Optimal Farm Size in Russian Agriculture

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Abstract

A set of dynamic DEA models is applied to investigate the determinants of farm size of Moscow oblast corporate farms in the period 1996-2004. New institutional economics is found to be more relevant to explaining farm sizes and their changes than the neo-classical framework. The results prove the hypothesis that the development of farm size is mainly caused by reducing transaction costs associated with getting access to product markets..

Keywords: farm size, returns to scale, dynamic DEA

1 Introduction

In the early 1990s many economists expected that small family farms in the former USSR would be more viable than large corporate farms (Lerman, 2001). At present, this expectation seems to prove wrong. Lerman (1998) argues that the implementation of Western-type individual farming is hampered by a variety of factors connected with economic reforms, ranging from domestic political difficulties to individual risk aversion. However, the average size of corporate farms[1] was declining during the transitional period (Table 1A, Appendix). Many Russian studies (e.g. Altukhov, 2005; Miloserdov, 2005) maintain that this happened rather due to market failures than in consequence of deliberately chosen economic strategies of farm owners and managers. And indeed, these authors have found statistical evidence that performance indicators positively correlate with farm size.

In this paper, we contribute to this discussion. We therefore develop a framework for analyzing the determinants of farm size. In particular, we investigate whether farm size development is driven by (constant) returns to scale (*neoclassical approach*) or the minimization of transaction costs (*new institutional economics,* Williamson, 1975). At first glance, the new institutional economics approach appears to be more relevant for transition economies than the neoclassical framework. High uncertainty leads to high market transaction costs which are likely to push farms to grow. Otherwise they might not receive enough resources to access the markets. In order to assess how far both approaches can contribute to farm size development, the following hypotheses are stated and will be tested within appropriate methodological framework:

a) Farm size positively correlates with performance. Moreover, higher growth leads to better performance.
b) The average size of best-practice farms increases during the transitional process.
c) Corporate farms in Moscow oblast **do not** operate at increasing returns to scale (RTS).
d) Agricultural prices positively correlate with farm size.

All four hypotheses are expected to be supported if transaction costs can be proved major factors in inclining Russian farmers towards large-scale operations. Hypotheses (a) and (b) focus on the relationship between farm size, performance and farm growth. Given that these two hypotheses are supported, the analysis can proceed with hypotheses (c) and (d). The next step therefore would mean to identify the reason behind these developments. If it were attributable to scale economies, hypothesis (c) should be rejected. However, if it could not be rejected, new institutional economics would provide

[1] Russian corporate farms are commonly considered as large. Some figures (2004 data of the Moscow oblast corporate farms registry) may illustrate this: average size in terms of workers was 213, in terms of farmland 3384 ha. However, their sales volumes were comparatively low ($1.80 million per farm). Average bank loans per farm amounted to $484 thousand.

the main reasons for the determination of farm size developments. The same argumentation holds true for hypothesis (d).

The rest of the paper is organized as follows. Section 2 discusses the methodology employed in this study. Section 3 describes the data basis. Section 4 deals with the results of this investigation in due detail. The last section provides conclusions and discussions.

2 Methodology

As stated above, it seems more favorable to conduct the analysis within the framework of new institutional economics. A closer look at the intention of this investigation is to justify this choice. In order to test hypothesis (a), we have to measure farm size and long-term performance. Instead of applying a single conventional measure of size (e.g. a Tornqvist index of output volumes), we capture farm size by outputs and inputs. In doing so, we are able to investigate whether or not the relationship between farm size and performance is invariant with respect to size indicators. Moreover, regarding the performance measure, there are two requirements that must be fulfilled. First, it must reflect long-term performance, and second, it must also allow for data that are inconsistent with (standard) regression analysis. Indeed, such a measure can be derived from non-parametric dynamic data envelopment analysis models (DDEA) developed by Nemoto and Goto (2003).

