Trade Impacts of Soviet Reform: A Heckscher-Ohlin-Vanek Approach

by

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Introduction

If the ongoing reforms in the Former Soviet Union (FSU) succeed, there will be an associated increase in trade in both industrial and agricultural goods. Under central planning, trade patterns of the FSU were determined by the Ministry of Foreign Trade (MFT). Imports were viewed as a way of covering internal shortages, and exports were viewed as a means of payment. Under this policy, there was no guarantee that existing resources were used in their most productive manner. Consequently, attempts to project trade patterns after economic reforms based on present FSU production patterns, would likely be seriously biased. For example, land used elsewhere in the world for wheat may have been allocated to corn or cotton.[1] This bias would become evident if after liberalization, land for growing corn was utilized for wheat production even though the relative producer prices of corn and wheat remained unchanged.

A second problem with projecting changes in the trade pattern of the FSU is the quality and consistency of the data. Prior to the reform, the Soviet government used a different measurement system than the West. For example, meat consumption was calculated using a greater proportion of the animal's liveweight than in the United States. Also, there were years when apparently, for political reasons, little data were published. With the break-up of the USSR, responsibility for data collection has been dispersed with the result that inconsistencies may be introduced into data for recent years. A high-quality, consistent, time-series of data for the FSU may be sometime in coming. Unfortunately, the more recent data and those most suspect, are exactly those necessary for econometrically studying the consequences of the reforms for trade. Thus, analysis to determine the implications of the reform for trade must rely on more stylized and conceptually based approaches, the focus of this paper.

The Heckscher-Ohlin-Vanek (HOV) equations provide a primitive but approachable method for projecting the longer-run trade patterns of the FSU. The HOV model requires data on the resource base of the FSU and a projection of the efficiency with which these resources will be translated into outputs, after liberalization. Implicit in the choice of this approach is the hypothesis that data on Soviet resources are more accurate than those on production and consumption. This would be true if Soviet and NIS officials required accurate measures of the resource flows for production planning. United States input/output coefficients for 1967 were superimposed on the FSU resource flows. These U.S. input/output coefficients are taken from Bowen, Leamer, and Sveikauskas 1987.[2] Thus, our projections assume that resource flows of the FSU are used with the same efficiency as in the

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[1]One indication that resources were used inefficiently is a recent calculation that "if all the raw materials that Russia produces were sold abroad, the country would earn twice as much as its present total GNP. Yet, raw materials output is included in GNP" (*The Economist*, December 4, 1992 survey).

[2]We use 1967 input/output coefficients because they are the only ones available.

United States in 1967. Because the results depend on the HOV assumptions coupled with the attainment of 1967 U.S. efficiency levels, they are only crude approximations of the long-run trade patterns. Nevertheless, these procedures present a way to address the issue of trade and at least qualitative responses of the economic reform.

The economy-wide model predicts a large turnaround in Soviet grain trade. This result is a potentially important output of this research and merits additional attention. To accomplish this, we present a second scenario wherein we focus on temperate agricultural products. This second analysis is done on a much more disaggregated level. The results of this second analysis confirms the earlier results regarding grains even though we use completely different data sets and different efficiency measures.

The following section introduces the HOV model. Here we place emphasis on the stringent assumptions upon which the model rests as well as the available evidence as to the accuracy of the procedure in projecting existing trade patterns. The following sections successively discuss the data collection procedures for the economy-wide model, compare the HOV projections for the entire economy with those that existed prior to the current economic transformation, discuss the data used in the agricultural model, and compare forecasted and actual trade patterns.

The Heckscher-Ohlin-Vanek Equations

In the theory supporting the HOV, a country's trade patterns are determined mostly by comparative advantage in the production of certain commodities. In a two-country, two-factor world, the commodity version of the earlier Heckscher-Ohlin (HO) theorem shows that the source of comparative advantage is relative factor abundance. That is, a country will export the commodity which uses relatively more intensively the factor in relative abundance. Rigorous empirical testing of the HO theorem intensified after Leontief's (1953) results that questioned its validity. Vanek (1968) restated the HO theorem to focus on the factor services embodied in the goods traded rather than all products. This allowed an expansion of the model to n goods, and the "factor content" version of the HO theorem, the HOV theorem. Leamer (1980) used the HOV approach to resolve the Leontief paradox. Subsequently, the generalized HOV theorem has become the basis of most empirical work and competitiveness on international trade.

