Russia's Agro-food Sector: Towards Truly Functioning Markets
Wehrheim, P., E. V. Serova, K. Frohberg, and J. von Braun (eds.)
Kluwer Academic Publishers, pp. 495 – 512

SECTION 9: INSTITUTIONAL ISSUES AT THE FARM LEVEL

Chapter 9.3

Agricultural Enterprise Restructuring in Russia, 1991-95: A Technical Efficiency Analysis

David J. Sedik, Michael A. Trueblood, and Carlos Arnade

Abstract: In this paper, we consider the extent to which there has been genuine restructuring of Russian corporate farms by oblast and attempt to explain the various levels of farm restructuring by oblast. To do this, we measure the average level of technical efficiency of crop production on corporate farms by oblast over the period 1991-1995 and the change in technical efficiency by oblast over that period. We find that many of the producing regions that were relatively efficient before the reforms have maintained this status since reforms began. However, the most inefficient regions have become even more inefficient. We also find that variations in efficiency by oblast can be explained by economic and institutional factors, including shocks in relative prices, average farm size, the extent of state marketing channels, the degree of privatization, subsidy levels, and movement towards crop specialization.

Keywords: data envelopment analysis; stochastic frontier analysis; corporate farms; passive restructuring.

1. FARM RESTRUCTURING AND TECHNICAL EFFICIENCY

Two distinct processes characterize the economic transition in the agricultural sectors of the countries of the New Independent States and

Eastern Europe. The first is the transformation of the economic policy environment in which agricultural enterprises function. Policy changes such as price liberalization, the opening of the economy to foreign trade, the establishment of a legal system capable of enforcing contracts, and the partial elimination of subsidies and hardening of farm budget constraints all provide incentives to farms to utilize resources according to a pattern more consistent with consumer demand and unsubsidized costs of production. The second process is the transformation of the farms themselves, in order that they survive within this new market environment. The two phenomena associated with this producer transition are the growth of private sector output (on private farms and plots) and the restructuring of former state and collective farms (hereafter referred to as corporate farms).

Previous studies of agricultural enterprise restructuring in Russia have relied on farm-level surveys in a small number of oblasts (for example, BROOKS and LERMAN 1994; BROOKS et al. 1996; BROCK 1997). The conclusions of these studies can be summarized as follows:

— Most farms (95 percent) have complied formally with the decrees mandating reorganization into share holding (corporate) farms and divestiture of state-owned land;

— Most share holding farms are managed internally like collective farms of the past, but with more administrative autonomy and less financial security than in the past;

— Markets for commercial agricultural land have yet to develop. Neither legislators nor farm managers and employees see much usefulness in allowing land markets that might facilitate borrowing (with land as collateral), investing, and modernizing.

In this paper, we estimate and explain patterns of technical efficiency of crop production on corporate farms in Russia on the level of the oblast, rather than the farm. In this sense, our study follows PARDEY and CRAIG (1997), who investigated agricultural efficiency levels in U.S. states. By technical efficiency, we mean the physical relationship between inputs and outputs. We are only able to make judgements about best practice efficiency of an 'average' corporate farm within each Russian oblast and its efficiency relative to others, and not to global standards of efficiency.

Technical efficiency of a farm is only one of a number of indicators that should show improvement (or less deterioration) as a result of genuine farm restructuring, leading (eventually) to the formation of viable producers. Other measures that should show improvement are the allocative efficiency in employment of farm inputs, total factor productivity in agriculture, and profitability of farms.

Using previously unutilized oblast-level data from 70 (out of a total 89) oblasts over the period 1991-95, we address the following questions:

(1) First, what is meant by and how can we measure genuine farm restructuring?

(2) Second, what has been the pattern of the relative average (1993-95) levels of technical efficiency of crop production by region?

(3) Third, what has been the pattern in the changes in technical efficiency by region as a result of reform from 1991 to 1995?

(4) Next, what economic and institutional factors can explain the pattern in the levels of technical efficiency?

And, (5) what conclusions can be drawn about the extent of farm restructuring by region in Russia, based on the evidence?

