model contains equations for 149 individual countries or country aggregates. The commodities included are wheat, rice, maize, millet and sorghum, other coarse grains, bovine meat, pigmeat, sheepmeat and goatmeat, poultry meat, dairy products, butter, fats and oils, and oilmeal proteins. While the model was used for 1980-90 commodity projections, the base data period is 1961-82 for cereals and dairy, 1968-81 for meat, and 1971-81 for fats and oils and oilmeals.

Domestic price changes in the FAO model are linked to changes in international prices through response coefficients, FAO's term for price transmission elasticities. These coefficients are close to 1 for those countries that have few trade restrictions on a particular commodity and the domestic price of the commodity varies in the same direction and to the same degree as the world market price, while they are very small (with a lower limit of zero) for those countries where domestic prices bear little or no relationship to international (export and import) prices.

Specifically: $PP_t = PP_{t-1} * (PX_t/PX_{t-1})^{a1} * (PM_t/PM_{t-1})^{a2}$

where PP = domestic price
PX = export price
PM = import price
a1 = response coefficient relating to export price (= 0 for importer)
a2 = response coefficient relating to import price (= 0 for exporter)

The third major source of elasticities is the Tyers and Anderson's Grains, Livestock, and Sugar (GLS) model (14). Commodities included in this model are wheat, coarse grains, rice, ruminant meat, nonruminant meat, dairy products, and sugar. Their model depends heavily on price transmission elasticities. In the second version of their model, they expanded their usage to include short- and long-term, as well as producer and consumer, effects (tables 4-6 in this paper include estimates from their first model (14), since it documented elasticities for more regions than the second version of their model (15)). As with the IIASA model, however, the distinction between producer and consumer elasticities is more in theory than practice. Similarly, many of the long-term elasticities are identical to their short-term values.

Their current model is based on 1980-82 data, but simulations extend to 1995. Price transmission equations are used to measure each country's food price policies. For their model, a production component raises the trend level of food prices faced by domestic producers and consumers around which prices fluctuate, and a stabilization component adjusts trade to limit changes in domestic prices due to shifts in domestic supply or world price levels.

Price transmission equations were econometrically estimated for each country and commodity in the GLS model. Reduced-form Nerlovian partial adjustment equations were used to incorporate shortrun and longrun elasticities of price transmission. More protected markets are characterized by small shortrun price transmission elasticities, relative to longrun values. Separate elasticities were associated with producer and consumer prices.

Criteria for Selecting Elasticities

The TLIB model comprises 36 regions, each of which can contain equations for up to 22 commodities. The developed and centrally planned country regions generally have full commodity coverage, while many of the developing country regions exclude the livestock and dairy sectors equations due to their relative lack of importance. Each commodity included in each region requires a price transmission elasticity.

We consulted a variety of sources to construct the required data. While differing in their approaches, three studies were most useful due to the comprehensiveness of their coverage. These are the models described above by FAO, IIASA, and Tyers and Anderson. Additional estimates were obtained from Bredahl, Meyers, and Collins; Dunmore and Longmire; Collins; McCalla, Abbott, and Paarlberg; and Roe,

Table 4--Developed country elasticities

Country/region	BF	PK	PM	WH	CN	RI	Source
United States	0.20	0.40	0.80	0.80	0.80	0.60	FAO
	.80	.95	.95	1.00	1.00	.59	Tyers, Anderson
Canada	.80	.80	.40	.80	.40	.40	FAO
	.21	.50	.50	.63	.89	.49	Tyers, Anderson
	.64	.41	.41	1.12	1.00	--	IIASA
European Community	.50	.33	.33	.33	.33	.33	FAO
	.09	.24	.24	.00	.00	.00	Tyers, Anderson
	.15	.54	.54	.38	.33	--	IIASA
Japan	.25	.20	.20	.20	.20	.05	FAO
	.12	.83	.83	.00	.50	.09	Tyers, Anderson
	--	.71	.71	1.00	1.60	--	IIASA
Australia	.70	.70	.70	.70	.70	.70	FAO
	.80	.50	.50	.48	.60	.56	Tyers, Anderson
	--	--	--	.75	1.06	--	IIASA
New Zealand	.70	.20	.70	.20	.70	.20	FAO
	.60	.50	.50	.50	.60	.60	Tyers, Anderson
	1.00	1.00	1.00	--	--	--	IIASA

-- = Not applicable.

