WESTERN AGRICULTURAL ECONOMICS ASSOCIATION

PAPERS OF THE

1989 ANNUAL MEETING

WESTERN AGRICULTURAL ECONOMICS ASSOCIATION

COEUR D'ALENE, IDAHO

JULY 9-12, 1989

SESSION 5

THE SOVIET ROLE IN THE WORLD GRAIN ECONOMY IN THE 1990S

James R. Jones
and
Hassan Mohammadi

INTRODUCTION

Per capita money incomes increased rapidly in the Soviet Union in the 1970s while retail prices of livestock products remained at artificially low levels. Soviet grain production was unable to keep pace with the growth of demand for livestock feed propelled by increasing meat production and consumption (Johnson and Brooks, 1983). A shock wave hit the world grain economy when the Soviet Union reversed its long term role as a net exporter, and imported unprecedented quantities of grain. Great stock has been placed in the proposition that the planning hierarchy made a policy decision to cover grain shortfalls by importing grain rather than cutting back livestock programs, but Marxist policy makers have to pay bills too. A surge in oil prices at this time provided a windfall in foreign exchange earnings that permitted the shortfall in domestic grain production relative to expanding use to be offset by imports. In economic parlance, the terms of trade favored Soviet imports of grain and exports of energy (Vanous, 1983).

Soviet agricultural performance in the early 1980s fell significantly below the planners' goals, and even below the performance achieved in the late 1970s preceding the 1980 embargo. As Soviet production languished, imports of grain continued to be a factor in world grain markets, peaking at 55 million metric tons in 1984/85. However the windfall of expanding petroleum export earnings stalled and more recently Soviet grain production has shown signs of recovering at least some of its original momentum.

This paper discusses the likely Soviet role in the world grain economy in the 1990s. By extrapolating economic trends in Soviet grain production and hard currency export performance,

scenarios are constructed and incorporated into an econometric model to give quantitative coherence to the assumed relationship among factors expected to shape the Soviet's role in the world grain market during the next decade. The first portion of the paper discusses the specification and characteristics of the econometric model and the second portion discusses the projection scenarios and resulting forecasts for Soviet grain imports through the 1990s.

A SOVIET GRAIN TRADE FORECASTING MODEL

An econometric model of Soviet grain imports consisting of four behavioral equations explaining aggregate import expenditures, livestock inventories and domestic meat output, and net grain imports provides the framework for projecting grain imports into the 1990s. Table 1 presents the model in the estimated form used in making the projections discussed later in the paper, and tables 2 and 3 give descriptions of the endogenous and exogenous variables included in the model. The model's structure treats the import decision process in a framework of planners considering domestic agricultural events and programs in interaction with economic constraints imposed by international balance of payments considerations. Variations in foreign exchange earnings and reserves affect aggregate import expenditures in an import exchange equation. The specific impact of foreign exchange allocation on grain imports is measured by the coefficients associated with aggregate import expenditures in a grain import equation. Domestic output of course grains and wheat supplemented by imports determine the availability of grains which in turn affects livestock inventories. Meat production is treated in part as a function of livestock inventories at the beginning of the year. Also, meat output is a function of use of grains per livestock unit. 1

1 Imports of grain initially were specified as a function of import prices relative to oil export prices, total import capacity, domestic output, and meat output which in turn was a function of income. Statistical and estimation problems necessitated a simplified version of the model that omitted some of these variables. Also initially feed grain imports were treated separately from wheat imports, but in the model used for projections grain imports were aggregated. The initial model from which this forecasting model evolved is reported in another study that also incorporated a dummy variable in the import equation in an attempt to determine whether the 1980 embargo shifted the Soviet demand for imports (USDA, Ch. 14, 1986).

In addition to four behavioral equations, the model contains two identities. The complete structure of the estimated model is given in table one. The model was estimated using 3SLS simultaneous equation estimation procedure from data for 1960-1986. Generally the estimates presented in table 1 are consistent with apriori expectations and statistically significant. The results are discussed below in terms of characteristics of each estimated equation.

