Debts, subsidies and performance of Russian agricultural enterprises

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Abstract

This study evaluates the impact of capital structure and subsidizing program on technical efficiency of agricultural production on Russian farms. The agency cost, free cash flow, and credit evaluation concepts of finance theory complemented with features of Russian farming provide alternative explanations for the potential relationship between financing arrangements and farm-level performance. A panel of large-scale dairy farms from the Moscow Region over the period 1996-2000 is the focus of the application. A two-stage procedure is employed. First, Data Envelopment Analysis is used to compute technical efficiency. Second, the performance measures are regressed on financial characteristics, such as debt to asset ratio, proxy for soft budget constraints, subsidies to revenue ratio and a set of socio-economic factors using a Tobit regression model. The analysis shows that debt to asset ratio does not fully depict the financial situation on Russian farms. No strong relation between capital structure and efficiency is found. However, a strong support of a negative role of soft budget constraint is observed. Loss-making farms that accumulate high debts and are nevertheless get external finance by means of credits, loans, supply of inputs and subsidies are less efficient. Higher wages is the key stimulating mechanism for increasing efficiency.

JEL classification code: Q12, Q14, P31

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1. Introduction

The reforms in Russian agriculture initiated in the beginning of the 90s resulted in a substantial decline of agricultural production and productivity in the years thereafter (OSBORNE and TRUEBLOOD, 2002; SVETLOV, 2002). The performance of the agricultural sector is and most likely will be determined by the performance of large-scale farms, the successors of former sovkhozes and kolkhozes. Large-scale farms operate 82-85% of total agricultural land and remain the main producers of grain, meat, eggs and milk in Russia. High indebtedness of agricultural producers suggests a poor sectoral performance: in 2000, about 80% of Russian farms had overdue debts. Indebtedness or, in other words, capital structure, can be a result, as well as a cause of poor performance. In the finance literature, capital structure is studied in both directions. In transition economies, economists explain the debt accumulation problem as a result of supply or demand shocks, tightening of the credit conditions, absence of bankruptcy and land markets (see SEDIK et al., 2000a; YASTREBOVA, 2001). Since Russian agriculture has been highly indebted for many years already, the consequences for individual farm and sector performance are of importance.

Parallel with accumulating high debts, the enterprises experience cuts in subsidies – the key element of price policy in the centralized Russian economy as they compensated for the difference between administered prices and actual costs of products. Despite declining trends in both output and subsidies, the share of subsidies in the regional agricultural output remains about 12.5 % in 1997-1998 (see MINSELKHOZPROD, 2000). About 95% of dairy farms in the region received subsidies in 1996-2000 that in one way or another underlines their contribution to performance.

In different fields of research, performance is measured with different indicators. In production economics, technical efficiency is often used while in corporate finance the performance is usually measured as profitability or Tobin's Q representing the value of a firm. In this study, the degree of technical efficiency (TE) attained by farm businesses is used as a performance indicator. TE contributes directly to resource productivity and provides a clear signal of managerial effectiveness. Thus it is a significant determinant of business performance.

The impact of capital structure and subsidies on resource allocation and performance may be positive or negative. At the micro level, subsidies can create impediments to competition through unequal conditions for functioning of the farms. Furthermore, they can lead to ineffective distribution of resources, give wrong market signals and perpetuate loss-making enterprises (LEGEIDA, 2001). High debts can either hamper the opportunities of borrowings aimed at timely financing of production or be a source of production expansion, ensuring sufficient financing of production and investments.

