1-1980

The Effect of Price-Insulating Poll Policies on Exchange Rate Analysis

William H. Meyers
Iowa State University

Elizabeth J. Gerer
ESCS

Maury E. Bredahl
University of Missouri–Columbia

Follow this and additional works at: http://lib.dr.iastate.edu/econ_las_pubs

Part of the Agricultural Economics Commons, Economic Policy Commons, and the International Economics Commons

The complete bibliographic information for this item can be found at http://lib.dr.iastate.edu/econ_las_pubs/76. For information on how to cite this item, please visit http://lib.dr.iastate.edu/howtocite.html.
The Effect of Price-Insulating Poll Policies on Exchange Rate Analysis

Abstract
A model derived to compute exchange rate effects on trade uses foreign internal demand elasticities and price transmission elasticities which account for government price-insulating policies. Appreciation of the Japanese yen relative to the dollar is analyzed for impacts on Japanese imports of U.S. wheat, feed grains, and soybeans.

Keywords
Exchange rate, Government price policy

Disciplines
Agricultural Economics | Economic Policy | International Economics

Comments
This article is from Agricultural Economics Research 32 (1980): 25–30.
THE EFFECT OF PRICE-INSULATING POLICY POLICIES ON EXCHANGE RATE ANALYSIS

By William H. Meyers, Elizabeth J. Gerber, and Maury E. Bredahl*

The relationship between exchange rate fluctuations and U.S. agricultural exports has been a topic of considerable interest to policymakers and economists since the currency adjustments of the early seventies. The recent weakening of the U.S. dollar has intensified the debate on the nature and magnitude of exchange rate impacts. Schuh postulated that the currency realignment of the early seventies had a major effect on subsequent crop price increases. Kost proposed some theoretical reasons why the impact should be small. Bredahl and Gallagher extended Kost's analysis by developing conditions under which export impacts could be large or small.

Free trade models were often analyzed, and Johnson, Grennes, and Thursby tested Schuh's hypothesis for wheat, using derived price elasticities and concluded that foreign government policies were more important than exchange rates in explaining the price and export changes.

The size of the U.S. export demand elasticities colors much of the debate over the magnitude of exchange rate impacts. Schuh pointed to foreign demand elasticity computations by Tweeten, which were large. Bredahl, Meyers, and Collins later showed that omitting the effects of price-insulating policies in trading countries leads to serious overestimates of U.S. export demand elasticities. These internal price policies are therefore an important factor in the analysis of exchange rate effects.

We develop a model of short-run exchange rate effects which uses price transmission elasticities to account for price-insulating policies. The model derives the commodity equilibrium impacts on U.S. price and exports as a weighted summation of effects in individual countries. We demonstrate the price transmission effects by a partial equilibrium application to Japan.

The analytical model

The impact of the exchange rate on U.S. agricultural exports can be divided into two components (see figure). A devaluation of U.S. currency rotates import demand (ID) to the right. Exports increase from M₀ to M₁ at the initial export price P₀. This is the maximum impact on exports. Equilibrium price rises to P₂ if export supply is not perfectly elastic, and the net increase in exports is reduced to M₂-M₀. Given the elasticities of export supply (ηₑₛ) and import demand (ηᵣₑ), and the relative shift in import demand at P₀(M), the relative changes in equilibrium price (P) and exports (X) can be determined by

\[ \hat{P} = \frac{1}{\etaₑₛ - \etaᵣₑ} (\hat{M}) \]  
\[ \hat{X} = \frac{\etaₑₛ}{\etaₑₛ - \etaᵣₑ} (\hat{M}) \]

Countries must be treated individually, because exchange rates behave differently in each country. The shift in the import demand at P₀(dM) can be separated into shifts in demand (dD) and supply (dS) by country:

\[ dM = \sum (dD_i - dS_i) \]

---

*Assistant professor of economics with Iowa State University, formerly international economist with the National Economics Division, ESCC, and assistant professor of agricultural economics with the University of Missouri-Columbia.

1 Italicsized numbers in parentheses refer to items in references at the end of this article.
Countries must be treated individually, because exchange rates behave differently in each country.
where

\[ E_{d1} \] = Elasticity of demand with respect to \( P \),

\[ E_{d2i} \] = Elasticity of demand with respect to \( P_{0i} \),

\[ E_{r1i} \] = Price transmission elasticity of \( P \),

\[ E_{r2i} \] = Price transmission elasticity of \( P_{0i} \).

