

Agricultural Productivity and Efficiency in Russia and Ukraine: Building on a Decade of Reform. By Stefan Osborne and Michael A. Trueblood. Market and Trade Economics Division, Economic Research Service, United States Department of Agriculture. Agricultural Economic Report No. 813.

Abstract

This study examines the impact of agriculture-specific and economywide institutional reform in Russia and Ukraine on the productivity and efficiency of agricultural production. Production in the agricultural sector in Russia and Ukraine has fallen since reforms began in 1992. The decline is to a certain extent an inevitable result of reform as input and output prices realign to world prices. However, some of the decline is due to incomplete agriculture-specific and economywide institutional reform. Russia and Ukraine have the potential to increase grain exports significantly if reforms are implemented: the most likely scenario projects that wheat and barley exports from Russia and Ukraine could double from current projections, reaching 21 million metric tons by 2011.

Keywords: Russia, Ukraine, reform, productivity, efficiency.

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Summary

This study examines the impact of agriculture-specific and economywide institutional reform in Russia and Ukraine on the productivity and efficiency of agricultural production. Production in the agricultural sector in Russia and Ukraine has fallen since reforms began in 1992. The decline is to a certain extent an inevitable result of reform as input and output prices realign to world prices. However, some of the decline is due to incomplete agriculture-specific and economywide institutional reform. The analysis shows that Russia and Ukraine have the potential to increase grain exports significantly if reforms are implemented.

Russia and Ukraine have undergone rapid economic and political changes since they became independent in 1992 and began to pursue economic reforms. In both countries, the economywide reforms have led to steep declines in per capita income, which has only recently started to rebound. Agricultural production and trade patterns also changed dramatically. Grain production fell by 46 percent from 1988-90 to 1998-2000, and similar declines were observed for other crops and livestock. From 1992 to 2000, net grain imports fell from 10 percent of world grain imports to less than half of 1 percent. In contrast, since reforms began, Russia has become a significant meat importer. In 2001, Russia's meat imports totaled 2.5 million metric tons (mt), about 19 percent of total world meat imports by volume. U.S. poultry meat exports to Russia were slightly over 1 million mt in 2001, accounting for about 79 percent of total Russian poultry imports and 33 percent of total U.S. poultry exports.

The transformation of the agricultural sector began with the general reform programs in 1992. Some of the proposed reforms were agriculture-specific, such as bankruptcy procedures for insolvent farms and land reform, but they were not implemented early on. The reforms that affected agriculture the most were economywide, such as price and trade reform, as well as institutional reforms such as privatization. The expectation was that output would contract initially as subsidies were eliminated, but eventually recover as farm managers increased their productivity, eventually leading to an increase in exports. The actual result of reforms to date has been a large drop in production, but no corresponding rise in output or productivity. This report shows that several measures of productivity and efficiency have declined since reform began.

This study argues that the productivity decline is due to incomplete reform. The price and trade reforms have been fully implemented, but agriculture-specific and economywide institutional reforms have been only partially implemented. Agriculture-specific reforms not yet fully implemented include:

- **Bankrupting insolvent Russian and Ukrainian farms.** Currently, farms can avoid bankruptcy simply by rolling over their debt. By removing the threat of bankruptcy, this practice eliminates an incentive for farmers to produce efficiently.
- **Liberalizing land transactions.** In prohibiting the use of land as collateral, current law severely limits farms' liquidity and the functioning of the agricultural credit market in general.

Economywide reform would involve:

- **The creation of a system of commercial law that protects property rights.** The threat of expropriation of profit reduces the incentive to engage in long-term investment and to care for durable assets. This problem is particularly acute in agriculture, where the failure to care for land or machinery has strongly negative long-term effects on productivity and profitability.
- **More legislative stability.** The system of commercial law as it exists now operates inefficiently primarily because legislation is constantly changing. Also, regional legislation often contradicts Federal legislation. Contradictory and frequently changing legislation makes it difficult for the court system to impose clear and consistent property rights definitions.

The main effect of completing these reforms would be to increase the flow of resources from unprofitable to profitable farms. Bankrupting insolvent farms would free up resources to be used elsewhere. The creation of a functioning credit market and other reforms that improve the investment climate would direct resources to low-cost producers, which will improve the overall competitiveness of the agricultural sector.

To illustrate the impact of hypothetical productivity increases if reforms were to be completed, some modeling projections are made for wheat and barley for the next decade using the USDA Baseline.

- Under the modestly optimistic **base** scenario, wheat and barley production in Russia and Ukraine reach 83 million mt in 2011, of which 10 million mt is exported.
- In the **“Russia only”** scenario, production increases to 93 million mt in 2011, and exports increase to 15 million mt.
- In the **“moderate growth”** scenario, production increases to 97 million mt in 2011, with exports of 21 million mt.
- In the high-growth **“catch up”** scenario (the least likely case), production rises to 114 million mt by 2011, of which 34 million mt are exported.
- In all three scenarios simulating production growth, exports probably would go to countries in the former Soviet Union, parts of the European Union, the Pacific Rim, and the Middle East.
- World wheat prices would decline from \$112/mt in 2011 in the base scenario to \$106/mt in the “moderate growth” scenario, and to \$99/mt in the “catch up” scenario.

Agricultural Productivity and Efficiency in Russia and Ukraine

Building on a Decade of Reform

Stefan Osborne and Michael A. Trueblood

Introduction

This report concentrates on the progress to date of agriculture-specific and economywide institutional reforms in Russia and Ukraine and explores the effect that reform would have on agricultural production and trade if these reforms were to be fully implemented. If the present pace of reforms and economic trends continues, Russia will remain a minor wheat exporter and a major meat importer, while Ukraine will remain a minor wheat exporter. However, if Ukraine and Russia are more aggressive in implementing reform, then they both have the potential to become significant grain exporters.

The analysis focuses on Russia and Ukraine. The Union of Soviet Socialist Republics (USSR) and, following the reforms of 1992, the Commonwealth of Independent States (CIS)¹ were important to international food markets in the past century. Russia and Ukraine, in particular, have been important as the dominant agricultural producers in the region. Both Russia and Ukraine were significant grain exporters in the early 20th century, and Ukraine is still remembered as the “breadbasket of Europe.”² More recently, Russia and Ukraine jointly accounted for more than 70 percent of total USSR production of several commodities

from 1988 to 1990, including meats and grains, a pattern that still holds for the CIS today (fig.1). These countries have continued to be important to international markets, but they have shifted in the past decade from significant grain importers to major meat importers.

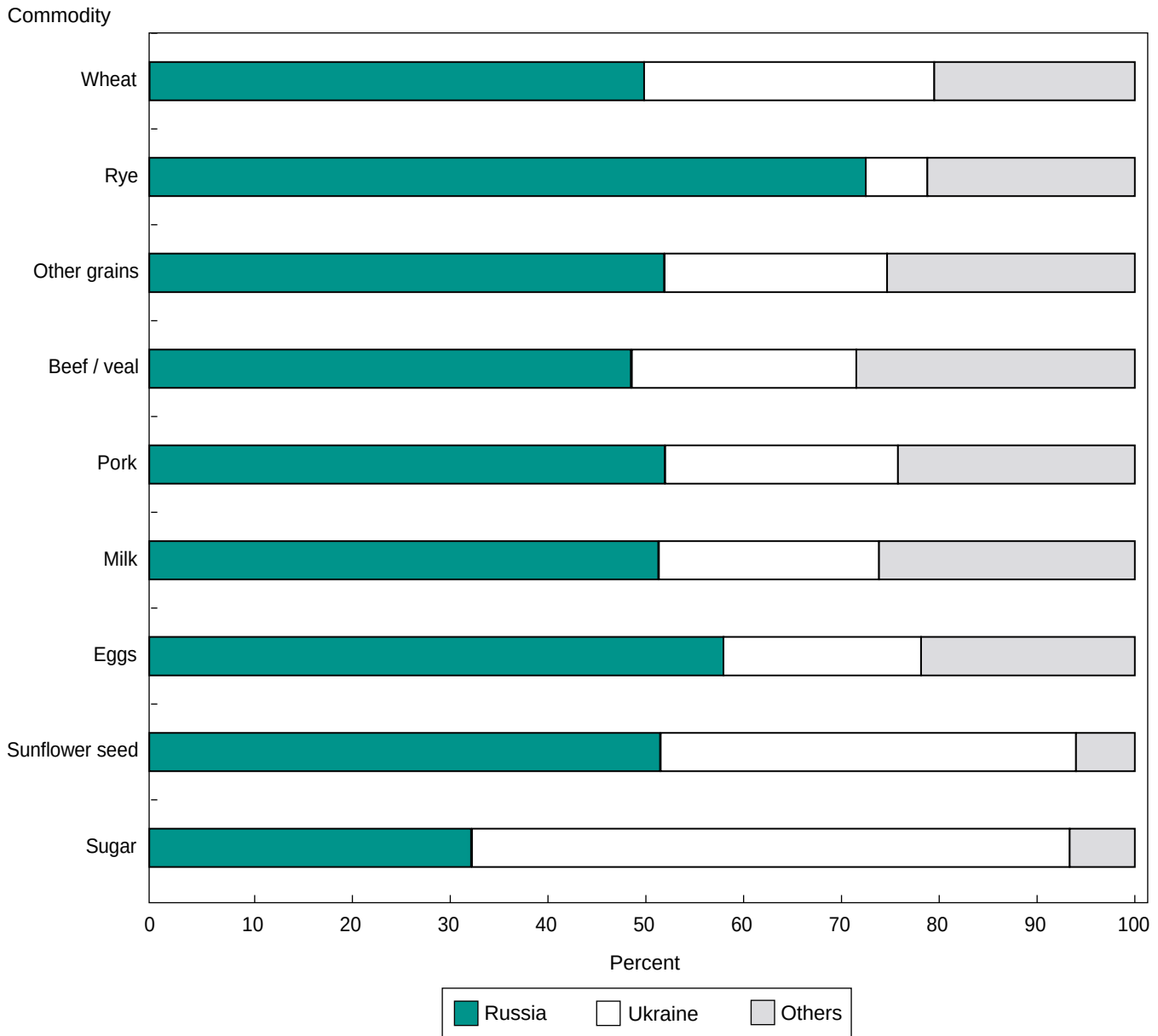
The study focuses mainly on state and collective (“corporate”) farms in the crop sector in Russia and Ukraine and their potential to increase agricultural production in response to the completion of needed reforms. Corporate farms are the dominant type of farm, accounting for approximately 91 percent of arable cropland in Russia. They supply about 90 percent of grain and sugarbeet production and slightly less than half the livestock output. Private subsidiary garden plots, which are attached to corporate farms, account for 5 percent of arable land. These are distinct from private farms, which account for 4 percent of arable land. The private subsidiary plots account for more than 50 percent of gross agricultural output, but produce mostly vegetables and potatoes. Also, livestock production on the subsidiary plots is gradually overtaking that of corporate farms. (See box, “A Discussion of Farm Classifications.”)

Changes in the agricultural sector in the CIS were to be brought about by reforms targeted at the agricultural sector and the overall economic reforms implemented at the beginning of 1992. Agriculture-specific reforms involved primarily the privatization of corporate farms and farmland. Economywide reforms include price and trade reform, and institutional reforms (e.g., privatization, reform of the court system, legislation supporting a market-oriented economy, etc.). Price and trade reforms were widely implemented, but institutional reforms (both agriculture-specific and economywide) were only partially implemented.

¹The CIS is all the countries of the former Soviet Union except for the Baltic countries of Estonia, Latvia, and Lithuania.

²A significant amount of trade from Russia and Ukraine goes to Europe, which borders them to the west. Russia also trades significantly with countries on its long southern border, which extends from the Middle East to Asia. Both Russia and Ukraine are located at latitudes that are similar to Canada. Ukraine’s agricultural sector is noted for the fact that one-third of the world’s rich black soil is located there.

Figure 1

Russia and Ukraine production shares of agricultural commodities in USSR, 1988-1990

Source: USDA, 2002b.

At the beginning of the 1990s, analysts from ERS and elsewhere expected these reforms to have two offsetting effects on agricultural production. First, price and trade liberalization was expected to lead to the removal of price subsidies and should have exposed the agricultural sector to foreign competition. The initial result would be the contraction of agricultural production as prices received by farmers dropped. Offsetting that effect would be an increase in productivity as profit-maximizing farm managers learned to respond to the new, market-oriented price signals. In the long run, agriculture was expected to recover, leading to an increase in exports.

The actual result of reforms on the agricultural sector to date has been a large drop in production as subsidies were eliminated, but no corresponding rise in output or, as shown in this report, productivity. Several indicators of productivity and efficiency have declined since reform began. Productivity decline is evident from a casual glance at partial productivity measures, such as the total value of output per unit of land and labor (table 1).

