Import Demand for Feed Grains in Venezuela

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Abstract. Domestic food and agricultural policies of individual importing and exporting countries significantly affect international trade in grains This case study focuses on Venezuela's import demand for sorghum It investigates the tradeoffs in a country's decision to import or to produce feed grains in an environment of agricultural price supports and subsidies to feed millers This study also develops a consumer and producer maximization model with government expenditure and foreign exchange constraints

Keywords. Feed grain imports, price policy, Venezuela

The domestic food and agricultural policies of individual importing and exporting countries significantly affect the international grain trade The domestic pricing policies of many importing countries alter the level of international trade High support prices tend to increase domestic production and reduce imports at the expense of consumers, whereas low consumer prices tend to increase domestic consumption, and perhaps imports, at the expense of domestic producers In the long run, however, a government must bear the cost of its domestic pricing policy Several econometric models have been developed to evaluate the impact of various types of government intervention on international trade and prices (*1, 4, 10, 11, 12*).[1]

A common aspect of these studies is that the models developed are extremely general Their lack of detail prevents one from forming an accurate picture of the goals and consequences of government price policies in different countries and for different commodities, where prices are used as a proxy for government intervention The specification of an import demand for feed grains must also differ, at least in theory from that for food grains A model that examines a specific commodity of a given country in depth, particularly with respect to policy, rather than a general model imposed across a wide variety of commodities and countries, can be far more revealing

In recent studies of the international food grain trade, researchers have recognized the importance of including both government expenditures for subsidies and foreign exchange allocation in modeling import demand (*6, 7*) In cases where domestic consumer and producer prices are insulated from international prices, factors like size of government expenditures for subsidies, the allocation of these subsidies among consumers and producers, and the foreign exchange allotment are important policy variables that should be incorporated into estimating import demand functions In this article, we examine the effects of Venezuela's price policies and the financial constraints on the import demand for feed grains We highlight the elements of official policy that affect demand and incorporate them into a welfare maximization model We apply this model to Venezuela's import demand for sorghum Finally, tradeoffs between government expenditures for subsidies and foreign exchange allocation are drawn with respect to the results provided by the model

Venezuela's Policy in the Feed Grain Sector

Sorghum has been the leading U S feed grain export to Venezuela since 1970 Venezuela has used sorghum primarily to develop its poultry industry Imported corn competes with sorghum somewhat The corn, sorghum, and poultry industries are subject to considerable government intervention through administered prices and import restrictions Since 1970, the Venezuelan Government has maintained control over the marketing of basic agricultural commodities like sorghum and poultry through the Corporacion de Mercadeo Agricola (CMA), whose most important function has been to control sorghum prices and imports Throughout most of the seventies, the CMA set the farm price of sorghum well above the world market price to encourage farmers to increase production They also set a reference price, between the farm

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[1]Italicized numbers in parentheses refer to items in the References at the end of this article

price and the import price, at which feed manufacturers would purchase both imported and domestically produced sorghum