Shane, and Vo (3,5,4,9,10). The effect of exchange rates on price transmission, as described by Bolling (2), is not covered in this paper, since exchange rates in the current model are implicitly fixed. (The effect of varying exchange rates would be captured in the measurement of agricultural support). A subset of these price transmission elasticities is documented in tables 4, 5, and 6. The complete lists of TLIB price transmission elasticities are in appendix tables 1, 2, and 3.

A general observation about the state of the literature on price transmission elasticities is that it contains many more words than numbers. Many more estimates for grains have been reported than for livestock, and many more numbers for developed countries than for centrally planned or developing ones. There are also very few estimates for dairy, oilseeds, or other products.

The level of commodity aggregation also differed across studies. The 22 commodities covered by the TLIB model actually consist of 17 individual commodities and 5 aggregate commodities, such as other coarse grains, which includes barley, millet, mixed grains, rye, oats, and sorghum. The studies consulted for use in the model could not be expected to have the identical commodity coverage. Hence, an elasticity reported in one study for ruminant meat was used as part of the process of generating estimates for both beef and mutton in the TLIB framework. The same procedure applied to nonruminant meat, pork, and poultry. Reporting of an aggregate coarse grains estimate was the most common problem, whereas the TLIB model distinguishes between corn and other coarse grains. As a result, the price transmission elasticities in the TLIB database in most cases are identical for corn and other coarse grain.

Table 5--Centrally planned and Latin American elasticities

Country/region	BF	PK	PM	WH	CN	RI	Source
Eastern Europe	0.50	0.33	0.33	0.33	0.33	0.33	FAO
Soviet Union	.30	.25	.25	.25	.25	.25	FAO
	0	0	0	0	0	0	Tyers, Anderson
China	.50	.40	.40	.20	.20	.30	FAO
	0	0	0	.10	.10	.10	Tyers ,Anderson
Mexico	.20	.40	.40	.40	.40	.40	FAO
	.50	.50	.50	.80	.80	.30	Tyers, Anderson
	--	.28	.28	.60	--	--	IIASA
Brazil	.80	.80	.80	.30	.30	.30	FAO
	.50	.60	.60	.80	.80	1.00	Tyers, Anderson
	.65	.90	.90	--	--	--	IIASA
Argentina	.80	.30	.30	.80	.80	.80	FAO
	.50	.20	.20	.80	.70	.20	Tyers, Anderson
	.80	--	--	1.13	.59	--	IIASA

-- = Not applicable.

The varying time frames upon which the range of price transmission elasticities are based is another problem. The TLIB model is constructed to reflect policy adjustments with an implicit lag of approximately 5 years. Thus the supply, demand, and price transmission elasticities should all reflect this medium-term adjustment process. The model is static, however, so that dynamic elasticities are not an option in the modeling framework. In addition, the TLIB model makes no distinction between producers and consumers in terms of price transmission, so a single representative elasticity is needed to reflect the effects on both groups.

Of the three main sources used, both IIASA and Tyers and Anderson report short- and longrun estimates, while FAO's estimates were used for longrun projections. The TLIB elasticities, with their implicit 5-year lag, would then be expected to be in the middle range of these estimates. As a result, the means of these three sets of elasticities were calculated as a starting point, and compared with other studies to assess their reasonableness for particular commodities and countries. For developed countries' commodities such as grains, a variety of estimates available assisted in this process. See appendix table 4 for an example of wheat estimates available. For many of the developing country regions in the TLIB model,