Table 1—Russian crop output and input use of corporate farms, 1991-98*

Table 2 Russian crop output and input use of corporate farms, 1992-98						
Year	Output <i>Billion 1983 rubles</i>	Inputs				
		Land	Labor	Fertilizer	Fuels	Machinery
		<i>1,000 hectares</i>	<i>1,000 man-days</i>	<i>1,000 metric tons</i>	<i>1,000 metric tons</i>	<i>1,000 horsepower</i>
Aggregate						
1991	70.7	250.8	2,379	60,518	---	---
1993	52.5	233.3	2,401	16,658	34,280	248
1994	44.8	218.8	2,048	8,149	32,827	224
1995	36.8	211.2	1,902	7,154	28,518	205
1996	36.2	224.5	1,744	7,590	25,084	187
1997	38.8	214.9	1,593	8,235	22,704	175
1998	29.6	202.7	1,599	9,335	21,608	163
Annual growth						
rate, 1993-1998 (percent)	-11.4	-2.8	-8.1	-11.6	-9.2	-8.4
-----1,000 1983 rubles-----						
Output per unit of input						
1991	n.a.	281.90	29.72	1.17	---	---
1993	n.a.	224.93	21.86	3.15	1.53	211.99
1994	n.a.	204.66	21.86	5.49	1.36	199.49
1995	n.a.	174.18	19.34	5.14	1.29	179.67
1996	n.a.	161.30	20.76	4.77	1.44	194.04
1997	n.a.	180.42	24.33	4.71	1.71	221.16
1998	n.a.	146.11	18.51	3.17	1.37	181.75

*Data for 1992 are not available.

n.a. = not applicable, --- = not available.

Source: Goskomstat (2001).

A Discussion of Farm Classifications

“Corporate farm” originally referred to the state (“sovkhozi”) and collective (“kolkhozi”) farms from the Soviet era. After privatization efforts in the 1990s, these farms were legally reorganized and turned over in their entirety to the farmers and pensioners. These farms continue to operate largely as they did under the Soviet system. Today, the term “corporate farm” is an all-inclusive phrase describing the various forms of privatization that did not involve breaking parcels of land off from the original farm.

A **“subsidiary plot”** is the name for the small plots of land (on average about 0.4 hectare) owned by the corporate or “mother” farm that workers were allowed to cultivate in their spare time. After privatization, the workers were granted limited ownership of these plots as part of the privatization process.

“Private farms” in Russia and Ukraine are the equivalent to family farms in the United States, where one farmer is the sole owner of land parceled off from the previously state-owned farm.

Since the funding and the political will to return to large-scale subsidization of the agricultural sector are lacking in the CIS countries, it would be difficult to reverse the price and trade liberalization reforms. While it is technically possible to reinstate state control of prices and trade, in a practical sense it is not likely. Consequently, the output fall resulting from

these reforms can be thought of as “irreversible.” However, if agriculture-specific and economywide institutional reforms are completed, then some of the fall in agricultural output can be recovered through gains in productivity. Thus, some of the fall in output can be considered “reversible,” once the requisite reforms are implemented.

To illustrate the impact of hypothetical productivity increases on agricultural trade if reforms were to be completed, some modeling projections are made for wheat and barley for the next decade using data from the USDA Agricultural Baseline Projections to 2011 (USDA, 2002c). The present USDA predictions for the CIS region incorporate optimistic projections of gross domestic product (GDP) growth, but are less optimistic about productivity growth. The hypothetical cases incorporate more optimistic productivity assumptions. The projections show that Russia and Ukraine could become significant grain exporters, putting downward pressure on world grain prices.

The first section of the study describes the agricultural sector in Russia and Ukraine before and after the breakup of the Soviet Union, including details on the “irreversible” changes in output and trade, as well as potentially “reversible” changes. The next section examines various empirical measures of productivity for large-scale, corporate farms. That is followed by an examination of the future of agriculture-specific and economywide institutional reform. Next, the study analyzes potential agricultural output and trade in Russia and Ukraine, which includes a modeling exercise with different productivity scenarios. The final section summarizes the findings of the report.

Photo courtesy Belarus Tractor International.



The Agricultural Sector Before and After the Breakup of the Soviet Union

Pre-Reform Agricultural Policy in Russia

In the late 1960s and early 1970s, the leaders of the Soviet Union noted that consumption of meat and animal proteins of Soviet citizens lagged behind that of Americans and Europeans. Consequently, Soviet leadership placed a high priority on increasing the supply of meat products, a strategy pursued until the dissolution of the Soviet Union in 1992. Planners also sought to maintain stable retail prices, the result being an implicit and gradually increasing real subsidy on retail food prices.

In the drive to increase per capita meat consumption, Soviet livestock herds expanded to such an extent that domestic grain production, itself subsidized and expanded to a significant degree, could not satisfy the increased feed demand. The Soviet Union and Eastern European satellite countries began to import substantial quantities of grains for feed. The USSR's livestock subsidization policy had a significant impact on world grains markets. In 1992, just as the reforms began, net grain imports (imports minus exports) for Russia and Ukraine were 21.7 million mt, about 10 percent of total world imports. U.S. grain exports to Russia and Ukraine in 1992 were 7.2 million mt and accounted

for over 8 percent of total U.S. grain exports (table 2). However, the grain imports of Russia and Ukraine were erratic and sometimes very large, which added significant volatility to world markets. The volatility was due largely to the linkage of grain purchases to revenues earned from oil and gold exports (USDA, 1988).

The livestock expansion policy also led to increasing agricultural subsidies. By 1989, total subsidies in the USSR amounted to 13.5 percent of GDP, of which subsidies to agriculture accounted for 11 percent of GDP (fig. 2). The policy did succeed in raising per capita meat consumption, which in 1990 was equal to or higher than that in the United Kingdom, despite the fact that per capita income in the United Kingdom was over two times that of the USSR (Sedik, 1993).

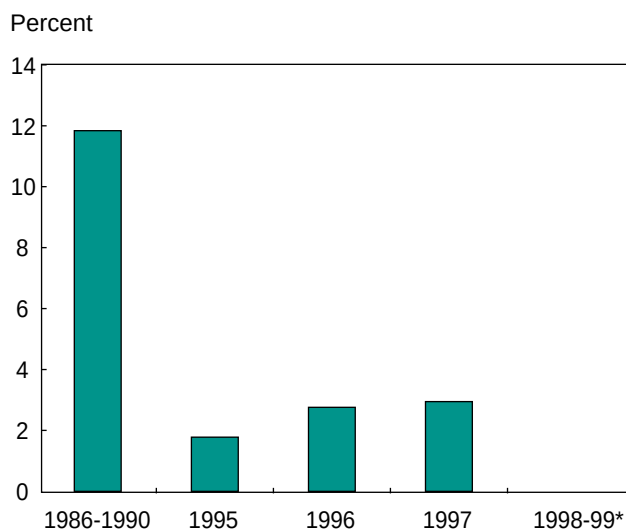
The Consequence of Reform

Following reforms in 1992, the subsidies supporting expanded livestock inventories were removed, affecting both livestock and grain production. Livestock inventories fell dramatically in all countries of the former Soviet Union and Eastern Europe, and so far have recovered only slightly in Poland and Hungary. Between 1992 and 2000, cattle inventories in Russia and Ukraine fell from 78 to 38 million head. Average grain production in Russia and Ukraine declined from 145 million mt in 1988-90 (about 8.7 percent of total world grain production) to 78 million mt in 1998-2000, a 46-percent decline (table 3).³

Another factor behind the production declines was the fall in income that accompanied reforms (fig. 3), which came about because final goods prices rose faster than nominal incomes. The reforms also unleashed a period of hyperinflation that was brought down to single digits annually only in 1996.

These large structural changes had a significant impact on agricultural trade in Russia and Ukraine. The fall in livestock inventories led to a fall in demand for feed grain (fig. 4), resulting in diminished grain imports. In 2000, net grain imports for Russia and Ukraine were less than 1 million mt. Because livestock production had fallen faster than meat consumption (fig. 5), Russia had become a significant meat importer, a development consistent with Russia's relatively high

Figure 2
Agricultural subsidies as a percent of national income, selected years, USSR/Russia



*Agricultural subsidies during 1998-1999 were effectively zero.
Source: OECD, (2001).

³Given the tendency to overreport production during the Soviet era, the actual output drop may have been somewhat lower.

Table 2—Changes in net grain imports in Russia and Ukraine, 1989-2001

Year	Russia and Ukraine total net imports	Total world imports	U.S. net exports to Russia and Ukraine	Total U.S. exports
-----1,000 metric tons-----				
1989	20,200	207,400	0	119,442
1990	17,918	189,600	0	104,252
1991	22,763	206,200	563	98,723
1992	21,813	205,900	7,197	102,641
1993	6,438	188,100	3,335	101,115
1994	221	200,000	548	91,514
1995	3,698	187,100	229	118,884
1996	1,168	194,400	176	106,131
1997	(1,189)	189,900	99	91,120
1998	(3,691)	198,500	1,072	91,762
1999	4,267	217,200	1,471	104,597
2000	645	207,500	45	101,726
2001	(8,305)	207,900	0	98,716

For additional detail, see appendix table 1.

Numbers in parentheses indicate net exports.

Source: USDA (2002a,d).

cost of meat production (Liefert, 1994; 2002). In 2001, the volume of total meat imports into Russia was 2.5 million mt (carcass weight equivalent of beef, pork, and poultry), about 19 percent of world total meat imports. U.S. poultry meat exports to Russia were slightly over 1 million mt in 2001, which accounted

for about 79 percent of Russian total poultry imports and 33 percent of total U.S. poultry exports. The net result of the reforms was a 50-percent decrease in the total value of agricultural imports, a 30-percent decrease in grain production, and a 55-percent decrease in livestock inventories.

Table 3—Changes in agricultural production, Russia and Ukraine, 1987-2001

Year	Total grains	of which:		Beef & veal	Pork	Poultry
		Wheat	Coarse grains			
----- Million metric tons -----						
1987	137.25	56.52	79.92	...	...	...
1988	130.80	61.57	68.38	6.17	4.98	0.70
1989	146.66	71.40	74.52	6.27	5.09	2.56
1990	157.82	79.97	77.20	6.32	5.06	2.51
1991	121.86	60.06	61.24	5.87	4.61	2.41
1992	137.60	65.68	71.37	5.29	3.96	1.93
1993	137.33	65.33	71.51	4.68	3.45	1.64
1994	109.97	45.96	63.63	4.67	3.02	1.33
1995	93.03	46.37	46.31	3.92	2.67	1.09
1996	89.91	48.45	41.16	3.62	2.49	0.92
1997	119.92	62.60	57.06	3.26	2.32	0.82
1998	71.56	41.94	29.29	2.89	2.21	0.85
1999	77.40	44.59	32.39	2.69	2.15	0.84
2000	86.26	44.65	41.19	2.59	2.18	0.85
2001	121.95	68.30	52.00	2.35	1.99	0.91

For additional detail, see appendix table 2.

... = not available.

Source: USDA (2002a).

“Irreversible” Output Decline

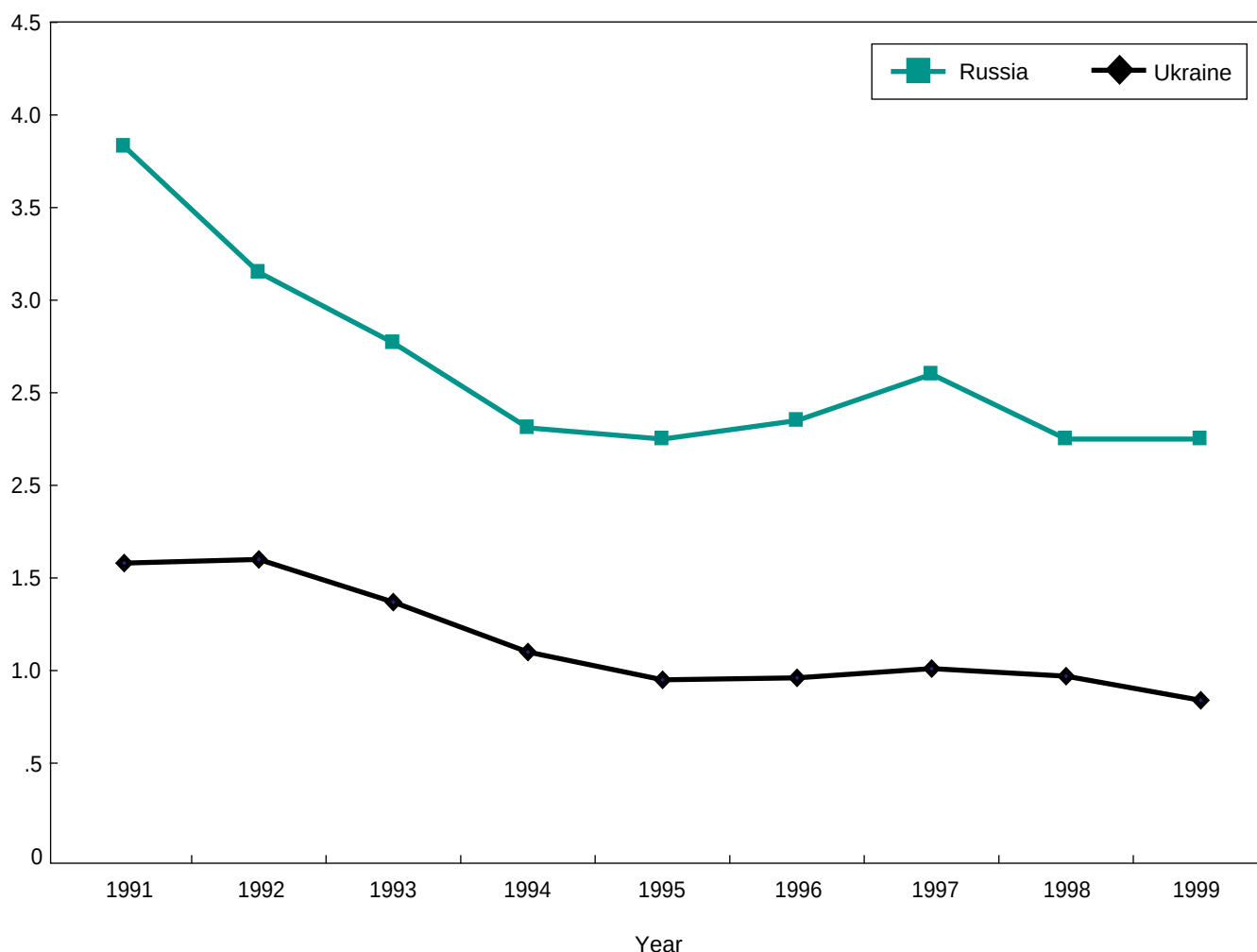
Some of the loss in agricultural output in Russia and Ukraine is a direct result of the implementation of price and trade liberalization and the corresponding reduction in producer and consumer subsidies. As prices began to respond flexibly to market conditions and producers were exposed to foreign competition, input and output prices adjusted to reflect the real costs of production, as well as the true preferences of consumers. Current prices in world markets have exposed the unfavorable cost structure of the agricultural sectors in Russia and Ukraine. Consequently, market liberalization has had a direct negative impact on agricultural production.