2. MEASURING THE EFFECTS OF FARM RESTRUCTURING

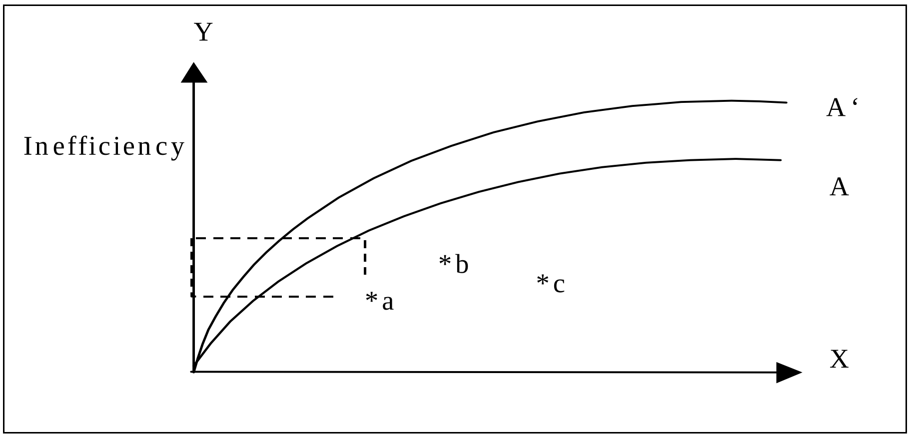
Genuine restructuring involves serious changes in four areas of farm operation: management and control, internal organization of the business, modernization through capital investment, and social services provided by the enterprise. Of these, management leadership and capital investment are the most critical ingredients (BLASI et al. 1997: 122). Genuine restructuring requires proactive adjustment of enterprise operations, such as developing new products, changing production technologies, substantial changes in production to more closely align it with demand, and reduction of costs of production. These adjustments often (though not always) require investment, and thus a track record of profitability, in order to gain access to long term bank loans (ERNST et al. 1996: 24-27).

The actions involved in genuine restructuring can be divided into two categories: those that improve the technical efficiency of production but leave the production technology unchanged, and those that change the production technology, thus shifting the maximum output obtainable. Figure 1 illustrates the distinction between these two concepts with a single-input production function. The x-axis measures the quantity of input, say, land. The y-axis measures the quantity of output produced. Frontier A defines the maximum output that can possibly be produced using each level of input x. This frontier corresponds to a production function in microeconomic theory. Empirically, we observe a number of enterprises which produce at points inside the production frontier, at points a, b or c. We can think of these enterprises as exhibiting signs of x-inefficiency

(LEIBENSTEIN 1966). That is, improvements in management of the production process at these enterprises could result in higher output using the same quantity of inputs. An improvement in x-efficiency results in better exploitation of the potential of a given production technology. Alternatively, shifting the production frontier involves changing the technology of production, which most likely requires capital investment from either retained earnings, long term bank loans, or direct investment by another company.

The change in efficiency or movement toward the production frontier is what we measure in this paper. We think that it may be premature to expect investment of the scale required to shift the production frontier out for corporate farms, particularly because 80 percent of them reported in 1996 that they were unprofitable.

Figure 1: The production frontier A and inefficient enterprise production at points a,b and c



Genuine restructuring should be distinguished from so-called ‘defensive’ or ‘passive’ restructuring of the survival-oriented enterprise (SOE) (ICKES and RYTERMAN 1994). In the face of the severe uncertainty which is characteristic of the transition period, SOEs place predominant emphasis on current cash flow, rather than long-run asset value. As SOEs, there are very good reasons to suppose that Russian corporate farms engage predominantly in ‘passive’ rather than genuine restructuring. Genuine restructuring of enterprises is usually associated with far-reaching changes, such as: (1) significant hardening of the enterprise budget constraint, (2) significant outside ownership of the enterprise, and (3) institutions promoting good corporate governance, such as accurate financial disclosure, democratic boards of directors, independent shareholder registers (BLASI et al. 1997: 122-166; ERNST 1996: 31-78). Russian corporate farms continue to operate under a soft budget constraint, are organized as closed partnerships, and are run predominantly by the old state and collective farm managers.

The above considerations and previous studies indicate that the restructuring that has occurred in Russian corporate agriculture can generally be characterized as 'passive restructuring,' a survival strategy which leads to a deterioration of economic performance, capital decumulation, continued unprofitability and lack of growth. While we do not dispute these findings, they do not allow us to account for the large (and increasing) differences in farm productivity performance by region. In this study, we attempt to arrive at an explanation for these differences by a process of elimination. If we are able to account for differences in efficiency that stem from different growing conditions or weather, the most important factor not accounted for is the quality of management or entrepreneurship.

3. METHODOLOGY

We employed two methods to measure technical efficiency: data envelopment analysis (DEA) and stochastic frontier analysis (SF). Both methodologies are relatively established and straightforward ways of obtaining a static measure of technical efficiency. The use of two approaches allowed us to cross check the results obtained from each methodology. The patterns of efficiency levels and changes using both methods were quite similar, and we report only the results from the stochastic frontier analysis in this paper.

