Short-Run Demand Elasticity Estimates in International Grain Trade

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Abstract: The international market for grains joins economic and political decision making at the national level. Outcomes predicted from the theory of comparative advantage can be potentially swayed by political choices as well as technical factors. Empirical estimates of import demand elasticities for grains provided in this paper are based on a model that treats domestic agricultural policy as an active ingredient in trading decisions. Results show that domestic pricing, production, and stockholding policies of importing countries can and often do have an impact on demand elasticities at the international level. Taking into consideration the interdependence of domestic policy effects contributes to the development of effective agricultural and foreign policy.

Introduction

The distribution of food increasingly depends on events beyond national borders. In all but a few countries, domestic consumption of agricultural products is not confined to what is domestically produced. Trade simultaneously binds the well-being of consumers to the well-being of producers worldwide. The benefits are available to importer and exporter alike. However, despite apparent mutual advantages, impediments to agricultural trade not only still exist but are increasing. The economic forces driving international demand for and supply of food are complex and necessarily involve the broader political-economic environment within which trade takes place. Short-run demand elasticity estimates can help to understand better international demand for imported grains under economic and political constraints.

Characteristics of the International Market for Grains

The growth in trade, the change in major participants in trade, and the degree of instability or volatility in prices and/or quantities traded have been major characteristics of the international market for grains since World War II. Trade in wheat and coarse grains grew at a rate of over 7 percent per year during 1960-81, although the early 1980s saw some decline in this trend. As trade becomes more widespread, variable yields in any one country are more easily and quickly transmitted to other countries (Blandford, 1984). The hegemony of industrial nations in grain trade has weakened with greater participation of LDCs and centrally planned countries in grain trade. Opportunities for friction between countries arising from conflicting national goals (agriculturally oriented or otherwise) are increased as trading relationships become more pluralistic (Warley, 1976). Interdependence among nations has thus increased not only through growth in physical quantities traded but also through political and financial connections.

Modelling Net Import Demand for Grains

Standard trade models based solely on comparative advantage no longer (if they ever did) suffice to explain the dynamics of trading relationships. In attempting to determine what governs international demand for grains, recognition must be given to how the realities of trade deviate from the conditions associated with perfectly competitive markets and to how macroeconomic and political factors influence trade.

For empirical estimation of trade elasticities, differentiating among characteristics of domestic demand and supply and those in the trade sector is important. Under assumptions associated with perfect competition, domestic demand and supply functions give rise to excess demand and supply functions found at the international level. Trade elasticities are simply the sum of domestic demand and supply elasticities. Domestic prices in trading countries tend towards equalization through changes in factor prices brought about through trade. Equilibrium prices and quantities are thus determined through the interaction of excess demand and supply relationships. In reality, however, prices in individual countries are observed to differ from those anticipated by theory and trade elasticities derived solely from domestic demand and supply relationships are inadequate estimators of actual demand responses. Therefore, focusing solely on domestic relationships does not permit adequate analysis of intervening factors.

The model used in this paper estimates net import demand directly, as opposed to estimating trade relationships from domestic demand and supply functions. The estimating equation is based on a set of individual country behavioural equations. This model was developed by Abbott (1976) as a way of explicitly introducing government policy choices into trade decisions.

Domestic economic relationships specified include demand, supply, stocks, and, in particular, a separate price relationship where domestic price can be a function of direct government policy. Specifically, the influences of both past domestic prices and the current world prices are reflected in current domestic prices. If domestic pricing policies are not effective, domestic prices will vary proportionally to the world prices (adjusted for such criteria as the exchange rate and inflation rate) and the price coefficient will be (negative) one. If domestic pricing policies completely dominate, the price coefficient will be zero. Where the stocks relationship appeared to correspond to domestic production, a single supply variable is used.

The net import demand equation is a reduced form of the behavioural model. Independent variables include a world price estimate adjusted for inflation and exchange rates, national income represented by real gross domestic product, annual domestic production, and beginning stocks. The last three variables are specified on a per capita basis.

This equation differs from Abbott's original specification in that it excludes food aid and foreign exchange availability variables. The latter, along with the exchange rate, were included in earlier estimations (Chase, 1985). These variables (as specified) were highly collinear with price and, in some cases, with income. Therefore, the results are not reported here.