ERS has examined the effect of reforms on the livestock sector for all the countries of Eastern Europe and the CIS (USDA, 2002a). Following the 1992 price liberalization in Russia and Ukraine, farmgate prices in those countries rose much more slowly than prices for feed (feed is the main input and cost component in meat production). Demand for meat also fell as output prices rose faster than wages, making meat products less affordable to the general population.

Figure 3

Annual per capita income in Ukraine and Russia, 1991-1999

\$1,000



Source: World Bank, (2001).

The crop sector suffered similar problems. The increase in the crop price was outstripped by rises in the price of fuel, fertilizer, and other agricultural chemicals like pesticides and herbicides. Table 4 shows the large increases in fertilizer and fuel prices as they adjusted to world prices. The effect of the devaluation of the ruble after the 1998 financial crisis can be seen as Russian fertilizer and gasoline prices fell compared with U.S. prices after 1998.

“Reversible” Output Decline

The consensus among observers of Russia and Ukraine in the early 1990s was that agricultural sector reform would lead to less waste and improved productivity. The potential for improvement in agricultural practices is well recognized within Russian policy circles. One

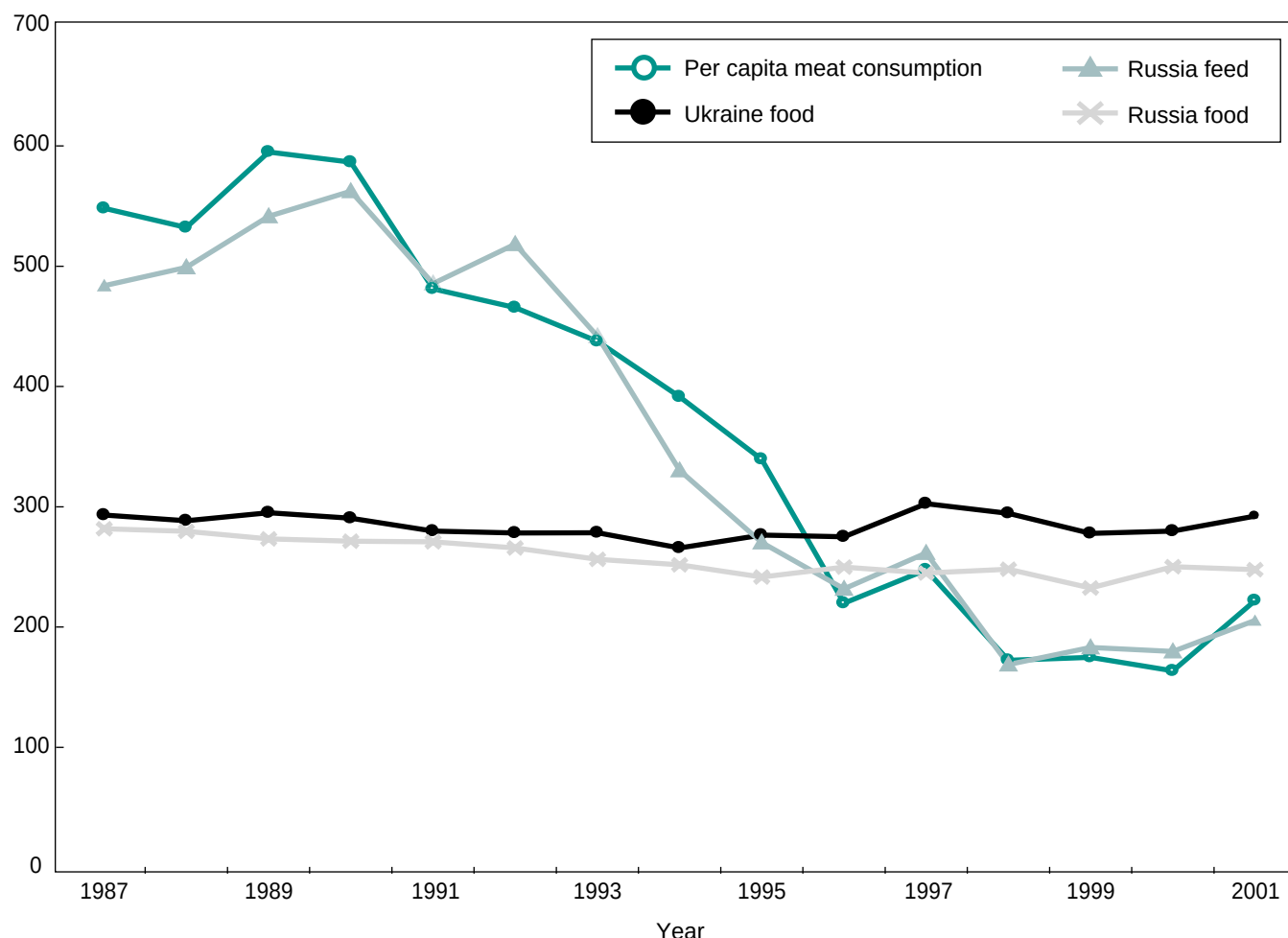
recent study attempting to explain the superior performance of the U.S. agricultural sector (Cherniakov, 1997) concluded that U.S. agriculture used a number of “technical and technological solutions that allowed for increased labor productivity, ... the minimization of losses, and increased quality.”

Because Russian policymakers feel that these productivity increases will come from large-scale, capital-intensive agriculture, they have been reluctant to allow the large corporate farms inherited from the Soviet era to go bankrupt. The view that large-scale agriculture is more efficient in Russia is supported by findings of Russian analysts. The Cherniakov study noted that the most financially successful farms (and those least likely to go bankrupt) are the large-scale commercial farms that are capital-intensive and highly specialized.

Figure 4

Grain food and feed use, Russia and Ukraine, 1987-2001

Kilograms per capita



Source: USDA, (2002b).

Table 4—Russian prices for fertilizer and gasoline realign with world prices, 1992-99

Year	Ammonium nitrate		Gasoline	
	Russia	United States	Russia	United States
	----- \$/kg -----		----- \$/gal. -----	
1992	0.005	0.178	0.13	1.13
1993	0.015	0.186	0.32	1.11
1994	0.037	0.196	0.47	1.11
1995	0.089	0.223	0.99	1.11
1996	0.150	0.233	1.15	1.23
1997	0.149	0.227	1.16	1.23
1998	0.091	0.193	0.71	1.06
1999	0.041	0.181	0.58	1.17

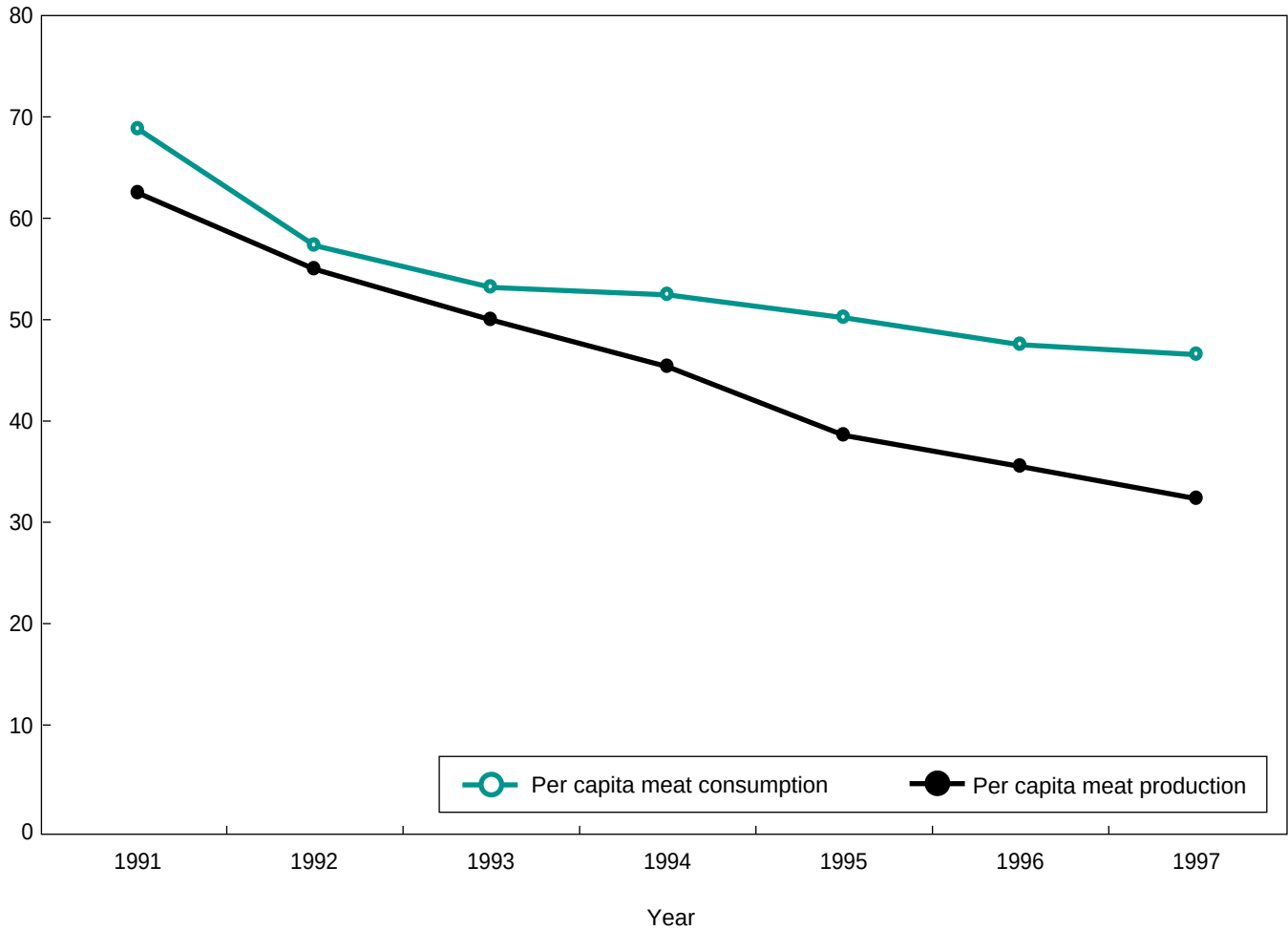
Source: Goskomstat, (2001); U.S. Department of Agriculture, (2001); U.S. Department of Energy (2002).

A different study of Russian farms by Uzun (2001) reported a similar finding for the 300 most successful agricultural enterprises from 1997 to 1999. The study found that the 300 most successful agricultural enterprises were, on average, 1,000 hectares larger than the average agricultural enterprise in Russia. These 300 farms used 2 percent of total area sown but earned 16 percent of total revenue from agricultural production.

Figure 5

Russian per capita meat consumption and production, 1991-97

Kilograms per capita



Source: USDA, (2002b).

However, corporate farms in Russia and Ukraine have performed poorly since reforms began in 1992. ERS has completed a number of analyses of Russian and Ukrainian corporate farms, all of which paint a consistent picture of deteriorating economic performance

during the 1990s. These studies use data from a number of publications from Goskomstat that surveyed 10 percent of Russia's corporate farms from 1991 to 1998.

