Measuring the Success of Agricultural Transition: An Application to Russia

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Paper prepared for presentation at the 104th (joint) EAAE-IAAE Seminar Agricultural Economics and Transition:

„What was expected, what we observed,

the lessons learned."

Corvinus University of Budapest (CUB)

Budapest, Hungary. September 6-8, 2007

ABSTRACT

The paper presents a model of the agro-food system in a transition economy, which shows how the move from a planned to a market economy affects the production and consumption of goods and economic welfare. The model is then used to identify two complementary approaches for measuring the success of agricultural transition, where success is defined as increasing consumer welfare. The first approach is to identify and measure quantitative indicators of economic gain. The second is to identify the policies that would lead to greater welfare, and then measure the extent to which these policies have been implemented. An assessment of Russian agricultural reform using the two evaluation approaches shows that only modest progress has been made. Russia has not met the (perhaps overly optimistic) expectations of many observers that transition would substantially increase farm efficiency and productivity.

Keywords: transition, agricultural reform, Russia, efficiency, productivity, comparative advantage

1 INTRODUCTION

The paper begins by presenting a model of the agro-food system in the countries of the former Soviet bloc, which shows how the transition from a planned to a market economy affects the production and consumption of goods and economic welfare. The model is then used to identify two complementary approaches for evaluating the success of agricultural transition. Success is defined as increasing consumer welfare. The first approach is to identify and measure quantitative indicators of economic gain. The second is to identify the policies that would lead to rising welfare, and then measure the extent to which these policies have been implemented. Given that policies are the means to the end of achieving economic gains, the relationship between policies, welfare gains, and quantitative indicators of these gains is examined.

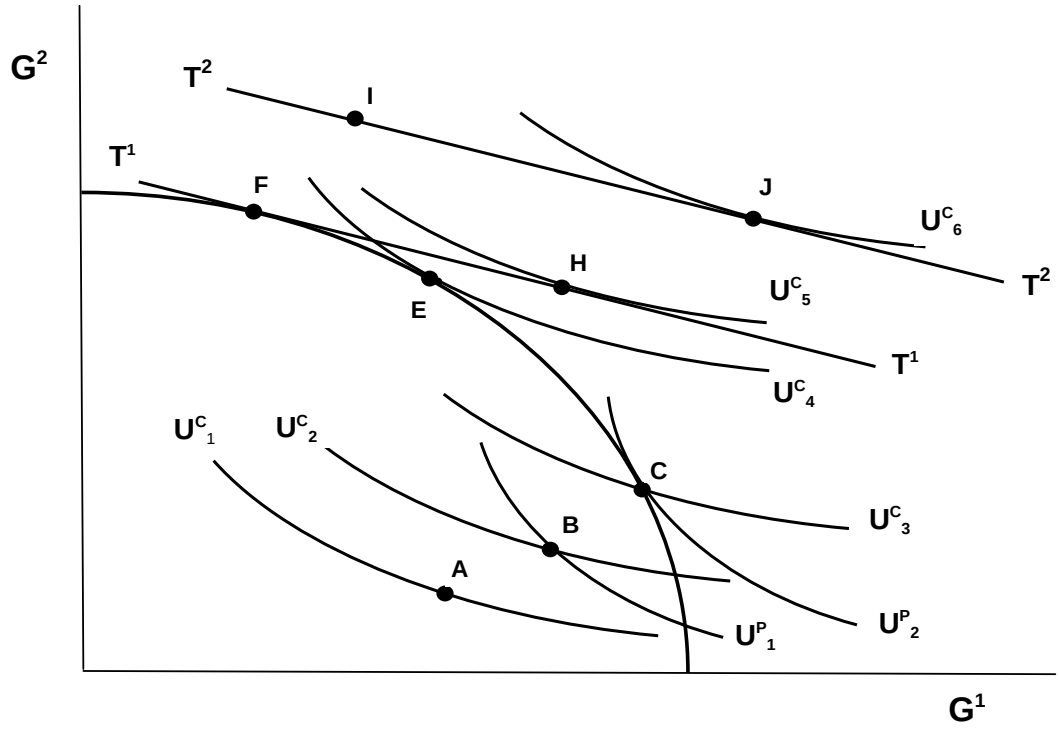
We then apply the model and two evaluation approaches to an assessment of the Russian agro-food economy during transition. This has two purposes. The first is to demonstrate use of the evaluation approaches for a particular economy, and the second is to examine the reform progress that Russia specifically has made during its transition. The assessment, however, is based completely on previous empirical work. For some of the quantitative success indicators, only limited work has been done. The assessment of Russia's agricultural reform progress therefore cannot be definitive. That point notwithstanding, the available empirical evidence indicates that Russia's agricultural reform progress has been modest, in particular that reform has not substantially raised farm efficiency and productivity.