USDA data are used for physical variables (imports, exports, production, and stocks). These estimates are considered conservative compared with, say, those of FAO (Paulino and Tseng, 1980). World price data (using prices as proxies) also come from USDA. Estimates for other financial variables (exchange rates, inflation rates, and GDP) as well as population estimates are from the IMF.

The model is applied to a cross section of wheat and coarse grains importers. Most are developing countries (both low and middle income), with a few industrial countries included. Countries with centrally planned economies are not represented, largely because of data availability problems.

In general, estimated coefficients and resulting elasticities are expected to follow standard demand theory. However, given the proliferation of domestic agricultural policies in both developed and developing countries, price elasticities are anticipated to be relatively small. An elasticity at least as large as the sum of domestic demand and supply elasticities would indicate that domestic pricing policies have no inhibiting effects on trade. Income (GDP) is expected to have a positive relationship with imports, with the exception of a situation where a country's particular path of development leads to a successful national policy of self-sufficiency in the traded grain (Magee, 1975). Grain imports are expected to vary inversely with domestic production levels and also stock levels (imports providing a substitute for domestic production). Production elasticities are likely to be larger as the level of self-sufficiency in the traded grain is higher.

Elasticity Estimates

Trade elasticities estimated directly from an equation representing net import demand tend to bear out expectations for the majority of countries for both wheat and coarse grains. Tables 1 and 2 (pages 286 and 287, respectively) give estimation results from the above model.

Price elasticity estimates are generally negative and small. For wheat, 19 out of 24 countries (76 percent) have price elasticity estimates smaller (in absolute magnitude) than -0.30. Coarse grains price elasticity estimates are slightly higher, but still two-thirds of the countries in this group have estimates less than -0.33. Of the four independent variables, price has the least overall significance in determining net imports. These relatively low and/or insignificant price elasticity estimates support the theory that domestic pricing policies are effective in insulating domestic markets from a change in the world price. Price elasticities in the lowest income group are marginally higher than those for higher income groups, indicating that these countries have greater sensitivity to border price changes, perhaps because the costs of domestic price maintenance may become prohibitive beyond a certain range of price fluctuations.

As opposed to price, income elasticity estimates representing changes in net imports to changes in per capita GDP are relatively large and significant. Coarse grains income elasticities are somewhat

larger than those for wheat. Typically, income is a more stable variable than price or domestic supply, so a large elasticity is not likely to be a big factor when looking at market instability. However, a large income elasticity appears to be an important growth factor in overall net imports.

Domestic supply elasticities, on the other hand, are more relevant to market instability. Results here show that domestic supply (production and/or stocks) typically has an inverse relationship with net imports, indicating some transmission of domestic supply variability to international markets. In terms of the size of production elasticities, the effects appears larger for coarse grains than for wheat and somewhat larger for industrial countries than for LDCs. Large production elasticities found in developing countries tend to be associated with countries where the domestic production base relative to consumption is relatively large.

Table 1—Wheat Elasticity Estimates

Country	Price	Income	Production	Stocks	R^2
		Low income countries			
Bolivia	-0.166	0.176	-0.208	†	0.641
Colombia	-0.412*	2.204*	-0.074	-0.242*	0.829
Ecuador	-0.008	0.937*	-0.513*	†	0.959
Egypt	-0.046	0.671*	-0.349	0.62*	0.848
Morocco	-0.231	2.123*	-1.075*	†	0.677
Nigeria	-0.107	0.512**	0.011	0.064*	0.891
Paraguay	-0.521***	-0.611**	-0.189***	-0.197**	0.239
Peru	-0.224*	0.604*	0.138***	†	0.547
Philippines	-0.271**	0.367**	‡	-0.064	0.243
Sri Lanka	-0.257	0.414	‡	0.072	0.044
Thailand	-0.380**	1.861*	‡	-0.114***	0.830
Tunisia	-0.068	1.904*	-1.925*	†	0.880
		Middle income countries			
Brazil	-0.047	0.558*	0.313*	-0.117**	0.727
Chile	0.280**	0.644**	0.265	†	0.352
Israel	0.201	0.327***	-0.344*	-0.148	0.342
Korea (Rep. of)	0.042	0.072	-0.226	0.165**	0.575
Libya	0.006	0.625*	-0.113***	-0.040*	0.903
Malaysia	0.023	0.082	‡	-0.020	-0.108
Saudi Arabia	-1.106*	0.287***	0.100	-0.049***	0.647
Venezuela	-0.180	0.088	0.003	†	-0.789
		Industrial countries			
Germany (Fed. Rep. of)	0.337	-2.574***	-0.660	-2.947*	0.686
Italy	0.188	0.272	-4.642*	-0.648**	0.670
Japan	-0.273	1.408*	-0.765*	†	0.945
Portugal	0.015	0.926***	-1.264*	-0.085	0.842