Empirical Measures of Corporate Farm Productivity

Multifactor Productivity

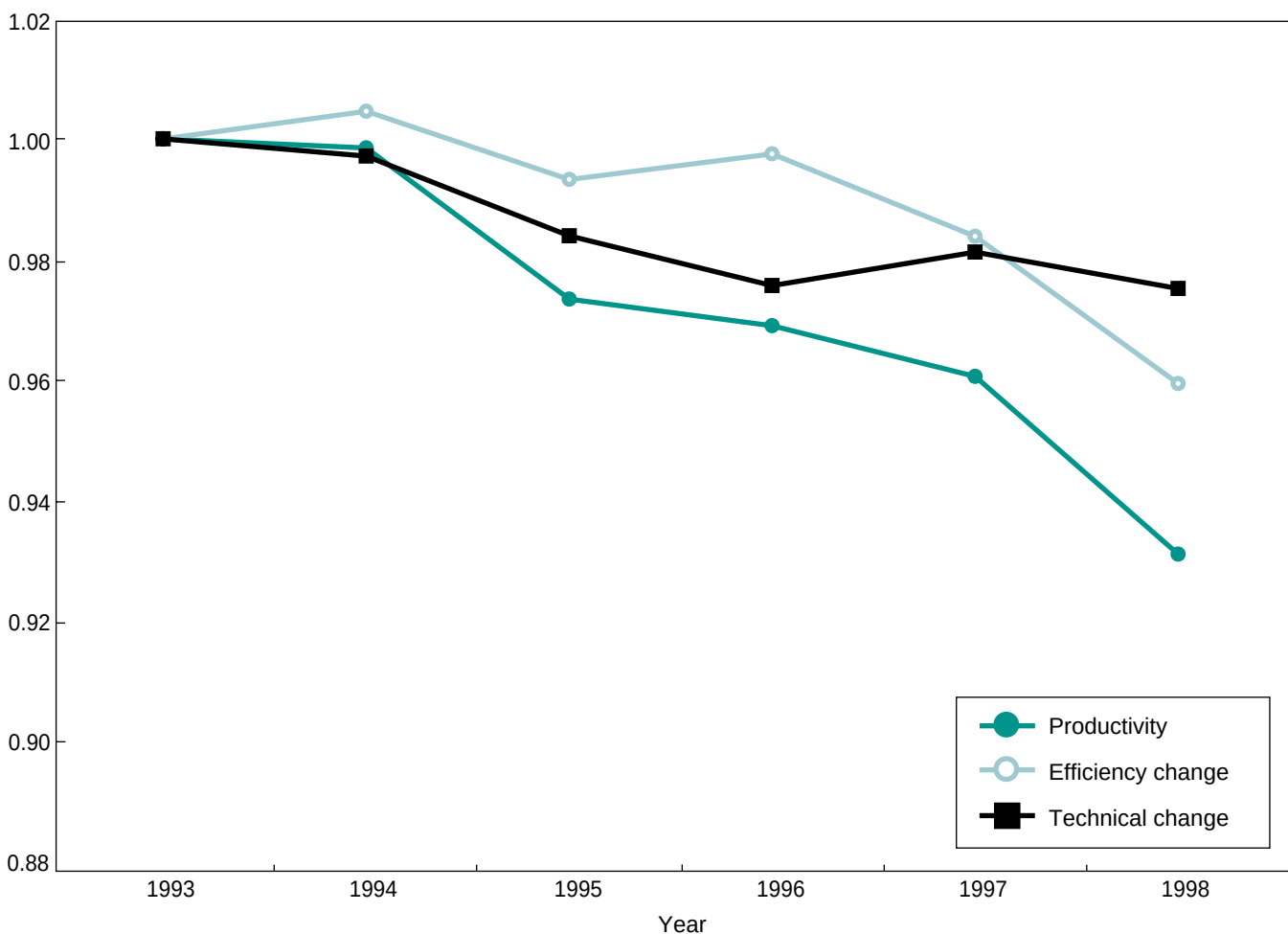
Some of the evidence of poor corporate farm performance is revealed by the multifactor productivity (MFP) measure achieved by corporate farms in Russia from 1993 to 1998 (Trueblood and Osborne, 2002) (fig. 6). MFP measures the growth in total output relative to the growth of total input use, in which the inputs are aggregated with appropriate weights. The results of the analysis show that MFP declined by 1.7 percent per year from 1993 to 1998. Changes in the ratio of input use to output can be attributed to two sources: 1) changes in the relative performance of

farms compared with the best domestic practice (i.e., improvements in efficiency); and 2) changes in the best domestic practice (shifts in the production frontier). The production frontier contracted by 0.6 percent per year, while the decline in efficiency caused an average decline of 1.1 percent.

Earlier studies of the USSR found that agricultural productivity before 1992 was stagnant at best (Trueblood, 1996; Arnade, 1997). One study found that MFP declined by 1.69 percent a year from 1960 to 1980 (Wong, 1986). More recently, Voigt and Uvarovsky (2001) found a similar result for the overall productivity of the crop and livestock sector combined. Apart from including the livestock sector, their study differs from Trueblood and Osborne (2002) in that they exclude fuel and land from the measured produc-

Figure 6
Russia's crop multifactor productivity, 1993-98*

1993 = 1



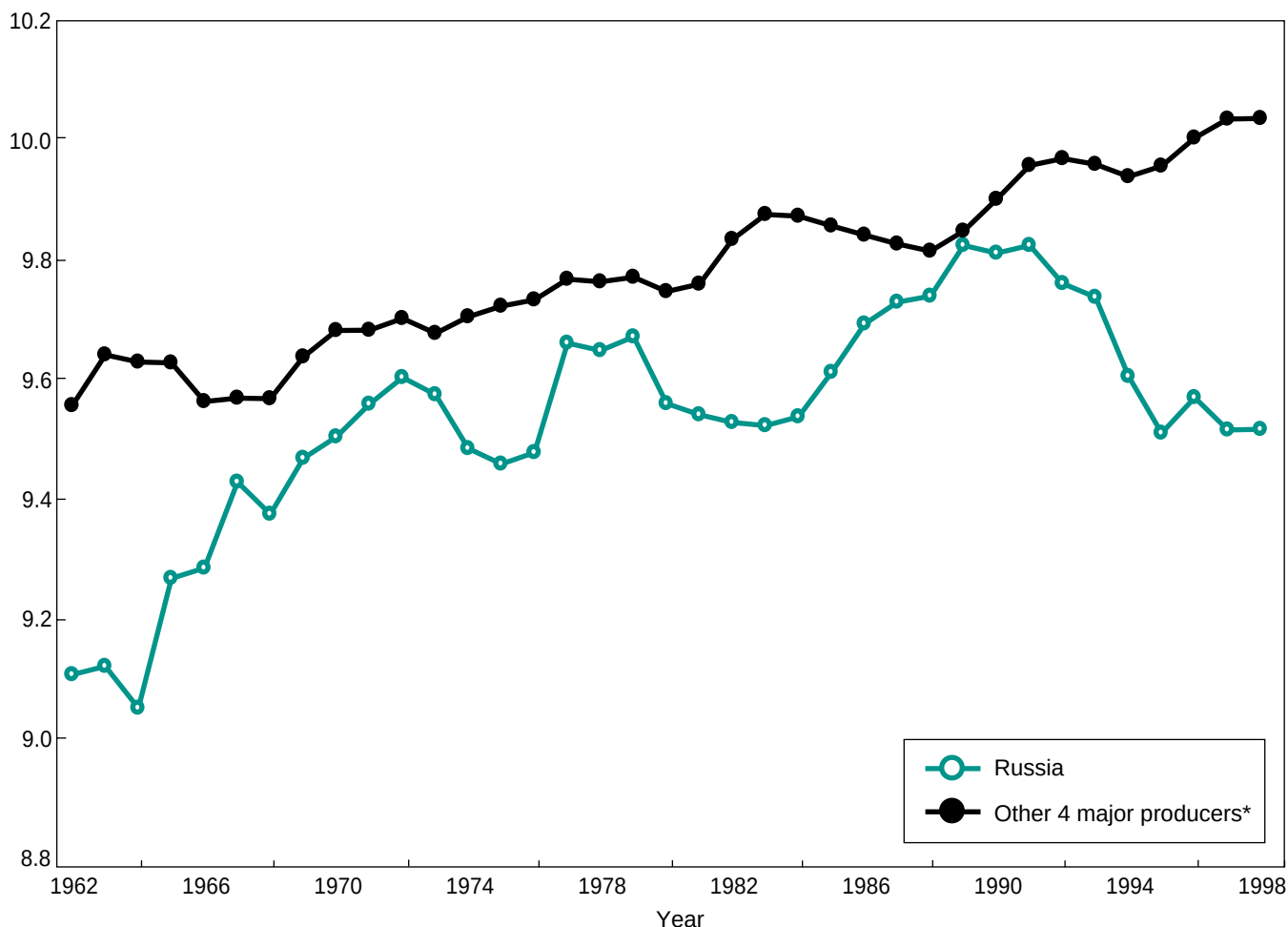
*Productivity changes can be attributed to changes in the best domestic practice (technical change), and departure from the best domestic practice (efficiency change).

Source: Trueblood and Osborne (2002).

Figure 7

Comparison of Russian yield trends with other major wheat producers with similar endowments

Kilograms per hectare (logarithm)



*The other four main producers are Canada, United States, Argentina, and Australia.

Source: Trueblood and Arnade (2001).

tion function, and they find that technical efficiency rose from 1993 to 1998. However, a recent paper by Lerman et al. (2001) suggests that agricultural productivity growth in Russia was positive between 1992 and 1997 (7-percent cumulative growth). The seemingly contradictory conclusions reached by Lerman et al. result partly from the use of data from 1992. From 1992 to 1993, the use of fertilizer and other chemicals dropped drastically (table 1), resulting in a one-time increase in productivity. The ERS analyses span the period from 1993 to 1998, so this one-time productivity increase is not measured.⁴ Except for the one-time

jump in productivity in 1992, it seems that the decline in productivity that started under Soviet rule continued throughout the 1990s.

Yields

The fall in overall productivity is reflected also in the fall in yields (Trueblood and Arnade, 2001). Until 1992, yields in the Soviet Union were approaching those in the West, but since the 1992 reforms, the gap between yields in the West and the CIS has fallen back to the levels of the 1960s. This finding holds for six of the most important crops in Russia (wheat, corn, rye, sugarbeets, sunflowers, and potatoes). Figure 7 illustrates this phenomenon for wheat.

⁴The Lerman et al. study also used a different methodology, included all former Soviet republics in the analysis, and measured productivity for the entire agricultural sector (including livestock).

Much of the drop in yields resulted from the deterioration in terms of trade following the price liberalization of 1992. Following the removal of subsidies on fertilizers and grain (table 4), farmers drastically reduced the amount of fertilizers applied to crops, as shown in table 1. While the resulting decline in yields could be considered part of the “irreversible” output decline described earlier, the decline in fertilizer use may have had an effect on MFP as well. Fields that have not been treated with fertilizer for many years generally lose some fertility, resulting in lower yields.

Technical Efficiency

Evidence of deteriorating corporate farm performance was also found in declining technical efficiency from 1993 to 1996 (Sotnikov, 1998; Sedik et al., 1999). This indicator, which can be considered a component of overall productivity growth described earlier, measures the extent to which a farm’s output would increase if it were to adopt the best domestic practice. The studies used input and output data from corporate farms in different regions of Russia to compute numerical “technical efficiency” scores showing how each region performed compared with the best domestic practice. This method offered the advantage of simultaneously measuring and explaining the changes in technical efficiency.

Sedik et al. identified several factors that explained the declining technical efficiency scores, but two of the more important factors were:

- **The soft budget constraint.** One compelling theoretical explanation for the weak incentive to improve performance is the “soft budget constraint” phenomenon (that is, routine loan forgiveness). The technical efficiency scores provide evidence that incentives to improve performance are weak because initial conditions are a good predictor of technical efficiency scores. Firms that enjoy a soft budget constraint are usually strategically important and can convince the government to subsidize them to prevent bankruptcy. Knowing that bankruptcy is not a real threat, farms have no incentive to operate efficiently. In Russia, very few farms were forced into bankruptcy during the first 6 years of reform, although some liquidated themselves voluntarily.⁵

⁵In the last 2 years, outside creditors have started to bankrupt chronically insolvent farms, but the number of bankruptcies remains small.

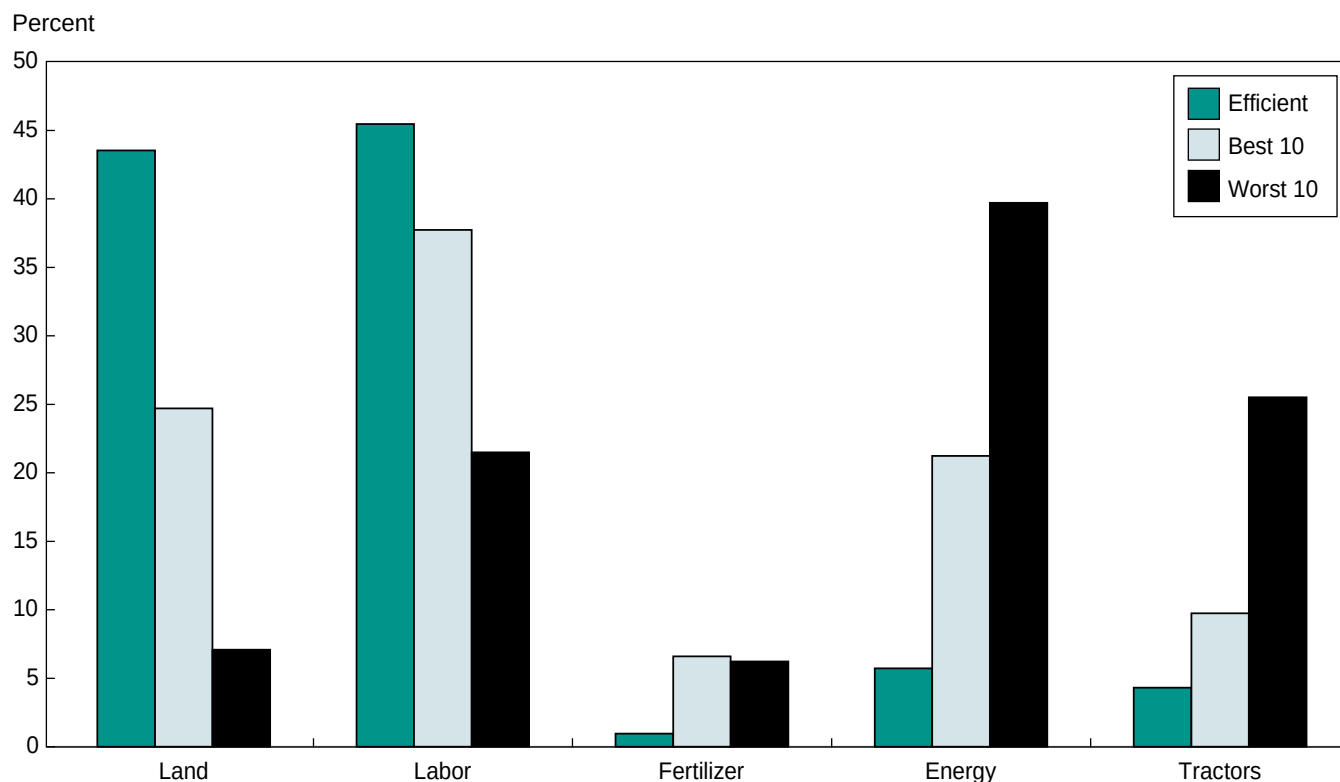
The theory of the soft budget constraint also predicts that farms can only be kept out of bankruptcy with subsidies, so that the poorly performing farms will have a high percentage of revenue from subsidies. This was borne out by the technical efficiency scores. The combination of subsidies to keep insolvent farms afloat and the lack of bankruptcy procedures were particularly characteristic of the operation of firms in the planned economy. The measured inefficiency, then, may show that the economic environment corporate farms face has not changed much since the Soviet period.⁶ Agriculture-specific reform (particularly privatization) was supposed to make farms’ budget constraints “harder,” but the technical efficiency scores suggest that the reforms implemented so far have been insufficient.