Table 1. Estimated Structural Equations

Aggregate Import Exchange Equation

(1) $M = 3297.00 + 0.274\ R_{-1} + 0.449\ F - 0.201\ DF$
[3.80] [3.38] [3.53] [-0.94]
R-SQUARE = 0.934 RMSE = 2563.78

Meat Production and Livestock Inventory Equations

(2) $WLS = 15.58 + 0.768\ WLS_{-1} + 0.104\ DAV$
[1.62] [6.19] [2.08]
R-SQUARE = 0.94 RMSE = 3.65

(3) $MP = -11969.02 + 152.43\ WLS + 3892.43\ USE$
[-12.84] [14.97] [3.59]
R-SQUARE = 0..972 RMSE = 474.53

Grain Import Equation

(4) $NIG = 4.945 + 0.002\ MP + .002\ M - 0.281\ NDOG$
[0.42] [1.38] [4.76] [-3.93]
R-SQUARE = 0.88 RMSE = 6.88

Identities

(5) $DAV = NDOG_{-1} + NIG_{-1}$

(6) $USE = (NIG + NDOG - DSTOCK) / WLS$

Table 2. Description of the Endogenous Variables

NAME	UNIT[a]	DESCRIPTION
M	U.S.$M	Hard currency import expenditures, deflated
WLS	M head	Weighted livestock animal units in terms of oat consumption equivalents: cows 1.0; other cattle 0.6; hogs 0.3; sheep and goats 0.1; horses 1.0; poultry 0.02. Source: Economic Research Service, U.S.D.A.
MP	1000MT	Meat production. Source: Economic Research Service, U.S.D.A.
NIG	MMT	Net imports of grain (imports - exports). Includes wheat, coarse grains (barley, rye, oats, corn and millet), buckwheat, rice, pulses, and miscellaneous grains. Source: Economic Research Service, U.S.D.A.
DAV	MMT	Grain availability calculated as the previous year's production (net of waste and dockage) plus current year net imports. Source: Economic Research Service, U.S.D.A.
USE	MMT	Grain use per livestock unit. Source: calculated from Economic Research Service data

a) MT = Metric Tons, M = Million

Table 3. Description of Exogenous Variables

NAME	UNIT	DESCRIPTION
F	U.S.$M	Hard currency export earnings
R_{-1}	U.S.$M	Accumulated trade balance proxy for foreign exchange reserves.
NDOG	MMT	Volume of Soviet grain production net of estimated waste and dockage. Source: ERS
$NDOG_{-1}$	MMT	Previous year's output of grain
WLS_{-1}	M head	Previous year's livestock inventory

a) MT = Metric Tons, M = Million

Aggregate Imports Exchange Equation

As a starting point in the analysis of Soviet grain import behavior, an equation was constructed to capture import capacity. In market economies operating with fully convertible currency regimes, aggregate import behavior is traditionally specified so that the flow of imports is a function of import prices relative to prices of domestically produced substitutes and aggregate domestic economic activity (Leamer and Stern, 1970). Hemphill (1974) argues that this approach needs to be modified in applications to developing countries to take into account the effects of trade and foreign exchange restrictions. Following Hemphill's specification and its adaptation to commodity specific import analysis by Scobie (1981), equation 1 of the model of grain imports explicitly recognizes that the decision to import grain depends on foreign exchange earnings and other imports. Total imports are a function of hard currency earnings and, assuming separability, the authorities then allocate foreign exchange for grain versus other import purchases.

In constructing the variables used to estimate the aggregate imports exchange equation, data on foreign exchange earnings and international currency reserves are needed. We were unable to fully generate these data because the USSR not being a member of IMF, data are not reported for all years used in the sample. Reserves (R) were approximated by accumulated trade balances and foreign exchange earnings were approximated by export earnings (F). Admittedly this is a crude representation of the balance of payments adjustment and foreign exchange allocation process, but it was the best solution we could develop given the state of the arts of available data. 2

---

2 In spite of the incompleteness of the data the estimated structural equation appears to explain a large portion of the variation in aggregate imports. In an alternative specification that omitted the proxy foreign exchange reserve variable above and the change in export earnings (DF) only 85 percent of the variation in aggregate imports was explained as compared to 93 percent in this specification.

Domestic Livestock Inventory and Meat Production Equations

Conventional wisdom holds that in the 1960s the Soviet hierarchy decided to expand livestock production through building up livestock herds and then in the early 1970s a further decision was made to import grains rather than engage in stress slaughtering of animals in years of grain shortfalls. Analysts have at times used dummy variables to capture this alleged policy decision. Allen (1987) and Miller and Jones (1986) have speculated that this was a necessary but not sufficient condition to explain the shift to large grain imports in the early 1970s. If the windfall in energy prices and export earnings had not occurred at this same time, we question whether the Soviets would have switched to such large imports of grain as a way to maintain livestock programs over the past 15 years. This debate is looked at in greater detail below in the discussion relating to the grain import equation.