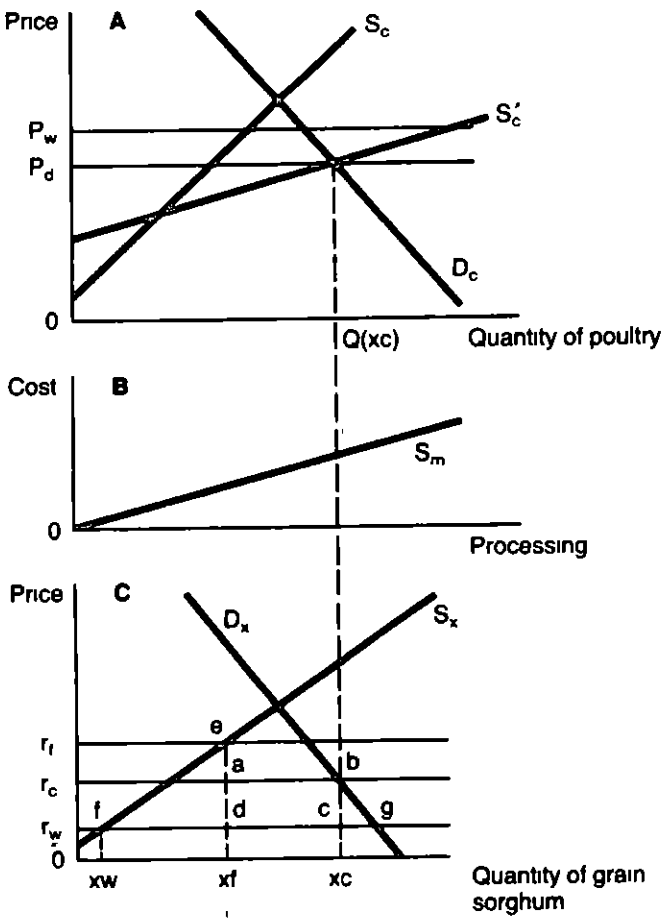
The relationship between the sorghum and poultry sectors and the impacts of Venezuela's pricing policies on international trade can be represented with a multi-paneled diagram such as that found in figure 1 (*3*) Panel (C) represents the sorghum sector Venezuela produces sorghum for use in the domestic production of poultry The domestic supply function is S_x Domestic sorghum supply can be supplemented, if necessary, by imports at the fixed world price, r_w Prices r_f and r_c are the officially set producer and reference prices Panel B represents the domestic, nontradeable processing sector The function S_m is the domestic supply curve of processing services

There are two poultry supply curves in panel A The first, Sc, is the vertical addition of S_x and S_m Hence, S_c is the supply of poultry when autarky prevails in the sorghum market, all sorghum and processing services are obtained domestically The function S_c' is the vertical addition of r_c and s_m It is the supply of poultry when either foreign or domestic supplies of sorghum, at the official reference price, r_c, are combined with processing services At reference price r_c, sorghum quantity xc would be used to produce Q(xc) of the poultry, satisfying domestic poultry demand at price p_d With the producer price officially set at r_f, domestic production of sorghum would equal xf The difference between xc and xf would be imported by the CMA at world price rw In the absence of Government intervention, Venezuela would only produce a small quantity of sorghum, xw, at world price rw and would import the remainder of its needs

The amount of Government expenditures needed to subsidize sorghum producers, given this price policy, depends on both the relative changes in the world, reference, and farm prices, and on the quantities produced and imported During the early seventies, when world prices were relatively low and domestic sorghum production was small, the cost of subsidizing domestic producers, the area bounded by $r_f edr_w$ in panel C could be absorbed by Government revenues collected from millers, the area $r_c bcr_w$ During these years, there was a simple transfer of funds from millers to producers through the CMA Since then, domestic production has grown and the farm-to-miller price spread has increased As a result, the transfer of funds to domestic sorghum producers is no longer covered by Government revenues collected from millers. At this point in panel C, abcd would be smaller than $r_f ear_c$ This situation has meant that large Government budget outlays have been necessary to subsidize domestic producers By the early

Figure 1

Venezuelan poultry and grain sorghum sectors



eighties, these subsidies were of considerable concern to the Venezuelan Government, because 70 percent of Venezuela's sorghum production was marketed through CMA, resulting in burdensome Government outlays to cover these direct subsidies and the eventual dissolution of CMA in 1984

The Model

In deriving a feed grain import demand model, we assume that the Government attempted to maximize both the social welfare of consumers of meat products and producers of feed grains. Let the demand for the ith meat product and the supply of the jth grain be represented in linear form as equations 1 and 2, respectively.

$$P_i = a_i - b_i Q_i \quad a,b > 0 \quad (i = 1, 2, .., n) \qquad (1)$$

where Q_i is the quantity of the ith meat product, and P_i is a unit price of Q_i

$$rf_j = c_j + d_j xf_j \quad c_j \quad 0 \text{ and } d_j > \quad (j = 1, 2, \quad , m) \qquad (2)$$

where xf_j is domestic production of the jth feed grain, and rf_j is the unit price of xf_j Consumer surplus (CS) is then measured by

$$CS = \sum_{i=1}^{n} \left(\int_0^{Q_i} (a_i - b_i Q) \, dQ - P_i Q_i \right)$$

$$= \sum_{i=1}^{n} (a_i - P_i) Q_i - 0\,5 \sum_{i=1}^{n} b_i Q_i^2 \qquad (3)$$

Producer surplus (PS) associated with feed grain supply can be measured by

$$PS = \sum_{j=1}^{m} \left(rf_j \cdot xf_j - \int_0^{xf_j} (c_j + d_j \cdot xf_j) \, dxf_j \right)$$

$$= \sum_{j=1}^{m} (rf_j - c_j) xf_j - 0\,5 \sum_{j=1}^{m} d_j \cdot xf_j^2 \qquad (4)$$