- **The degree of regional crop specialization.** The more specialized agricultural production was in a given region, the more efficient it was. Some regions with high-quality land have tried to encourage diversification of crop production in the name of self-sufficiency. Many regions pursued this policy after neighboring regions restricted trade outflows. However, by diversifying agricultural production, regions are necessarily producing less of what they produce best. The cost of the self-sufficiency policy is lower technical efficiency. Since these trade restrictions are largely the result of policy instituted by regional officials, they can only be removed by enforcing the Federal Government’s jurisdiction over internal trade flows more firmly.

Ukraine’s agricultural enterprises also displayed declining technical efficiency scores from 1993 to 1996. However, unlike Russia, technical efficiency scores have recovered slightly in Ukraine since 1996 (Murova, 2000). This same study also compared technical efficiency in Russia and Ukraine and found that Ukraine’s average technical efficiency scores were higher than Russia’s, even after adjusting for land quality. The variation in efficiency scores between regions in Ukraine was smaller than in Russia, in part due to Ukraine’s smaller geographic area and homogeneous weather patterns and land endowments.

⁶Farms also face incentives to overstate their losses in order to avoid paying profit taxes. Some measured drop in productivity may be a result of underestimates of revenue earned from output or the exaggeration of expenditures on inputs.

Figure 8

Optimum cost shares, and shares of most, least efficient farms

Source: Osborne and Trueblood (2002).

Allocative Efficiency

Evidence of declining corporate farm performance in the 1990s can also be found in declining allocative efficiency scores, which measure the loss (in rubles) resulting from the use of a mix of inputs other than the cost-minimizing one (Osborne and Trueblood, 2002). This study measured the allocative efficiency of Russian corporate farms from 1993 to 1998 and tried to identify nonmarket incentives that are encouraging farmers to use an inefficient mix of inputs.

The results of the allocative efficiency study show that, given current input prices, corporate farms use too much machinery, fuel, and fertilizer relative to labor and land (fig. 8). Since the technical efficiency study showed that all input use could be reduced, the allocative efficiency results suggest that greater cost savings could be achieved by reducing the use of machinery, fuel, and fertilizer relative to that of labor and land. Table 1 shows that the use of machinery, fuel, and fertilizer has already fallen relatively more than land and labor since reforms began, so the analysis indicates that these trends must continue for corporate farms to

continue to lower their costs (fig. 9). Before reforms began, the Soviets encouraged machinery-intensive farming practices, and Russian and Ukrainian agriculture have inherited the technology of the Soviet era. The present environment suggests that technology would be more efficient if it were more labor-intensive, given that rural labor is presently inexpensive.

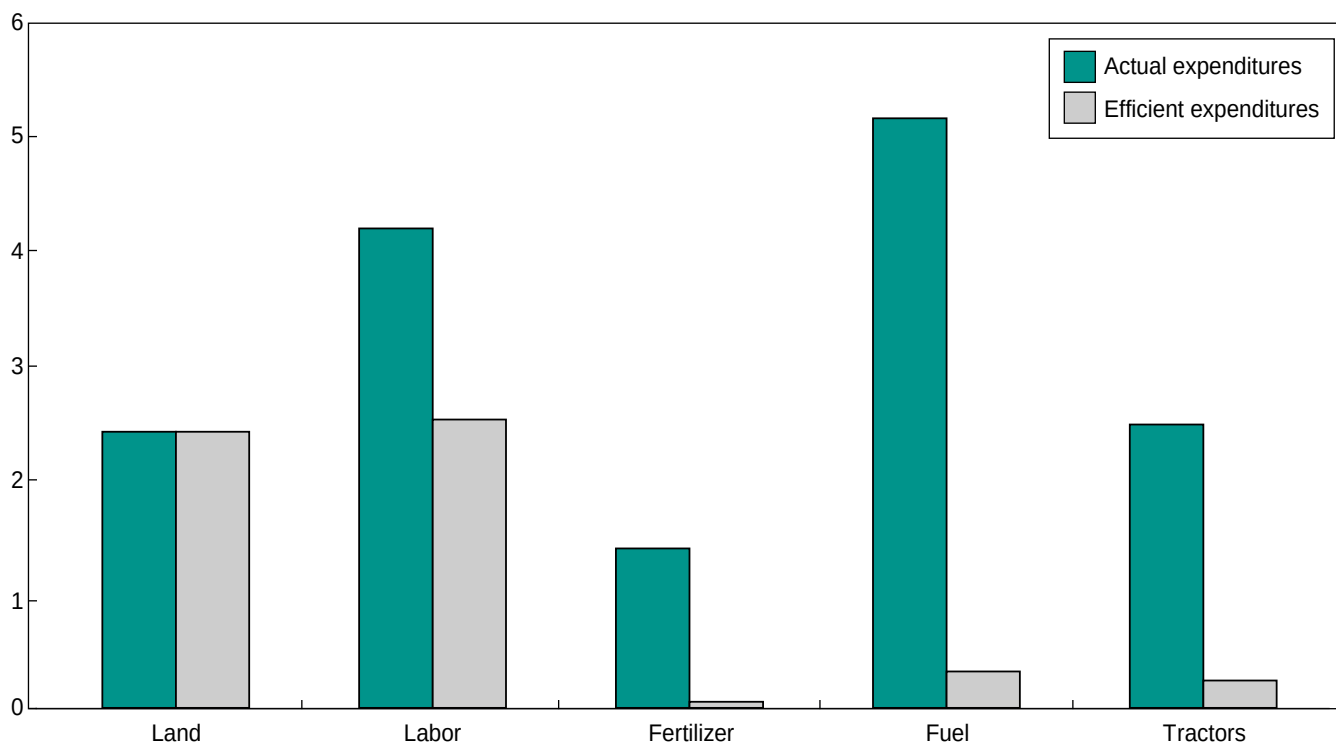
If the agricultural credit markets in Russia and Ukraine were well developed, farms could invest in more labor-intensive machinery. For example, large combines that operate most efficiently in combination with other heavy machinery could be replaced by smaller machines, where manual labor performs more of the work. In general, the equipment inherited from the Soviet era needs to be replaced, and small tractors and small-scale machinery may be the appropriate replacement technology. Unfortunately, agricultural credit markets are not well developed, a topic discussed in more detail below.

The apparent overuse of fuel and fertilizer may also be due to the diversion of inputs from corporate to subsidiary plots. Private or “subsidiary” plot farming in

Figure 9

Average actual and efficient expenditures per farm

Million 1996 rubles



Source: Osborne and Trueblood (2002).

Russia, although using less than 10 percent of the available arable land, accounts for more than 50 percent of the value of total crop production.⁷

However, the relative success of subsidiary plot farming compared with corporate farms may not be due to more efficient agricultural production. At least part of the success of subsidiary plots arises from the workers' access to inputs appropriated clandestinely from the mother farms. Subsidiary plots are not equivalent to privately owned farms, but instead are a relic of the Soviet era. In the planned economy, workers at the corporate farms were allowed to work small plots⁸ in their spare time. These plots were ostensibly the property of the corporate "mother" farm. Pilferage of

inputs for use on subsidiary plots was common practice in the Soviet era. The analysis suggests that this practice has continued into the present.

Eliminating the redirection of resources from corporate farms to subsidiary plots—an incentive to do so could be provided by the credible threat of bankruptcy for insolvent farms—might improve the corporate farms' performance relative to the subsidiary plots.

Output Targeting

Anecdotal evidence suggests that a further source of poor corporate farm performance is that incentives for farm managers may not have changed since the era of the planned economy. Rather than responding to input and output prices to maximize profits, managers may be responding to pressure from local authorities to maximize the crop output and livestock inventories (as was the practice under the Soviet regime). However, economic research on crop production early in the reform period found that the loss of profitability due to output targeting is fairly small when considering crop

⁷The composition of subsidiary plot farming is generally different from that of corporate farms. Corporate farms produce mostly grains, oilseeds, and sugarbeets, while subsidiary farms grow vegetables, potatoes, and livestock.

⁸The average subsidiary plot is about 0.4 hectare. The average size of a truly private farm in Russia is about 50-60 hectares.

output in general (Arnade and Gopinath, 2000).⁹ For wheat and sugarbeets, where corporate farms respectively account for 92 and 94 percent of crop production, output targeting lowered profits by only 5 percent. The impact of output targeting is greater for other

specific crops. For potatoes and vegetables, profitability would have been 44 and 33 percent higher, respectively, if outputs had not been targeted. However, corporate farms do not normally produce potatoes and vegetables—barely 1 percent of the potato and vegetable harvest comes from corporate farms. Therefore, while there is some evidence of residual Soviet-style output targeting in the new market economy, its effect on agricultural production is relatively slight.

⁹Arnade and Gopinath studied the profitability of agriculture in Russia in 1994 and 1995.

How Important Is a Mortgage Market?

This study makes frequent references to mortgage markets as one of the more important reforms Russia and Ukraine can implement to improve productivity in agriculture. Since using land for collateral is politically unpopular, it is worth taking a closer look at mortgage markets and their role in improving agricultural productivity.

Mortgages influence agricultural productivity in two ways. One is to penalize mortgagees for failure. The fact that a mortgagee will lose the collateralized property if the loan goes into default encourages the mortgagee to make an effort to pay off the loan. The other purpose is to provide investors with a minimum payoff when they engage in a risky loan.

The Russian government may choose a policy strategy that provides similar incentives. For example, the government can force nonperforming farms into bankruptcy in order to penalize farmers for failing to repay loans. The government can also guarantee loans made to the agricultural sector in order to guarantee investors a minimum payoff.

However, the Russian government continues to resist forcing farms into bankruptcy. It is exceedingly difficult, politically, to justify the loss of rural jobs that will result from bankrupting an agricultural enterprise. The increase in rural jobs and incomes that would result from increased productivity and efficiency of corporate farms will take some time to manifest, at which point local politicians may find themselves already voted out of office. The policy of providing soft credit to agriculture is equivalent to a loan guarantee: because the loans are either rolled over or forgiven, the government is in effect guaranteeing the returns on these loans. But this strategy has proven extremely expensive, as the majority of farms in all but the last year of the last decade have not repaid their soft credit loans. By 2000, the Russian government had abandoned the soft credit strategy in favor of subsidizing interest rates for loans.

Liberalizing land and mortgage markets will provide better incentives to use land efficiently than the current policy, which would then lead to an increase in agricultural productivity.



Photo from ERS photo files.

Summary

There are many factors that hinder efficiency improvements in Russian agriculture. However, based upon the empirical evidence in recent studies, four of the most important problems may be summarized as follows:

1. The soft-budget constraint phenomenon discussed in the technical efficiency study;
2. The diversion of inputs (machinery, fuel, fertilizer, etc.) from corporate farms to subsidiary plots, as revealed by the allocative efficiency study;
3. The obsolescence of machinery-intensive technology inherited from the USSR, another conclusion of the allocative efficiency study; and
4. The lack of crop specialization due to self-sufficiency policies, pointed out in the technical efficiency study.

The first two problems can be solved by refusing to roll over unpaid loans to farms, which will force insolvent corporate farms to go bankrupt (see box, “How Important Is a Mortgage Market?”). The threat of bankruptcy will provide an incentive to operate the farms more efficiently and prevent the diversion of inputs to subsidiary plots. The third problem must be addressed by improving the performance of credit markets in Russia, which would help replace the machinery-intensive technology inherited from the Soviet Union with more labor-intensive machinery. The last problem must be addressed in the policy arena. Although the issue of output targeting has also been raised as a potential obstacle to improving efficiency, ERS research has found little evidence to support that premise.