Table 6--Developing country elasticities

Country	BF	PK	PM	WH	CN	RI	Source
Nigeria	.40	.30	.30	.30	.30	.30	FAO
	.40	.70	.70	.40	.30	.40	Tyers, Anderson
	--	.98	.98	--	--	--	IIASA
Egypt	.40	.30	.30	.30	.30	.50	FAO
	.50	.70	.70	.20	.30	.30	Tyers, Anderson
	--	--	--	.67	--	--	IIASA
India	.50	.20	.40	.20	.20	.10	FAO
	.40	.14	.14	.15	.64	.17	Tyers, Anderson
	--	--	--	.39	.49	--	IIASA
Indonesia	.25	.20	.20	.20	.50	.20	FAO
	.20	.20	.20	.09	.15	.08	Tyers, Anderson
Thailand	.50	.40	.40	.20	.80	.50	FAO
	.20	.18	.18	.49	.57	.33	Tyers, Anderson
	--	1.00	1.00	--	--	--	IIASA
Philippines	.25	.20	.20	.20	.20	.50	FAO
	.08	.24	.24	.53	.52	0	Tyers, Anderson
South Korea	.25	.20	.20	.20	.20	.20	FAO
	.01	.38	.38	.31	.26	0	Tyers, Anderson

-- = Not applicable

however, FAO was the only source available. In these cases, some judgement was employed to achieve consistency of estimates across regions known to have similar policies. For all the following tables, refer to tables 1 and 2 for the definitions of the commodity and country codes.

Entering Elasticities into the SWOPSIM Algorithm

The SWOPSIM price linkage equations are specified at the observed equilibrium situation, which includes the effects of any policies in place. Liberalized equilibrium prices are prices that would operate if policy interventions were removed.

The way the price transmission elasticities affect the model is through the equations that generate new producer and consumer prices, which then affect the supply, demand, and net trade equations. The equation for the producer price for a given commodity in a given country that results from model simulation shows how this process works.

LPRPRICE=PRCONST-PRSUBW+IMSUBW-EXSUBW+TDCONST*WDPRICE^CTRAN.EL

The equation is presented using spreadsheet terminology, to correspond to notation used in the SWOPSIM modeling framework. The PRCONST term is the producer price minus the trade price, an initial constant term. Price wedges associated with agricultural support measures are shown in the terms PRSUBW, IMSUBW, and EXSUBW, for producer, importer, and exporter subsidies. The term TDCONST is a constant margin term based on the initial trade price. The term WDPRICE is for the world price in U.S. dollars (all model prices are converted to U.S. dollars before model construction). The exponential effect of the price transmission elasticity term CTRAN.EL, when it takes a value less than one, clearly reduces the effect of world price changes on the producer price within a region. Given the structure of the TLIB model, this will also then affect the consumer price, and demand and supply equations, as the model iterates to a solution.

The price wedges and transmission elasticities are used as alternative measures in most model simulations. When the price wedges are removed for a country in a model simulation, the price transmission elasticity is set at 1. Only when the price wedges are retained, in effect set to 0 in the above equation, does the price transmission elasticity equal less than 1.

The SWOPSIM model used for this report represents the 1986 world temperate and subtropical zone agricultural markets in intermediate run equilibrium. In a static model like this, the observed quantities produced, consumed, and traded in 1986 are assumed to be in an equilibrium that results after adjustment to 5 years of unchanged prices and policies. This assumption about the adjustment period enters the model through the selection of values for the supply, demand, and price transmission elasticities. This is the base model.

The following section presents the results of experiments using a small SWOPSIM model in which new equilibrium solutions are obtained. The new solutions represent an approximation of the resulting adjustments in production, consumption, trade, and prices of agricultural commodities expected after 5 years.

This permits the analysis to isolate and identify the differences between the new solution and the initial or base solution that are attributable to the experiments.

Use of Price Transmission Elasticities in the TLIB Model

The use of price transmission elasticities in the TLIB modeling work has been very limited to date. For this report, a small model of 11 regions was constructed from the 36-region database for sensitivity analysis with different values of price transmission elasticities. While all 22 commodities were included in the model, we focus on just 7. The 11 regions consist of 7 developed country/regions, the centrally planned region, 2 separate developing country regions (developing exporters and developing Asian importers), and a rest of world region comprising the remaining developing countries. The commodities examined in detail are beef and veal, pork, wheat, corn, other coarse grains, rice, and sugar. We constructed two scenarios of developed country liberalization.

For illustrative purposes, a partial liberalization reference scenario (ST86), removing 50 percent of support in developed countries, was run using a price transmission elasticity of one for all the commodities in the developed country regions. As mentioned in the previous section, most model scenarios would use price transmission elasticities of unity only for regions that removed all their agricultural support. A price transmission elasticity of 0.2 was assumed for all commodities in the centrally planned region, while 0.5 was used in the three developing country regions. As can be seen in appendix tables 2-3, which were constructed based on estimates found in various studies, these average values are within the range used by other researchers.