Therefore, the social welfare the Government attempts to maximize can be given as follows [2]

$$W = CS + PS$$

$$= \sum_{i=1}^{n} ((a_i - P_i) Q_i - 0\,5\, b_i Q_i^2)$$

$$+ \sum_{j=1}^{m} ((rf_j - c_j) xf_j - 0\,5\, d_j \cdot xf_j^2) \qquad (5)$$

The social welfare function (equation 5) is then maximized subject to the following constraints represented in equations 6, 7, and 8 [3]

$$\sum_{i=1}^{n} P_i Q_i \leq Y \qquad (6)$$

where Y is the aggregate disposable income allocated for livestock and poultry products Q_i ($i = 1,2, \quad ,n$)

$$\sum_{j=1}^{m} ((rf_j - rw_j) xf_j - (rc_j - rw_j) xc_j) \leq G \qquad (7)$$

where G represents Government expenditures for subsidies to feed grains xf_j

$$\sum_{j=1}^{m} rw_j \cdot xm_j \leq FE \qquad (8)$$

where xm_j is excess demand of the jth feed grain, rw_j is the unit price of xm_j, and FE is foreign exchange alloted to import feed grains

Equation 6 states that consumer expenditures for meat products must not exceed disposable income allocated for livestock and poultry products The first and second terms in the left side of the inequality in equation 7 represent Government subsidies to producers and Government revenue collected from millers Therefore, equation 7 limits Government subsidies to producers less Government revenue collected from millers at a level not to exceed Government expenditures for subsidies In cases where the world price (rw_j) is greater than the millers' price (rc_j), $-(rc_j - rw_j)$ represents the Government subsidy to millers for one unit use of xc_j Therefore, the interpretation of equation 7 is that Government subsidies to producers and millers should not exceed Government expenditures for subsidies Equation 8 states that import purchases of feed grains must not exceed the foreign exchange allotted to pay for these imports For equations 5 through 8, the Lagrangian equation to be maximized is given by

$$L = \sum_{i=1}^{n} ((a_i - P_i) Q_i - 0\,5\, b_i Q_i^2)$$

$$+ \sum_{j=1}^{m} ((rf_j - c_j) xf_j - 0\,5\, d_j \cdot xf_j^2)$$

$$+ \lambda_1 (Y - \sum_{i=1}^{n} P_i) Q_i$$

$$+ \lambda_2 (G - \sum_{j=1}^{m} ((rf_j - rw_j) xf_j - (rc_j - rw_j) \; xc_j))$$

$$+ \lambda_3 (FE - \sum_{i=1}^{m} rw_j \cdot xm_j) \qquad (9)$$

Solving a set of Kuhn-Tucker conditions for the social welfare maximization, one can drive the reduced-form equation of xm_j such that [4]

$$xm_j = xm_j (P_1, P_2, \quad , P_n, rc_1, rc_2, \quad , rc_m, rf_1, rf_2, \quad rf_m,$$

$$rw_1, rw_2, \quad , rw_m, Y, G, FE) \qquad (10)$$

In cases where $rc_i = rf_i = rw_i$, as it is under free trade with no transportation costs, the import demand equation 10 becomes

$$xm_j = xm_j (P_1, P_2, \quad , P_n,$$

$$rw_1, rw_2, \quad , rw_m, Y, FE) \qquad (11)$$

[2]The Government may attempt to reduce social costs associated with the subsidy program, where social costs (that is, deadweight losses) are represented by the triangles fed and cbg in panel C of figure 1 However, Venezuela's price policy is to increase domestic production of sorghum, therefore, we have not considered deadweight losses in the model (5)

