Economic Transition in Central and East Europe, and the Former Soviet Union: Implications for International Agricultural Trade

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EFFECTS OF MARKET REFORMS IN THE FORMER SOVIET UNION ON WORLD GRAIN TRADE: RESULTS FROM A MULTI-MARKET WHEAT TRADE MODEL

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This segment of the report discusses an evaluation of market reforms that was undertaken using a multi-market wheat trade policy simulation model. The results are highly aggregated and serve two purposes. First, the results provide valuable insights into the effects of market reforms in the Former Soviet Union (FSU) on market relationships among several important wheat exporters and importers. Second, the results offer a benchmark against which to compare results obtained from less-aggregate models.

The Model

A multi-region wheat trade model was constructed. Wheat is the chief commodity of interest because of the highly competitive nature of the world wheat market. Since wheat has been shown to differ considerably in quality and use characteristics by source, we modeled wheat as a differentiated product (Haley, 1995a). The model includes net trade of wheat from six specific sources (Argentina, Australia, Canada, the European Union (EU), Saudi Arabia, and the United States) and wheat from all other exporters. The model was specified using the Armington framework and imposed Hjort's three stage methodology of wheat demand. Armington-type models explain bilateral trade flows by assuming that commodities exported by different countries are not perfectly homogeneous and Hjort's methodology provides a systematic framework to utilize the Armington analysis for wheat.

The model is a static, partial equilibrium, nonspatial model, and is characterized by an economic structure that includes constant elasticity of supply and demand equations. Supply and demand are functions of own and cross prices. Net trade is the difference between domestic supply and demand. Domestic incentive prices depend on the level of consumer and producer support and on world prices denominated in a local currency. Price transmission elasticities regulate the extent to which changes in world prices affect domestic prices. World markets clear when net trade of a commodity across all regions sums to zero. The model, WHEAT, is a 33-region, 11-commodity, simulation model of world trade that has been parameterized with a 1992 database. The model yields results expected to occur in the medium term, or about 5-7 years for adjustment to be complete.

Hjort's methodology separates wheat demand into three stages. In the first stage, total wheat needs are determined, as are imports required to satisfy the quality characteristics desired by users in the importing country (e.g., for milling, feed uses). This aggregate demand will be called stage one demand. In the second stage, the mix of wheat imports by class that will satisfy stage one demand is determined. Weak separability is assumed: that is, the marginal rates of substitution among wheat classes

are independent of the determination of stage one demand. The goal of the importer is to minimize the cost of fulfilling aggregate demand for wheat. The solution to the optimization problem shows the mix of wheats that will satisfy demand for wheat quality characteristics. In the third stage, the importer determines the exporters to fulfill class-level wheat demand. Weak separability is again assumed: the marginal rate of substitution between suppliers of wheat is independent of quantities of other classes of imported wheat. The formal goal is the maximization of class I importing agent's utility given the choice of multi-sourced class I wheat and given the expenditure constraint from stage two. The solution is the compensated demand that depends on the quantity of class I imports and the price of all within-class wheats.

Based on Hjort's theoretical model, own and cross price elasticities can be derived. The necessary elements are an own price elasticity of demand (stage one), elasticities of substitution corresponding to wheat classes (σ, stage two) and to wheat suppliers of particular classes (σ_i, stage three), and consumption and/or import shares. Calculation of own and cross price elasticities are based on the Armington specification, where:

η = demand elasticity for wheat
η_{ii} = own price demand elasticity of class I wheat
η_{ih} = cross price demand elasticity of class I wheat with respect to class h wheat
S_h = expenditure share of class h wheat imports.

The own price demand elasticity for class I wheat can be shown to equal:

(1) $$\eta_{ii} = -(1 - S_i) * \sigma + S_i * \eta$$

The cross price demand elasticity of class I wheat with respect to class h can be shown to equal:

(2) $$\eta_{ih} = S_h * (\sigma + \eta)$$

Within each class of wheat additional own and cross price elasticities are defined as follows:

$\eta_{i,jj}$ = own price demand elasticity of class I wheat from exporter j
$\eta_{i,jm}$ = cross price demand elasticity of class I wheat from exporter j with respect to exporter m
$S_{i,m}$ = expenditure share of class I wheat imports from supplier m.