A considerable number of applications studied the efficiency of firms in agriculture, including those in Central and Eastern Europe. Much of the work on efficiency in Russian agriculture has been limited to the analysis of aggregate (Oblast level) data (ARNADE and GOPINATH, 2000; SEDIK et al., 2000b; SOTNIKOV, 1998; VOIGT and UVAROVSKY, 2001). There are no studies on technical efficiency, to the best of the authors knowledge, at the Russian individual farm level; the major reason being a lack of data. There are limited applications to Russian agricultural data that introduce financial characteristics, i.e. debt structure in the study of financial performance of large-scale farms from St.-Petersburg region (EPSTEIN, 2001) and Volgograd region (SCHULZE et al., 2001). SCHULZE *et al.* (2001) find no statistically significant relation between profitability and absolute level of debts payable. Analysis of aggregated data in SEDIK *et al.* (2000b) shows a negative impact of subsidies on technical efficiency of Russian crop producers in 1991-1995.

In Russian agriculture, the relationship between capital structure (debt-to-asset ratio) and efficiency, subsidies and efficiency remains unclear. This study attempts to shed some light on these relationships. The paper is organized as follows. The next section proceeds with a description of the indebtedness problems and subsidy programs in Russian agriculture. This is followed by a review of financial theory concepts (agency cost, free cash flow, and credit evaluation concepts) and soft budget constraint theories that contribute to explaining the relation between debts and efficiency. The methodological approach of two-stage modeling is presented in section 4. Section 5 summarizes the data and presents the description of variables. Section 6 presents the research findings. Conclusions are found in Section 7.

2. Subsidies and farm indebtedness in the 90's

To understand the motivation of the study, it is helpful to briefly review debt accumulation problem in Russian agriculture and also to give a general description of a sector performance.

Ten years of transition from the socialist system to a market economy have brought an invaluable experience to the whole Russian economy and to its sectors, including agriculture. Large collective (*kolkhozes*) and state (*sovkhozes*) farms passed through the reorganization and restructuring campaign initiated in 1991-1992. Recent studies in the Ukraine and Russia showed that about half of the farm employees reports that no real change has taken place so far in 'reorganised' farms, i.e. the internal management, actual organization, and work incentives did not really change (LIEFERT and SWINNEN, 2002; MACOURS and SWINNEN, 2000). Since 1992, agricultural producers had to face the new operating environment characterized by price liberalization, abolishment of state procurement and cuts in state subsidies. As can be seen in Table 1, both the level of subsidies granted to

dairy farms in Moscow region and percentage of subsidies in agricultural revenue decreased dramatically in the period 1996-2000 and especially right after the year of financial crisis (1998) lowering down to 2.4% in 2000.

After an initial fall in agricultural production, Russian agriculture was expected to recover significantly. However, gross agricultural output (GAO) has declined by over 40% between 1991-1998[1], and more than half of the enterprises were unprofitable since 1994. In 1997, the sector demonstrated a small economic growth of 1.7%. After stabilization of the sector in 1999-2001, agriculture is expected to grow by 3-4% (LIEFERT and OSBORNE, 2002). However, the problem with high debts accumulated in the sector remains unresolved.

The level of debts both long- and short-term in constant prices increased throughout 1995-2000 by 150%. As can be seen from Table 1, short-term debts (85%) having accounts payable as the main component (75%) prevail over long-term debts (15%). The largest component of debt payables on Moscow dairy farms in 1996-2000 is debt to suppliers (55%). Tax arrears together with debts to social insurance funds constitute 28%, wage arrears – 8%. It is remarkable that the nature of debts differs from that in western agriculture where the major part of debts is from commercial (agricultural) banks. The discussion on implication of different sources of debts follows in section 3.2.

Table 1 here

The change in the structure of payables reflects the changing attitude of farms towards their business partners. Much depends on the attitude of creditors as well. The composition of overall farm debts on Moscow region dairy farms changed in several ways that mostly repeats the dynamics observed for all Russian farms (see YASTREBOVA, 2001). First, during the period 1996-2000, the percentage of debt on credits decreased, and percentage of accounts payable increased accordingly. Second, payables to especially social funds (pension, medical insurance, education, etc.) grew rapidly. In contrast, the share of debts to suppliers remains above 40%, reflecting the importance of non-commercial creditors for farms.