[3]It is implicitly assumed that the utility the Government received from consumer and producer welfare is weakly separable Under this assumption, disposable income, government expenditures, and foreign exchange are allocated in a way that allows them to maximize social welfare

[4]Since the welfare function 4 is concave and the constraint equations 6, 7, and 8 are linear, the Kuhn-Tucker conditions are sufficient, as well as necessary, conditions

Note that the variable representing Government subsidies, G, does not appear in equation 11 However, in cases where the producer and consumer prices are not equal to the world price and are partially adjusted to the world price at the border, equation 10 becomes:

$$xm_j = xm_j(P_1, P_2, \ldots, P_n, rw_1, rw_2, \ldots, rw_m, G, Y, FE) \quad (12)$$

Government Expenditures and Foreign Exchange Allotments

Venezuela can meet millers' demand for sorghum by increasing imports or by increasing domestic production through increased producer subsidies The Government's choice between increasing expenditures for producer subsidies and increasing foreign exchange to import can be derived from the Kuhn-Tucker conditions for maximization of the Lagrangian equation 9 Partial differentiation of equation 9 with respect to xf_j is given by·

$$\frac{\partial L}{\partial xf_j} \leq -\sum_{i=1}^{n}((a_i - p_i)(\frac{\partial Q_i}{\partial xc_j}\frac{\partial xc_j}{\partial xf_j}) - b_i Q_i(\frac{\partial Q_i}{\partial xc_j}\frac{\partial xc_j}{\partial xf_j})) - (rf_j - c_j) + d_j \cdot xf_j + \lambda_1 \sum_{i=1}^{n}(\frac{\partial Q_i}{\partial xc_j}\frac{\partial xc_j}{\partial xf_j})P_i + \lambda_2(rf_j - rw_j) - \lambda_2(rc_j - rw_j) = \lambda_1 \sum_{i=1}^{n} rc_j + \lambda_2(rf_j - rw_j) - \lambda_2(rc_j - rw_j) \quad (13)$$

Following McCarl and Spreen (*8*), we can interpret the Lagrangian multiplier λ_1 as the marginal social welfare of disposable income spent to purchase one unit of the ith meat product, Q_i, and λ_2 can be interpreted as the marginal social welfare of Government expenditures for subsidies Therefore, equation 13 explains that the marginal social welfare resulting from one unit of production of xf_j must be equal to or less than the sum of the marginal social welfare of disposable income contributed to the purchase of one unit of xf_j and the marginal social welfare of net Government expenditures to subsidize producers for one unit of production of xf_j Partial differentiation of equation 9 with respect to xm_j is given by

$$\frac{\partial L}{\partial xm_j} \leq -\sum_{i=1}^{n}((a_i - p_i)(\frac{\partial Q_i}{\partial xc_j}\frac{\partial xc_j}{\partial xm_j}) - b_i Q_i(\frac{\partial Q_i}{\partial xc_j}\frac{\partial xc_j}{\partial xm_j})) + \lambda_1 \sum_{i=1}^{n}(\frac{\partial Q_i}{\partial xc_j}\frac{\partial xc_j}{\partial xm_j})P_i - \lambda_2(rc_j - rw_j) + \lambda_3 rw_j = \lambda_1 \sum_{i=1}^{n} rc_j - \lambda_2(rc_j - rw_j) + \lambda_3 rw_j \quad (14)$$

The negative Lagrangian multiplier λ_2 can be interpreted as the marginal social welfare of Government revenue collected from Venezuelan millers for the use of one unit of xm_j The Lagrangian multiplier λ_3 can be interpreted as the marginal social welfare of foreign exchange spent to import one unit of xm_j Therefore, equation 14 explains that the marginal social welfare resulting from the use of one unit of xm_j must be equal to or less than the sum of the marginal social welfare of disposable income contributed to the purchase of one unit of xm_j by the millers and the marginal social welfare of foreign exchange allotted to import one unit of xm_j less the marginal social welfare of Government revenues collected from the millers for one unit of xm_j If one compares equation 13 with equation 14, the Government's choice between increasing imports or increasing domestic production depends on the following marginality conditions The marginal social welfare of Government expenditures spent to subsidize producers for one unit of production of xf_j must be equal to the marginal social welfare of foreign exchange spent to import one unit of xm_j at the equilibrium