The HOV model has been summarized into the HOV equations by Leamer (1984) and others. These equations give a unique relationship among the trade vector, matrix of factor intensities, and excess factor abundance supplies of a particular country. The HOV equations rely on several assumptions which are summarized here.

1. Technological knowledge is the same in all countries, and production exhibits constant returns to scale.
2. There is perfect competition in both the factor and commodity markets and factors are fully utilized.
3. All individuals have identical and homothetic preferences and they face the same price vector.

To derive the HOV equations, we define for a particular country
Q_i = output of commodity i, where i = 1,...,m.
P_i = price of commodity i, where i = 1,...,m.
V_i = endowment for factor i, where i = 1,...,n.
W_i = reward of factor i, where i = 1,...,n.
A_{ij} = total (direct and indirect) amount of factor i required to produce a unit of commodity j.
C_i = amount of good i consumed, where i = 1,...,m.

By the full employment condition (Assumption 2) we have

$$\sum_{j=1}^{m} A_{ij}Q_j = V_i \qquad i = 1,\ldots,n \tag{1}$$

and by the zero profit condition (Assumption 2) we have

$$\sum_{i=1}^{n} W_i A_{ij} = P_j \qquad j = 1,\ldots,m. \tag{2}$$

Define V^w and Q^w as world factor endowment and output vectors, respectively. By linearity of Equation (1), and the assumption that the factor price equalization theorem holds, we get

$$\sum_{j=1}^{m} A_{ij}Q_j^w = V_i^w \qquad i = 1,\ldots,n. \tag{3}$$

Assumption 3 implies that each country consumes commodities in the same proportion. This is given as

$$C_j = sQ_j^w, \tag{4}$$

where s is the country's consumption share of world output.

Suppose there is balanced trade; then the value of consumption equals the value of production. This can be expressed as

$$\sum_{j=1}^{m} P_jQ_j = \sum_{j=1}^{m} P_jC_j = \sum_{j=1}^{m} sP_jQ_j^w. \tag{5}$$

Hence s can be determined as follows

$$s = \frac{\sum_{j=1}^{m} P_jQ_j}{\sum_{j=1}^{m} P_jQ_j^w} = \frac{Y}{Y^w}. \tag{6}$$

Define T_j, the net trade value of commodity j, as the production minus the consumption of commodity j. Then $T_j > (<) 0$ implies the country is a net exporter (importer) of commodity j. T_j is written mathematically as

$$T_j = Q_j - C_j. \tag{7}$$

By replacing C_j by sQ_j^w in Equation (4) and multiplying through by ΣA_{ij}, we get the following equality

$$\sum_{j=1}^{m} A_{ij}T_j = \sum_{j=1}^{m} A_{ij}Q_j - s\sum_{j=1}^{m} A_{ij}Q_j^w \qquad i = 1,\ldots,n. \tag{8}$$

Using Equations (1) and (3), Equation (8) can be simplified to

$$\sum_{j=1}^{m} A_{ij}T_j = V_i - sV_i^w \qquad i = 1,\ldots,n. \tag{9}$$

Suppose m = n, and the matrix A is nonsingular, then we get

$$T_j = \sum_{j=1}^{m} A_{ji}^{-1}(V_i - sV_i^w) \qquad i = 1,\ldots,n. \tag{10}$$

Equations (9) and (10) are referred to as the HOV equations. These equations are a set of relationships among factor intensities A, trade T, and excess factor endowment supplies $(V - sV^w)$.

The empirical validity of equations (9) and (10) has been extensively researched in the literature. The most comprehensive work in this endeavor is Leamer (1984). Leamer used a reduced form version of Equation (10) to conduct his analysis, in which he concluded among other things that "the simple linear model explains a large amount of the variability of net exports across countries." Bowen, Leamer, and Sveikauskas (1987) used Equation (9) to examine the validity of the HOV model. They concluded that "even though the HOV equations are not exact, it is the best available theory that explains the patterns of trade." Other papers that examine the empirical validity of the HOV equations include Maskus (1985), Brecher and Choudhri (1989) and Harkness (1978).