The analysis of an intertemporal frontier is based on the assumption of year-specific production possibility sets Φ_t such that:

$$\Phi_t = \{(\mathbf{x}_t, \mathbf{k}_{t-1}, \mathbf{k}_t, \mathbf{y}_t) \in \mathbb{R}_+^{l+m} \times \mathbb{R}_+^{m+n} \mid (\mathbf{k}_t, \mathbf{y}_t) \in Y(\mathbf{x}_t, \mathbf{k}_{t-1})\}. \quad (1)$$

Here *l, m and n* are numbers of variable inputs, quasi-fixed inputs, and outputs, respectively. $t \in \{1, 2, \ldots, T\}$ denotes the time period, $\mathbf{x}_t$ a $l\times1$ variable inputs vector, $\mathbf{k}_t$ a $m\times1$ quasi-fixed inputs vector, and $\mathbf{y}_t$ is a $n\times1$ outputs vector. Y is a $\mathbb{R}_+^{l+m}$ to $\mathbb{R}_+^{m+n}$ production correspondence. The intertemporal production possibilities ($\times_{t=1}^{T}\Phi_t$) are given by the Cartesian product of all period specific production possibility sets which can be represented by a convex combination of the firms' input and output vectors:

$$\times_{t=1}^{T}\Phi_t = \{\mathbf{X}_t\boldsymbol{\lambda}_t \le \mathbf{x}_t, \quad t = 1,\ldots,T, \quad (1\text{ i})$$

$$\mathbf{K}_0\boldsymbol{\lambda}_1 \le \mathbf{k}_0, \quad (1\text{ ii})$$

$$\mathbf{K}_{t-1}\boldsymbol{\lambda}_t \le \mathbf{k}_{t-1}, \quad t = 2,\ldots,T, \quad (1\text{ iii})$$

$$\mathbf{K}_t\boldsymbol{\lambda}_t \ge \mathbf{k}_t, \quad t = 1,\ldots,T, \quad (1\text{ iv})$$

$$\mathbf{Y}_t\boldsymbol{\lambda}_t \ge \mathbf{y}_t, \quad t = 1,\ldots,T, \quad (1\text{ v})$$

$$\mathbf{i}'\boldsymbol{\lambda}_t = \mathbf{1}, \quad t = 1,\ldots,T, \quad (1\text{ vi})$$

$$\boldsymbol{\lambda}_t \ge \mathbf{0}, \mathbf{y}_t \ge \mathbf{0}, \mathbf{k}_t \ge 0, \quad t = 1,\ldots,T\}. \quad (1\text{ vii})$$

Given this, *overall dynamic efficiency (ODE)* can be defined in an output-oriented specification as:

$ODE = R \big/ R(\overline{\mathbf{k}}_0)$, where

$R = \sum_{t=1}^{T}\gamma_t(\mathbf{w}_t\overline{\mathbf{y}}_t)$ and

$$R(\overline{\mathbf{k}_0}) = \max_{\{\mathbf{y}_t,\mathbf{k}_t,\boldsymbol{\lambda}_t\}_{t=1}^T} \left\{ \sum_{t=1}^{T} \gamma^t (\mathbf{w}_t{}'\mathbf{y}_t) \,|\, (\mathbf{x}_t, \mathbf{k}_{t-1}, \mathbf{k}_t, \mathbf{y}_t)_{t=1}^T \in \times_{t=1}^T \Phi_t, \mathbf{k}_0 = \overline{\mathbf{k}}_0 \right\} \quad (2)$$

A bar indicates observed values exogenously given. γ^t is a discount factor, and $\mathbf{w}_t$ is a $n \times 1$ vector of output prices. In this context, it is important to notice that $\mathbf{w}_t$ comprises common product prices for all firms. An assumption that is essential for our purpose, as it allows distinguishing internal factors which are captured by (2) and external factors affecting farm-specific prices. Thus, the efficiency indicator ODE provides an approriate measure for reflecting a firm's best performance subject to perfect markets. The tests for significance of correspondences between size and efficiency are based on the non-parametric Spearman rank correlation measure. However, as correlations do not provide information about the direction of causality, it seems reasonable to resort to conventional techniques. In order to establish that farm size indicators and their growth do affect performance, we conduct regressions of the form:

$$ODE_n = a_{0st} + a_{1st}(s_{nt}/s_{nt-1}) + \varepsilon_{snt},$$

where s denotes a specific size indicator, t the year and n the number of a farm. If $a_1 > 0$, the proposed relationship holds. The existence of the inverse relationship, i.e. higher performance leads to farm growth, is tested using rank correlations between the residuals (ε) and the efficiency indicator ODE. Altogether, a positive test ascertains a significant impact of efficiency on farm size.