Noting that

\[ \tilde{D}_i = E_{dri} \hat{r}_i \] (9)

we combine equations (2), (4), and (9) to obtain

\[ \dot{X} = \frac{\eta_{es}}{\eta_{es} - \eta_{ed}} \sum \left( E_{dri} \frac{D_i}{M} \right) \] (10)

We determine the impact of changes in exchange rates on U.S. exports by the elasticities of export supply (\( \eta_{es} \)) and aggregate import demand (\( \eta_{ed} \)) and the demand shift in each country (\( E_{dri} \hat{r}_i \)) weighted by the size of the country's domestic market relative to U.S. exports (\( D_i/M \)).

The model represented by equations (8) and (10) has interesting features. First, we would not expect exchange rate changes to have impact in countries where internal prices respond to world price fluctuations, the response in import levels to changes in exchange rates depends on the internal price elasticity of demand.
Conventional weighted exchange rates and other analyses which ignore government price-insulating policies will not measure exchange rate effects reliably

\[ Q_{FG_t} = a_0 + a_1 PC_t + a_2 PSM_t + a_3 LP_t + a_4 RF_t + u_t \]  

(11)

where

- \( Q_{FG} \) = Total demand for corn and sorghum (1,000 metric tons),
- \( PC \) = Corn, wholesale price index, Japan (1970 = 100),
- \( PSM \) = Soymeal, wholesale price index, Japan (1970 = 100),
- \( LP \) = Pork and poultry, production index, Japan (1970 = 100),
- \( RF \) = Rice fed to livestock in Japan (1,000 metric tons)

Ordinary least squares estimates of these demand coefficients are equations (1) and (2) in table 1. The coefficient on rice feed (RF) indicates that the program in Japan to divert surplus rice to feeding in the early seventies displaced corn and sorghum at a rate of about 8 to 10 to livestock production (LP), the major demand shift variable, has an elasticity of approximately 1.0. In equation (1) the soymeal price coefficient has a high standard error. It was omitted in equation (2), and the corn direct price elasticity changed only slightly.

Demand for Soybeans

Japan's demand for soybeans is also specified as a feed demand equation

\[ Q_{SB_t} = b_0 + b_1 PS_t + b_2 PC_t + b_3 LP_t + u_t \]  

(12)

where

- \( Q_{SB} \) = Total soybean demand (1,000 metric tons),
- \( PS \) = Soybeans, wholesale price index, Japan (1970 = 100),
- \( PC \) = Corn, wholesale price index, Japan (1970 = 100),
- \( LP \) = Pork and poultry, production index, Japan (1970 = 100)

The OLS estimates of these demand coefficients are equations (3) and (4) in table 1. A dummy variable for 1972/73 (DV72) accounts for effects of the U.S. soybean embargo in those years. Its coefficient reflects the unusually high Japanese soybean imports in 1972/73. Livestock production is the major cause of growth in demand, its elasticity is 0.68 at the means. In equation (3), elasticities at mean levels are -0.37 and 0.02 for soybean and corn prices, respectively. The corn price, however, is not significant. In equation (4), it is omitted, which reduces the direct price elasticity for soybeans to -0.35.

Price Linkage Equations

The price linkages for each commodity are specified as follows

\[ JP_t = c_0 + c_1 (USP_t + r_t) + u_t \]  

(13)

where

- \( JP \) = Japanese wholesale price index (1970 = 100)
- \( USP \) = U.S. price (dollars per bushel)
- \( r \) = Japanese exchange rate (yen per U.S. dollar)

The estimated price transmission elasticities computed at means range from 0.99 for soybeans to 0.77 for soybean meal (equations (6) and (7) in table 1). The estimate for corn price (5) is 0.85.

Exchange Rate Impact

We compute the price elasticities of demand and the price transmission elasticities from the estimated relations using the mean of the last 4 years in the estimation period (1973/74 to 1976/77). These are used in table 2 to compute exchange rate elasticities. The computed elasticities of demand for the exchange rate are -0.21 and -0.42 for feed grains and soybeans, respectively. Recall that these shifts in demand (with U.S. commodity prices constant) give the maximum exchange rate impact. Thus, a 10-percent appreciation of the yen would at most increase Japanese feed grain demand 2.1 percent and soybean demand 4.2 percent. At 1977 levels, Japanese demand and U.S. exports would increase 300,000 metric tons (12 million bushels) for corn and 155,000 metric tons (5.7 million bushels) for soybeans.