[Confidence levels: *99 percent, **95 percent, and ***80 percent. †Production and stocks are combined. ‡Variable equals zero during 1960-81. Note: All elasticity estimates are calculated at the mean of the variables.]

Implications of Trade Elasticities for US Policy

Trade elasticities are important to US policy. Both the range of opportunities for policy effectiveness and the range of constraints on policy change over time (Duncan and Borowski, 1980). Domestic agricultural trade policies in the USA are now more interdependent with those of other countries.

US farm price and income policies have been historically inward oriented towards problems faced by domestic producers. Increasingly, however, short-run problems such as unstable prices and incomes are not generated solely within the confines of the US economy. Low short-run demand elasticities of imports of US grain imply that little market adjustment is made by importers in response to changes in US prices. Furthermore, world grain price changes (influenced by domestic US policy either directly or indirectly via supply response) have little bearing on prices and quantities in other countries in the short run. In the long run, greater responses may come about through budgetary pressures, either internal or with respect to foreign exchange availability. Low demand price elasticities imply that, at least in the short run, price is an ineffective medium through which to influence the amount of grain traded. In general, importing countries operate their own domestic pricing policies, which counteract the short-run impact of changes in the US price on quantities traded.

Large short-run income elasticities of importing countries indicate that manipulation of this variable has a more significant influence on trade. Export subsidy programmes of the USA such as

Table 2—Coarse Grains Elasticity Estimates

Country	Price	Income	Production	Stocks	R^2
		Low income countries			
Colombia	-1.017**	4.090*	-1.545	†	0.591
Ecuador	-0.982**	1.942*	-2.128***	†	0.695
Egypt	0.135	1.685*	0.466*	†	0.503
Nigeria	-0.321	-0.719***	0.321	0.459*	0.877
Philippines	0.288	7.423**	-4.303***	0.122	0.460
Peru	0.528	4.556*	-3.178**	†	0.698
Tunisia	-1.572***	2.451*	-0.315	†	0.601
		Middle income countries			
Chile	-0.174	0.926***	1.083***	-0.103	0.171
Israel	0.177	0.438***	-0.104**	0.064	0.776
Korea (Rep. of)	-0.257	1.560*	-0.396***	†	0.923
Libya	-0.917***	0.140	-1.012**	†	0.317
Malaysia	-0.207	1.209***	0.294***	†	0.857
Saudi Arabia	-0.617	1.242***	-0.997	0.266*	0.840
Venezuela	-0.329	2.980*	-1.082**	0.116***	0.833
		Industrial countries			
Germany (Fed. Rep. of)	0.159	1.551***	-1.770**	-0.603***	0.262
Italy	-0.154	1.634*	-2.561*	-0.146	0.754
Japan	-0.186**	0.859*	-0.083***	0.183*	0.973
Switzerland	0.056	1.919*	-0.392***	†	0.800

[Confidence levels: *99 percent, **95 percent, and ***80 percent. †Production and stocks are combined. Note: All elasticity estimates are calculated at the mean of the variables.]

Public Law 480 food assistance programmes and the more recent blended credit programme can potentially increase US competitiveness in international grain markets by tapping in a selective (targeted) manner the import responsiveness of countries to income opportunities (Perkins, 1983).

Short-run production/supply elasticities of grain importers are typically large. Here, annual production variability has the potential to destabilize world markets by transmitting domestic supply changes through import demand changes. Current US stockholding policies can mitigate this effect (Morrow, 1980), although, in a competitive international environment, not all benefits are able to be captured by the USA.

Note

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