Figure 2 illustrates the relationships between Government expenditure for subsidies and foreign exchange allotments It also illustrates whether Government expenditures are used to subsidize producers in one case or consumers in the other In panel A of figure 2, the Venezuelan Government is assumed to subsidize feed grain producers For this case, the Government can make a tradeoff between Government expenditures and foreign exchange to meet domestic demands In panel B of figure 2, the Government is assumed to subsidize millers For this case, Government expenditures for the subsidy and foreign exchange allotment are complementary The shape of tradeoffs and complement curves depends on the import demand elasticities of Government expenditures and foreign exchange variables

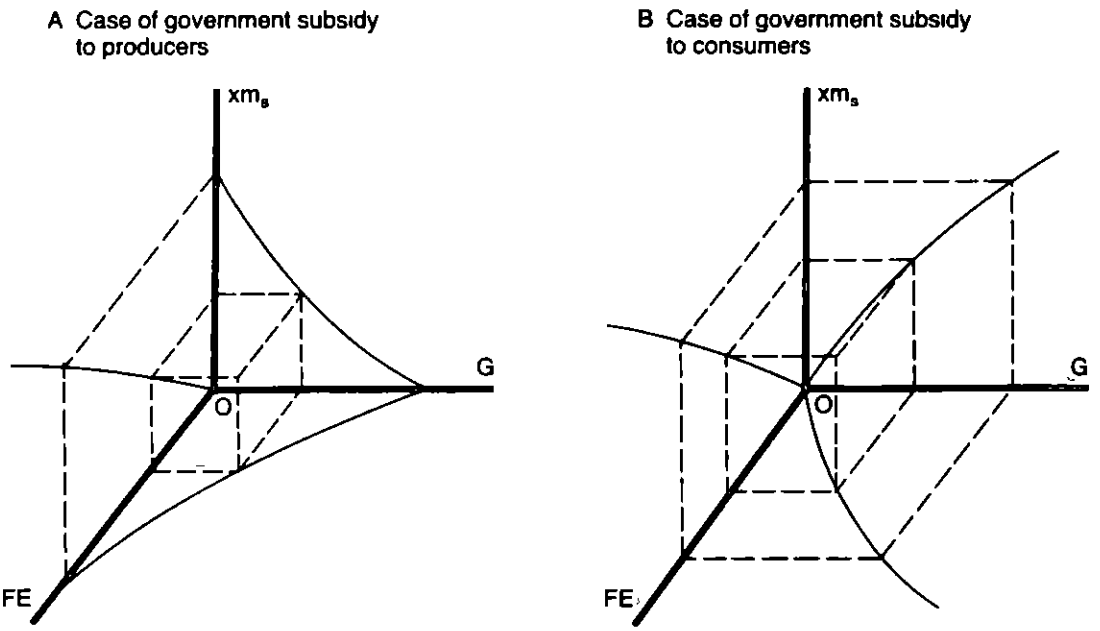
The relationship between Government expenditures for producer subsidies and imports in panel A of figure 2 may be given in the general form

$$xm_s = a_0 G^{-a_1} \qquad a_0, a_1 > 0 \quad (15)$$

where a_0 and a_1 are constants

Figure 2

Relationship between government expenditures for subsidy and foreign exchange allotment for importing



Similarly, relationships between foreign exchange and imports may be given by

$$xm_s = b_0 FE^{b_1} \qquad b_0, b_1 > 0 \tag{16}$$

where b_0 and b_1 are constants

Combining equations 15 and 16, one can obtain a tradeoff equation between Government expenditure for producer subsidies and foreign exchange such that

$$FE = (a_0/b_0)^{1/b_1} \; G^{-a_1/b_1} \tag{17}$$

The marginal rate of substitution between Government expenditures and foreign exchange is then given by

$$\frac{d\,FE}{d\,G} = (a_0/b_0)^{1/b_1} \; (a_1/b_1)\, G^{-(a_1+b_1)/b_1} \tag{18}$$

The Case of Sorghum in Venezuela

We will examine the 1970-82 period since Venezuela began to develop its own poultry industry in the early seventies with the use of imported sorghum When domestic miller prices are adjusted to the world price and producer prices are subsidized by the Government, equation 12 is the relevant equation Sorghum is used mainly for poultry production, so we consider only the consumer price for chicken in this model