Of particular relevance to this project is the projection of GNP (Equation 6) via equation 5. The work cited earlier was undertaken to determine if the HOV equations adequately explained existing trade patterns, i.e., the answer (including GNP) were known in advance. There is a unique value of s that equates the value of exports and exports in Equation (10). In solving for this value, we calculate the income level of the FSU expressed as a percentage of world income. The intuition is as follows. The resource endowment v expressed through the inverse of the factor intensity matrix A provides a measure of production. Then assumptions 1 and 3 (identical technologies and homothetic preferences) allow us to calculate the income level that equates the total value of consumption with the total value of production.

Data for the Economy-Wide Model

Ten commodity aggregates, which are exactly those formed by Leamer (1984), are the ones used in the first phase of this analysis. These aggregates are divided into three main categories: primary products (two aggregates), agricultural products (four aggregates), and manufactured products (four aggregates). Leamer's commodity aggregates were formed according to the Standard Industrial Trade Classification (SITC) codes, while the input/output tables, from which the data for the technology matrix were calculated, were given according to Standard Industrial Classification (SIC) codes. Thus, the SIC codes in the input/output table were aggregated to represent Leamer's SITC aggregates.

There are ten factor aggregates which are grouped into four main categories: capital, labor, land, and natural resources. There are three labor categories which are taken from those defined at the one-digit level of the International Standard Classifications of Occupations (ISCO). The skilled professional category is taken from ISCO group 0/1/2, the skilled nonprofessional category is taken from ISCO group 3/4/5, and unskilled category is taken from ISCO group 6/7/8/9. The three land definitions are those used by the Food and Agricultural Organization (FAO). Natural resources have three categories that are derived from the 367-order U.S. input-output table for 1967; from I/O sectors 5.00-10.00. Crude oil is taken from I/0 sector 8.00, coal is taken from I/O sector 7.00, and other minerals are taken from I/0 sectors 5.00-6.02, 9.00, and 10.00. The commodity and factor aggregates are summarized in Table 1. Data for the FSU[3] for capital, labor, and land were collected from the official *Soviet Statistical Yearbook (SSY)* (*Narodnoye Khoziaistvo* 1990). The data in *SSY* were aggregated to conform to the United Nations' classifications.

The measure of capital available in the FSU depends on the roubles per dollar exchange rate that is chosen. Should we use the 1993 exchange rate of several hundred roubles per dollar, it would so reduce the 1989 estimate of capital stock that the results would be those of a country with almost no capital. Our sense is that in the period for which this study is valid, the countries of the FSU will, by international aid or through internal generation, have acquired a level of capital to commensurate with its resource base. Therefore, we use the 1989 market economy exchange rate of 2.5 roubles per dollar as reported in the 1990 Plan Report. This rate was determined at interdepartmental auctions and should bear some approximation to the market value of the rouble for our base year. For comparison Liefert, Koopman, and Cook, in a similar study to ours, used shadow exchange rates between 1.91 and 2.5 roubles to the dollar.

The data for the rest of the world is taken from a group of 50 countries, selected to reasonably reflect actual world aggregate. One criteria for selection was having a market economy. The countries used and data collected are available in Table A.l. Data for natural

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[1]The data used for this model is for 1989. This is before the break-up of the Soviet Union. Hence the use of the name Former Soviet Union will refer to the 15 republics of the Soviet Union as of 1989.

Table 1. The summary of commodity and factor aggregates

Factor Aggregate Name and Number	Commodity Aggregate Name and Number
A. Capital	A. Primary products
1. Capital	1. Petroleum products
	2. Raw materials
B. Labor	
2. Skilled professional	B. Agricultural products
3. Skilled nonprofessional	3. Forest products
4. Unskilled	4. Tropical agriculture
	5. Animal products
C. Land	6. Cereals, etc.
5. Arable land	
6. Pasture land	C. Manufactured products
7. Forest land	7. Labor intensive
	8. Capital intensive
D. Natural Resources	9. Machinery
8. Crude oil	10. Chemicals
9. Coal	
10. Other minerals	

resources were taken from U.S. Central Intelligence Agency's (CIA's) *Handbook of Economics Statistics* and the Bureau of Mines' *Mineral Yearbook*. The procedures by which the data were derived and aggregated are also explained in an Appendix which is available from authors.