As can be seen, both the level of subsidies and percentage of subsidies in agricultural revenue decreased right after the 1998 financial crisis. Subsidies for milk remain the main component of livestock subsidies, although their share in gross subsidies reduced over the years. The proportion between regional (80%) and federal (20%) subsidies remains more or less constant over the years indicating no major changes in subsidizing programs.

Attempts of the government to resolve the financial problems of the farming sector by introducing formal procedures, like debt restructuring or bankruptcy procedures, have not improved the financial situation on the farms so far

[1] This figure is given for all types of producers. Gross agricultural output by agricultural enterprises reduced even more dramatically: 1991-1998 by 60%. Given the tendency to overreport production during the Soviet era, the actual output drop may have been somewhat smaller (OSBORNE and TRUEBLOOD, 2002).

(YASTREBOVA, 2001). A long-term crisis management strategy is lacking and as a result, most farms continue to carry the burden of historical debts. The problem of the weakest farms is solved through different reorganisation options, including actual liquidation without using the formal bankruptcy procedure such as takeovers by strong farms and other businesses, offers for leasing of residual assets, separation through daughter companies, etc. This improves the utilisation of resources of hopeless companies, but does not resolve the pressing issue of debts in the farming sector.

3. Financial Concepts and Farm-Level Efficiency

This section addresses to finance theories that explain the effect of capital structure on firm performance. Next, it raises the issues relevant for application of these theories to Russian agriculture under existence of soft budget constraints.

3.1 Financial concepts in market economies

MODIGLIANI and MILLER (1958) conclude in their seminal paper that the capitalstructure is irrelevant to firm value under a set of strong assumptions. Studies on debt structure and its relevance for performance are often found in the empirical corporate finance literature referring to applications in industrial corporate sector. There are two different arguments in favor of positive or negative impact of high indebtedness on performance of a firm. The *agency cost concept* in finance originated by JENSEN and MECKLING (1976), hypothesizes that monitoring, bonding, and adverse incentive costs are incurred in a borrower-lender relationship in order to resolve problems of asymmetric information and misaligned incentives between the two parties. Various practices may be utilized to reduce these agency costs (reporting requirements, reputation effects, penalties) that in any case increases the costs of firm operation and lowers efficiency.

In contrast, the *free cash flow concept* developed by JENSEN, 1986) suggests a positive effect of high debts on performance. According to this concept, agents with excess cash flows and abundant financial assets may exercise managerial laxness, devote insufficient attention to detail, and squander resources in nonbusiness uses. Managers faced with high debt obligations increase their effort, thereby enhancing technical efficiency and business performance.

The *credit evaluation concept* suggests that lenders will prefer to finance more efficient farmers because these borrowers have lower credit risks (ELLINGER et al., 1992). Agricultural bankers often use management/efficiency variables (i.e. operating costs per acre, yield per acre, profit per cow, etc) along with various financial variables in evaluating creditworthiness. Use of greater financial leverage by some borrowers could represent certification of greater technical efficiency, through the lender's favorable evaluation of the borrower's creditworthiness and the resulting loan decisions. Also, farms that manage to attract new credits likely

demonstrate higher efficiency, since higher efficiency indicates their creditworthiness. Thus, the credit evaluation concept suggests positive relationship between technical efficiency and debt-to-asset ratio (NASR et al., 1998).

Following these theories, any relation between debt and performance can be expected. In agriculture, these concepts are applied in studying the relation between capital structure and technical efficiency of American grain farms (NASR *et al.*, 1998) with the outcome in support of Jensen's free cash flow concept.