3.1 Stochastic frontiers

The stochastic frontier methodology uses an econometric approach to estimate static technical efficiency (AIGNER et al. 1977; MEEUSEN and VAN DEN BROECK 1977). Its general estimation form is the following (for panel data):

(1) $$Y_{it} = \exp[x_{it}\,\beta + v_{it} - u_{it}]$$

where:

y_{it} is output for unit i in year t,

x_{it} is a vector of inputs for unit i in year t

β is a vector of parameters to be estimated

v_{it} is the random error term

u_{it} is a non-negative measure of technical inefficiency.

Common functional forms used in practice include the Cobb-Douglas functional form and translog functional form. An important feature of this model is the composite nature of the error term. In essence, this model can be considered a special case of violating the standard OLS model assumption of having a spherical error term. When this assumption is violated, the error term is examined further to separate random noise and systematic technical inefficiency. It is common to assume $v \sim N(0,\sigma^2)$, but researchers made a variety of assumptions about the distribution of u_{it}. Three commonly assumed distributions are the truncated half-normal distribution proposed by AIGNER et al. (1977), the truncated normal distribution proposed by STEVENSON (1980), and the gamma distribution proposed by GREENE (1980).

The expression of technical efficiency relies on the value of the unobservable u_i, which must be predicted. These predictions are obtained by deriving the expectation of the appropriate function of u_i conditional on the observed value of $v_i - u_i$.

We apply maximum likelihood techniques to estimate parameters and predict errors on the above model. These have proven to be the most popular approaches to estimating parameters in the stochastic frontier model.

There have been several variations on this model, as discussed in a few different literature reviews (e.g., SCHMIDT 1986; BAUER 1990; BATTESE 1992). One extension by CORNWELL et al. (1990) and KUMBHAKAR (1990) included using a time variable to capture changing efficiency over time. In this paper, we use the FRONTIER (4.1) software program developed by BATTESE and COELLI, which incorporates a time variable into the error term u_i to estimate the following general Cobb-Douglas model:

(2) $$y_{it} = \exp[\ln A + \Sigma_I \ln x_{ijt} + v_{it} - u_{it}]$$

where:

$v \sim \text{iid } N(0, \sigma^2)$

$u = u_i \exp(-\eta(t-T))$,

$u_i \sim \text{iid } N(\mu, \sigma^2) \quad (u_i \geq 0)$

and where η is a parameter that captures changes in efficiency over time and is estimated. Setting $\eta = 0$ gives the time-invariant model.

The FRONTIER program sets up a likelihood function that uses the reparameterization of the BATTESE and CORRA (1977) model to replace σ_v^2 and σ_u^2 with $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2 / (\sigma_v^2 + \sigma_u^2)$. This implies that $\gamma \in [0, 1]$. If this coefficient is not significant, then an OLS model without inefficiency parameters is appropriate. In the other extreme, a significant γ that equals one implies that the only source of error is due to inefficiency. The parameter η allows for time-varying technical inefficiency in a panel data model, such as the one used in this study. Similarly, the parameter μ (which can be tested for statistical significance) allows for a general non-zero mean for a truncated normal distribution.

3.2 Explaining technical efficiency

In this paper, we not only measure technical efficiency, but also attempt to explain it. This leads to more complex methodological issues. With both DEA and SF methodologies, earlier studies engaged in two step approaches (first measuring technical efficiency, then regressing these scores by other explanatory variables), which was later found to be a theoretical problem. With SF, this problem can be explained by quoting BATTESE and COELLI (1995: 325-326):

Early empirical papers, in which the issue of the explanation of these inefficiency effects was raised, include PITT and LEE (1981) and KALIRAJAN (1981). These papers adopt a two-stage approach, in which the first stage involves the specification and estimation of the stochastic frontier production function and the prediction of the technical inefficiency effects, under the assumption that these inefficiency effects are identically distributed. The second stage involves the specification of a regression model for the predicted technical inefficiency effects, which contradicts the assumption of identically distributed inefficiency effects in the stochastic frontier.

This has led to a few alternative formulations for simultaneous estimation. In this paper, we use the BATTESE and COELLI (1995) formulation in which the following model is estimated (using the FRONTIER program):

(3) $$y_{it} = \exp(x_{it}\beta + v_{it} - u_{it})$$

where the variables are as before, except that we now also simultaneously estimate

(4) $$u_{it} = z_{it}\delta + w_{it}$$

where:

z_{it} is a vector of exogenous explanatory variables

δ is a vector of parameters to be estimated

w_{it} is a random variable

Here, w_{it} is a truncated normal variable with zero mean and variance σ^2 such that $w_{it} \geq -z_{it}\delta$, which is consistent with $u_{it} \sim N(-z_{it}\delta, \sigma^2)$.