An important issue is how exchange rates are incorporated into the model Chambers and Just reviewed both the theoretical and empirical results in the agricultural economics literature on how changes in exchange rate affect international grain trade

> A more pragmatic alternative which has been used is to treat the exchange rate as a price index for all other traded goods In addition to the above discussion relating to separability, the Orcutt hypothesis tends to suggest that it may be appropriate to include the exchange rate directly in excess demand and import equations to allow for the differential effects of exchange rate and price fluctuations (2)

Because exchange rates influence sorghum trade between the United States and Venezuela, a variable representing the exchange rate is inserted into the import demand function for sorghum in Venezuela·

$$xm_s = xm_s(P_{ch}, rw_s, rw_c, EX, Y, G, FE) \tag{19}$$

where P_{ch} is the retail chicken price, rw_s and rw_c are the import prices of sorghum and corn, respectively,

EX is the real exchange rate, Y is the aggregated disposable income, G represents Government expenditures to agriculture, and FE represents foreign reserves Because reliable import prices of corn and sorghum are not available for the entire study period, U S gulf prices are used for rw_s and rw_c All variables expressed in mandatory terms are converted into Venezuelan bolivares and then deflated by the Venezuelan consumer price index (1980 = 100) A list of variables follows

- xm_s = Imports of grain sorghum (1,000 metric tons (MT)),
- rw_s = World price of grain sorghum (1980 bolivares/MT),
- rf_s = Producer price of grain sorghum (1980 bolivares/MT),
- rc_s = Miller price of grain sorghum (1980 bolivares/MT),
- rw_c = World price of corn (1980 bolivares/MT),
- P_{ch} = Retail price of chicken (1980 bolivares/MT)
- EX = Exchange rate (1980 bolivares per 1980 U S dollar)
- Y = Personal disposable income (million 1980 bolivares),
- G = Government expenditures in agriculture (billion 1980 bolivares),
- FE = Foreign reserves (million 1980 bolivares), and
- Q = Domestic consumption of chicken (1,000 MT)

Statistical results indicate that the disturbance term associated with observations in a given period carry over into the future Therefore, we corrected problems associated with serial correlation using the Cochrane-Orcutt procedure [5]

$$\log xm_s = \underset{(2\ 2725)}{1\ 7911} - \underset{(-3\ 2502)}{11\ 1993}\log rw_s + \underset{(3\ 2939)}{11\ 6015}\log rw_c + \underset{(3\ 9780)}{3\ 6118}\log P_{ch} - \underset{(-2\ 4769)}{7\ 7250}\log EX - \underset{(-1\ 0650)}{0\ 5476}\log Y - \underset{(-3\ 4793)}{3\ 1553}\log G + \underset{(4\ 0745)}{2\ 0840}\log FE$$

$$\text{Adjusted } R^2 = 0\ 96 \qquad (20)$$

Numbers in parentheses below the coefficients are estimated t-values The signs on all variables in equation 20, except disposable income, are consistent with *a priori* expectations The parameter estimate associated with the disposable income variable is negative, but statistically insignificant [6] The parameter estimates for the world sorghum price and world corn rice variables indicate that the feed millers and Government purchasing agents were willing to substitute corn for sorghum when the sorghum price rose or the corn price fell in the world market The estimated world sorghum price elasticity (e = 11 2) is quite high Considering that sorghum is a feed grain rather than a staple food grain and that corn is a good substitute for sorghum in chicken production, high direct- and cross-price elasticities are expected Venezuela's import share of U S sorghum exports rose from 4 percent in 1970 to nearly 10 percent in 1982 This increase in Venezuela's imports is consistent with the high import price elasticity The impact of the retail chicken price on sorghum imports is significant The disposable income variable appears to have no significant impact on sorghum imports in Venezuela Government authorities set domestic chicken prices lower than the free trade price and consumers favor beef over chicken These factors may account for the insignificant impact of income on sorghum imports