The Future of Agriculture-Specific and Economywide Institutional Reform

The poor performance of agricultural enterprises in Russia and Ukraine is partly due to the failure of reforms to provide adequate incentives. Farms generally face two kinds of incentives in a market economy. One incentive is a penalty for failure – farms that do not perform well financially will eventually go bankrupt. The other incentive is a reward for success – owners of farms that perform well will earn profits, and perhaps be able to expand their operations. Economic reforms should provide such incentives to Russian farmers to encourage the flow of resources – land, labor, and capital – from unprofitable to profitable farms.¹⁰

Investment is also critical to the revitalization of Russian and Ukrainian agriculture. The stock of agricultural machinery is severely depreciated, and what remains from the Soviet era is too capital-intensive (as suggested by the allocative efficiency results). Without new investment, the percentage of Russia's already well-aged tractor fleet that is completely depreciated will grow. In 1999, the Russian Ministry of Agriculture reported that 25 percent of the total tractor fleet and 30 percent of the grain combine fleet was nonoperational (Ministry of Agriculture, 2002).

Such investment and the necessary flow of resources from unprofitable to profitable farms will not occur without some important economic reforms. Necessary reforms can be divided into two general categories: agriculture-specific and economywide institutional reform. Agriculture-specific reforms include bankrupting insolvent Russian and Ukrainian farms and liberalizing land transactions. Economywide reform would involve the creation of a system of commercial law that protects property rights and an increase in the stability of legislation in general.

¹⁰CEFIR, the Center for Economic and Financial Analysis based in Moscow, points out the importance of resource market mobility in a paper describing the benefits of joining the World Trade Organization (CEFIR, 2001).

Agriculture-Specific Reforms

Bankruptcy procedures for insolvent farms. At the farm level, clear bankruptcy procedures that allow profitable farms to take over unprofitable ones should encourage farmers to use their inputs more productively and adopt technology that is more appropriate to the relative prices of machinery and labor. Very few farms have gone bankrupt since reforms began. In 1998, the year of Russia's financial crisis, 88 percent of all corporate farms were unprofitable (Goskomstat, 2001). In 1999, when the devalued ruble made agricultural production more competitive, 54 percent were still unprofitable.¹¹ The lack of bankruptcies, combined with the overall unprofitability of the agricultural sector, indicates that a large amount of land, labor, and other resources is tied up in inefficient farms. Farms could become more cost-efficient if they were to adopt more labor-intensive techniques in general, and switch from crops requiring machinery-intensive technology to more labor-intensive ones (for example, from wheat and sugarbeet production to fruit and vegetable production).

Mortgage markets and the ability to use land as collateral. Mortgage markets can do much to facilitate the redistribution of land to low-cost producers. The most cost-efficient farmers earn the highest profits and are therefore willing to bid the most for agricultural land. However, the lack of a mortgage market limits the supply of available land at any given time and, in general, limits the ability of low-cost producers to make attractive bids to purchase land.

Western policy advisors have pushed for land reform consistently throughout the reform period, and Russian policymakers have just as consistently resisted it. The opposition originates, as can be expected, from members of the Communist Party, who argue that “the introduction of free buying and selling of land will destroy our village, turn villagers and all working people into laborers without rights, and tear Russia's state sovereignty and territorial integrity out by the roots.” (Comments on the proposed land bill by Communist Party leader Gennady Zyuganov and Agrarian faction leader Nikolai Kharitonov, Interfax, June 2001)

¹¹As mentioned earlier, farms may be deliberately exaggerating their losses in order to avoid paying back loans, although the number of loss-making farms is probably accurate. The threat of bankruptcy would counterbalance the incentive to exaggerate losses.

The Effect of Land Reform on the Russian Agricultural Credit Market

Below we present some estimates of the impact of land reform on agricultural credit markets in Russia. Some analysts claim that the current price of land in Russia is so low that using land for collateral will not provide enough credit to the average farm to purchase even one tractor. However, current land prices reflect the inability to use land for collateral. If land reforms were implemented, the price of land would rise.

This is an interesting empirical question: if land could be used for collateral, how much credit could the average farm in Russia raise? Under the assumption that a bank will not lend a farmer more than the purchase price of land, the amount of credit each farm can raise will be roughly equal to the value of its land. Thus, an estimate of the land's value should provide an approximate idea of how much credit could be raised by mortgaging land.

The lack of land markets makes it difficult to measure land prices in Russia and Ukraine. However, the allocative efficiency study estimated shadow prices of land of corporate farms in various regions of Russia (shown below). The shadow price of land is the price implied by the farmer's choice of how much land to sow, given the expected output price and the prices of other inputs. These yearly rental values can be used to estimate the purchase price of the land.

Annual shadow land prices, adjusted for land quality, by district

	1995	1996	1997	1998
	<i>Dollars per hectare</i>			
Russia	12.3	12.6	12.5	7.9
Northern District	19.0	19.0	16.9	11.4
Northwest District	24.1	21.7	23.0	15.4
Central District	19.7	19.0	17.8	11.9
Volga-Vyatka District	9.5	10.0	10.0	6.4
Central Black Earth District	15.8	14.8	14.4	9.6
Povolzhsky District	14.0	13.7	14.2	8.4
North Caucasus District	17.4	19.9	20.1	12.7
Urals District	9.1	10.1	9.9	6.0
Western-Siberian District	10.0	11.2	11.2	7.1
Eastern-Siberian District	8.7	7.5	7.0	4.5
Far East District	30.1	21.2	22.5	12.5

In both Russia and Ukraine, land sales are virtually nonexistent, and land transactions presently are carried out through leasing arrangements. While leasing allows a rental market to exist, leased land cannot be used as collateral. Many Russian policymakers believe that land prices, as reflected in current prices for leased land, are so low that the benefit from allowing land to be used for collateral would be negligible. ERS research suggests that this is not the case (see box, "The Effect of Land Reform on the Russian Agricultural Credit Market").

Currently, several oblasts (the Russian equivalent of States or provinces) are experimenting with land markets, permitting the purchase and sale of land. At present, the use of agricultural land for collateral is

expressly forbidden in Russia, although a new land code liberalizing agricultural land markets and allowing for the use of land as collateral was passed by the legislature in 2002.¹² The current version of the agricultural land reform bill will choose a set of rules to follow when liberalizing land markets, but allow the oblasts to decide whether and when to start the liberalization procedure. This approach would legitimize the agricultural land reforms that are already underway in some parts of Russia, while allowing less progressive regions to outlaw land sales altogether if they wish. In Ukraine, a land reform bill was passed in 2001, but

¹²In 2001, the legislature passed a law allowing the sale of land in urban markets.

The above prices reflect both the quality of land and the relative scarcity of land compared with labor. For example, the Central Black Earth District has some of the best land in Russia, but prices are not high because arable land is abundant. In the Far East District arable land is scarce, so land prices are high.

The purchase price of land can be approximately calculated as the rental price divided by the real interest rate. This approximation arises because the present discounted value (PDV) of an asset expected to generate income forever is equal to the yearly cash income of the asset, discounted by the interest the income could have earned if invested in a riskless asset. That is, if the yearly cash income is CI , and the interest rate is r , then

$$PDV \cong CI + CI \cdot (1-r) + CI \cdot (1-r)^2 + CI \cdot (1-r)^3 + \dots = \frac{CI}{r}$$

It is reasonable to use 5 percent as an "optimistic" interest rate (5 percent is approximately the inflation-adjusted rate of return of the U.S. treasury bill) and 30 percent as a "pessimistic" rate (the real rate of return of Russian domestically issued debt in the months prior to the domestic default in August 1998). Using these two interest rates, we can estimate "optimistic" and "pessimistic" land values that would prevail once land prices rise to the ERS estimates of their current contribution to production.

Given the value of land in 1997 (when the harvest was about as great as in 2001), how many hectares of land must be mortgaged to purchase one \$5,000 Byelorussian tractor? This is a useful benchmark to use, since if not even one tractor can be purchased, then liberalizing the land market will have no impact. Under the pessimistic scenario, about 120 hectares would have to be mortgaged to purchase one tractor. Under the optimistic scenario, about 40 hectares would have to be mortgaged. Even the relatively few private farms, whose average size is about 40 hectares, could afford to purchase a tractor by mortgaging their land.

land transactions will not be allowed until 2005. Furthermore, the transactions that will be allowed must be less than 100 hectares. Unrestricted land transactions will be allowed only in 2010.

Economywide Reforms

Legislative environment. The legislative environment and the system of commercial law must be geared toward allowing farmers to profit from long-term investments. Even with functioning markets, investment will not occur if profits are appropriated by taxes, criminal elements, or rent-seeking government officials (Safavian et al., 2001). When farmers are not certain that they will benefit personally if their farm shows a profit in the future, they tend to extract profits

from existing assets today at the expense of future income. Macroeconomic risk can also make farmers short-sighted, as can the general uncertainty caused by the constantly changing tax and licensing legislation. Also, legislation from different branches of the government is often contradictory.

Farmers' short-sighted behavior results in the failure to care for or invest in physical assets like machinery and land. Many Ukrainian farmers, for example, do not bother to rotate their sunflower crops, necessary to avoid future insect infestations, since there is no guarantee that future profits will accrue to them. A key outcome of successful commercial law reform would be to improve the incentive to take better care of durable assets, which in turn will tend to reduce waste and

The Importance of a Stable and Predictable Legal System to Economic Growth

The legal system can provide third-party enforcement of contracts. Without third-party contract enforcement, transactions are generally restricted to a closed group of acquaintances, with whom repeated future transactions are expected to occur. In such a case, even without a developed court system, the threat of losing future business is enough to ensure a contract will be carried out. Non-acquaintances have no such threat, and appealing to the court system can be a long and costly process, in any country.

However, over the course of the years, the court systems in the West have decided cases consistently enough that the court's decisions can be forecast before a dispute comes before it. This is the main advantage of a legal system that makes decisions consistently - because the court's decision can be predicted beforehand, the dispute can be resolved without officially addressing the court, saving both time and expense.

In Russia, the legislative environment is too unstable to allow the outcome of a court case to be predicted before it actually goes before the court. Consequently, Russians often conduct business only with close acquaintances whom they trust. If the legislative environment in Russia stabilizes, Russians may be able to do more business outside their immediate circle of acquaintances.

encourage investment (see box, “The Importance of a Stable and Predictable Legal System to Economic Growth”).

The credit market. Also problematic for agricultural investment is the poor performance of the credit market in general, and the credit market in the agricultural sector in particular. There are a number of reasons unrelated to agriculture for this poor performance. The unstable macroeconomic environment tends to drive away risk-averse investors, lowering the overall liquid-

ity in the banking system. Furthermore, prior to the 1998 financial crisis, the Russian government was paying an average return of 30 percent on its debt after inflation. In order to compete with government debt, investment projects had to compete with the return on government debt. After the crisis, the interest rate on government debt fell significantly, so the problem has become less severe.

Labor market reforms. Many Russian and Ukrainian farms tend to maximize employment rather than profit, a factor that restricts labor movement from one farm to another, or away from farming entirely. Farm managers tend to hire more than the optimal number of laborers in response to pressures from local governments, who use their access to government reserves (fuel, seed stocks, fertilizers, etc.) to demand that rural employment be maintained. Farms that comply are able to purchase inputs in exchange for a proportion of the upcoming crop. Most farms have no choice because there is no agricultural credit market that would allow them to cover input purchases without government aid. While achieving the short-term goal of increased rural employment, the practice tends to erode the farm's profitability in the long run.

Other Institutional Problems

A number of institutional problems continue to dampen investment, which neither Russia nor Ukraine has addressed:

- The transportation infrastructure in Russia is poor and deteriorating, making it particularly difficult to transport perishable food products (such as unrefrigerated meats) across long distances.
- Few national-level institutions in either country distribute market information, like the Chicago Board of Trade or the USDA's market reports.
- Government tax and loan policies, perhaps inadvertently, discourage farms from becoming profitable. Once farms begin to show a profit, they will probably be expected to pay back loans that until now have been routinely forgiven. Taxes on profits do not apply when a farm is insolvent, but these will become an additional burden for profitable farms. Thus, farms have an incentive not to show a profit in order to avoid repaying loans and paying taxes on profits.

- Russia and Ukraine do not have an effective system to diffuse new agricultural technology to farmers. The system that was developed in the former Soviet Union was very ineffective in creating and disseminating new agricultural knowledge. Since independence, neither Russia nor Ukraine has funded significant projects to improve agricultural research and development and the extension system.

Many of the proposed agriculture-specific and economywide reforms are interrelated and complementary. For example, land reform will work best once the legislative environment is stabilized and the regulatory system is improved. Stabilizing the legislative environment and reducing the regulatory and licensing requirements to do business in Russia should allow farmers to profit more from their investments. Farmers then would become more forward-looking, but would be unable to act on their long-term investment plans without a well-functioning credit market. Allowing land to be used for collateral and setting up legislation supporting a national mortgage market probably would improve the performance of the agricultural credit market. The improved investment climate then would lead to higher agricultural production.

The Future of Agricultural Production in Russia and Ukraine

There are signs of improvement in Russia's institutional environment, even without significant agricultural reforms. The Russian parliament recently passed legislation reforming the tax and court systems that could significantly simplify the working environment for Russian businesses. The passage of the tax code and judicial reform legislation in 2001, as well as the land code legislation proposed for 2002, may help stabilize the legislative environment in those areas. A stable legislative environment will allow the legal system time to interpret gray areas of the law and let entrepreneurs learn how the system works.