The second hypothesis (b) is addressed by informal comparative dynamics. These relative performance criteria are applied to size indicators that characterize the whole sample and the best-practice subsample which is defined as the top sextile of ODE.

Test for hypothesis (c) requires a measure of returns to scale (RTS). Following the reasoning in Banker (1984) and Banker et al. (1984), we estimate year-specific RTS indicators as the difference

$$\Delta = s\, R(\overline{\mathbf{k}_0}) - R(\overline{\mathbf{k}_0}, s), \text{ where}$$

$$R(\overline{\mathbf{k}_0}, s) = \max_{\{\mathbf{y}_t,\mathbf{k}_t,\boldsymbol{\lambda}_t\}_{t=1}^T} \left\{ \sum_{t=1}^{T} \gamma^t (\mathbf{w}_t{}'\mathbf{y}_t) \,|\, (s\mathbf{x}_t, s\mathbf{k}_{t-1}, s\mathbf{k}_t, \mathbf{y}_t)_{t=1}^T \in \times_{t=1}^T \Phi_t, \mathbf{k}_0 = \overline{\mathbf{k}}_0 \right\} \quad (3)$$

and $s \leq 1$ is a scaling factor that should not be confused with the size indicator from the ODE estimation equation. According to Δ, the difference turns out to be positive (negative) if returns to scale are increasing (decreasing). In order to prove validity, the generated values of Δ have to be tested for significance (5% level). Therefore, an ordinary t-test is conducted on the different RTS regimes. Consequently, hypothesis (c), after which the farms do not operate at increasing RTS, cannot be rejected if the estimated returns to scale (Δ) are found to be either insignificant (level?) or significantly decreasing.

Finally, it remains to deal with hypothesis (d). Assuming a positive correlation between prices and size indicator, it can adequately be examined by Spearman's rank correlation test. Consequently, significant positive values indicate that hypothesis (d) cannot be rejected.

3 Data

The data source is a registry of Moscow oblast corporate farms for the period 1995-2004 provided by Rosstat[2]. Depending on individual years, the empirical models use 231 to 387 observations, thus

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[2] Rosstat (former Goskomstat) is a federal statistical agency of the Russian Federation.

forming an unbalanced panel of 3081 observations. Efficiency scores and RTS measures can only be computed for a subset of 175 farms because of limited data availability for all ten years. A criterion that also governed the selection of Moscow oblast as investigated region. Despite these sample limitations, the findings of this study can serve as a basis for reliable testing of the formulated hypotheses about farm size determinants of corporate farms in this region.

The available data basis for each farm is given as follows. Variable inputs (**x**) are the number of poultry, number of employees, arable land, hay lands and pastures, as well as long-term and short-term loans. The quasi-fixed inputs (**k**) consist of: number of cows, number of pigs, depreciation (unit) (as proxy for fixed assets), and production costs as indicator of material inputs. All monetary values are deflated employing appropriate price indices. The following merchantable outputs are considered: grain and milk (each in physical units and volume of revenues), as well as revenues from other crop and animal production at constant prices.

The prices used in this study are calculated values. For grain and milk, average annual prices for the oblast are obtained from sales and revenues assuming approximately similar quality of products among farms. For the group other crop and animal production, prices are set constant at the value of the base year. The discount parameter γ^t is approximated by the average interest rates on short-term (one year and shorter) Ruble credits that are issued in the given year by credit organizations to juridical persons.

The size indicators s_{nt} consist of selected inputs and outputs. They include total farmland, arable land, total revenues, production costs, depreciation and the stock of cows.

4 Results

4.1 Size and performance

The results of the analysis between farm size and performance are summarized in Table 1. Here is given the relation between year-specific farm size indicators s_t and dynamic efficiency ODE over the whole nine-year investigation period from 1996-2004. The first part of the table is reserved for Spearman's rank correlations whereas the second part takes the correlation between size indicators and residuals of the ODE regression.

From the figures follow that Spearman's rank correlations are positive and significant (5% level) in the majority of years, except for land. Moreover, as the correlations show increasing values over time, farm growth can be assumed to induce better performance; a result that is widely supported by the ODE regression analyses. Here, a_1 was found to be positive, though not always significant.