4. DATA

Oblast-level value of crop production, quantity of inputs used in crop production and financial and institutional variables pertaining to the economic environment of corporate farms are all taken or derived from official Russian State Committee on Statistics sources. For calculation of the relative levels of technical efficiency, we constructed a production function for Y, using the variables X1 . . . X7 for each oblast considered. These variables are defined as follows:

[Y] Value of crop output. Gross value of crop output from corporate farms using 1983 prices. Though not ideal, this is the only constant price output series currently available for agricultural production by sector and region.

[X1] Land. Land sown to crops on corporate farms on November 1 (in hectares). Land was quality adjusted by multiplying the number of hectares by an index of average oblast-level grain yield during the period 1985-90.

[X2] Labor. Thousand man-days worked in crop production.

[X3] Fertilizers. Tons of fertilizer purchased by corporate farms.

[X4] Oil Products. Tons of oil products purchased by corporate farms and used in crop production.

[X5] Fuel Products. Tons of fuel products purchased by corporate farms and used in crop production.

[X6] Electricity Used for Production. 1,000 Kwh used in crop production.

[X7] Tractor Power. 1,000 HP on corporate farms.

For calculation of the causes of technical inefficiency, we considered the following variables, Z1 . . . Z10, as weather and institutional variables which explain levels in technical efficiency. The Z variables are defined as follows:

[Z1] Precipitation. Mean rainfall (mm) for the critical growing months, May-July.

[Z2] Temperature. Mean temperature (degrees centigrade) for the critical growing months, May-July.

[Z3]. Employees per farm. For each oblast, total average number of workers and employees over the year employed in all production (includes permanent and seasonal) divided by the total number of corporate farms in the oblast.

[Z4] Average farm size. For each oblast, arable land (in hectares) in corporate farms divided by total number of corporate farms.

[Z5] Portion of Crops Marketed to State Procurement. Total value of crops from corporate farms marketed to state divided by total value of crops marketed to all sources.

[Z6] Portion of Crops Produced in Private Sector. Gross value of crops produced on private plots and private farms as a portion of gross value of total crop production, all in 1983 prices.

[Z7] Portion of Land in Private Farms. Agricultural land in private farms as a portion of total agricultural land in farms in the oblast.

[Z8] Cumulative Change in Farm Terms of Trade. Ratio of an index of agricultural output prices (1991 value = 1) and an index of agricultural input prices (1991 value = 1).

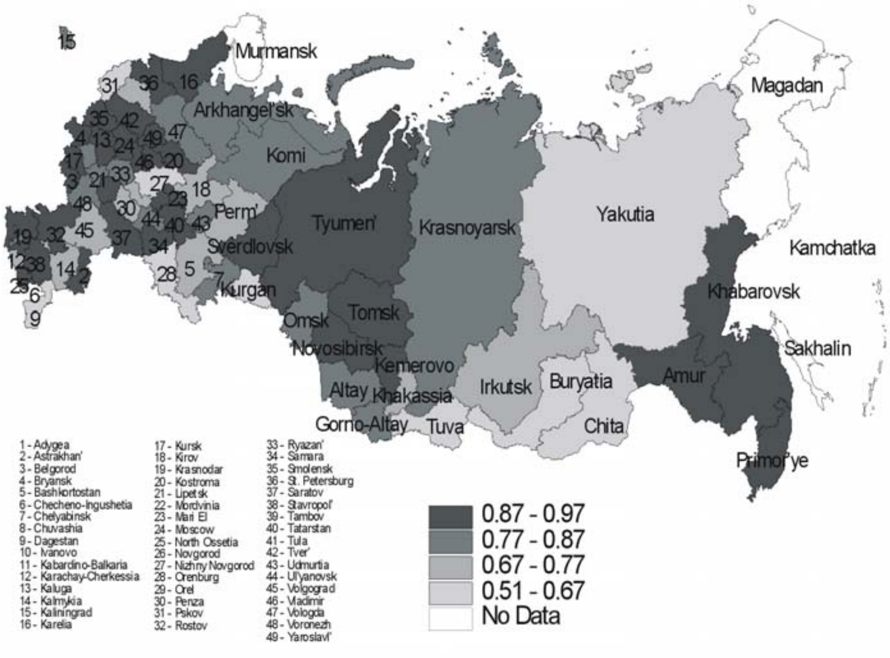
[Z9] Subsidies as a Portion of Crop Revenues. Total value of crop subsidies to corporate farms in an oblast as a portion of total crop revenues by corporate farms in that oblast.