2 A MODEL OF TRANSITION AGRICULTURE

Figure 1 presents a model as to how the move from a planned to a market economy during transition can affect the production and consumption of goods and consumer welfare. Although the model could be used to analyze transition's effect on any sector of the economy, our focus is on the agro-food system. The curve concave to the origin is the economy's production possibilities frontier (PPF) for goods G^1 and G^2. We extend the concept of economy-wide social indifference maps for consumers to include an indifference map for planners in the planned period (who represent the interests of the political leadership). In our analysis, planners

receive utility from goods from the various ways they put them to use within their overall plan for the economy. We assume that in the planned economy, planners and consumers have different preferences for goods, represented by different indifference maps. The large drop in production of military and heavy industrial goods and growth in consumer goods and services experienced by all the transition economies during their reform is general evidence of the difference in preferences between planners and consumers. U^{p}_{1}, U^{p}_{2}, U^{c}_{1}, U^{c}_{2}, etc. are specific indifference curves within the indifference maps for planners and consumers. If the planners are utility maximizers, the planned economy's production and consumption point is C, where the planners' indifference curve U^{p}_{2} is tangent to the PPF.

Figure 1: Transition's Effect on Production, Consumption, and Welfare



Production at point C assumes that the economy is technically efficient, that is, all producers are equally efficient in their use of inputs, and thereby none deviates from the best available domestic production practices. Given that planned economies lacked the cost-minimizing motive of market economies, and that technical inefficiency can exist within even market economies, technical inefficiency of some degree was a likely feature of planned economies. Technical inefficiency is represented in figure 1 by production at point B inside the PPF, such that the planners' welfare is that given by U^{p}_{1} rather than U^{p}_{2}.

The analysis also assumes that the planned economy is wholly autarkic and thereby does not engage in any foreign trade. All the planned economies of the former Soviet bloc did trade to some degree. The main purpose of trade, however, was not to reap the gains from trade based on comparative advantage, but rather to import products that were necessary inputs into the production plan but could not be domestically produced in sufficient quantity or quickly enough

(see HOLZMAN 1974). The planning objective was to be as autarkic as possible.

Transition can have five main effects on the structure of production and consumption and welfare of consumers. The first effect is negative, in that the disruptions of moving from a planned to a market system, especially in the linkages between input suppliers and farms and farms and processors, can temporarily reduce production. Rather than the flow of inputs and outputs in the production chain being specified by the planners, farms and enterprises must now establish these relationships themselves in a price-driven market system. In figure 1, this disruption is represented by the production point falling from B to A, with consumer welfare dropping from the level given by U^c_2 to that given by U^c_1. The reestablishment of these linkages would increase output, the isolated effect being the jump in production from A back to B (assuming that reform did not yet change the mix of output as determined by the planners).

Transition's second effect is that it can improve the technical efficiency of production. In figure 1, the elimination of all technical inefficiency would move production from B to C on the PPF (assuming that planners' preferences still determined production).[1] Consumer welfare would rise from the level given by U^c_2 to that given by U^c_3. (The specific policy changes that would generate these effects will be discussed later in the paper.)