From the second part of Table 1, however, it is clear, that there is also evidence of the inverse statement, i.e. higher performance as a prerequisite for farm growth (see Section 2). Significant Rank correlations of size indicators and ODE residuals ε back this conclusion, at least for some inputs such as revenue, material costs and number of dairy cows.

On the whole, the estimates support hypothesis (a). In more detail, the results prove a positive impact of size on performance for revenue, production costs, and dairy cows' number. The inverse statement, after which there is an impact of performance on size (via growth), is found to be significant in many years. Nevertheless, this only plays a secondary role in the revealed correspondence between ODE and these size indicators.

Table 1: Relationship between size indicators and dynamic efficiency ODE

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004
Spearman rank correlations between ODE and size indicators									
Farmland	-0.09	-0.09	-0.07	-0.01	-0.00	0.00	0.02	0.04	0.07
Arable land	-0.04	-0.02	-0.02	0.02	0.03	0.05	0.06	0.09	0.11
Revenue	**0.64**	**0.69**	**0.75**	**0.80**	**0.82**	**0.84**	**0.84**	**0.83**	**0.83**
Material costs	**0.47**	**0.52**	**0.60**	**0.69**	**0.73**	**0.76**	**0.76**	**0.76**	**0.75**
Depreciation	**0.24**	**0.24**	**0.23**	**0.30**	**0.35**	**0.47**	**0.51**	**0.58**	**0.56**
# of dairy cows	**0.19**	**0.26**	**0.35**	**0.41**	**0.47**	**0.52**	**0.55**	**0.62**	**0.64**
Correlations between size indicators and residuals of the ODE regression									
Farmland		–0.08	–0.07	–0.02	–0.00	0.03	0.03	0.05	0.08
Arable land		–0.03	–0.01	0.01	0.04	0.06	0.05	0.08	0.12
Revenue		**0.66**	**0.68**	**0.80**	**0.80**	**0.84**	**0.79**	**0.84**	**0.83**
Material costs		**0.48**	**0.51**	**0.62**	**0.59**	**0.76**	**0.76**	**0.75**	**0.76**
Depreciation		**0.24**	–0.00	**0.19**	0.06	0.09	0.10	0.14	–0.02
# of dairy cows		**0.17**	**0.32**	**0.39**	**0.51**	**0.51**	**0.55**	**0.64**	**0.60**

Bold number indicate significant correlations (5% level).
Source: authors' calculations.

4.2 Size of best-practice farms

The results concerning hypothesis (b) are displayed in Table 2. Here, the values of the diverse average size indicators are grouped into those referring to the whole sample and those referring to the best-practice farms, each measured relative to the year 1996. As the sample size of 175 farms does not include farms that could not sustain business during during the studied period the generated values may be biased and thus should be taken with reservation. Despite this, mean size indicators do not reveal positive trends (Table 2), thus not implying a positively biased effect of transition.

A look at the whole-sample-figures in detail reveals decreasing depreciation coefficients indicating degrading fixed capital. However, this does not necessarily imply that farms have no or increasingly difficult access to machinery equipment, and hence limited possibilities to adopt innovations. But there are alternatives to participating in technical progress. And indeed, leasing as a form of getting access to capital (i.e., mechanization and innovation) has become more widespread in Russian agriculture. Contrary to that, livestock is not a common subject of leasing, and thus decreases slower. Revenues and production costs remain nearly unchanged. Average land area displays unstable growth.

The top sextile of the sample comprises 28 farms which are called hereafter best-practice subsample. The average ODE of these farms is 0.800 versus 0.501 of the whole sample.

Table 2: Comparison of size indicators of sample and best-practice farms.