Results Using the Economy-Wide Data

Table 2 compares world and FSU factor endowments (columns 1 and 2), and measures of factor abundance (columns 3 and 4). The s value used in column 3 is that required to balance trade and equals 0.17. This means that had the FSU used its resource endowment with the same efficiency as that calculated for the United States in 1967, it would have had a GNP of $2,525 billion. For comparison, the equivalent U.S. value for 1989 was $4,219. The Appendix (available from the authors) gives further detail on the relative size of the FSU factor endowment and those of the 50 countries we choose to represent the rest of the world. The last column of Table 2 shows the FSU excess factor endowment ($V - sV^w$) expressed as a percentage of world factor endowment V^w. These values give some indication of the likely impact of liberalization of the FSU on world markets. For example, the capital inflow required to achieve the trade pattern discussed later represents about 14 percent of world capital stock. Likewise, the measure of crude oil available for export (either as oil or embedded in other goods) represents 15 percent of total world production in 1989.

The results for labor indicate that the FSU has a relative abundance of skilled labor and is relatively deficient in semi-skilled and unskilled labor. Many of the entries in the skilled labor category represent the enormous "managerial" class of the FSU. It is not obvious,

Table 2. World[a] and Soviet factor endowments, Soviet factor abundance supply, and Rank[b]

Factor Aggregate	V^w	V	$V - sV^w$	Relative Factor Abundance
a. Capital[c]				
1. Capital	15,849.86	509.60	-2,247.57	-14.18
b. Labor[d]				
2. Skilled	154.11	37.83	11.02	7.15
3. Semi-skilled	177.83	26.97	-21.37	-7.69
4. Unskilled	597.15	72.45	-31.42	-5.26
c. Land[c]				
5. Arable	450.60	96.40	18.02	4.00
6. Pasture	512.63	109.21	20.04	3.91
7. Forest	50.10	15.70	6.98	13.94
d. Natural Resources[c]				
8. Crude oil	340.70	110.50	51.23	15.04
9. Coal	147.62	38.92	13.23	8.97
10. Minerals	342.59	51.25	-8.34	-2.43

[a]World = 50 survey countries and the Soviet Union.
[b]Rank = $(V - sV_w)/V_w * 100$.
[c]In billion U.S. dollars.
[d]In million persons.

however, whether these individuals will be able to transfer managerial skills to the private sector.

Table 3 compares the economy-wide projections from the HOV model (Equation 10) with actual trade data for 1989. The results indicate that the FSU will export far less petroleum and export cereals and light engineering (machinery). These values make sense given the data we used. On paper, the FSU is capital scarce and has a surplus of high-quality labor. Other countries, such as Japan and South Korea which are in a similar position, have used export-oriented light industry to develop.

It is not clear, however, whether the entrepreneurial talents that propelled East Asian countries will emerge in the FSU. If the managerial classes that ran the economy before liberalization make the transition to the market economy, then one might expect export-led growth in the light industrial sector. In the event that the skilled labor does not transfer easily to the competitive portion of the economy, then the FSU will not reach the potential GNP and export levels indicated in Table 1. Given the problematical nature of the assumptions which underlie the HOV model, all one can say with confidence is that given the resource endowment, policies that focus on exportation of raw materials, cereals, and light

Table 3. Soviet post-reform net trade vector, calculated using the HOV equations, and official Soviet trade data for 1989

Commodity Aggregate	Net Trade[a]	
	HOV Prediction	Soviet Data[b]
a. Primary Products		
1. Petroleum products	6,586.20	38,072.12
2. Raw materials	12,780.63	1,125.93
b. Agricultural Products		
3. Forest products	3,560.34	2,072.68
4. Tropical agricultural	-15,546.10	-1,650.78
5. Animal products	260.28	793.78
6. Cereals, etc.	13,526.01	-4,782.97
c. Manufactured Products		
7. Labor intensive	-19,054.57	-7,085.22
8. Capital intensive	-5,052.29	-1,463.19
9. Machinery	56,763.24	-7,296.27
10. Chemicals	-53,816.84	-12,994.27
Trade Balance	0	-7,134.36

[a] In million U.S. dollars.
[b] SOURCE: Soviet *Foreign Trade Statistical Yearbook.*

industrial exports, will be more successful than those which rely on capital or labor-intensive products.