The parameter estimate of the exchange rate variable shows that the impact of the exchange rate on sorghum imports is significant Venezuela increasingly overvalued its currency against the U S dollar during the study period The overvalued Venezuelan currency made imported sorghum cheaper and thereby encouraged millers to use more imported sorghum Consequently, Venezuela could reduce its sorghum imports substantially by devaluing its currency against the U S dollar

The estimate of the Goverment expenditures variable shows a strong inverse impact on imports, indicating that the growth of Government subsidies to sorghum producers increased domestic production Foreign exchange significantly and directly affected sorghum imports in Venezuela, indicating that low foreign reserves can serve as a constraint on imports

When equation 20 is collapsed on the geometric means of all variables except xm_s and G or FE, one can obtain the following equations

$$xm_s = (2{,}208{,}102 \times 10^{14})/G^{3\ 1553} \qquad (21)$$

$$xm_s = (183 \times 10^{-9})\,FE^{2\ 0840} \qquad (22)$$

[5]The Cochrane-Orcutt procedure requires dropping the initial time period To save a degree of freedom, we transformed the first period observations as suggested by Pindyck and Rubinfeld (*9*)

[6]Because the import demand equation 20 represents the reduced form equation, the disposal income variable is retained in the model even though it is statistically insignificant

$$\frac{d\,FE}{d\,G} = 1\,5141\,\frac{(2{,}208{,}102 \times 10^{14})^{1/2\,084}}{(183 \times 10^{-9})} \cdot G^{-2\,5141} \quad (23)$$

If one uses equation 23, the rate of tradeoff between Government expenditures and foreign exchange allotment at the mean value, 5,100 bolivares, of Government expenditures is

$$\frac{d\,FE}{d\,G} = -9\,7 \quad (24)$$

During the study period, Venezuela's exchange rate policy provided strong inducements to use foreign exchange to import sorghum These inducements were stronger than those provided farmers to increase domestic production through the use of subsidies

One must apply econometric techniques to developing countries like Venezuela with caution First, one must be aware of the unreliability and meager availability of data to support sophisticated analysis Second, in a controlled economy, government policy can ultimately determine the course of events Policy decisions are erratic and can undermine the assumptions and, thereby, the theoretical models With this caveat and with the data available from published sources, we have identified the marginal rate of substitution between Government expenditures and foreign exchange and have attempted to quantify those results Incorporating this information into an econometric model gives us one more tool to evaluate import decisions by developing countries like Venezuela

Conclusions

Empirical modeling of international grain trade flows will undoubtedly continue to include government intervention as an endogenous variable whose value is determined by the values of other variables in the model We have presented a feed grain import demand model where government prices vary over time and are affected by government expenditures for subsidies. A Venezuelan sorghum variable was statistically significant The estimated import demand elasticity on the exchange rate (E = 7 725) indicates that Venezuela's sorghum imports could be substantially reduced if it devalued its currency However, expansion or contraction of sorghum imports was greatly affected by world prices of corn and sorghum, the exchange rate, and Government expenditures for subsidies Impacts of foreign exchange, retail chicken prices, and disposable income on sorghum imports were less significant

We derived a tradeoff equation between government expenditures for subsidies and foreign exchange to imports The rate of tradeoff between Venezuela's Government expenditures and foreign change allotment was −9 7, indicating that Venezuela encouraged domestic producers to produce sorghum by using subsidies during the study period.

Note that the reliability and availability of data do not adequately support sophisticated analysis Furthermore, Venezuela's policy decisions were erratic and might undermine the assumptions and the predictive power of our model

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In Earlier Issues

Each element of marketing charges and cash costs of production is a channel through which influences originating primarily in the nonfarm economy may be transmitted into the net income statements of farm operators The size of each such element for a given commodity is a presumptive indicator of the vulnerability of its producers to changes in a particular segment of the nonfarm economy

Modern techniques of analysis, such as the input-output or "interindustry relations" approach of Leontief and the "linear programming" methods of Dantzig, Koopmans and others, are creating a demand for more accurate data of this type These methods seem to hold much promise for the appraisal of governmental programs and for the general study of interrela tionships between different sectors of the economy Electronic computers can handle the formidable calculations required for such studies, but the accuracy of the final results must depend on that of the basic data

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Vol 4, No 1, Jan 1952