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Average over 175 farms, % to 1996									
Farmland	010.0	99.6	99.5	103.0	104.4	104.8	106.1	106.3	101.8
Arable land	100.0	98.5	99.7	102.9	104.1	105.0	106.1	106.3	101.5
Revenue	100.0	96.6	83.2	101.4	97.3	106.5	118.7	102.5	99.5
Material costs	100.0	98.6	83.6	89.6	95.5	99.4	97.9	102.1	90.6
Depreciation	100.0	80.2	50.4	29.7	23.8	22.3	21.0	20.9	18.6
# of dairy cows	100.0	92.7	87.0	85.1	84.2	82.0	79.8	76.6	72.3
Return to costs	–6.4	–6.9	8.9	41.8	18.5	32.3	25.4	14.4	14.8
Average over best practice farms, % to average over 175 farms in 1996									
Farmland	96.7	96.7	98.1	103.8	107.4	109.0	112.4	112.4	111.9
Arable land	94.0	94.9	96.3	102.2	107.0	109.1	112.2	112.3	110.9
Revenue	148.9	155.4	170.5	252.4	232.9	280.3	271.7	258.9	229.4
Material costs	120.9	131.0	119.0	138.9	162.5	178.3	181.6	188.4	168.4
Depreciation	116.1	97.4	65.2	42.7	36.4	38.2	37.6	39.0	35.2
# of dairy cows	120.3	117.6	118.5	120.4	126.5	129.1	130.8	130.4	130.3
Return to costs	15.4	11.0	34.1	70.1	34.2	47.2	40.1	28.7	27.6

Best-practice farms are the farms belonging to the top sextile with respect to ODE.
Source: authors' calculations.

Referring to Table 2, the comparison between whole-sample and best-practice subsample yields different results towards the diverse size indicators. In 1996, with respect to farmland and arable land, the difference only amounted to 3.3% and 6.0% lower values, respectively. For all other indicators, the results are more distinct. Again in 1996, best-practice farms yielded 49% higher revenues while, at the same time, only reporting 21% higher material costs; fixed assets (measured as depreciation) and number of dairy cows came out about 16% and 20% higher, respectively. What is more, despite their large initial values, they kept growing, though not steadily. The only exception from this general pattern reveals depreciation, which decreased. However, in 2004, a best-practice farm held more than twice as many fixed assets than an average farm. It is also worthy to note that livestock (number of cows) as proxy for quasi-fixed assets grew in comparison with the situation in the whole sample.

As also follows from Table 2, before 2001/2002, the best-practice farms took full advantage of their growth capacity and, unlike the other farms, could increase their sizes. In more recent years, the best-practice farms have appeared to be satisfied with the scale of production. However, they have remained definitely larger than their less efficient competitors who have failed to expand their production capacities.

Altogether, it is clear from this that the results are consistent with hypothesis (b). I.e., the analysis provides evidence of increasing growth of best-practice farms during the transition period 1996 - 2004.

4.3 Returns to scale

In order to conduct the analysis with respect to hypothesis (c), we started with checking for *prevailing* RTS by accounting for the number of farms which operated at both increasing and decreasing returns to scale. However, in terms of this coefficient, the sample is not unambiguous. In seven out of nine years the majority of farms showed positive returns to scale (Table 3). Volatile shares of increasing and decreasing RTS suggest that changes in technologies and prices during a year can induce a change of the direction of RTS of many farms. This characteristic of technology does not support long-term decisions. On the contrary, it deters farm managers from discerning the optimal scale of production .

Altogether, the statistics for the whole period do not reject the hypothesis that both RTS directions are equi-probable, what, in turn, conforms to the research hypothesis (c). But yet this result is not fully conclusive: for one thing farm sizes vary (in terms of revenue from 4.5 to 333.6 million Roubles in 2004, with a mean value of 64.7), and for another, the gross impact of increasing RTS on many small farms is likely to be smaller than the impact of decreasing RTS on a single large-scale farms. Because of this testing for prevailing RTS may easily result in biased conclusions about increasing RTS.

The above aforementioned considerations are taken into account in the bottom part of Table 3 where the information about the *dominating* RTS direction is given. To proceed, we test whether the difference Δ in section 2 is significantly different from zero, i.e., whether there is a significant deviation from neutral RTS. According to the test, however, the deviation appears to be random as it cannot be proved different from zero in most of the years. Thus, there is no corroborative evidence either for increasing or decreasing returns to scale.

Table 3: Direction of RTS.

Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	Total
Cases of RTS:										
Increasing**	**108**	**98**	**122**	**126**	**128**	**98**	30	**94**	52	88
Decreasing**	52	62	38	34	32	62	**130**	66	**108**	72
Prevailing RTS	+	+	+	+	+	+	-	+	-	**?**
Mean RTS*,***	**21**	**15**	3	7	-2	-1	**14**	4	231	293
Dominating RTS	**-**	**-**	**0**	**0**	**0**	**0**	**-**	**0**	**0**	**0**

* Million roubles per split into two similar entities.
Bold numbers indicate significant values (5% level): **Significance estimated using a binomial distribution with equal probability for both regeimes. *** Significance estimated by a t-test.
Source: authors' calculations.