The preceding analysis indicates that the FSU will become a large net exporter of cereals. To the extent that this is true, the United States will see an important customer become an important competitor.

The preceding results are very aggregated, and as a consequence, tell us little about what type of grain will be exported. Also, the results depend on measures of capital, stock, and labor quality that are problematical. In order to get more detail from the HOV procedure, one needs estimates of the factor-intensity matrix and factor availability that are consistent with those used in previous literature. Also it is important for all sectors to be equally disaggregated so that the factor disaggregation required to provide more detail in the agricultural sector is consistent with the factor requirements of other sectors. This disaggregated HOV model would require an enormous amount of data much of which would need to be assumed and is not attempted here. If, however, one is prepared to accept the assumption that agriculture is separable from the rest of the economy, then it is possible to conduct the HOV analysis with available data.

Post Reform Agricultural Trade Patterns

This section reports on an attempt to model the agricultural sector of the FSU as if agriculture was the only sector in the economy. There are some advantages to this approach. First, the two main factors that link agriculture and the rest of the economy—labor and capital—cannot be measured accurately. Second, the analysis reported here is completely independent of the work presented earlier, i.e., new measures of factor availability and factor intensity are used. This agriculture-specific analysis allows a measure of the robustness of the earlier results regarding cereal exports. Third, the disaggregation allowed when one focuses on one sector allows us to be more specific about the quality of land used. In particular, we were able to introduce crude measures of climatic conditions. The obvious disadvantage of this procedure is that we are conducting a partial equilibrium analysis with a general equilibrium model.

Data on data quality and climatic conditions are not available for some of the 50 countries that represented the world in the first section of this study. Consequently, we modified the HOV model so that accurate data on only two countries—the United States and FSU—are needed.

Suppose now there are only two countries, the United States and the Soviet Union. Let the variables with u and s superscripts, represent variables that pertain to the United States and the Soviet Union, respectively. Thus, C^s represents Soviet Union consumption and C^u represents U.S. consumption. Let g be defined as the Soviet consumption share of U.S. output.

Assume that

$$\frac{C^s}{C^u} = \frac{Y^s - B^s}{Y^u - B^u}, \tag{11}$$

where B^u and B^s are the U.S. and Soviet balance of trade, respectively. $B > 0$ implies a positive trade balance. From Equation (11) we get

$$C^s = gC^u, \tag{12}$$

where $g = (Y^s - B^s)/(Y^u - B^u)$. By the definition of the net trade vector, as output minus consumption, U.S. consumption can be given as $C^u = Q^u - T^u$, where T^u and Q^u are U.S. net export and output vectors, respectively.

Then, define the Soviet trade patterns as

$$T^s = Q^s - C^s. \tag{13}$$

Using Equation (12) and the fact that $Q = A^{-1}V$, Equation (13) can be rewritten as

$$T^s = A^{-1}V^s - g(A^{-1}V^u - T^u). \quad (14)$$

Simplifying Equation (14) we have

$$T^s = A^{-1}(V^s - gV^u) + gT^u. \quad (15)$$

Equation (15) provides patterns of trade predictions that are identical to the HOV model in Equation (10), as long as U.S. trade data conform to the HOV model. To see this, assume that the U.S. trading patterns, T^u, have been derived using the HOV equations. Then Equation (15) becomes

$$T^s = A^{-1}(V^s - gV^u) + g[A^{-1}(V^u - kV_w)], \quad (16)$$

where V_w is the world factor endowment vector and k is the U.S. consumption share of world output defined by $(Y^u - B^u)/Y_w$. Equation (16) can be simplified to

$$T^s = A^{-1}(V^s - gkV_w). \quad (17)$$

Note that gk is the Soviet consumption share of world output defined by s in Equation (10). Thus, Equation (17) is identical to the HOV equations given in Equation (10).

Since the model considers the agricultural sector as the whole economy, C^u and C^s are considered U.S. and Soviet agricultural consumptions, respectively. The ratio g is defined as the Soviet agricultural consumption share of U.S. agricultural consumption and can be calculated endogenously using the balanced trade assumption, or exogenously using 1989 data on quantities consumed in both countries.