These reforms, however, may not be sufficient to bring about productivity increases. Russia has yet to ade-

quately address farm insolvency issues, and many economywide reforms remain unaddressed. So far, Russia and Ukraine have earned a score of 5.6 and 5.4 out of 10, respectively, from the World Bank for their reform progress (Csaki and Fock, 2000). Russia and Ukraine receive relatively high marks only for the removal of subsidies, measures to mitigate the government monopoly on trade, and the elimination of price controls. However, they continue to lag behind other transition countries in land and institutional reform, and rural finance.

The reforms that remain are politically sensitive and would require a considerable investment of time and resources to implement. Forcing insolvent corporate farms to go bankrupt not only means tolerating the resulting unemployment, but will also require training judges to oversee the bankruptcy procedures. Furthermore, with the threat of bankruptcy, farm management would strive harder to prevent the diversion of inputs to subsidiary plots. Because the official unemployment insurance payments are so low, the subsidiary plots constitute Russia's primary social safety net, so any move to reduce the role of the plots in agriculture would be politically unpopular.

Furthermore, agriculture-specific reforms (bankruptcy procedures and land market reform) will be largely ineffective without complementary economywide institutional reforms. The right to buy and sell land will do little to improve farm performance if the institutions supporting land transactions, including legislation and regulation, are not in place. Furthermore, a land market will be more effective if land can be used for collateral and if the institutional environment for a national mortgage market exists.

Reversing the recent downward production trends will involve overcoming the longrun agricultural productivity decline dating back to the Soviet era. Earlier results seem to indicate that the gap in overall agricultural productivity has widened between the West and Russia. This suggests that if Russia were to implement appropriate reforms, the increase in the productivity growth rate could be relatively high as it "catches up" with the West.

Modeling Agricultural Reform in Russia and Ukraine

To illustrate the impact of a hypothetical productivity increase, some modeling projections have been made for wheat and barley for the next decade using the USDA Agricultural Baseline Projections to 2011 (USDA, 2002c). The USDA baseline estimates world production and trade and takes into account possible changes in world prices, making the system useful for predicting the response in world trade markets to productivity increases in the CIS. The effect of improving agricultural productivity on GDP is not modeled, which might be significant in Ukraine, where agriculture is about 30 percent of GDP. Nevertheless, because agricultural production is only 7 percent of GDP in Russia, the effects there would probably be slight. Wheat and barley were selected because they are the most significant crops produced in Russia and Ukraine that are widely traded on world markets. For each crop, productivity increases are modeled as an increase in the yield growth rate over the baseline projected growth rate.

Modeling Scenarios

The base scenario is modestly optimistic, assuming an average yield growth of 1.5 percent per year for each crop, reversing recent downward trends. The base scenario also incorporates optimistic consumption growth forecasts based on the 5-percent annual GDP growth

projected for Ukraine and Russia into the next decade. Under this scenario, wheat production increases 16 percent between 2001 and 2011 (table 6).

Consumption rises 6 percent to 54.5 million mt while exports (total) increase to 8.8 million mt (6.2 million mt net exports). Barley production increases 2 percent in the same period, and total exports increase to 1.6 million mt.

This guarded optimism is justified for a number of reasons. Oil prices have increased in recent years, allowing the Russian Government to afford more subsidized inputs.¹³ In addition, the ruble devaluation that occurred in 1998 shifted the terms of trade in favor of local producers relative to imports.¹⁴ Grain harvests in Russia have also rebounded in the past few years. While most of the rebound is due to favorable weather conditions, many believe that the favorable terms of trade resulting from the ruble devaluation have contributed significantly to the turnaround.

Because Russia is relatively more reform oriented, prospects for reform to impact productivity growth are

¹³Changes in world prices are usually not fully reflected in prices paid for fuel by Russian farmers.

¹⁴The real exchange rate as calculated by the Stockholm Institute of Transition Economics fell 30 percent from August to September 1998. The real exchange rate halted its devaluation in January 1999 at 37 percent of the August level and has been appreciating ever since.

Table 6—Summary of scenarios

	Russia and Ukraine				World				Ref. price
	Production	Imports	Exports	Consumption	Production	Imports	Exports	Consumption	
	<i>Million tons</i>								<i>\$/mt</i>
Wheat									
2001	52.4	4.2	2.2	51.4	588.2	110.0	110.0	601.7	110.1
2011									
Base	60.7	2.6	8.8	54.5	702.1	153.8	153.8	703.8	112.5
Russia only ¹	68.1	1.9	13.8	56.1	706.3	154.0	154.0	707.8	108.1
Moderate growth ²	71.5	1.9	17.0	56.4	708.2	154.6	154.6	709.6	106.0
"Catch up" ³	83.8	1.9	27.0	58.7	715.3	156.8	156.8	716.4	99.2
Barley									
2001	21.4	0.2	3.9	18.8	137.2	19.0	19.0	138.7	80.5
2011									
Base	21.9	0.6	1.6	20.9	155.7	19.8	19.8	155.3	73.8
Russia only	24.4	0.3	3.4	21.4	156.9	20.1	20.1	156.5	70.1
Moderate growth	25.8	0.3	4.0	22.1	158.0	20.2	20.2	157.6	68.7
"Catch up"	30.2	0.3	7.0	23.5	160.7	21.0	21.0	160.5	63.5

¹Yields in Russia increase by additional 1.5 percent.

²Yields in Russia and Ukraine increase by additional 1.5 percent.

³Yields in Russia and Ukraine increase by additional 3 percent.

greater for Russia than for Ukraine. The **“Russia only”** scenario considers yield growth in Russia alone. In this scenario, combined wheat production of Russia and Ukraine would increase by 7.4 million mt, while exports increase by 5 million mt. For barley, production increases by 2.5 million mt and exports increase by 1.8 million mt.

In the **“moderate growth”** scenario, yields in Russia and Ukraine are increased by an additional 1.5 percent (3-percent yield growth overall). This is the most realistic scenario, given the results of analysis from the “reversible output decline” section and the prospects for reform. The 3-percent growth rate is characteristic of the recent average yield growth in moderately high-growth performers, such as France, Hungary, India, and Pakistan. In this scenario, production of wheat and barley in both countries would increase from 82.6 million mt in the base scenario to 97.3 million mt in 2011, with corresponding exports increasing from 10.4 million mt to 21 million mt.

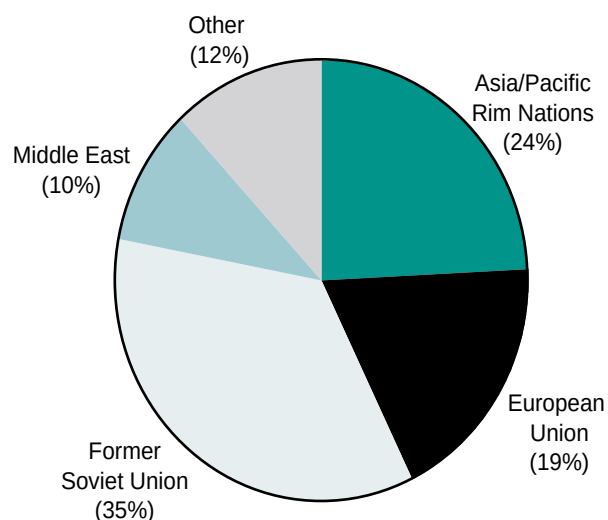
In the **“catch-up”** scenario, the yield increase is higher to allow Russia to close the productivity gap between Russian and Western countries that has been widening since the early 1960s. The catch-up effect is modeled as an increase in the yield growth rate of each crop by an additional 3 percent (4.5-percent growth rate overall). The catch-up scenario is possible, but difficult to achieve – only China was able to sustain such a high growth rate in average yields over the 1962-91 period among major wheat producers (Trueblood and Arnade, 2001). In this scenario, production of wheat and barley in both countries would rise to 114 million mt by 2011, of which 34 million mt would be exported.

An increase in grain exports from both Russia and Ukraine could have an important impact on world markets. While a large part of agricultural exports from Russia and Ukraine go to countries of the former Soviet Union (see figs. 10a and 10b), the European Union (EU), Pacific Rim, and Middle East are also large markets for agricultural products from Russia and Ukraine. If Russia and Ukraine significantly increase their production, exports to these traditional partners would likely increase, and perhaps compete with exports from other parts of the EU and the United States.

According to model results, successful agricultural reform in Russia and Ukraine would put downward pressure on world grain prices if both become large

Figure 10a

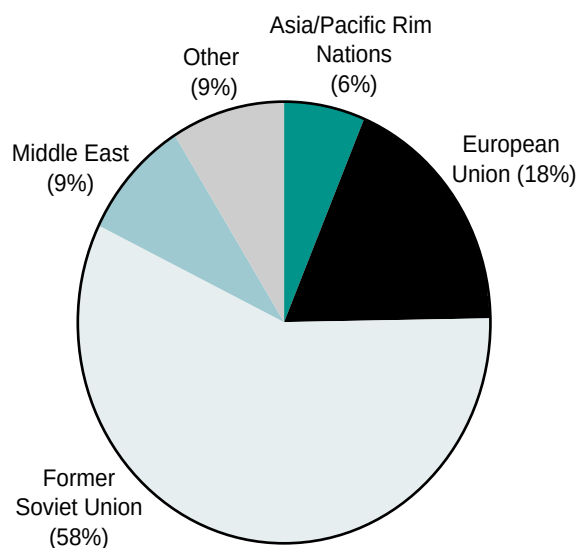
Russian main trade partners for its agricultural exports, 1997-2000



Source: United Nations (2001).
Ukraine data derived from trade partners.

Figure 10b

Ukraine's main trade partners for its agricultural exports, 1997-2000



Source: United Nations (2001).
Ukraine data derived from trade partners.

grain exporters. In the “moderate growth” scenario, world wheat prices in 2011 would be 6 percent lower than in the base scenario (\$106/mt compared with \$112/mt). In the less likely “catch-up” scenario, world wheat prices would decline by 12 percent to \$99/mt.



Photo courtesy Belarus Tractor International.

While the projections take into account shifts in global demand and supply, they do not incorporate possible policy responses on the part of other major players in world grain markets. For example, the fall in grain prices projected in the “catch-up” scenario could put pressure on EU agriculture and lead to a buildup of EU stocks, assuming EU internal support prices remain unchanged. This would probably create pressure for an increase in export subsidies, an increase in land set-asides, or reduction in domestic support price (or some combination of these policies). These policy responses on the part of the EU would reduce supply and offset to some extent the downward pressure on world prices. Another possible policy response from Russia or Ukraine would be to protect local industries from import competition, for example, in the livestock

sector. This might be accomplished by a number of policy instruments, including an export tax on feed grains.

As a final caveat, there are many other issues not addressed in these scenarios that could also affect the grain sectors of Russia and Ukraine. Such issues include grain quality improvements, feed issues related to the livestock sector (whose future is highly uncertain), and shifts in the structure of consumer demand due to changing preferences. Uncertainty over future agricultural trade is further complicated by Russia’s recent efforts to accelerate its accession to the World Trade Organization. These issues are beyond the scope of this report.

Conclusions

Russia and Ukraine have been important to international and U.S. agricultural markets, particularly in their role as importers. However, their production patterns have changed dramatically in the past two decades, leading to a shift in trade from significant grain importers to major meat importers. This report has tried to ascertain the future of agricultural production and trade for these two countries, should they speed up implementation of the reforms initiated when the Soviet Union was dissolved.

An important key to the future of agricultural production and trade in Russia and Ukraine will be the progress of agricultural sector reforms that began in 1992. These included price and trade reforms, and agriculture-specific and economywide institutional reforms. The price and trade reforms were expected to have a contraction effect on production in the short run as real prices dropped, but an expansion effect in the long run as other reforms were implemented and productivity increased, eventually leading to an increase in exports.

To date, only price and trade liberalization have been fully implemented, while economywide and agriculture-specific institutional reforms have been only partially implemented. The result has been a large drop in production, with few signs of a rebound in productivity. The currency devaluation that occurred in 1998 has improved real prices for agriculture and seems to have had a stimulating effect on output, but the complete data are not yet available to analyze the impact on productivity since 1998.

The results of the analysis in this study show that Russia and Ukraine have the potential to increase crop production significantly, if they implement the necessary agriculture-specific and economywide reforms aggressively. Economywide reforms – reform of the commercial code, stabilization of tax and regulatory legislation – will reduce uncertainty in the business environment. Agriculture will benefit significantly

from these reforms because agricultural production occurs over a long time period and is therefore more vulnerable to risk. Agriculture-specific reform – bankruptcy legislation and land reform – will help the agricultural credit market, although without economywide reform the effect will be small. These reforms will allow the agricultural sector to modernize and fully internalize the technological advances in agricultural production made over the last several decades.

If the necessary reforms are made and agricultural production improves in Russia and Ukraine, the impact on world grain markets could be significant. Modeling projections for wheat and barley show that between 2001 and 2011, production in both Russia and Ukraine would increase by 17 percent in a “moderate growth” scenario, and as much as 37 percent in a less likely high-productivity (“catch-up”) scenario. Exports would increase from 10.4 million mt to 21 million mt in the same period and perhaps reach 34 million mt. Agricultural exports from Russia and Ukraine would likely increase to the EU, Pacific Rim, and Middle East and perhaps compete with exports from the United States and the EU. The potential increase in grain exports might affect world grain prices. For example, wheat prices in the “moderate growth” scenario would decline by 6 percent by 2011 compared with base projections.