To gauge the usefulness of more extensive use of price transmission elasticities in the TLIB model, a second scenario (RK86) was constructed. The elasticities used for this run varied by commodity within each region, to simulate the possibility of a range of price transmission barriers in place even after the partial removal of agricultural support in the developed countries. The same 50-percent support removal experiment was simulated.

In general, the elasticities for the commodities in the centrally planned and rest-of-world regions did not differ substantially from their previous values of 0.2 and 0.5, respectively, although recent changes in the centrally planned world may in time result in higher levels of price transmission. The price transmission elasticities for the developed countries, however, did vary significantly from their previously assumed level of one.

The results of comparing these two scenarios show the biggest differences for beef, rice, and sugar (tables 7, 8 and 9). For these commodities, the price transmission elasticities used in the second scenario were substantially less than one, reflecting the values found in the literature. Sharp increases in both world prices and world trade were obtained from model simulation. The price changes were consistent with expectations, given the low elasticities for these commodities. The trade changes indicate traders respond to rising world prices.

Table 7--Developed country partial liberalization, ST86

Country/ region	Price transmission	Base period net trade	Net trade difference		Change in welfare
		1,000 tons		Million $U.S.	
United States:					
BF	1	-739	517	1,037	-158
PK	1	-470	239	525	-80
WH	1	26,752	-678	391	709
CN	1	39,085	-1,113	322	2,076
CG	1	7,456	-3,261	-232	392
RI	1	2,636	-72	29	106
SU	1	-1,697	-1,446	-286	460
European Community:					
BF	1	715	-735	-1,540	1,294
PK	1	174	-150	-348	483
WH	1	14,167	-6,368	-592	385
CN	1	-2,127	-4,536	-468	448
CG	1	6,022	2,115	242	581
RI	1	-175	-270	-64	33
SU	1	2,691	-814	-52	360
Japan:					
BF	1	-256	-151	-396	706
PK	1	-297	-272	-724	312
WH	1	-5,390	-457	-158	239
CN	1	-15,500	2,048	30	-222
CG	1	-5,910	-144	-63	151
RI	1	-20	-2,872	-653	3,660
SU	1	-1,853	-348	-112	80
Centrally planned:					
BF	.2	-61	39	78	-42
PK	.2	551	213	616	99
WH	.2	-26,250	2,126	-189	-392
CN	.2	-5,500	335	-28	-66
CG	.2	-5,895	565	1	-57
RI	.2	215	334	80	5
SU	.2	-5,973	204	-145	-181
Rest-of-world:					
BF	.5	-929	155	172	-170
PK	.5	-39	25	56	-10
WH	.5	-39,486	5,324	-2	-529
CN	.5	-14,259	2,015	40	-170
CG	.5	-12,227	2,103	87	-113
RI	.5	-6,264	2,134	376	-121
SU	.5	2,159	1,402	293	24

Table 8--Developed country partial liberalization, RK86

Country/ region	Price transmission	Base period net trade	Net trade difference		Change in welfare
		--- 1,000 tons ----------		-- Million $U.S.	-----
United States:					
BF	0.65	-739	559	1,110	-196
PK	1.00	-470	418	969	-105
WH	1.00	26,752	317	684	752
CN	1.00	39,085	-2,560	202	2,072
CG	1.00	7,456	-3,147	-213	387
RI	.80	2,636	8	119	145
SU	.20	-1,697	-1,581	-416	348
European Community:					
BF	.10	715	-1,120	-2,475	1,276
PK	.60	174	30	114	621
WH	.15	14,167	-8,064	-781	530
CN	.25	-2,127	-4,753	-494	465
CG	.10	6,022	924	149	682
RI	.00	-175	-285	-80	17
SU	.10	2,691	-1,343	-94	402
Japan:					
BF	.10	-256	-172	-500	766
PK	.50	-297	-280	-777	283
WH	.40	-5,390	-524	-202	223
CN	.75	-15,500	1,982	15	-214
CG	.75	-5,910	-77	-69	136
RI	.05	-20	-2,994	-763	3,709
SU	.10	-1,853	-408	-196	84
Centrally planned:					
BF	.07	-61	41	78	-27
PK	.01	551	-51	-15	37
WH	.19	-26,250	2,707	-252	-509
CN	.35	-5,500	1,685	102	-58
CG	.14	-5,895	279	-36	-75
RI	.10	215	409	114	22
SU	.46	-5,973	918	-195	-362
Rest-of-world:					
BF	.58	-929	297	412	-248
PK	.47	-39	22	47	-14
WH	.36	-39,486	4,971	-254	-743
CN	.53	-14,259	2,303	61	-178
CG	.52	-12,227	2,994	148	-130
RI	.21	-6,264	2,243	292	-230
SU	.21	2,159	1,093	350	136