Simultaneity is structured into the model on the hypothesis that the Soviet authorities have had to weigh the trade offs of increasing meat output with herd maintenance and balance of payments considerations associated with importing large quantities of grain. Following Brada and King, livestock inventories are modeled as dependent on the availability of grain, and simultaneously meat production is specified as a function of herd size and use of grain. Both equations display convincing statistical characteristics. The domestic meat output equation may seem lacking in that it leaves income out as a demand shifter. In alternative specifications multicollinearity problems were encountered between income, aggregate exports, and aggregate imports which rendered the overall model highly unstable. For this reason export earnings in the grain import equation discussed below implicitly permits income generated demand to energize meat production objectives into effective demand in the model. The alternative would have been to successfully specify the macro economic linkages between income, imports, and exports. This was deemed too ambitious in scope for this exercise.

Grain Imports

Evidence regarding the major factors that determine Soviet decisions to import grain has supported a wide range of positions. Work by Desai in the 1970s brought her to the conclusion

that the cost of grains in international markets was apparently subordinate to the need to sustain livestock herds in the face of grain shortfalls. In her regression study she looked at lagged domestic production, meat production and livestock inventories, and policy decisions to maintain current consumption levels as explanatory variables governing grain imports. More recent work by Ennew (1987) and Borsody (1987) challenged this specification. Using single equation estimation procedures, Borsody included commodity specific and overall terms of trade variables in his work. His results led him to discount almost totally the role of livestock and grain production variables. Nalsen (1987) also attributes most of the variation in grain imports to oil earnings. Our specification takes a middle role and stresses the importance of the interaction between international economic considerations and domestic agricultural performance and objectives. The structural equation describing Soviet net grain imports is specified so that the effect of foreign exchange earnings and allocations is captured through the aggregate import expenditure variable (M) and livestock inventory and production performance impact on grain imports is captured through a meat production variable (MP) that simultaneously reflects livestock herd size, grain availability and grain use in feeding rations. Domestic grain harvest net of postharvest losses is also included to capture the effect of grain shortfalls due to weather or performance problems.3

3 A note of explanation is needed as to why equation 4 fails to include a price variable. Centrally planned economies share with developing countries a propensity toward foreign exchange rationing and domestic price insulation from the effects of world price movements. Given the rigidity of the bureaucratic apparatus and ideological framework of Marxist oriented planners, world price movements have little direct effect in these economies via the domestic price structure. Some analyst have imposed a priori zero or near zero elasticities for the reasons noted above. In our mind this issue has not been resolved. Statistical evidence on the behavioral relationship between Soviet grain imports and world price movements has fielded a vast range of elasticity estimates varying from perfectly inelastic to highly elastic. We have demonstrated elsewhere (Jones, et. al.,1986), that the hard currency effect of world price variations needs to be taken into account in measuring import response to price or terms of trade movements. In previous specifications of equation one, attempts to include a terms of trade variable were unsuccessful. Brada and King also attempted to include this variable in an equation reflecting the excess demand for foreign exchange and failed to obtain statistically significant results. While this could be evidence that import decisions ignore terms of trade considerations and hard currency constraints, we also are very circumspect about the reliability of the arbitrarily constructed data series available in our estimation exercises. Suffice it to say that the price of grain is not included in this forecasting model because of statistical difficulties of so doing rather than because of an implicit assumption that price is not important.

FORECAST SCENARIOS

Projections of Soviet grain imports on the basis of the model discussed above will hinge upon assumed values of domestic grain production and hard currency foreign exchange earnings in the forecast period. Forecasts of Soviet grain imports are based upon three scenarios to give high, medium, and low projection levels for the 1990s. Table four contains grain projections and table 5 gives the assumed values of the exogenous variables used to obtain these forecast levels.

Table 4. Forecasts of Soviet Grain Imports in the 1990s

Scenario	1990	1995	2000
<u>High import projections</u>			
(1) 1970-86 crop shortfall/oil windfall projection	45.2	59.0	71.0
<u>Medium import projections</u>			
(2) 1960-86 crop and export earnings trend projection	36.2	48.9	59.1
<u>Low import projections</u>			
(3) export stagnation and production revival projection	25.4	31.4	35.7

Soviet planners targeted grain production at 235 million metric tons in 1988 which was 40 million metric tons over the mark! The shortfall between actual and planned or targeted production is typical of the extremely optimistic range of goals set by the planners. Planned production and actual production have not conformed since the 8th five year plan which covered the span 1966-70. Production was targeted at 195 million metric tons in the 9th five year plan (1971-75) but actual production averaged under 182 million metric tons. Plans began to go further astray over the next decade with actual production falling 20 million metric tons

below planned production in the last half of the 1970s. In the early 1980s actual production fell back to the levels achieved a decade earlier leaving a gap of over 40 million metric tons.