Transition's third effect is that it can improve the allocative efficiency of production and consumption. Complete allocative efficiency would be achieved if the production and consumption point moved from C to E, where the PPF is tangent to the highest possible consumer indifference curve (U^c_4). Complete allocative efficiency means that for every input/output pairing, the input price equals the value of the input's marginal product, which in turn equals the input's marginal product times the price of the output produced. Satisfying this condition means that for every pair of goods produced and consumed, the ratio of the goods' marginal cost equals the ratio of the goods' price. Allocative efficiency on the consumption side requires that the price ratio equals the ratio of the goods' marginal utility to all consumers of the two goods. These conditions create the tangency between the PPF and U^c_4.

The improvement in allocative efficiency (from consumers' point of view) results mainly from the shift from planners' to consumers' preferences as the driving force in determining what goods are produced and consumed. Allocative efficiency results in consumer welfare rising from the level of U^c_3 to that of U^c_4. Although we regard as valid the argument that during the planned period planners and consumers had fundamentally different preferences for goods and therefore can be represented by different indifference maps, substantial allocative inefficiency could have existed even if planners' and consumers' preferences had been similar.

Transition's fourth effect is to allow foreign trade based on comparative advantage. In figure 1, the slope of line T^1T^1 gives the world price ratio for G^1 and G^2. With free trade, the economy's consumption possibilities frontier switches from the PPF to line T^1T^1. Maximizing the gains from trade based on comparative advantage would result in moving the production

[1] Our model of transition's effects on an economy's behavior and performance builds on that in LIEFERT, LOHMAR, and SEROVA (2003), and is generally consistent with the model presented in SWINNEN and ROZELLE (2006). The differences between our and the Swinnen and Rozelle model is that the latter covers only production, and for only a single good, while our model covers production for two (which could be expanded to *n*) goods, consumption, trade, and welfare effects.

point from E to F (where the PPF and T^1T^1 are tangent), and then trading along T^1T^1 to consume at H (where T^1T^1 is tangent to U^c_5). The economy exports G^2 and imports G^1. Trade based on comparative advantage raises consumer welfare from the level of U^c_4 to U^c_5.

Transition's fifth effect is to motivate technological change, by exposing domestic producers to superior foreign technology and management practices and providing the systemic incentives to adopt it (profit maximization and competition). Effective technological change would shift the PPF outward. To avoid too messy a figure, figure 1 does not show the new PPF. Assume, however, that the new PPF is tangent to the trade line (T^2T^2 , parallel to T^1T^1) at I, the new production point. Technological change shifts production from F to I, and consumption from H to J. Consumer welfare rises from the level of U^c_5 to U^c_6.

2.1 Quantitative indicators of reform success

The preceding analysis allows for a quick summary identification of the main quantitative indicators that can be used to measure how successful agro-food reform has been in the transition economies, where success is defined as increasing consumer welfare. The four main performance indicators are those measuring:

1. technical efficiency
2. allocative efficiency
3. trade based on comparative advantage
4. technological change

For all four general areas of performance, specific and well-defined indicators exist, as well as methods to compute them. (A detailed examination of these definitions and methods of calculation is beyond the scope of this paper.) Given that the welfare levels associated with specific consumer indifference curves are unmeasurable in absolute terms, none of these empirical performance measures can determine the degree to which welfare has changed in an absolute sense. Yet, as the preceding section showed, all these performance indicators are positively associated with rising consumer welfare.

Improvement in both technical efficiency and the technology of production raises the productivity of input use. Reversing the initial drop in output from the disruption in supply linkages and other temporary dislocations from transition would also increase productivity. Productivity growth is therefore another (and broader) performance indicator, which can cover technical efficiency, technological change, and correcting the short run disruptions from transition.

2.2 Reform policies

The second main way to measure the success of agro-food reform for a country is to identify the policies that would lead to increasing welfare, and then measure the degree to which these policies have been implemented. The two approaches for measuring reform success ─ by the degree of policy implementation or the degree to which specific economic gains have been achieved ─ are complementary, in that policy changes are the means to the end of achieving economic gains.