Since successful reform will have a major impact on agricultural performance, it will be important to monitor the progress of reform in the future. The Russian government initiated some major institutional reforms in 2001 and 2002. The reforms that will impact the agricultural sector are the reforms of the court system and the tax code in 2001, and the passage of the agricultural land code in 2002 (which is in the process of being signed into law at the time of this writing). The issue of farm insolvency has not yet been addressed. The reforms that have been passed will increase agricultural investment if they are successful, so a good gauge of the progress of reforms would be the rate of domestic and foreign investment in the agriculture sector.

References

- Arnade, Carlos. "Using a Programming Approach to Measure International Agricultural Efficiency and Productivity," *Journal of Agricultural Economics*, Vol. 49 (1997), 67-84.
- Arnade, Carlos and M. Gopinath. "Financial Constraints and Output Targets in Russian Agricultural Production," *Journal of International Development*, Vol. 12 (2000): 71-84.
- Center for Economic and Financial Research, (CEFIR), "Russia in the WTO: Myths and Reality," Moscow, 2001.
- Cherniakov, B.A. (ed.). *Agricultural Sector of the United States at the End of the Twentieth Century*. Moscow: USA–Canada Institute, 1997.
- Csaki, Csaba, and Achim Fock. "The Agrarian Economies of Central-Eastern Europe and the Commonwealth of Independent States, 2000." Washington, DC: World Bank Working Paper No. 24.
- Goskomstat (Gosudarstvennyj Komitet Statistiki) of the Russian Federation, *Agriculture in Russia 2000*. Moscow: Goskomstat, 2001.
- Interfax Food and Agriculture Report*, June 15-21 2001, Volume VII, Issue 25.
- Latsis, Otto. "Liberal Talk, But Little Action," *The Russia Journal*. Moscow: July 27, 2001.
- Lerman, Zvi et al. "Agricultural Output and Productivity in the Former Soviet Republics," Selected Paper, American Agricultural Economics Association, Chicago, IL, 2001.
- Liefert, William M. "Economic Reform and Comparative Advantage in Agriculture in the Newly Independent States," *American Journal of Agricultural Economics*, Vol. 76 (1994): 636-40.
- Liefert, William M. "Comparative (Dis?)Advantage in Russian Agriculture," *American Journal of Agricultural Economics* (forthcoming), 2002.
- Ministry of Agriculture of the Russian Federation website, <http://www.aris.ru/INFO/STAT/>, Moscow, 2002.
- Murova, Olga Ivanovna. "Transition Economy Of Ukraine: Analysis Of Agricultural Efficiency, Productivity, and Supply Response." Ph.D. dissertation, Mississippi State University, Starkville, MS, 2000.
- Osborne, Stefan and Michael A. Trueblood. "An Examination of Economic Efficiency of Russian Crop Output in the Reform Period" (Submitted to *Agricultural Economics*), 2002.
- Organization for Economic Cooperation and Development. *Review of Agricultural Policies, Russian Federation*. Paris, 1998.
- Organization for Economic Cooperation and Development, Joint Working Party on Agriculture and Trade. "Medium-Term Impact of Agricultural Trade Liberalisation in OECD Countries on the Food Security of Non-Member Economies." Paris, 2001.
- Safavian, M., Graham, D., and C. Gonzalez-Vega. "Corruption and Microenterprises in Russia," *World Development*, Vol. 29 (2001): 1215-24.
- Sedik, David. "A Note on Soviet Per-Capita Meat Consumption," *Comparative Economic Studies*, Vol. 35 (1993): 39-48.
- Sedik, David, Michael Trueblood, and Carlos Arnade. "Corporate Farm Performance in Russia, 1991-95: An Efficiency Analysis," *Journal of Comparative Economics*, Vol. 27 (1999): 514-533.
- Sotnikov, Sergei. "Evaluating the Effects of Price and Trade Liberalisation on the Technical Efficiency of Agricultural Production in a Transition Economy: The Case of Russia," *European Review of Agricultural Economics*, Vol. 25 (1998): 412-431.
- Trueblood, Michael A. "Nonparametric Estimates of Intercountry Agricultural Efficiency and Productivity," Ph.D. dissertation, University of Minnesota, St. Paul, MN, 1996.
- Trueblood, Michael A. and Carlos Arnade. "Crop Yield Convergence: How Russia's Yield Performance Has Compared with Global Yield Leaders," *Comparative Economic Studies*, Vol. 43 (2001): 59-81.

Trueblood, Michael A. and Stefan Osborne. "Has Russia's Agricultural Productivity Increased Since Reform?" Unpublished manuscript, 2002.

United Nations. *TRAINS database*. New York, 2001.

U.S. Department of Agriculture. *The Soviet Livestock Sector*. Washington, DC: Economic Research Service, Foreign Agricultural Economic Report No. 235, June 1988.

U.S. Department of Agriculture. *Agricultural Prices: 2000 Summary*. Washington, DC: National Agricultural Statistics Service, Pr 1-3 (01)a, 2001.

U.S. Department of Agriculture. *Livestock Sectors in the Economies of Eastern Europe and the Former Soviet Union: Transition from Plan to Market and the Road Ahead*. Washington, DC: Economic Research Service, Agricultural Economics Report No. 798, February 2002a.

U.S. Department of Agriculture. *Production, Supply, and Distribution (PSD) Database*. Washington, DC: Economic Research Service, February 2002b.

U.S. Department of Agriculture. *USDA Agricultural Baseline Projections to 2011*. Washington, DC: Economic Research Service, 2002c.

U.S. Department of Agriculture. *Grains, World Markets, and Trade*. Washington, DC: Foreign Agricultural Service, May 13, 2002d.

U.S. Department of Energy. Gasoline and Diesel Fuel update website, <http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp>. Washington, DC.

Uzun, Y.Y. "Organizational Types of the Agricultural Production in Russia," USAID BASIS Conference (Framework for Investigating Issues in Factor Markets and Economic Organization of Russian Agriculture), Golitsino, Russia, July 2001.

Voigt, P. and V. Uvarovsky. "Developments in Productivity and Efficiency in Russia's Agriculture: The Transition Period," *Quarterly Journal of International Agriculture*, Vol. 40 (2001): 45-66.

Wong, Lung Fai. *Agricultural Productivity in the Socialist Countries*. Boulder, CO: Westview Press, 1986.

World Bank. *World Development Indicators*, CD-ROM database. Washington, DC, 2001.



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Appendix Tables

Appendix table 1—Changes in agricultural net imports, Russia and Ukraine, 1987-2001

Appendix 2: U.S. net exports to Russia and Ukraine, 1987-2001							
Year	Total grains ¹	of which:		Sugar- beets	Beef & veal	Pork	Poultry
		Wheat	Coarse grains				
----- 1,000 tons -----							
Russia and Ukraine total net imports							
1987	23,534	15,725	7,725	...	...	...	...
1988	25,100	8,235	16,730	...	...	...	...
1989	20,200	6,050	14,125	...	...	...	...
1990	17,918	8,559	9,339	1,520	620	440	314
1991	22,763	13,965	8,308	960	819	255	100
1992	21,813	14,953	6,737	2,575	305	129	50
1993	6,438	4,078	2,381	1,850	313	216	194
1994	221	1,648	(1,529)	1,144	384	324	510
1995	3,698	3,950	(704)	1,100	400	449	905
1996	1,168	699	117	1,913	412	452	1,195
1997	(1,189)	748	(2,189)	2,025	451	489	1,292
1998	(3,691)	(3,780)	(529)	4,069	386	376	1,020
1999	4,267	3,070	772	5,371	565	496	1,002
2000	645	1,500	(1,245)	5,321	266	357	1,073
2001	(8,305)	(3,596)	(3,310)	5,331	471	377	1,122
U.S. net exports to Russia and Ukraine							
1987	0	0	0	...	...	...	...
1988	1,000	0	1,000	...	...	...	...
1989	0	0	0	...	...	...	...
1990	0	0	0	...	...	...	...
1991	563	0	548	...	...	...	...
1992	7,197	3,375	3,822	14	0	0	9
1993	3,335	1,038	2,295	0	0	0	43
1994	548	514	16	9	1	17	315
1995	229	153	57	15	5	41	626
1996	176	79	88	0	2	23	929
1997	99	96	1	0	5	23	1,011
1998	1,072	564	405	0	10	45	917
1999	1,471	947	491	0	14	3	282
2000	45	0	0	0	24	42	560
2001	0	0	0	0	3	26	1,039

¹Numbers in parentheses indicate net exports.

... = not available.

Source: USDA (2002a,d). Total meat imports do not include transhipped imports and are understated.

Appendix table 2—Changes in agricultural production, Russia and Ukraine, 1987-2001

		of which:							
Year	Total grains	Wheat	Coarse grains	Sugar-beets	Sunflower seeds	Fluid milk	Beef & veal	Pork	Poultry
----- Million tons -----									
Russia									
1987	93.26	36.87	55.70	...	3.07	...	...	...	...
1988	88.73	39.86	48.12	...	2.96	54.53	4.15	3.40	0.00
1989	98.93	44.00	54.28	1.11	3.79	55.74	4.26	3.50	1.83
1990	110.57	49.60	60.39	3.20	3.43	55.72	4.33	3.48	1.80
1991	85.58	38.90	46.18	2.60	2.90	51.97	3.99	3.19	1.75
1992	102.45	46.17	55.79	2.20	3.07	46.78	3.63	2.78	1.43
1993	95.17	43.50	51.22	2.54	2.77	46.30	3.30	2.43	1.28
1994	77.54	32.10	45.10	2.70	2.55	42.80	3.24	2.10	1.07
1995	61.10	30.10	30.70	1.66	4.20	39.30	2.73	1.87	0.86
1996	66.80	34.90	31.65	2.06	2.77	35.80	2.57	1.70	0.71
1997	86.02	44.20	41.60	1.30	2.83	34.10	2.33	1.57	0.63
1998	46.24	27.00	18.95	1.30	3.00	33.00	2.09	1.51	0.64
1999	53.19	31.00	21.80	1.30	4.15	32.00	1.90	1.49	0.64
2000	63.01	34.45	28.20	1.50	3.92	31.90	1.84	1.50	0.66
2001	83.60	47.00	35.00	1.55	2.70	32.10	1.70	1.51	0.70
Ukraine									
1987	43.98	19.66	24.22	...	2.72	...	...	...	...
1988	42.07	21.71	20.26	...	2.78	24.10	2.02	1.58	0.70
1989	47.73	27.40	20.24	...	2.89	24.24	2.01	1.60	0.73
1990	47.26	30.37	16.81	5.63	2.73	24.36	1.99	1.58	0.71
1991	36.28	21.16	15.06	5.37	2.45	22.41	1.88	1.42	0.65
1992	35.15	19.51	15.59	4.18	2.28	19.11	1.66	1.18	0.50
1993	42.16	21.83	20.29	3.97	2.23	18.38	1.38	1.01	0.36
1994	32.43	13.86	18.53	4.19	1.57	18.14	1.43	0.92	0.27
1995	31.93	16.27	15.61	3.60	2.85	17.18	1.19	0.81	0.24
1996	23.11	13.55	9.51	3.80	2.12	16.00	1.05	0.79	0.22
1997	33.90	18.40	15.46	2.94	2.31	14.73	0.93	0.75	0.19
1998	25.32	14.94	10.34	2.03	2.27	14.55	0.80	0.70	0.21
1999	24.22	13.59	10.59	2.00	2.72	13.36	0.79	0.66	0.20
2000	23.25	10.20	12.99	1.72	3.50	12.40	0.75	0.68	0.19
2001	38.35	21.30	17.00	1.70	2.25	12.20	0.65	0.48	0.21
Russia and Ukraine									
1987	137.25	56.52	79.92	...	5.78	...	...	...	...
1988	130.80	61.57	68.38	...	5.73	78.63	6.17	4.98	0.70
1989	146.66	71.40	74.52	...	6.67	79.98	6.27	5.09	2.56
1990	157.82	79.97	77.20	8.83	6.15	80.08	6.32	5.06	2.51
1991	121.86	60.06	61.24	7.97	5.34	74.38	5.87	4.61	2.41
1992	137.60	65.68	71.37	6.38	5.35	65.89	5.29	3.96	1.93
1993	137.33	65.33	71.51	6.51	4.99	64.68	4.68	3.45	1.64
1994	109.97	45.96	63.63	6.89	4.12	60.94	4.67	3.02	1.33
1995	93.03	46.37	46.31	5.26	7.05	56.48	3.92	2.67	1.09
1996	89.91	48.45	41.16	5.86	4.89	51.80	3.62	2.49	0.92
1997	119.92	62.60	57.06	4.24	5.14	48.83	3.26	2.32	0.82
1998	71.56	41.94	29.29	3.33	5.27	47.55	2.89	2.21	0.85
1999	77.40	44.59	32.39	3.30	6.87	45.36	2.69	2.15	0.84
2000	86.26	44.65	41.19	3.22	7.42	44.30	2.59	2.18	0.85
2001	121.95	68.30	52.00	3.25	4.95	44.30	2.35	1.99	0.91

... = not available.

Source: USDA (2002a).