3.2 Application of financial concepts to Russian agriculture

Before applying these concepts and formulating the hypotheses about the effect of farm indebtedness on its performance, it is useful to recall that these concepts were developed for firms operating in market economies. It necessitates caution in their application to a transition economy. First, these concepts assume well-functioning credit markets, i.e. credit supply always meets credit demand. In Russia, the commercial credit market for agriculture is underdeveloped because of riskiness and low profitability of this business. Second, the leading role of commercial credit in developed economies and its minor role in transition economies was already mentioned in section 2. And finally, in developed countries firms with excessive obligations unlikely continue their business, whereas in Russian agriculture this is quite widely observed. Concluding, in Russian settings the Jensen's theory may not lead to finding a positive effect of debts due to their excessiveness. Moreover, this theory is mainly applicable to debts issued by commercial creditors, which impose strict regulations on borrowers[2].

The hypothesis about positive relationship between technical efficiency and debt-to-asset ratio that follows from the credit evaluation concept needs some justification for Russian agricultural enterprises. Since short-term debts on credits and loans have relatively little share in total and current debts (see Table 1), the creditors are not able to determine creditworthiness of a borrower while observing his debt-to-asset ratio because high debts in Russian context certainly do not indicate large bank loans but large debts to suppliers and the state. Thus, the credit evaluation concept fails when debt-to-asset ratio is analyzed. The ratio of new short-term credit to total assets may reveal a positive relation under the hypothesis that efficiency of farms that attract new bank loans is higher.

A positive impact of debts becomes likely when farms generate debts in order to use them as working capital to keep business operating instead of going bankrupt. The short-term debt payables may likely serve farms with working capi-

[2] It is not so easy to define such creditors in Russian agriculture, because agrobanks, which are appointed by the government and distribute state money, issue loans. Thus, bank loans may not represent the same sort of debts the financial theory is analyzing.

tal ("trade credit"), in which case a positive relation may be expected. This reasoning, though leading to an expectation of a positive sign, does not correspond with Jensen's free cash flow concept.

There is some evidence in support of the agency cost concept on negative effect of debts associated with increasing costs. Situations with high debts in many sectors of economy lead to barter transactions. Farms get inputs in exchange for their outputs or other services. In this case acquiring inputs is associated with higher transaction costs for producers (VARSHAVSKY, 2000). Empirical evidence for a negative impact of debts due to high transaction costs is presented in SEDIK *et al.*, 2000a) for the case of Ukrainian agriculture. There is another explanation for the negative effect of debts. Firms that have already accumulated large debts, i.e. have poor financial reputation, will be more restricted than firms that have not, i.e. increasing the debts will reduce the current and future possibilities to use this exemption to relieve liquidity constraints. The distinction between negative effect of SBCs and bad financial reputation of farms should be made.

As can be concluded, it is rather difficult to present a clear link between discussed above theories and appropriate measures of capital structure in transition economy. The workaround is suggested by the theories of soft budget constraints (SBCs). The definition of the SBC that is used most often by Kornai is a subsidy paid, typically by the state, to loss-making firms to guarantee their survival. The subsidy is paid ex post, after the state observes the firm's losses, without expectation of future repayment, and can take a variety of forms, e.g. direct budgetary subsidy, an injection of credit from the state or another institution, or a reduction in tax rates (SCHAFFER, 1998). In Kornai's analysis, the cause of the SBC is "paternalism" by the state. The state will rescue a failing firm because it is unwilling to accept the social consequences (e.g. unemployment) of its closure. HART and MOORE (1995) provide a model that shows that the optimal capital structure of a firm is determined by the trade-off between "hard" and "soft" debts. They show that the optimal level of short-term debt is zero. However, long-term "hard" debt, which is not renegotiable, is important in limiting managers' ability to raise new funds. With too much hard debt, managers would underinvest because the company would be overmortaged.

Studying the impact of capital structure on firm performance in a transition economy where SBCs are present, one would first focus on defying "soft" and "hard" debts in farm finance. According to the political-influence theory of the SBCs, the government pushes for surplus employment, and when losses are incurred, the subsidies are provided to bail out the enterprise. This theory is applicable to Russian agriculture, since the use of surplus labor is reported in many studies (see e.g. BEZLEPKINA et al., 2001; LIEFERT and SWINNEN, 2002). For more theories on SBCs one may consult MASKIN and XU (2001).