[Z10] Cumulative Index of Crop Concentration. Percent change since 1991 in share of total crop product value (in 1995 prices) of predominant crop in 1995. This index is computed for the three years considered, 1993, 1994 and 1995.

5. TECHNICAL EFFICIENCY OF RUSSIAN CROP PRODUCTION BY REGION, 1993-1995

We first examine the relative levels of crop production efficiency by region in Russia for the period 1991 through 1995. Figure 2 shows the three-year average level of efficiency of crop production in corporate farms on a scale from 0 to 1 for the years 1993-1995, where a grade of 1 indicates that crop production in the region was the most efficient. The highest levels of crop production efficiency were in the North Caucasus, the Volga Valley, parts of the Central Black Soil region (around Moscow), an area around St. Petersburg, and parts of West and East Siberia.

Figure 2: 1993-95 Efficiency Level



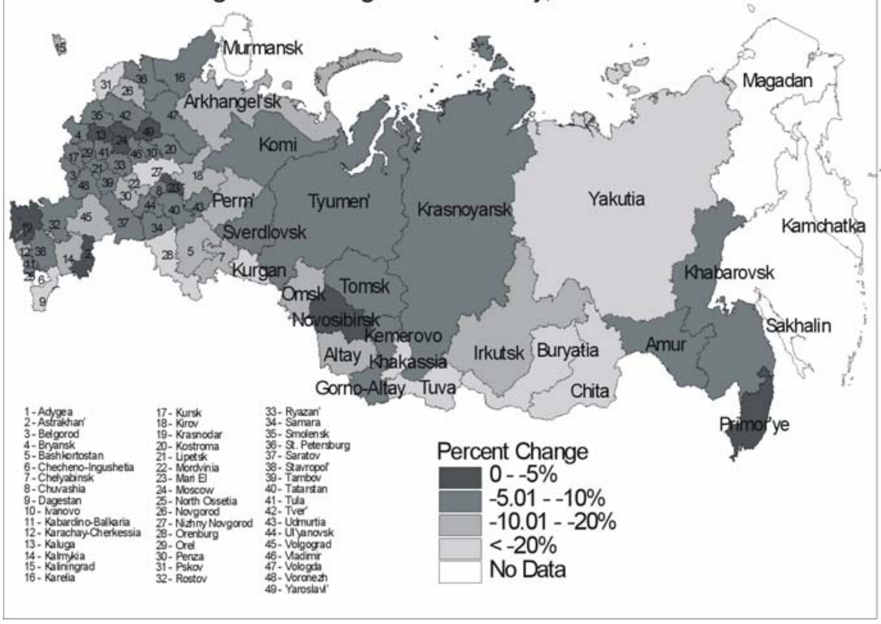
We are inclined to believe that the reason why corporate farms in some oblasts have performed better than in others is the quality of management, understood in a broad sense. This is the usual interpretation of the reasons for variations in efficiency in the literature. However, the quality of management depends in turn partly on institutional-environmental factors, though it is not entirely determined by them. For example, expectations about loan forgiveness (which reflects the softness of the farm budget constraint), as well as undeveloped markets for land and labor, farm size, etc., all influence managerial decisions which in turn influence the efficiency with which farms operate.

It is important to recognize that farm managers may be 'rational' while allowing the technical efficiency of their farms to fall. For example, farm managers may pursue goals other than profits or cost minimization, such as retaining workers or land, rent-seeking or seeking to carry out the wishes of the local authorities. Moreover, if an oblast is relatively remote and faces very high transportation costs, it may be prudent to be relatively self-sufficient.

6. CHANGES IN THE TECHNICAL EFFICIENCY OF RUSSIAN CROP PRODUCTION BY REGION, 1991-1995

We next examine the changes in efficiency scores of each region from the pre-reform year of 1991 to 1995 (four years after the beginning of price reform). We estimate that the average efficiency score of Russian regions declined from 0.70 in 1991 to about 0.54 by 1995. Figure 3 shows the percentage changes in the level of crop production efficiency from 1991 to 1995 for selected oblasts.

Figure 3: Changes in Efficiency, 1991-1995



The main picture that emerges from our analysis is that those areas that were efficient in 1991 have been holding their own, while the efficiency of areas which had low efficiency in 1991 has deteriorated quite significantly.

In other words, the variation in the efficiency performance of oblasts in the Russian Federation increased rapidly. Despite the tendency to grant soft loans to corporate farms (which, it must be said, has become less common in the past few years), the economic shocks that have hit agriculture in the past few years caused less efficient farming oblasts to become even less efficient. Oblasts that have stayed relatively efficient include Astrakhan', Novosibirsk, Krasnodar, and Kursk. Some of the oblasts that have deteriorated the most include Pskov, Khakassia, Karachay-Cherkassia, and Kurgan.