TABLE 5: Forecast Values of Exogenoas Variables

	1986 (Actual)	1990	1995	2000
Scenario I				
Net Domestic output of Grain mmt (1970-86 trend)	187.1	170.4	171.3	172.1
Foreign Exchange Earning (B$) (1970-86 trend)	22.1	39.5	48.5	57.2
Scenario II				
Net Domestic Output of Grain mmt (1960-86 trend)	187.1	192.6	204.1	215.6
Foreign Exchange Earnings (B$) (1960-86 trend)	22.1	32.8	40.4	46.8
Scenario III				
Net Domestic Output of Grain mmt and stagnant Export Earnings (1960-86 trend)	187.1	207.6	221.3	235.0
Foreign Exchange Earning (B$) (1986 level)	22.1	22.1	22.1	22.1

While grain production has recovered somewhat in the last three years, targeted production continues to far exceed actual performance. The average for this period has been 208 million metric tons and the target for 1990 is 250 million metric tons. Given this discrepancy this forecasting exercise utilizes actual production trends as the basis for extrapolating future levels of domestic grain production rather than relying on official plans or targets.

The highest range of grain import projections are based upon assumptions that trends underlying the rapid increase of imports from the 1970s through the mid early 1980s resume in the 1990s. Projections of domestic grain production are based upon extrapolated volumes from trends experienced over the 1970s and first portion of the 1980s. Before taking into account waste and dockage, grain production averaged 182 million metric tons over the period 1971-75. After going up to an average of 205 million metric tons in the latter half of the 1970s, grain production fell back to an average of 180 million metric tons from 1981 to 1985. This scenario in effect assumes Soviet grain production stagnates in the 1990s at a level close to the range experienced in the mid 1980s. Were this to occur, considerable shortages of food products could create morale problems among the Soviet populace. This would generate considerable pressure on the Soviet authorities to expand grain imports. It is assumed in this scenario that foreign exchange is abundant enough to allow this problem to be circumvented. As stated earlier, hard currency was readily available in the 1970s and early 1980s because of rising energy prices. Projecting foreign exchange receipts on a trend based upon this period implicitly assumes energy prices would have to resume a trajectory similar to the pattern of the 1970s and early 1980s, or that the Soviets are able to overcome their difficulties in selling domestically manufactured consumer and producer goods. Given the partial recovery of Soviet grain production in recent years and the leveling out of hard currency export earnings, this scenario is taken as indicative of what the significance of a repeat of circumstances of the era of expanding imports would be for world grain market.

Subjective judgement has led us to discount the probability of the high import projection occurring in the 1990s. Misfortune conspired with excessive demands in the grain sector to create a need for huge grain imports in the 1970s and early 1980s. Very fortunate circumstances in the external sector presented the planners with means as well as incentive to turn to international grain markets on a scale exceeding all past experience.

In the low range scenario we reverse this combination of events by simultaneously reducing the demand pull of stagnant grain performance and clamping a severe foreign

exchange environment on the Soviets. The low import scenario is based upon the assumption that domestic grain production gets back on a growth pattern consistent with the experience of the 1960s and that waste and dockage is halved in the 1990s. The essence of this projection is to assume that the Soviets will effectively have the ability to produce the equivalent of the amount of grain targeted for the beginning of the decade by the end of the decade. This forecast projection also holds Soviet hard currency export earnings constant throughout the 1990s at the disappointing level experienced in 1986. The drop in energy export prices which occurred at this time caused Soviet export earnings to fall from 33 to 22 billion dollars in two years time. This latter assumption in particular would force the Soviets to weigh hard currency expenditures on grain imports carefully. Judgmentally, we are associating this growth pattern with an improvement in performance reflecting evolutionary reforms in terms of improved agronomic practices and improved efficiency and enhanced incentives. Gorbachev's peristroika or economic restructuring program leading to decentralization of allocative decisions in the agricultural sector could release a surge in agricultural performance similar to that experienced in China following the abandonment of the communal agricultural system.