Table 9--Developed country partial liberalization, comparison of ST86 and RK86

	World price		World trade	
Item	ST86	RK86	ST86	RK86
	Percentage change from BASE			
BF	9.33	15.72	-25.03	-13.22
PK	6.55	8.95	1.09	-11.07
WH	15.64	20.81	-9.72	-10.53
CN	12.68	13.36	.44	-3.14
CG	10.32	12.82	-9.99	-12.69
RI	8.26	21.17	13.45	14.26
SU	22.43	47.22	13.90	10.40

In general, for the seven commodities examined here, trade patterns for the model regions were maintained. Specifically, for commodities that a region had initially exported, they now would export at an even higher export value. Similarly, commodities that were previously imported would now register an even higher import value. These value effects result from both higher prices and higher volume. (Import volume would increase when domestic price decreases offset world price increases). For the developed country regions, most of the price and trade changes resulted in higher levels of net welfare. Here net welfare is defined as the sum of producer and consumer surplus minus government expenditures.

Conclusions

Price transmission elasticities have played an important role in trade policy modeling. Their initial use in trade research served to approximate the conditions found in world agricultural trade, as opposed to the frictionless world devised by theory. Most recently, they have been used to specify barriers to trade in models designed to analyze the effects of agricultural trade liberalization. Removal of all support to agriculture, both tariff and nontariff, has been argued to result in price transmission levels of one for all commodities and countries removing their support.

Clearly the results generated by trade models vary significantly with the level of price transmission employed. As shown by the example with the small TLIB model, changes in trade value and welfare, as well as other variables, can be traced to changes in price transmission. It is for this reason that a consensus among trade researchers about appropriate levels for these elasticities would be desirable.

A related issue is the implied trade elasticities from models using imperfect price transmission. These elasticities are calculated using demand, supply, and price transmission elasticities, as well as quantities of supply, demand, and net trade. Tyers and Anderson (16) calculated the trade elasticities that were implicit in their model, but noted that ideally such estimates should come from a multicommodity, multicountry dynamic general equilibrium model of the world

economy. The TLIB model is a static partial equilibrium model, but its extensive commodity and regional coverage suggests that calculated trade elasticities from its simulation may be of interest. Refining the price transmission elasticities in the TLIB model would allow these calculations to be made.

For example, as a rough approximation for illustrative purposes, the base models for ST86 and RK86 were both shocked by a 10-percent shift in the supply of all U.S. commodities. The resultant world price percentage changes, along with the U.S. net trade percentage changes, were used to calculate net trade partial elasticities. Note that if the price transmission elasticities used in the RK86 scenario are appropriate, models based on ST86 elasticities would in general overestimate the U.S. trade response to world price changes (table 10). It should be mentioned, however, that few empirical estimates of net trade elasticities have been made for a number of commodities, including animal products, sugar, and tobacco. Hence, there is little agreement in the literature on expected elasticity levels.

Ideally, price transmission elasticities would be estimated independently for every trade modeling exercise, to reflect exactly the time period and policy conditions assumed by the model. Practically, time and data constraints prevent the use of this approach. Many researchers rely instead on the existing literature. The numbers thus generated should only serve as starting estimates, to be replaced by more appropriate ones generated by critical peer review as well as econometric estimation. In that context, this report documents initial efforts to incorporate price transmission elasticities into the TLIB framework.