Data Sources for the Agricultural Model

The nine commodity aggregates for the agricultural trade model are wheat, barley, corn, other grains (sorghum, oats, rye, and rice), soybeans, other oilseeds (sunflower seeds and rapeseed), cotton, beef, and pork/chicken. These factors are capital, skilled labor, unskilled labor, land I, land II, land III, fertilizer, chemicals, and energy.

Data for capital are taken as the amount of capital used in the agricultural sector in 1989. Soviet skilled labor is the part of the agricultural work force with university or college degrees. Arable land is divided into the three categories based on temperature and precipitation. Endowment for fertilizer is the amount used in the production of agricultural commodities in 1989. The data for chemicals are the amount of pesticide used in the agricultural sector in 1989. Energy is taken as the value of fuel and electricity used in the agricultural sector in 1989. Most of the Soviet data are taken from the *SSY* and *Soviet Agricultural Yearbook.* The U.S. data are taken from USDA's *Agricultural Statistics, Agricultural Resources,* and the U.N.'s *Fertilizer Yearbook.* The data used to calculate the amount of land required to produce a unit of each of the agricultural crops are from USDA's *Crop Production.* The data for the remaining inputs are calculated using information from the *U.S. Average Cost of Production for Major Field Crops*. The data used in the agricultural model are discussed in more detail in the Appendix (available from the authors).

Results from the Agricultural Model

Table 4 shows the results where trade is balanced by endogenously altering g and Table 5 shows the results where this restriction is lifted. In the case where we force a trade

Table 4. Post-reform Soviet agricultural trade patterns calculated using modified HOV and Soviet trade data and the balanced trade assumption

Commodity Aggregates	HOV Results	Soviet Data[a]
	(million U.S. dollars)	
Wheat	6,446.61	-2,108.50
Barley	3,900.46	-426.40
Corn	-5,291.93	2,221.10
Other Grains	4,597.94	-237.00
Soybeans	-4,237.46	-256.10
Other Oilseeds	1,964.13	75.70
Cotton	-3,346.62	1,320.90
Beef	-612.52	-819.00
Pork/Chicken	3,641.75	-284.70
Trade Balance	0	-4,956.20

[a]SOURCE: Zeimetz, Kathryn, *USSR Agricultural Trade* (August 1991).

balance, corn and cotton are imported as are soybeans and meats. If we remove the trade balance restriction, only soybean and meat are imported and the USSR runs up an enormous trade surplus. In particular, exports of wheat, barley, other grains, and other oilseeds are enormous.

The intuition behind the results in Tables 4 and 5 is that the FSU has an enormous land base in terms of its population. This is particularly true for land quality I which is represented by the Northern Plains in the United States. For example, the FSU has 109,800 thousand hectares in land category I compared with 606,000 in the United States (in Appendix which is available from authors). Currently some of this wheat-type land is being used for short-season corn and soybeans in the FSU, or has not been used to its productive potential. When we assume that this land can yield as much as its equivalent in the United States or Canada, it allows the FSU to produce more wheat and barley than the United States. Much of this production is then exported.

The results in Table 4 depend crucially on the balanced trade assumption. Here we have implicitly modeled the FSU as if agriculture was the only economic activity. The enormous resource base of the FSU would, under these circumstances, allow it to import large

Table 5. Post-reform Soviet agricultural trade patterns calculated using modified HOV and Soviet trade data

Commodity Aggregates	HOV Results	Soviet Data
	(million U.S. dollars)	
Wheat	8,879.34	-2,108.50
Barley	2,404.33	-426.40
Corn	839.89	-2,221.10
Other Grains	2,973.94	-237.00
Soybeans	-261.89	-256.10
Other Oilseeds	1,396.20	75.70
Cotton	102.65	1,320.90
Beef	-946.64	-819.00
Pork/Chicken	-1,630.99	-284.70
Trade Balance	13,756.84	-4,956.20

[a]SOURCE: Zeimetz, Kathryn, *USSR Agricultural Trade*, (August 1991).

quantities of commodities with the monies earned on agricultural exports. The imported commodities include corn, soybeans, and cotton. The imported corn and soybeans are then used to produce meat for domestic consumption. The balanced trade assumption is obviously unrealistic when applied to a sector of the economy. In this case, it allows the agricultural sector to consume the entire value of agricultural production. In reality, it is likely that other sectors of the economy would run trade deficits, financed by the agricultural surplus.