How do we explain this pattern of changes in efficiency levels over time? We can only make educated conjectures, based on the results of our formal work on explaining the levels of technical efficiency (reviewed in the following section), as well as our qualitative knowledge of the patterns of change in Russian agriculture in the past few years. However, the following is a scenario consistent with the observed changes in technical efficiency of corporate farm production of crops of the past few years. The pattern is consistent with what one would expect following the liberalization of prices with trade under a situation of soft budgets for the relatively inefficient producers. As corporate farms have experienced negative changes in their terms of trade, those regions which have an economic advantage in crops (low cost producers) continue to produce, while regions which have an economic disadvantage in crops cut production significantly. However, production does not cease in these regions altogether, for two reasons. First, oblast governments and corporate farms are reluctant to cease production of crops such as grain or sugar beets, for example, because of concerns about self-sufficiency or keeping processors employed. Second, soft loans or favors compensate corporate farms for such behavior, which is often at odds with pure profit maximization.

The above scenario accounts for the continued production of crops in regions, which have an economic disadvantage in their production. However, how do we account for the significant worsening of the efficiency of relatively inefficient producers? According to our research aimed at explaining the relative efficiency of crop producers, it is precisely the poor performers that tend to receive soft loans, that have a softer budget constraint. However, soft budget constraints tend to encourage behavioral inertia, thus hindering less efficient farms from improving their performance. Soft loans primarily for less efficient farms tend to increase the fall in efficiency on these farms.

7. EXPLAINING THE LEVEL OF TECHNICAL EFFICIENCY IN RUSSIAN REGIONS

7.1 Factors explaining levels of technical efficiency

A number of factors could be responsible for differences in the technical efficiency of corporate farms between oblasts: weather, institutional differences, different political environments associated with the political affiliation of oblast administrations. We utilized weather (precipitation and temperature) and institutional variables in our analysis.

There are a number of possible institutional causes of technical efficiency differences in Russian agricultural enterprises. These institutional differences fall outside the conventional definition of the production function, which is typically concerned with quantities of inputs, outputs, and a specific production technology. The degree of budget softness has been discussed extensively in the transition economics literature as an institutional source of technical inefficiency (GOMULKA 1985; SCOTT 1990; RAISER 1997; KORNAI 1985). The quality of management is the cause most cited in the technical literature on efficiency measurement in non-profit organizations (PESTIEAU and TULKENS 1993). Increasing managerial transaction costs connected with the size or scope of the enterprise is another possible cause of relative differences in the level of technical efficiency between oblasts (WILLIAMSON 1985). Lack of competitive product markets and low production specialization are other likely causes of technical inefficiency. A further potential cause of inefficiency is suggested by the literature on the effects of economic disorganization in the transition process (BLANCHARD 1997). The presence of reliable and unchanging channels of both supply and sales tend to reduce the amount of resources devoted to search on both input and output markets, as well as the uncertainty associated with the transition. Thus, preservation of the old channels of state supply and sales could be associated with minimal falls in technical efficiency.

We estimated the impact of several factors that we believe may explain the static efficiency scores discussed above: (1) employees per corporate farm, (2) average farm size (in ha.), (3) percent of crops marketed through state channels, (4) portion of the value of crop production in the oblast raised privately, (5) percent of agricultural land in the oblast in private farms, (6) changes in relative output and input prices, (7) subsidies to corporate farms as a percent of total farm revenue, and (8) crop concentration on corporate farms.

In our analysis, we found that the following factors were very important in explaining the relative efficiency of corporate farm crop production by oblast:

Average farm size (by acreage): Larger farms tended to be least efficient. This finding suggests that farms in Russia, on average, employ too much land in crop production. This is not surprising, since the average corporate farm in Russia is 6 times larger than the largest farms in the United States.

Employees per corporate farm: This finding suggests that labor is quite scarce on corporate farms, a result consistent with what we know about labor use on corporate farms before reforms. Before reforms, state and collective farms traditionally employed military troops, students, and other city dwellers during the harvest period to augment their labor force. Now that these practices have been curtailed, this result seems to indicate that there are labor shortages, probably during the harvest season. As a result, for corporate farms identical in all other respects, the added benefit of employing another worker most likely exceeds the extra cost of keeping that worker.