Table 10--U.S. net trade partial elasticities

Item	Supply shift	Net trade elasticity ST86	Net trade elasticity RK86	Item	Supply shift	Net trade elasticity ST86	Net trade elasticity RK86
BF	0.10	13.47	8.58	CG	0.10	-4.12	-3.16
PK	.10	22.52	11.49	RI	.10	-8.21	-3.26
ML	.10	38.59	20.84	SB	.10	-.47	-.38
PM	.10	-27.22	-20.35	SM	.10	-.78	-.86
PE	.10	-98.94	-69.21	SO	.10	-3.59	-3.74
DM	.10	0	0	OS	.10	-15.77	-12.27
DB	.10	-38.19	-18.34	OM	.10	2.93	5.38
DC	.10	27.07	5.45	OO	.10	3.27	3.17
DP	.10	-2.67	-1.03	CT	.10	-1.98	-1.96
WH	.10	-2.49	-1.89	SU	.10	7.81	4.47
CN	.10	-1.19	-1.42	TB	.10	-75.68	-68.36

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Appendix table 1--Developed country price transmission elasticities

Item	US	CN	EC	SP	PT	WE	JP	AU	NZ	SF
BF	0.65	0.6	0.1	0.1	0.1	0.1	0.1	0.9	0.5	0.8
PK	1	.5	.6	.6	.6	.25	.5	.75	.8	1
ML	.9	.6	.1	.1	.1	.6	.4	.9	.5	.8
PM	1	.3	.6	.6	.6	.25	.8	.75	.8	1
PE	1	.3	.6	.6	.6	.25	.8	.75	--	1
DM	.2	.1	.05	.05	.05	.1	.1	.25	1	.3
DB	.2	.1	.05	.05	.05	.1	.1	.25	1	.3
DC	.2	.1	.05	.05	.05	.1	.1	.25	1	.3
DP	.2	.1	.05	.05	.05	.1	.1	.25	1	.3
WH	1	.85	.15	.15	.15	.15	.4	.8	.7	.3
CN	1	.95	.25	.25	.25	.2	.75	.9	.75	.4
CG	1	.95	.1	.1	.1	.25	.75	.9	.75	.65
RI	.8	.75	0	0	0	.65	.05	.5	--	.7
SB	1	1	.3	.3	.3	1	.7	1	1	1
SM	1	1	.5	.5	.5	1	.7	1	1	1
SO	1	1	.5	.5	.5	1	.7	1	1	1
OS	1	1	.3	.3	.3	1	.7	1	1	1
OM	1	1	.5	.5	.5	1	.7	1	1	1
OO	1	1	.5	.5	.5	1	.7	1	1	1
CT	1	1	1	1	1	1	1	1	--	1
SU	.2	.3	.1	.1	.1	.1	.1	.7	.5	.3
TB	1	1	1	1	1	1	1	1	1	1
Average	.79	.66	.34	.34	.34	.51	.51	.77	.86	.73

-- = Not applicable

Note: These averages are simple unweighted averages of the commodities modeled within a region.

Appendix table 2--Centrally planned and Latin American countries price transmission elasticities

Item	EE	SV1/	CH	MX	CA	BZ	AR	VE	LA
BF	0	0.10	0	0.5	0.5	0.6	0.65	0.65	0.65
PK	0	.05	0	.5	.5	.75	.2	.2	.2
ML	0	.23	0	.5	.5	.6	.65	.65	.65
PM	0	.14	0	.5	.5	.75	.2	.2	.2
PE	0	.02	--	.5	.5	.75	.2	.2	.2
DM	0	0	0.1	.1	.5	.2	.2	.2	.2
DB	0	.55	.1	.1	--	.2	.2	.2	.2
DC	0	.04	.1	.1	--	.2	.2	.2	.2
DP	0	.98	.1	.1	--	.2	.2	.2	.2
WH	0.4	.14	.15	.5	.45	.3	.8	1	.7
CN	.8	.65	.05	.45	.5	.5	.7	.6	.5
CG	.4	.06	.05	.75	.3	.45	.7	.6	.7
RI	0	.21	.1	.3	.5	.5	.2	.2	.4
SB	1	1.36	0	.75	.6	.6	.4	.4	.7
SM	1	.88	0	.75	.6	.6	.4	.4	.7
SO	1	1.14	0	.75	.6	.6	.4	.4	.7
OS	1	.04	0	.75	.6	.6	.4	.4	.7
OM	1	.04	0	.75	.6	.6	.4	.4	.7
OO	1	.37	0	.75	.6	.6	.4	.4	.7
CT	0	.38	0	.9	.5	.4	.5	.5	1
SU	0	1.02	.1	.2	.2	.3	.2	.2	.2
TB	0	.37	0	.5	.5	.5	.5	.5	.5
Average	.35	.40	.04	.50	.50	.49	.40	.40	.50

-- = Not applicable

1/ SV elasticity estimates prepared by Bill Liefert, ATAD/ERS/USDA, January 1989.