Values for these elasticities can be calculated based on equations resembling equations 1 and 2, given within-class elasticities of substitution between wheat suppliers and appropriate expenditure share data:

(3) $$\eta_{i,jj} = -(1 - S_{i,j}) * \sigma_i + S_{i,j} * \eta_{ii}$$

(4) $$\eta_{i,jm} = S_{i,m} * (\sigma_i - \eta_{ii})$$

(5) $$\eta_{i,jm} = S_{h,m} * \eta_{ih} \; where \; h\_i$$

Data

Data for supply, trade flows, and export prices were obtained from the International Wheat Council (IWC). The 1992 crop year was selected as the base year due to the availability of published data for world trade in that year. The IWC was also the source of data for transport costs and some subsidies for the United States and the EU. The remainder of the transport data were obtained from Maritime Research Inc. The USDA was the source of US wheat class trade flow data, Export Enhancement Program subsidies, and US food aid flows.

Elasticity values used for this study come from (or are based on) numerous sources. Supply and demand elasticities were obtained from the ERS SWOPSIM Global Database (Sullivan, Roningen, Leetmaa, and Gray) and SWOPSIM price transmission elasticities were used (Sullivan). The values of the wheat elasticities by type were obtained from Haley, Leetmaa, and Webb, and Haley (1995b). These elasticities are based on a function of a country's end uses for the wheat. The elasticities also reflect the preferences of, and the constraints faced by, those who make wheat import decisions. The values of the inferred between-class elasticities tend to be low (0.50), and the between-supplier elasticities tend to be higher (3.0) (Haley, Leetmaa, Webb).

Analysis

The objective of this analysis was to determine how potential changes in the FSU wheat market, brought about by economic reform, may alter U.S. competitiveness in the world wheat market. Because the FSU has not been a large player in the world market as of late, we elected to analyze other possible changes that might have major impacts on world grain trade and compare them in relative magnitude to FSU reform.

The WHEAT model was used to analyze the potential affects of various scenarios on the world wheat market and on U.S. competitiveness. The following scenarios were analyzed:

Large increase in FSU wheat production due to successful economic reform;
Large increase in Chinese wheat imports;
Increase in the „Asian Tigers'" income levels;
EU accession of the CEEs.

Results

The collapse of the Soviet Union and the ensuing introduction of economic reforms created much uncertainty for farmers. Due to financial upheaval, the State, the sole purchaser of grains in Soviet times, became unable to pay farmers for their crops in a timely manner and also eliminated input subsidies, which resulted in a decline in yields. As market reforms progress, it is likely that wheat yields will rebound. If FSU wheat yields were to increase to 1985-1994 average FSU levels (25.56 bushels/acre), FSU production would increase by roughly 11 percent, allowing for an increase in net exports

of almost 9 million tons (see Table 1). However, there would be little change in U.S. and Canadian production and exports, because FSU wheat does not directly compete with their higher quality wheats. The EU would be the hardest hit of the major wheat producers, since the FSU and the EU produce similar types and qualities of wheat. EU production could be expected to decrease by nearly 2 percent, while exports could fall by as much as 13.5 percent. Though unlikely in the near term, if the FSU was able to increase yields to U.S. (36.53 bu/acre) or French levels (92.52 bu/acre), the effect would be far more dramatic. If the FSU farmed as intensively as the French, the U.S. and Canada would suffer decreases in net exports of 9 and 14 percent respectively. The EU would be most adversely effected and could stand to lose as much as 38 percent of their net exports. If the FSU were to produce wheat as efficiently as the French, they would rule the global wheat markets with a 74 percent share of net exports.

According to Lester Brown, China may soon become an importer of massive quantities of grain, triggering an unprecedented rise in world food prices. Brown estimates that to meet the goal of 200 eggs per person per year by the year 2000 China would require an additional 24 million tons of grain. We have analyzed the impact of a 50 percent increase in Chinese wheat demand (roughly 50 million tons) imposing current Russian wheat yields, the higher historical FSU yields, and U.S. wheat yields for the FSU (see Table 2). We elected not to analyze increased Chinese demand imposing French wheat yields on the FSU because achieving such high yields would be highly unlikely in the medium term, if ever.