We follow LIEFERT and SWINNEN (2002) in arguing that reform of the transition

economies' agro-food sectors has involved four main policies: (1) market liberalization; (2) farm reform and restructuring; (3) reform of upstream and downstream operations and services; and (4) creation of institutional infrastructure for a market economy. Market liberalization involves removing government controls over the allocation of resources and output, thereby allowing the market to become the main means of allocation. Two main subpolicies of market liberalization are domestic price liberalization and trade liberalization. Price liberalization involves the corollary policy of reducing or eliminating state budget subsidies to producers and consumers that were needed during the planned period to financially support the state-set price system (where prices were often set below production costs). Freeing prices and reducing subsidies are therefore key policy changes that result in consumers' preferences replacing planners' preferences as the driving force in determining what goods are to be produced and consumed. Price liberalization's main economic effect would be to increase allocative efficiency. In terms of figure 1, it would drive the move in the production and consumption point from C to E, and correspondingly the increase in consumer welfare from the level of U^c_3 to that of U^c_4 .

Trade liberalization would end the state's foreign trade monopoly and allow trade based on comparative advantage. With complete free trade, production would move to point F, consumption to H, and consumer welfare would rise from the level of U^c_4 to that of U^c_5 .

Successful implementation of the second major reform policy ─ farm reform and restructuring ─ would both reduce technical inefficiency and encourage technological change. Technical efficiency would rise because of farms' requirement to be self-financing combined with competitive pressure, while exposure to superior foreign technology and management practices, combined again with the carrots and sticks of competition, would encourage technological change. As discussed earlier, the elimination of technical inefficiency would shift the production point from B to C and raise consumer welfare from U^c_2 to U^c_3 , while technological change would shift the PPF rightward, move the consumption point from H to J, and raise welfare from U^c_5 to U^c_6.

Reform of upstream and downstream operations and services extends the analysis of reform's effects on production, consumption, and welfare from that of primary agriculture to that of the entire agro-food system. It could be grouped with farm restructuring and reform to cover reform of all farm producers (including plotholders) and enterprises within the agro-food economy, as well as those providing inputs and services. With respect to figure 1, goods G^1 and G^2 could now include processed and retail products as well as primary agricultural output, with PPF the corresponding production possibilities frontier ─ that is, the model depicted in figure 1 could apply to any stage in the agro-food production chain.

Building the institutional infrastructure that a market-driven agro-food system needs, such as systems of market information and commercial law that protects property and enforces contracts, allows all the other reform policies to work better. In particular, weak market institutions increase transaction costs. To a large degree these costs are a manifestation of the disruption to the production chain that we identified as transition's first main effect on the agro-food system. Eliminating transaction costs would raise productivity and thereby output, as represented in figure 1 by the move in the production point from A to B, and rise in consumer welfare from U^c_1 to U^c_2 . We argued earlier that the benefits of greater technical efficiency and technological change that would result from effective farm/enterprise reform and restructuring

could both be captured by productivity growth. Productivity growth could also capture the gains from stronger market institutions that reduce transaction costs.

The four main agro-food reform policies we identify are similar to the taxonomy of reform policies used by the World Bank (CSAKI and NASH 1998) in it annual evaluation of the agricultural policy reform performance for the transition economies covering 1997- 2005. The World Bank reform policies are: (1) price and market liberalization; (2) land reform and privatization; (3) privatization and reform of agro-processing and input supply enterprises; (4) rural finance; and (5) institutional reform. The only major difference between our and the Bank's list of reform policies is the latter's addition of rural finance. Given that finance can be viewed as a production service (being a means to acquiring capital), within our policy scheme it could be added to the third area of reform, creation of upstream and downstream operations and services.