According to SCHAFFER (1998), the state in transition countries tends to soften the liquidity constraints by subsidising the firms and mostly by means of allowing the enterprises to generate tax arrears that is a part of accounts payable. The SBC phenomenon in Russia reveals via governmental debt restructuring and forgiveness practice. Moreover, the law on bankruptcy has not been heavily applied to the farms and thus only a small percentage of highly indebted enterprises went through this procedure (OSBORNE and TRUEBLOOD, 2002). Thus, under absence of bankruptcy threat and possibility to renegotiate debts, in other words under SBCs, managers likely will exercise their laxness. This reasoning would imply a negative debt-performance relation. KONINGS et al. (2002) find a weak evidence for a negative relation between long-term debts and efficiency in Bulgarian economy interpreting it as the presence of SBCs. CARLIN et al. (2000) show the importance of removing the soft budget constraints in achieving better performance of firms in transition economies.

Jensen's free cash flow concept, which is in line with SBC theory, may work well for explaining a negative impact of subsidies on managerial performance. However, these subsidies are supposed to be Kornai-type subsidies that are granted to a loss-maker to keep it in operation. Subsidies granted to a financially healthy but politically powerful firm may reveal positive impact on performance (see CARLIN *et al.*, 2000). The paternalizm model predicts that firms that make losses will be rescued, but there are other possible reasons, compatible with the existence of hard budget constraints, for loss-making farms to receive subsidies, such as e.g. product-specific subsidies (SCHAFFER, 1998). A negative relationship between subsidies and efficiency is found in KARAGIANNIS (2002) for analysis of Greek agriculture and in Sedik et al. (2000b) for Russian crop producers. Both studies support the hypothesis that farmers tend to put less effort on farming activities as a larger part of their income is guarantied through subsidy.

Summarizing, well defined for western economies financial concepts cannot be directly applied to Russian agriculture. First, appropriate measures to test these concepts should be identified. Distinguishing between debts with "soft" and "hard" nature is of great importance in this analysis. Different sources of debts may reveal different ways of influencing the managerial efforts and thus technical efficiency. Thus, it is reasonable to discriminate between debts from different creditors, e.g. commercial banks and others. Such discrimination also helps in assessing the sensitivity of performance to a particular source of debts. Apart from different groups of creditors, capital structure involves the distinction between short-term obligations (to finance production and marketing) and long-term obligations (to finance fixed assets). It is expected that short-term debts are stronger related to efficiency than long-term or total obligations because technical efficiency refers to production and finance decisions having a short-term nature.

4. Methodology

A two-stage methodology applied in this study is rather common. First, technical efficiency of farms is computed using Data Envelopment Analysis (DEA), a non-parametric method. Such measure of farm performance accounts for the relation between inputs and outputs on the farm. Second, the efficiency measures derived from DEA are regressed on the financial characteristics, such as debt to asset ratio, composition of debt (to suppliers, state and employees), subsidy rate and other socio-economic farm characteristics using a Tobit regression model.

4.1 Efficiency measures: Technical, Pure technical, Scale and Congestion

Modeling of farm production involves optimization of input and output mix. The DEA technique allows for both input and output orientation. In this study an input oriented model with the objective to produce the observed outputs with as little inputs as possible is used (FARE et al., 1994). Under the planned economy, agricultural enterprises had to comply with output targets even at cost inefficient use of resources. Often the current situation is compared to pre-reform period. Having limited options of state support in input supply, it is rather likely to assume that enterprises aim at minimizing costs to achieve pre-reform output levels. Earlier studies on Russian agriculture point to overuse of fixed inputs as land, workers (e.g. LIEFERT and SWINNEN, 2002). Input orientation is helpful in this context to allow for input congestion or in other words, for input slacks.