China imports high protein wheat from Canada and the U.S. to blend with domestic and imported wheat. At present FSU yields, if Chinese demand for wheat would increase by 50 percent, world wheat prices would increase sufficiently to increase FSU production and net trade. In terms of volume, the largest gainer in the Chinese market would be the U.S., followed by Canada, with the largest percentage gain. If FSU reforms are successful and yields increase, the FSU could be the largest gainer from increased demand by the Chinese. FSU wheat production could more than double if yields reach U.S. levels, making the FSU the largest net exporter in the world wheat markets.

In order to analyze the impact of CEE integration into the EU, some assumptions were made about the terms of accession. Because the CEEs produce a lower quality wheat than the EU, it was assumed that they would receive roughly 10 percent less than EU-15 farmers for their wheat. Also, it was assumed that EU imports of generic wheat were first filled by the CEEs. It was also assumed that the EU and CEE GATT commitments would be summed to determine the EU-19 GATT commitments.

If, or when, the EU accepts the CEEs as members of the EU, it appears that the U.S. wheat market will not be greatly impacted. U.S. production is expected to decline less than one percent, as is their net trade. The U.S. will maintain its market share. Canada, which produces a complementary wheat to the EU, may see a minimal increase in production and net trade, slightly increasing its market share. The EU-15 will see a slight drop in production and a larger drop in net trade, but this will be offset by the gain in CEE production and net trade. The incentive of higher prices is expected to increase CEE wheat production by over 20 percent. Consequently, the higher wheat prices will also cause a large drop in demand, allowing for a sizeable increase in CEE net exports (approximately 20 million tons). If we net out supposed intra-trade, the net

gain in net trade for the EU-19 is expected to be only 4.1 million metric tons (about 25 percent) and the gain in net trade for the CEEs to the rest of the world (excluding other EU countries) is expected to be roughly 5.8 million tons.

Assuming that Russian yields reach pre-FSU levels, the FSU is not likely to benefit from EU enlargement. Though the results suggest that FSU production will increase, the increase is due to the exogenous supply shock accounting for the higher yields, not a price change. The decrease in world price, brought about by the increase in supply from the CEE countries spurs increased FSU wheat demand, resulting in a decrease in net trade of roughly 3.4 million tons.

If the incomes of the so-called „Asian Tigers" continue to increase, the demand for wheat, especially as a feed, could increase as well. Using SWOPSIM (Sullivan, Roningen, Leetmaa, and Gray) income elasticities for wheat, we estimate that a 7.2 percent increase in income in the high growth Asian countries (South Korea, Taiwan, Malaysia, Philippines, Thailand, and Indonesia) and a 15 percent increase in income in China will have little impact on U.S. wheat exports. However, the EU could suffer a fairly sizeable decrease in net exports, while the FSU could increase their net exports. Were the FSU able to increase their yields to pre-reform levels, they could possibly increase their net exports by as nearly 12 million tons.

Table 5 compares base market shares of net exports to the shares estimated in our simulations. In all scenarios except for CEE integration to the EU, the FSU would gain in market share. In the scenarios where the 1992 base yields were assumed, the FSU either remains a net importer of wheat, or captures only a small portion of market share. If yields were to increase to historical (1986-1994 average) levels, the FSU could become a major player in the global wheat market (though this is unlikely in the near future). If efficiency were increased and FSU yields boosted to French, or even U.S. levels, the FSU could become the largest net exporter on the world market, surpassing even the U.S.

Conclusion

Though the FSU has imposed some economic reforms on their agricultural sector, the reform process is far from complete. Our analysis suggests that if the sector continues to operate as it has since the break-up of the Soviet Union, the U.S. has little to fear in the world wheat market. However, if the FSU allows for complete privatization of the sector, leading to efficiency gains in production, it is possible that the FSU could become a major exporter of wheat.

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Table 1: Absolute and percentage changes in production and net trade with FSU increasing yields to former, US, and French levels.