This result may seem surprising, since it is often found that joint stock companies with soft budget constraints in transition economies retain excess labor, so that the added benefit of employing another worker is small compared to the extra cost of keeping that worker. However, the findings of our study are not as surprising as they might appear at first glance. Recall that our study concerns exclusively workers employed in crop production. It may be the case that corporate farms tend to retain excess labor for livestock production, but we did not consider the livestock sector in our study. Temporary labor was and is not used for livestock production, only crops. The results of our study highlight important differences between the two sectors.

Changes in the agricultural terms of trade (the ratio of output prices to input prices): The more radical the worsening in the agricultural terms of trade, the more were farms forced to improve their efficiency. Such improvement through adversity reflect the fact that price shocks on the input side led to more rational use of inputs, especially for fertilizers, which were previously overused.

Temperature: Hotter than normal temperatures and occasional droughts in critical growing months in some oblasts led to sharp declines in output after inputs had already been used, which had the effect of showing up as a decrease in efficiency.

The portion of crops produced in the private sector: Most crop production (by value) in the private sector is produced on small (0.5 to 1 hectare) private plots attached to the large corporate farms. We found that the greater the portion of the value of crop output produced in the private sector (primarily on these private plots, engaged in intensive cultivation of fruits and vegetables), the less efficient has been crop production on corporate farms. This finding may be a result of the widely reported pilfering of corporate farm inputs (including labor time) by private plot holders. An increase in production on these plots, leading to increased pilfering, would tend to lower the apparent efficiency of corporate farms.

The following factors were not as strongly determinant of crop production efficiency, but still seemed to have an important impact:

Percent of crop marketed through state channels: The more output that went through old state marketing channels, the less inefficiency there was. This suggests that oblasts that relied on the old channels did not have to incur short-run search and transaction costs and were able to minimize efficiency losses.

Percent of land held privately (not collectively): Although land held by corporate farms is formally privatized, it is owned collectively. Most agricultural land devoted to crop production and held privately is employed in private farms (rather than private plots), which raise field crops such as wheat and sunflower seeds. The oblasts in which corporate farming was most efficient tended to support the most private farming as well. This result seems to indicate that either a legacy of successful farming or less risky natural conditions in certain oblasts encourages both well managed corporate farms and private farm entrepreneurialism.

Subsidies as a percent of revenues: The higher percentage of subsidies (compared to total revenues), the more inefficient are corporate farms. This suggests that government support policies amount to subsidizing the least efficient corporate farms, and/or that support policies tend to encourage less efficient production.

Crop specialization: The more concentrated the crop mix, the more efficient corporate farm production in the oblast. This result is consistent with the hypothesis that specializing in products in which a region has an economic advantage tends to mitigate efficiency losses.

7.2 Policy implications

Our research identified several policy implications for the improvement in the efficiency of Russian farms. One important factor is land policy. Our results indicate that the larger corporate farms are the least efficient. While this is not surprising for those who have followed collective agriculture for years, it points to a rather elementary (but politically difficult at this time) way to improve the efficiency of Russian agriculture: reduce farm size.

The second area in which efficiency could be improved by policy measures is the granting of soft government loans, exemplified here by subsidies as a portion of revenues. It is clear that the granting of subsidies to less efficient farms is highly correlated both with the year by year efficiency scores and with the worsening of efficiency as well.

Third, adverse movement in relative output and input prices seems to be correlated with higher levels of efficiency, as well as lower losses of efficiency. This adverse movement in relative prices mainly reflects the rise in input prices, which were previously kept artificially low. The policy implication from this result is that the more liberalized are input prices for farms, the more efficient those farms tend to be.

Lastly, the more specialization in crop production that occurred from 1991 to 1995, the more efficient the farms. This is a clear argument for allowing farms to specialize in the crops in which they have a comparative advantage.

8. ARE FARMS IN RUSSIAN REGIONS ENGAGING IN GENUINE OR ‘PASSIVE’ RESTRUCTURING?

The general pattern of declining efficiency scores over time in our study is consistent with earlier studies that concluded that Russian corporate farms have been engaging, on the whole, in *passive* restructuring. One of the most interesting parts of our study, however, is the large variation in performance observed among oblasts. What can explain the generally good performance over time of the small number of oblasts with the highest efficiency scores? We are inclined to believe that managers in the most efficient oblasts are doing a better job of adjusting to the shocks of the past few years, that they have managed to minimize falls in efficiency. This performance is despite difficult conditions that have caused the badly managed farms to falter, dropping their efficiency by 20 percent. In as much as better management is a part of *genuine* restructuring, farms in the best performing oblasts seem to have engaged in *real* restructuring.

9. REFERENCES

AIGNER, D., C.A.K. LOVELL, and P. SCHMIDT (1977): Formulation and Estimation of Stochastic Frontier Production Function Models. *Journal of Econometrics*, 6: 21-37.