Consequently, research hypothesis (c), assuming the absence of increasing RTS, is supported by the estimates, although the greater number of farms operate at increasing RTS in seven out of nine years (see Table 3). The conclusion, however, holds true because the impact of "increasing-RTS-farms", ceteris paribus, cannot compensate the positive effect of splitting large farms.

4.4 Correlation between prices and size

Hypothesis (a) is supported not only for ODE, but also for *pure dynamic efficiency*, hereafter called PDE. SDE suggests that farms, regardless of size, have almost similar opportunities to improve performance by changing size. But mean SDE (0.954, varying from 0.747 to 0.992), compared to mean ODE (0.501), can scarcely motivate the farms to exploit economies of scale by changing size, especially subject to volatile RTS. Accordingly, returns to scale fail to prescribe large-scale farm production in Moscow oblast. In this respect it is worth mentioning that a few outliers on either side were excluded from the analysis. To resolve this contradiction, the underlying reasons should be sought outside the farm.

The studied farms had only few years to adjust their technologies to dramatically changed prices. Moreover, success in pursuing high performance is subjected to available funds, which are likely to depend on both size and transaction costs. But, as small farms are expected to be exposed to a disproportionately heavier burden of transaction costs (due to fewer transactions, in number and volume), hypothesis (d) seems compelling. This is, of course, decisive because validity of this hypothesis is a necessary requirement for our approach to explaining the reasons for large-scale farming in Moscow oblast as formulated above.

Table 4: Significance level α of rank correlation between prices and size indicators

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004
Milk prices									
Farmland	**-0.43**	**-0.37**	**-0.28**	**-0.19**	**-0.25**	**-0.16**	**-0.25**	**-0.18**	**-0.22**
Arable land	**-0.44**	**-0.35**	**-0.27**	**-0.17**	**-0.26**	**-0.15**	**-0.24**	**-0.17**	**-0.23**
Revenue	**0.41**	**0.44**	**0.54**	**0.43**	**0.37**	**0.44**	**0.42**	**0.39**	**0.43**
Material costs	**0.36**	**0.37**	**0.48**	**0.39**	**0.34**	**0.40**	**0.39**	**0.32**	**0.39**
Depreciation	**0.17**	0.10	**0.19**	**0.13**	**0.16**	**0.21**	**0.18**	**0.16**	**0.29**
# of dairy cows	**-0.22**	-0.08	**0.10**	**0.14**	0.04	**0.14**	**0.12**	0.08	0.12
Grain prices									
Farmland	**0.60**	-0.07	**-0.14**	0.08	0.03	-0.03	-0.05	**-0.12**	**-0.14**
Arable land	-0.02	**-0.15**	**-0.17**	**0.11**	0.04	-0.02	-0.09	**-0.13**	**-0.18**
Revenue	**0.11**	-0.10	**-0.10**	**0.22**	-0.07	-0.08	-0.04	-0.03	**-0.16**
Material costs	0.08	**-0.11**	**-0.11**	**0.14**	-0.07	-0.05	-0.04	-0.04	**-0.16**
Depreciation	-0.03	**-0.15**	**-0.13**	0.05	-0.02	0.03	0.01	0.03	-0.11
# of dairy cows	**0.12**	-0.00	-0.03	**0.14**	0.07	0.00	0.01	0.00	-0.07

Bold numbers indicate significant values (5% level):
Source: authors' calculations.

To corroborate hypothesis (d), we have to capture the relationship between product prices and size indicators. In order to do so, we have to determine Spearman’s rank correlations between these two factors. But, since the corresponding farm specific prices are based on limited data, the rank correlations are only applied to two kinds of output, namely milk and grain. The calculated Spearman’s rank correlations are listed in Table 4. As can be seen from this table, there are two different conclusions to draw: in case of grain prices, the correspondence is almost always insignificant, but in case of milk prices significant.