Table 1: Agricultural Reform Policies, Success Indicators, and Welfare Gains

Policy	Success indicator	Welfare gain
Farm/enterprise reform	Productivity growth	
	technical efficiency	U^c_2 to U^c_3
	technological change	U^c_5 to U^c_6
Price liberalization	Allocative efficiency	U^c_3 to U^c_4
Trade liberalization	Trade based on comparative advantage	U^c_4 to U^c_5
Building institutional infrastructure	Productivity growth	U^c_1 to U^c_2

Table 1 summarizes the key reform policies and quantitative indicators of reform success, as well as the relationship between the policies and quantitative indicators. The table also identifies the welfare gains (with respect to figure 1) that successful policies, as measured by the indicators, could generate. The relationship between policies and indicators as summarized in the table is general rather than precise and absolute. The policies identified could affect more than one indicator, while the economic gains as measured by the indicators could be impacted by more than one policy, or by non-policy factors. For example, failure to maximize allocative efficiency and trade based on comparative advantage might result not only because of market intervention policies, but also because of imperfect market conditions. These could include enterprise market power (perhaps held by food processors or input suppliers) and weak physical and institutional infrastructure. The latter can create high transport and transaction costs, and also impede price arbitrage both within the economy and between border and domestic prices (incomplete price transmission). LIEFERT (forthcoming a) argues that this is a particularly serious problem for the Russian agro-food economy. Correcting these problems also involves policies, but which go beyond those of market liberalization.

3. MEASURING THE SUCCESS OF AGRICULTURAL TRANSITION IN RUSSIA

We next use the two approaches for measuring the success of agricultural transition to evaluate the performance specifically of Russia. Since policy change is the means to the end of improving economic performance and reaping economic gains, we begin by assessing Russia's success in implementing agro-food reform policies. The World Bank taxonomy of agro-food reform policies mentioned earlier was created for the very purpose of allowing the Bank to grade the agricultural reform progress of the transition economies of the former Soviet bloc. Every year over the period 1997-2005, the Bank graded each country from 1 (the lowest) to 10 (the highest) for each of its five areas of agricultural reform policy (CSAKI et al. 2006 is the last publication in the annual series). Table 2 gives the Bank's grades for Russian agricultural reform for the first and last years of the evaluation period.

Table 2: The World Bank Evaluation of Russia's Transition Agro-food Policies

Policy	1997	2005
Price and market liberalization	7	6
Land reform and privatization	5	6
Privatization and reform of agro-food processing and input supply enterprises	7	9
Rural finance	6	7
Institutional reform	5	5
Average	6.0	6.6

Note: The scores are from 1 (lowest) to 10 (highest).
Source: World Bank (1998) and World Bank (2006)

In 1997, Russia received an average grade (the unweighted average of the 5 different grades) of 6.0, which roughly means that the country had moved about 60 percent toward full implementation of reform policies that would establish a well-operating and market-driven agro-food system. By 2005, Russia had improved its score to only 6.6. In the area of privatization and reform of agro-processing and input supply enterprises, Russia jumped from a score of 7 to 9, but in price and market liberalization it regressed from 7 to 6. Russia's agro-food system was still far from a high score, and was progressing at a slow rate.

Russia's 2005 score of 6.6 compares to the 2005 average score of 6.4 for all the transition economies covered by the Bank's evaluation. Russia was doing better than most of the other countries of the Commonwealth of Independent States, but less well than the countries of Central and Eastern Europe.[2]

[2] In its initial evaluations, the Bank covered all the transition economies of the former Soviet bloc. By 2005, however, it had stopped evaluating those countries that had joined the Economic Union (EU), judging that their

We next evaluate Russia's agricultural performance with respect to the quantitative performance indicators identified earlier. Most of the empirical work involving these indicators covers the 1990s rather than the 2000s. However, the slow pace of Russian agricultural reform from 1997 to 2005 as indicated by the Bank's evaluation suggests that Russia's agricultural performance has not improved much during the 2000s.

Of the quantitative indicators identified in table 1, the most work done for Russian agriculture during transition has been on measuring technical efficiency. Such work includes SOTNIKOV (1998); SEDIK et al. (1999); VOIGT and UVAROVSKY (2001); GRAZHDANINOVA and BROCK (2004); GRAZHDANINOVA and LERMAN (2005); LERMAN and SCHREINEMACHERS (2005); OSBORNE and TRUEBLOOD (2006); BOKUSHEVA and HOCKMAN (2006); BROCK et al. (forthcoming). Most of the work covers some period in the 1990s, with Brock et al. giving the most recent results (for 2002). All the studies estimate a production function for some set of commodities, farms, and regions within Russia, using either stochastic frontier analysis, data envelopment analysis, or both approaches. With both procedures, actual performance is measured against the value of 1, with a performance value of 1 meaning that all farms are technically efficient, in that all are employing the best available domestic production practices.