BATTESE, G. and T. COELLI (1995): A Model of Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data. *Empirical Economics*, 20: 325-332.

BATTESE, G. and G.S. CORRA (1977): Estimation of a Production Frontier Model. *Australian Journal of Agricultural Economics*, 2: 169-179.

BATTESE, G. (1992): Frontier Production Functions and Technical Efficiency: A Survey of Empirical Applications in Agricultural Economics. *Agricultural Economics*, 7: 185-208.

BAUER, P. (1990): Recent Developments in the Econometric Estimation of Frontiers. *Journal of Econometrics*, 46: 39-56.

BLANCHARD, O. (1997): The Economics of Post-Communist Transition. Oxford: Clarendon Press, 1997.

BLASI, J., M. KROUMOVA, and D. KRUSE (1997): Kremlin Capitalism: Privatizing the Russian Economy. Cornell University Press, Ithaca.

BROCK, G. (1997): Are Russian Farms Efficient? *Journal of International and Comparative Economics*, 5: 45-66.

BROOKS, K. and Z. LERMAN (1994): Land Reform and Farm Restructuring in Russia. World Bank Discussion Paper No. 233, Washington, D.C.

BROOKS, K., E. KRYLATYKH, Z. LERMAN, A. PETRIKOV, and V. UZUN (1996): Agricultural Reform in Russia: A View from the Farm Level. World Bank DP 327, Washington, D.C.

CORNWELL, C., P. SCHMIDT, and R.C. SICKLES (1990): Production Frontiers with Cross-Sectional and Time-Series Variation in Efficiency Levels. *Journal of Econometrics*, 46: 185-200.

ERNST, M., M. ALEXEEV, and P. MARER (1996): Transforming the Core. Westview Press, Boulder.

GOMULKA, S. (1985): Kornai's Soft Budget Constraint and the Shortage Phenomenon: A Criticism and Restatement. *Economics of Planning*, 17: 1-11.

GREENE, W. (1980): A Gamma Distributed Stochastic Frontier Model. *Journal of Econometrics*, 13: 27-56.

ICKES, B. and R. RYTERMAN (1994): From Enterprise to Firm: Notes for a Theory of Enterprise in Transition. In: Campbell, R. (ed.): The Postcommunist Economic Transformation: Essays in Honor of Gregory Grossman, Westview Press, Boulder, CO.

KALIRAJAN, K.P. (1981): An Econometric Analysis of Yield Variability in Paddy Production. *Canadian Journal of Agricultural Economics,* 29: 283-294.

KORNAI, J. (1985): Gomulka on the Soft Budget Constraint: A Reply. *Economics of Planning,* 19: 49-55.

KUMBHAKAR, S.C. (1990): Production Frontiers, Panel Data and Time-Varying Technical Efficiency. *Journal of Econometrics,* 46: 201-211.

LEIBENSTEIN, H. (1966): Allocative Efficiency and X-Efficiency. *American Economic Review,* 56: 392-415.

MEEUSEN, W. and J. VAN DEN BROECK (1977): Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error. *International Economic Review,* 18: 435-444.

PARDEY, P. and B. CRAIG (1997): A New Look at State-Level Productivity Growth in U.S. Agriculture. *American Journal of Agricultural Economics.*

PESTIEAU, P. and H. TULKENS (1993): Assessing and Explaining the Performance of Public Enterprises. *Finanz Archiv,* 50: 293-323.

PITT, M. and L-F. LEE, (1981): Measurement and Sources of Technical Inefficiency in the Indonesian Weaving Industry. *Journal of Development Economics,* 9: 43-64.

RAISER, M. (1997): Soft Budget Constraints and the Fate of Economic Reforms in Transition Economies and Developing Countries. Kieler Studien No. 281, J.C.B. Mohr, Tübingen.

SCHMIDT, P. (1986): Frontier Production Functions. *Econometric Reviews*, 4: 289-328.

SCOTT, C. (1990): Soft Budgets and Hard Rents. A Note on Kornai and Gomulka, *Economics of Planning,* 23: 117-27.

SEDIK, D. (1996): Agricultural Policies Mitigate Production Declines, but Have Considerable Costs for the Countryside. In: USDA/ERS, International Agriculture and Trade Report, Situation and Outlook Series: Former USSR, WRS-96-1: 4-8.

STEVENSON, R.E. (1980): Likelihood Functions for Generalized Stochastic Frontier Estimation. *Journal of Econometrics*, 13: 57-66.

WILLIAMSON, O. (1985): The Economic Institutions of Capitalism. Free Press, New York.