IMPLICATIONS

Conventional weighted exchange rates and other analyses which ignore government price-insulating policies will not measure exchange effects reliably.
Table 1—Ordinary least squares estimates of demand coefficients and price linkages for feed grains and soybeans, Japan (1960-76)

<table>
<thead>
<tr>
<th>Corn and sorghum</th>
<th>C</th>
<th>PC</th>
<th>PSM</th>
<th>LP</th>
<th>RF</th>
<th>R²</th>
<th>Standard error</th>
<th>Durbin Watson statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Coefficient (z)</td>
<td>1804</td>
<td>-1941</td>
<td>5893</td>
<td>2334</td>
<td>-0.7934</td>
<td>0.97</td>
<td>663</td>
<td>1.27</td>
</tr>
<tr>
<td>Elasticity</td>
<td>(2.2)</td>
<td>(-1.9)</td>
<td>(0.62)</td>
<td>(9.7)</td>
<td>(-1.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) Coefficient (z)</td>
<td>2082</td>
<td>-1853</td>
<td>2426</td>
<td>-0.8594</td>
<td>0.97</td>
<td>647</td>
<td>1.43</td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>(3.1)</td>
<td>(-1.9)</td>
<td>(13.2)</td>
<td>(-1.6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soybeans</th>
<th>C</th>
<th>PC</th>
<th>PS</th>
<th>LP</th>
<th>DV72</th>
<th>R²</th>
<th>Standard error</th>
<th>Durbin Watson statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3) Coefficient (z)</td>
<td>1729</td>
<td>0.3745</td>
<td>-8238</td>
<td>0.5671</td>
<td>569.9</td>
<td>0.97</td>
<td>131</td>
<td>3.26</td>
</tr>
<tr>
<td>Elasticity</td>
<td>(14.1)</td>
<td>(0.13)</td>
<td>(-3.3)</td>
<td>(15.8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) Coefficient (z)</td>
<td>1737</td>
<td>-7965</td>
<td>0.5666</td>
<td>564.5</td>
<td>0.97</td>
<td>126</td>
<td>3.26</td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>(17.1)</td>
<td>(-5.7)</td>
<td>(16.5)</td>
<td>(4.2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>C</th>
<th>(USP)</th>
<th>R²</th>
<th>Standard error</th>
<th>Durbin Watson statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn price</td>
<td>15.59</td>
<td>0.1805</td>
<td>0.94</td>
<td>7.13</td>
<td>1.67</td>
</tr>
<tr>
<td>Elasticity</td>
<td>(2.8)</td>
<td>(16.3)</td>
<td></td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>Soybean price</td>
<td>0.8150</td>
<td>0.0966</td>
<td>0.94</td>
<td>9.47</td>
<td>1.95</td>
</tr>
<tr>
<td>Elasticity</td>
<td>(0.11)</td>
<td>(16.6)</td>
<td></td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>Soybean meal</td>
<td>25.00</td>
<td>0.0026</td>
<td>0.84</td>
<td>13.2</td>
<td>2.52</td>
</tr>
<tr>
<td>Elasticity</td>
<td>(2.6)</td>
<td>(9.4)</td>
<td></td>
<td>0.77</td>
<td></td>
</tr>
</tbody>
</table>

Note: Elasticities are computed at means of variables.
rate effects reliably. The measurement error will be greater for commodities whose prices are more highly protected by trading countries.

The commodity equilibrium model we presented incorporates the effect of price insulating policies. It requires the weighting and summing of exchange rate effects within individual countries to obtain the impact on equilibrium price and export levels. The procedure, although not complex, requires large amounts of data. The elasticities of demand and price transmission used in the model could be assumed or obtained from previous studies to reduce the computational requirements. The model was discussed in the context of analyzing US exports but can be applied to any exporting country. The same procedure could be used to derive a model for import analysis.

The model could be enhanced by adding a supply response component for each country. The data requirements would increase but it would be possible to analyze longer-run impacts of exchange rate changes. The individual country components of the model can also be used for partial equilibrium analysis (with US prices constant). This simple procedure, as applied to Japan above, provides useful estimates of the maximum exchange rate impacts.

REFERENCES


(4) Greenshields, Bruce L. "Changes in Exchange Rates," USDA, ERS-Foreign 364 1-17


(9) Tweeten, Luther G. "The Demand for United States Farm Output." Food Research Institute Studies 7 (1967) 343 369