Schematically, the production technology L transforming factors of production (inputs x_1 and x_2) into a single output (y) is presented in Figure 1.

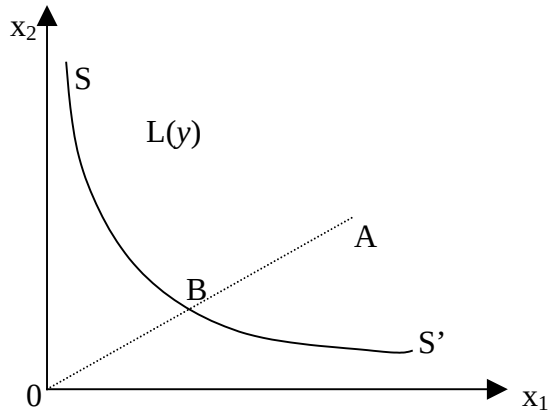

Figure 1: Input orientation with inputs x1 and x2

L(y) denotes the subset of all input vectors (with a frontier of SS') which yield at least y. In this case, the efficiency of production units in the interior of the frontier, can be measured by the distance to the frontier. For example, if a firm produces at point A, then its efficiency can be measured with the ratio of OB/OA.

DEA uses a piece-wise linear convex hull approach for frontier estimation. This can be achieved with mathematical programming (MP). Assuming there are data on K inputs and M outputs for each of N farms and variable returns to scale (VRS), pure technical efficiency (PTE) can be computed from the following linear programming (LP) model:

$$\min \lambda^n \qquad (1)$$

$$\text{subject to} \quad y_{n,m} \le \sum_{n=1}^{N} z_n y_{n,m} \quad , \ \text{m=1…M}$$

$$\lambda^n x_{k,n} \ge \sum_{n=1}^{N} z_n x_{k,n} \quad , \ \text{k=1…K}$$

$$\sum_{n=1}^{N} z_n \ge 0 , \quad \sum_{n=1}^{N} z_n = 1 \quad \text{(VRS)}$$

where λ^n stands for input-oriented technical efficiency, z_n are intensity variables. The value of λ^n attained is the pure technical efficiency score for the n-th firm. It will satisfy: $\lambda^n \le 1$, with a value of 1 indicating a point on the frontier and hence a technically efficient firm. The linear programming problem must be solved N times, once for each firm in the sample.

Overall technical efficiency is decomposed into its three components: (a) scale efficiency, (b) pure technical efficiency and c) congestion-free efficiency (FARE *et al.*, 1994). The overall input-oriented technical efficiency measure and each component are computed for each farm to obtain the degree of inefficiency arising from (a) failure to operate at optimal size, (b) pure technical inefficiency and (c) congestion arising from the overutilization of some inputs. These calculations imply some standard changes in model (1), which can be found in (COELLI et al., 1999; FARE *et al.*, 1994). Denoting constant returns to scale (CRS), variable returns to scale (VRS), strong disposability (SD) and weak disposability of inputs (WD), the resulting decomposition of the overall technical efficiency measure then looks as follows:

$$\underbrace{Fi(y,x\,|\,C,S)}_{\text{overall technical efficiency under CRS and SD}} = \underbrace{Si(y,x\,|\,S)}_{\text{scale efficiency underSD}} * \underbrace{Fi(y,x\,|\,V,S)}_{\text{pure technical efficiency under VRS and SD}}$$

$$\underbrace{Fi(y,x\,|\,V,S)}_{\text{pure technical efficiency under VRS and SD}} = \underbrace{Cni(y,x\,|\,V)}_{\text{congestion efficiency under VRS}} * \underbrace{Fi(y,x\,|\,V,W)}_{\text{efficiency under VRS and WD}}$$

The pure technical efficiency measure is more appropriately related to the testable hypotheses since it represents the ability of the firm to operate without wasting inputs rather than operating at an inappropriate scale. The scale efficiency, congestion efficiency and overall technical efficiency models are also studied to get some insight on relation between farm characteristics and inefficiency sources.