Note: These averages are simple unweighted averages of the commodities modeled within a region.

Appendix table 3--African, Middle Eastern, and Asian countries price transmission elasticities

Item	NG	AF	EG	MP	MO	ND	OS	DO	TH	ML	PH	SA	SK	TW	EA	OA	RW
BF	--	--	0.5	0.5	0.5	0.4	--	--	--	--	0.1	--	0.1	0.1	0.1	--	0
PK	--	--	--	--	.5	.1	--	--	--	--	.2	--	.4	.1	.1	--	0
ML	--	--	.5	.5	.5	.4	--	--	--	--	.1	--	.1	.1	.1	--	0
PM	--	--	.7	.7	.7	.5	--	--	0.6	--	.2	--	.4	.1	.1	--	0
PE	--	--	.7	.7	.7	.1	--	--	--	--	--	--	.4	.1	.1	--	0
DM	--	--	.7	.7	.7	.2	--	--	--	--	--	--	--	--	--	--	0
DM	--	--	.7	.7	.7	.2	--	--	--	--	--	--	--	--	--	--	0
DB	--	--	.7	.7	.7	.2	--	--	--	--	--	--	--	--	--	--	0
DC	--	--	.7	.7	.7	.2	--	--	--	--	--	--	--	--	--	--	0
DP	--	--	--	.7	.7	.2	--	--	--	--	--	--	--	--	--	--	0
WH	0.25	0.4	.35	.3	.6	.3	.25	.25	.5	.2	.5	.5	.5	.3	.6	0	0
CN	.5	.5	.5	.9	.9	.8	.9	.4	.7	.3	.6	.5	.7	.9	.6	0	0
CG	.25	.5	.4	.9	.9	.3	.2	.4	.5	.4	.6	.5	.3	.9	--	--	0
RI	.4	.2	.3	.3	.2	.2	.4	.1	.3	.3	0	0	0	.1	.1	0	0
SB	1	.5	.5	.5	.5	.5	.5	.5	.5	.4	.1	.1	.3	.1	.1	0	0
SM	1	.5	.5	.5	.5	.5	.5	.5	.5	.4	.1	.1	.3	.1	.1	0	0
SO	1	.5	.5	.5	.5	.5	.5	.5	.5	.4	.1	.1	.3	.1	.1	0	0
OS	1	.5	.5	.5	.5	.5	.5	.5	.5	.4	.1	.1	.3	.1	.1	0	0
OM	1	.5	.5	.5	.5	.5	.5	.5	.5	.4	.1	.1	.3	.1	.1	0	0
OO	1	.5	.5	.5	.5	.5	.5	.5	.5	.4	.1	.1	.3	.1	.1	0	0
CT	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	0	0
SU	.2	.2	.2	.2	.2	.2	.3	.2	.5	.2	.5	.2	.2	.2	.2	--	0
TB	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	0	0
Ave.	.66	.45	.51	.56	.48	.37	.47	.41	.51	.37	.26	.25	.33	.25	.21	0	0

-- = Not applicable

Note: These averages (ave.) are simple unweighted averages of the commodities modeled within a region.

Appendix table 4--Wheat price transmission elasticities

Source	US	CN	EC	JP	AU	SV
Bredahl and others	--	--	0	0	--	0
Dunmore, Longmire	1	0.8	0.1	0.3	0.8	1
Abbott	1	1	.1	.1	.9	.32
Collins	--	1.1	.14,.17	.33	.9	--
FAO	.8	.8	.25,.4	.2	.7	0
Tyers, Anderson 1	1	.63	0	0	.48	0
Tyers, Anderson 2	1	.68,1	.09,.16	.13,.63	.45,.82	--
IIASA	--	1.12	.38	1	.75	--

-- = Not applicable

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