When we drop the balanced trade assumption in Table 5, the FSU becomes an exporter of corn and, to a relatively minor extent, of cotton. Agriculture runs a very high trade balance, thereby allowing imports in other sectors of the economy.

Again these numbers should not be taken as accurate predictions of how trade will evolve. It is unlikely, for example, that a country would simultaneously import corn and export barley. This result is due more to the law of one price assumption (i.e., no transportation costs) than on the superiority of corn and soybeans in animal rations. The results do, however, indicate that the current pattern of importing wheat and exporting cotton is likely to change. The results may also imply that corn production will fall at the expense of small grains.

It is interesting to compare our trade post liberalization FSU projections with others who have addressed the same issue. Liefert, Koopman, and Cook use a spatial model (Swopsin) and project a decline in net grain imports from 28 million tons to 1.5 million tons. They also project that the FSU will become a net exporter of wheat and project an increase in soybean imports. In addition, cotton production falls due to a reduction in area devoted to the crop after liberalization. Johnson (1992) argues, as do we, that one cannot "project future trading patterns from analysis of the revealed comparative advantage of particular commodities under the socialized system." He uses market insight and a description of existing inefficiencies to argue that "the shift in trade position for grain implied by the effects of system change is a very large one from perhaps 35 to 40 million tons of imports to about one-half that large a volume of exports."

Anderson argues that because agriculture can respond more rapidly to export opportunities, it will lead the economic development of the former centrally planned economies in the medium term. Later, industrial exports will overshadow agriculture. Anderson's analysis is richer than ours in that it offers a time frame. In his model, both agricultural and industrial exports lead the economy at different time periods, with agricultural exports declining as incomes rise under industrialization. Our analysis shows that FSU resources are large enough to allow it to consume at U.S. or European levels and continue to export agricultural products. Anderson makes projections for all of the centrally planned economies and consequently uses more aggregated data than is used here. Land resources, for example, are measured in hectares of arable land, plus permanent crops and pastures per capita. Also, he makes the quite reasonable assumption that U.S.- or EC-style yields will not be reached unless governments subsidize prices. When Russia is broken out separably, his results, even in the long-run, agree with ours, i.e., Russia exports both grain and energy.

Tyers uses a very comprehensive model. The Tyers-Anderson model of international trade is used to evaluate simultaneously, both CAP reform and the ongoing reforms in the FSU. His FSU-specific results "yield net cereal exports and, in the medium-term, net livestock product imports. It would permanently reduce (world) average grain prices by at least 20 percent and until technology improvements are in place, raise international meat and dairy product prices slightly."

All of the studies mentioned above use different modeling techniques and data. Yet all agree that the FSU (or Russia) will export grains. In other respects, the results differ from ours, but they differ in ways that can be traced to underlying assumptions or data.

Our method requires the least subjective input from the author, a characteristic that can be viewed as both a strength and a weakness. Our results are "objective" in that they flow directly from the data using well-established, theoretical principals, but this method can produce counter-intuitive results such as the simultaneous exportation of barley and importation of corn. The strength of the studies listed above is that their authors have developed an extensive knowledge of the FSU and its agriculture. Their results are - quite reasonably - based on this expertise. That our study is in agreement with the others is supportive of their more subjective methods.

Conclusion

This paper has attempted to evaluate the likely trade patterns of the FSU under the assumption that U.S. efficiency levels are achieved. We argue that data problems and possible resource misallocations make it difficult to justify an elasticities-based model. Instead, we rely on measures of the resource base as of 1989 and a trade model that projects trade patterns independently of existing patterns of trade and production.

The analysis is conducted separately for the entire economy and for agriculture. The results we derive can only be used to indicate the likely future direction of trade if the economy of the FSU is liberalized. One result that occurs with some consistency is that the FSU will become a major net exporter of small grained cereals. A second conclusion that can be drawn is that the FSU will become a net importer of tropical agricultural products and a major exporter of temperate agricultural commodities.

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