The results in the aggregate show that Russian agriculture suffers from significant technical inefficiency. An unweighted average of the aggregate technical efficiency scores from each of the above studies in the last year for which each study reports results gives a value of 0.67.[3] If roughly accurate for Russia, this means that farms have been performing at only two-thirds the possible level of efficiency. Russia could decrease agricultural input use by about one-third without reducing output levels by simply eliminating all its technical inefficiency. Another conclusion is that technical efficiency has apparently worsened rather than improved during transition. Some studies compute technical efficiency at both the beginning and end of a time period. Most of these studies show that technical efficiency worsens rather than improves over time. For these studies, the unweighted average of the technical efficiency scores at the beginning of the period of calculation is 0.73, which falls to an average of 0.69 for end period efficiency.

Because the policies that most directly affect technical efficiency performance also impact performance with respect to technological change (specifically farm and enterprise reform), we next examine the empirical record with respect to technological progress. The only relevant study we could find is by VOIGT and UVAROVSKY (2001, identified also in the list of technical efficiency studies). They estimate a production function for farms in 75 of Russia's 88 oblasts and territories using data for the period 1993-98. They then use the production function

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transition to market economies was largely completed. Thus, reform scores for these countries are not included in the 2005 average score of 6.4 for all the economies evaluated by the Bank. If the EU-acceded countries were included in the average score, Russia's relative agricultural reform performance would be much worse.

[3] In computing these averages, we ignore the studies by Grazhdaninova and Brock and Grazhdaninova and Lerman. The reason is that these studies are part of the USDA-funded BASIS project on Russian agriculture, and are based on data for Russian farms in the three oblasts of Rostov, Ivanovo, and Nizhni Novgorod in 2001, obtained from a project survey. Brock et al. provides a summary of the BASIS project work on technical efficiency, and thereby uses the same database as the above two studies. To avoid "double counting" work based on this specific database, we include in the average technical efficiency calculation only the results from Brock et al.

to compute that over this period, technological change in Russian agriculture worsened by 20 percent.

As mentioned earlier, both technical efficiency and technological change (as well as institutional reform that reduces transaction costs) can be captured by the indicator of productivity growth. LERMAN et al. (2003) computes that over 1992-97, total factor productivity in Russian agriculture rose by a total of 7.4 percent. This result contrasts with the conclusion of Voigt and Uvarovsky that technological change worsened rather than improved during the 1990s, as well as with the general conclusion from the various technical efficiency studies that performance with respect to this indicator also worsened. Yet, even if Lerman et al.'s productivity growth calculation is the more accurate, the productivity gain is quite modest. This is especially true relative to expectations about Russian agriculture at the start of transition. In the early 1990s, Russian agriculture was perceived as suffering from substantial waste, technical inefficiency, and technological backwardness inherited from the Soviet period. Many observers therefore felt that the potential for gains in technical efficiency, technological progress, and productivity growth was large.[4] Such expectations, however, have not been met.

The main study of Russian agricultural allocative efficiency during transition is the USDA-funded BASIS project on Russian agriculture, which measures the allocative efficiency of input use. Most of the project's empirical work covers corporate farms in the three oblasts of Rostov, Ivanovo, and Nizhni Novgorod in 2001. The main test of allocative efficiency used is the relationship between input prices and the value of the inputs' marginal product (VMP). LIEFERT (forthcoming a) summarizes the project's empirical work on allocative efficiency (which covers LIEFERT et al. 2003; GRAZHDANINOVA and LERMAN 2005; LIEFERT 2005; LIEFERT et al. 2005). He finds that material inputs tend to be overused (price greater than VMP), while the specific inputs of labor, fertilizer, and spare parts are underused (wages or prices less than VMP). Yet, for labor, fertilizer, and spare parts, either data or methodological issues bias the results in the direction of underuse. Liefert concludes that the empirical evidence does not indicate that inputs in the aggregate were seriously overused or underused, and that Russia's performance with respect to the allocative efficiency of input use appears fairly respectable.