For the futurist who expects that a such a tremendous increase in Soviet grain production could follow perestroika it may seem that we should have assumed even greater rates of increases in grain harvest's in the 1990s. However if perestroika in fact were to release such a surge of performance, and if this carried over to the manufacturing sector as well, then our export earnings scenario would likely be overly restrictive on grain imports. In this scenario the Soviets are still projected to continue as significant buyers of grain in the 1990s. Perestroika itself could be harmed if grain imports are curtailed, so we would conjecture that this low import projection would be very likely just to sustain consumer and worker morale. As the Polish authorities learned in the early 1980s, worker morale can not be buttressed by imports if earnings and credit are exhausted, but the Soviets currently are still in relative strong position in terms of their international credit capacity. Further analysis is in process at this writing. If

and when we see the case for a scenario adding a more conservative profile a reiteration of the forecast solution will be undertaken, time and resources permitting.

The mid range projection assumes Soviet production of grain and earnings of foreign exchange are set by the longer term trends dating from the 1960s through the mid 1980s (1960-86). Grain imports are projected at a range that encompasses the high and the medium actual import levels of the 1980s with the higher level becoming the projected norm by the year 2000. The range of projections from high to low is not intended to imply that the mid range should be construed as most likely. Judgmentally we are inclined to dismiss the upper range from being a likely case. In looking at the other two trajectories this places the mid range projection at the upper end of our forecasted imports in the 1990s. Variability of actual Soviet grain imports in the 1980s has ranged from a low of 27 to a high of 55 million metric tons so we would expect that there will be years in the 1990s that encompass all of the projected values in the low and mid range forecasts.

REFERENCES

Allen, George. "USSR Grain Imports: Past and Future", Food Policy. Volume 12, No. 2 (May, 1987), pp. 90-93.

Borsody, Lajos. "Forecasting USSR Grain Imports", Food Policy. Volume 12, No. 2 (May, 1987), pp. 94-105.

Brada, Josef C. and King, Arthur E. A. Disequilibrium Approach to Modeling Foreign Trade in Centrally Planned Economics.

Carter, Colin A. and Fu-Ning Zhong. China's Grain Production and Trade. Westview Special Studies on China. Boulder, Colorado: Westview Press, Inc., 1988.

Cook, Edward C. "Have the Soviets Turned the Corner on Grain Imports?", Food Policy. Volume 12, No. 2 (May, 1987), pp. 116-122.

Desai, Padma. "Soviet Grain and Wheat Import Demands in 1981-85", American Journal of Agricultural Economics. (May, 1982)

Ennew, C.T. "A Model of Import Demand for Grain in the Soviet Union", Food Policy. Volume 12, No. 2 (May, 1987), pp. 106-115.

Hemphill, William L. "The Effect of Foreign Exchange Receipts on Imports of Less Developed Countries", International Monetary Fund Staff Papers. Vol. 21 (November, 1974).

Johnson, D. Gale and Karen McConnell Brooks. Prospects for Soviet Agriculture in the 1980s. Bloomington, Indiana: Indiana University Press, 1983.

Jones, James R. (editor). East-West Agricultural Trade. Westview Special Studies in International Economics and Business. Boulder, Colorado: Westview Press, 1986.

Leamer, Edward E. and Robert M. Stern. Quantitative International Economics. Chicago: Aldine Publishing Co., 1970.

Miller, Dennis D. and James R. Jones. "Terms of Trade and Soviet Agricultural Import Behavior". Paper presented at annual meeting of the Eastern Economics Association, Philadelphia, Pa.(April 11, 1986).

Nalsen, Sherry Woods. An Economic Analysis of the Impacts of Changing Petroleum Prices on Soviet Grain Imports. Master of Science Thesis, Department of Agricultural Economics, Oklahoma State University, 1987.

Scobie, Grant M., "Government Policy and Food Imports: The Case of Wheat in Egypt". Research Report 29, International Food Policy Research Institute, (December, 1981).

USDA, ERS. Embargoes, Surplus Disposal, and U.S. Agriculture. Agricultural Economic Report Number 564, Ch. 14. December 1986.

Vanous, Jan. "Comparative Advantage in Soviet Grain and Energy Trade", Ch 4 in Gordon B. Smith, The Politics of East-West Trade. Boulder, Colorado: 1983.

*Invited paper given at the Western Agricultural Economics Association Annual Meetings at Coeur d' Alene, Idaho, July, 1989. Permission of the authors is requested for citations. James R. Jones is Professor of Marketing Economics in the Department of Agricultural Economics and Rural Sociology, University of Idaho and Hassan Mohammadi is Assistant Professor of Economics, Illinois State University.