	Russian Yields		U.S. Yields		French Yields	
	Production	Net Trade	Production	Net Trade	Production	Net Trade
US	105.1 (0.18%)	109.6 (0.32%)	-888 (-1.5%)	-713 (-2.1%)	-3981.8 (-6.8%)	-3180.6 (-9.1%)
Canada	218 (0.93%)	190.9 (0.95%)	-585 (-2.5%)	-620 (-3.1%)	-2781 (-11.8%)	-2856.2 (-14.2%)
EU	-971.6 (-1.95%)	-2139.6 (-13.5%)	-21825 (-4.4%)	-3159.9 (-20%)	-5253.9 (-10.6%)	-6096.3 (-38.6)
FSU food	2948.6 (10%)	1881.2 (169%)	16136.4 (54.5%)	13096.5 (1177.5%)	77958.5 (263.4%)	62425.6 (5612.6%)
FSU feed	5475.9 (11.9%)	8885 (888500%)	27360.3 (59.5%)	32923.1 (329231%)	139634.3 (303.6%)	149260.2 (149260%)

Table 2: Changes in Wheat Production and Net trade with a 50 Percent Increase in Chinese Wheat Demand.

	Current Yields		Historical Yields		U.S. Yields	
	Production	Net Trade	Production	Net Trade	Production	Net Trade
U.S.	1725.1 (3.0%)	1556.8 (4.5%)	1445.6 (2.5%)	1320.7 (3.8%)	-579.4 (1.0%)	-380.6 (-1.1%)
Canada	1470.7 (6.3%)	1488.5 (7.4%)	1230.3 (5.2%)	1247.0 (6.2%)	-335.5 (-1.4%)	-337.8 (-1.7%)
EU	-157.3 (-0.3%)	-715.5 (-4.5%)	-532.8 (-1.0%)	-1042 (-6.6%)	-2796.7 (-5.6%)	-3177.4 (-20.1%)
FSU	869.3 (1.1%)	2875 (258.5%)	8897 (11.8%)	11282 (1014%)	80071.3 (105.9%)	82188.6 (7389%)

Table 3: Changes to World Wheat Trade with EU Accession of the CEEs.

	Change in Production	Change in Net Trade
U.S.	-466 (-0.8%)	-287.5 (-0.8%)
Canada	131.6 (0.56%)	105.3 (0.52%)
EU	-680 (-1.4%)	-1589.5 (-10.1%)
CEE	5216.3 (22.5%)	5729.7 (4702%)
FSU	7794.4 (10.3%)	-3437.4 (-450%)

Table 4: Change in production and Net Trade with an 7.2 percent Increase in „Asian Tigers" Income.

	Base Yields		Historical FSU Yields	
	Production	Net Trade	Production	Net Trade
U.S.	567.1 (1.0%)	512.5 (1.5%)	314.6 (0.5%)	303.3 (0.9%)
Canada	593 (2.5%)	572.5 (2.9%)	372.4 (1.6%)	351.2 (1.8%)
EU	-558.1 (-1.1%)	-1708 (-10.8%)	-910 (-1.8%)	-1988 (-12.6%)
FSU	491.4 (0.7%)	3607.5 (324.3%)	8488.8 (11.2%)	11910.9 (1071%)

Table 5: Net Export Share for all of the Simulations.

		Yield Increases			Chinese Demand			Integ.	Asian Tigers	
	Base	Hist.	U.S.	Frnch	Base	Hist.	U.S.		Base	Hist.
U.S.	37.81	34.14	26.19	11.1	32.71	32.49	20.71	37.64	35.80	34.45
Canada	22.85	20.95	15.65	6.04	23.66	20.34	12.07	23.29	22.18	21.21
EU	17.33	13.28	9.62	3.40	12.80	12.63	7.61	17.28	13.49	12.92
Australia	10.04	9.10	6.66	2.29	9.05	8.88	5.06	10.19	9.70	9.23
Argentina	7.62	6.56	5.20	2.18	6.21	6.22	4.13	7.38	6.80	6.16
Saudi Arabia	2.65	2.29	1.86	0.85	2.09	2.11	1.47	2.59	2.36	2.30
FSU	-1.2	9.28	34.16	74.03	1.49	8.69	48.81	-5.29	2.97	9.05
Other	1.7	4.40	0.66	0.0	11.98	8.65	0.15	1.62	6.67	4.23