Another relevant study is OSBORNE and TRUEBLOOD (2006), who compute not only the technical efficiency but also the allocative efficiency of Russian agricultural input use in crop production over the period 1993-98. They find that the elimination of allocative inefficiency in 1998 could have decreased the cost of agricultural production by 30 percent without reducing output.

The only study we could identify that empirically measures Russia's performance with respect to trade based on comparative advantage is LIEFERT (2002). Liefert uses the social cost-benefit ratio approach (see MASTERS and WINTER-NELSON 1995) to measure the comparative advantage for various agricultural commodities (grain, meat, and sunflowerseed) and inputs (fertilizer and energy). The social cost-benefit ratio gives the value of all resources used to produce a product domestically, though with tradable inputs valued at trade prices, divided by the product's trade price. The higher (lower) this value is for a product, the greater is

[4] One of the most optimistic was JOHNSON (1993), who argued that by eliminating waste and moving to more efficient Western-style practices, Russia could increase the amount of grain available for either domestic use or export by 55 million metric tons.

a country's comparative disadvantage (advantage) in the good.

Liefert finds that Russia's trade in agricultural output and inputs in the late 1990s was generally consistent with its comparative advantage. His results indicate that Russia had a general comparative disadvantage in agricultural output vis-à-vis inputs, as well as a comparative disadvantage in meat relative to bulk crops (grain and sunflowerseed). Russia at that time (and still presently) was a large importer of meat (1997 net imports of over two million metric tons), an exporter of sunflowerseed (1997 net exports over a million tons), and a large exporter of fertilizer (1997 net exports over 12 million tons) and energy (RUSSIAN CUSTOMS COMMITTEE).

Yet, Russia was not maximizing its gains from agricultural trade based on comparative advantage. (A country maximizes its gain from trade if it produces all tradable goods to the level where the social cost-benefit ratios for all goods are equal.) The country would gain from importing more meat, and poultry in particular, as well as exporting more sunflowerseed, fertilizer, and energy products. Nonetheless, Liefert's results indicate that Russia's performance with respect to trade based on comparative advantage in the second half of the 1990s was also generally respectable.

4 CONCLUSION

Based on a model of the transition process for the agro-food economy, the paper identifies and examines the relationship between two complementary approaches for measuring the success of agricultural transition in the countries of the former Soviet bloc, where success is defined as increasing economic welfare. The first approach is to identify and measure quantitative indicators of welfare gain, and the second to identify and measure the policies that would lead to increased welfare.

Application of the two methods to Russia's agricultural transition shows that the country has made only limited reform progress, with much more improvement possible. According to the World Bank's evaluation of its policy reform record, by 2005 Russia had moved only about two-thirds toward full implementation of reform policies that would establish a well-operating and market-driven agro-food system. Only marginal progress was made from 1997 through 2005. In the areas of allocative efficiency and trade based on comparative advantage, the limited empirical record indicates that Russia's performance has been respectable, though with further progress possible. In the areas of technical efficiency, technological change, and productivity growth, where success depends largely on farm-level restructuring and reform, the empirical record has clearly been disappointing. Most studies show negative rather than positive change, while for those studies that show improvement, the measured gains have been very modest. Russia has not met the (perhaps unrealistic) expectations that many had at the start of its transition that the move to a market economy would substantially increase farm efficiency and productivity.

ACKNOWLEDGMENTS

The author thanks Carlos Arnade, Barry Krissoff, Olga Liefert, Mary Anne Normile, and Mathew Shane for comments, and is responsible for any remaining deficiencies. The views expressed are the author's alone and do not in any way represent official USDA views or

policies.

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