A closer look at the figures will provide more detail. The correlation between milk prices and size is positive for monetary indicators; however, it is negative for land and varying in the number of dairy cows. The explanation is that land is *not* a scarce resource for the majority of farms. On average, the share of farms that only used a part of their arable land varied from a minimum of 65.8% (in 1996) to a maximum of 74.4% (in 1999). The demand for agricultural land only existed at low prices (Il'ina and Svetlov, 2006). As a consequence, large land area is unlikely to help increase sales and reduce transaction costs per unit of output. Conversely, the larger the land area the lower the sales of milk are. A statement that holds true, as the share of farm assets used in crop production increased, accompanied by rising costs of land congestion. Table A2 in the appendix provides an illustration of these considerations.

Hence, it is clear that hypothesis (d) can only be partially confirmed in this study. The statement is valid for at least one output and selected size indicators. Moreover, the significance of transaction costs of milk production is appropriate to explain the inclination of farms to grow and to join business networks: the share of grain of total sales varied from 1.5% in 1999 to 3.7% in 1997. The share of milk produced by such networks, however, increased from 26.8% (1997) to 42.4% (2004).

5 Conclusions and discussion

This paper provides a methodological framework for identifying the propensity of farm managers to increase farm size. The importance of RTS as factor of superior performance is found to be minor in Moscow oblast corporate farms. In contrast, the impact of incentives to reduce transaction costs and to concentrate capital for market entry does not contradict with the estimates. Hence, the framework of new institutional economics proves to be more relevant to the explanation of farm size determinants in the transitional economy of Moscow oblast than the neo-classical framework.

The acceptance of research hypothesis (a) provides evidence that there is a field for establishing farm business networks in Moscow oblast in the sense of Spoor and Visser (2004). These networks offer a tool for decreasing the share of transaction costs which are associated with the market price of agricultural products. Moreover, this tool is of substantial importance in the situation of sustaining transition, especially when transaction costs are expected to be high in comparison to well developed markets. Support for research hypothesis (b) clearly makes it evident that the smaller the farms in transitional markets the lower their chance to survive. A simple rule that is applicable to the farms in Moscow oblast.

The corroborated research hypothesis (c) suggests that internal factors like returns to scale currently cannot be considered pivotal motivation in making decisions about farm size. Compared to other sources of inefficiencies, scale inefficiencies are low in the majority of farms. Since there is no clear direction of returns to scale, they cannot provide corporate farms with reliable information on making long-term decisions towards farm growth. In contrast to this, the accepted hypothesis (d) points to the undeniable impact of external factors on growth, transaction costs of milk production and marketing. This calls for sustainable agricultural policies, aiming at not only lowering transaction costs but also easing milk market entry to any agricultural producer.

In summary, it can be foreseen that, subject to successful transition, the tendency to large-scale farming in the Moscow oblast agricultural business will decrease and will come to a halt. This is why, the lower the transaction costs and the higher the prices of land are the lower are the benefits of large-scale farming. However, the current situation is such that the majority of corporate farms must either grow or vertically integrate in order to secure competitiveness and to survive.

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Appendix

Table A1: Size changes of Russian corporate farms.

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004
Employers	230	212	193	188	170	171	159	149	139
% to year 1996	100.0	92.2	83.9	81.7	73.9	74.3	69.1	64.8	60.4
Sown area, ha	3078	2919	2810	2674	2504	2677	2669	2638	2689
% to year 1996	100.0	94.8	91.3	86.9	81.3	87.0	86.7	85.7	87.4
Cows	327	287	257	244	226	231	219	216	209
% to year 1996	100.0	87.8	78.6	74.6	69.1	70.6	67.0	66.1	63.9

Source: Rosstat (2006).

Table A2: Farm-gate milk prices (2004, roubles per kg) depending on gross revenue and arable land.

Groups on revenue / Groups on arable land	Lower 33% (1.5- 28.2 m rouble)	Average 34% (28.6 - 63.4 m rouble)	Higher 33% (64.2- 1243.2 m. rouble)	Whole sample
Lower 33% (78 - 2442 ha)	6.93	7.03	7.88	7.19
Average 34% (2459 - 4100 ha)	6.29	6.46	7.35	6.60
Larger 33% (4105 - 10893 ha)	6.07	6.26	7.18	6.68
Whole sample	6.52	6.58	7.39	6.82

Source: authors' calculations.