4.2 Two-Step Empirical Model

A commonly used two-step procedure approach is employed to explain variation of efficiency scores across firms. The first step is to estimate the efficiency scores, and the second step is to explain the variation of the efficiency scores using appropriate regression procedures.

A few conceptual issues arise with this approach. First, the efficiency scores (scale efficiency, pure technical efficiency, and congestion-free efficiency) have an upper bound of 1.0 and a lower bound of 0.0. Thus, ordinary least square estimates are inconsistent. A Tobit regression model is one way to overcome these problems (GREENE, 1997).

In agricultural literature, it can be seen that often the efficiency measures are regressed on farm individual characteristics such as age, education, availability of a successor (for private farming). In Russian agricultural enterprises settings such managerial characteristics as age (the younger the easier adjusted to new environment), years of experience, involvement in local governance (networking) could be of importance. Unfortunately such data are unavailable. The choice of socio-economic indicators is explained in section 5.2. Although the data set created for this study is panel, nonparametric efficiency measures are computed for each year independently.

5. Data

5.1 Data source

Panel data of large-scale specialized dairy farms in the Moscow Region are obtained from data on Russian farms collected by the state statistical committee. The sample of specialised dairy farms includes farms for which the share of marketable milk production takes more than 2/3 of agricultural revenue. The unbalanced panel set contains 700 observations from 130-144 farms annually over the period 1996-2000.

On average, agricultural land area takes about 3200 ha, the average number of all employees per enterprise is 250 and there are about 800 dairy cows. On these farms, on average 71.8% of revenue comes from milk and 11.9% from beef production. The shares of other livestock production (egg production, pig production) and arable farming (potato, cereals, vegetables and other) are 7.5% and 8.8%, respectively.

5.2 First-stage variables

Five inputs and two outputs are distinguished in the first stage calculation of technical efficiency. Outputs are milk and other output (beef, pig meat, poultry meat, eggs, cereals, potato, vegetables). Variable input represents aggregated input

costs for marketable output. Implicit quantities of variable input and the two outputs are obtained as the ratio of costs and revenues and their price indices. Price indices for milk and variable inputs are taken from the national statistics (GOSKOMSTAT, 2002), whereas the Tornqvist price index (COELLI *et al.*, 1999) is calculated for other output category on the base of national price indices and other output composition on individual farms. Price indexes vary over years but not over farms, implying that differences in the quality and composition of inputs and outputs are reflected in the quantity (see also COX and WOHLGENANT, 1986). Other inputs in the first stage are labour, land, capital, and livestock.

Labour is measured as number of farm employees involved in agricultural production. This measure is not corrected for labor quality because of lack of data. Capital is measured as the value of depreciation. This measure does not resolve the potential problems with overvalued capital stock widely discussed in the literature (LISSITSA and ODENING, 2001; VOIGT and UVAROVSKY, 2001) but has an advantage of reflecting the costs of fixed capital involved in producing the earlier defined outputs. Heads of livestock represent fixed capital invested in livestock. Depreciation value is normalized by regional consumer price index. Descriptive characteristics can be viewed in the upper part of Table 2.

5.3 Second-stage variables

Financial characteristics. This section presents measures of capital structure and defines a proxy for SBC. The data from balance sheets on debts and subsidies[3] are available at different degree of details for the period 1996-2000. The complete overview of farm accounting forms, the correspondence of variables among the forms can be found in MINSELKHOZ (2000). Total liabilities represent a sum of long-term and current obligations (credits and loans, accounts payable and dividends)[4]. Debts are disaggregated by their maturity and by creditors (banks and other creditors for debts on credits and loans; tax arrears, wage arrears, debts to the social development funds, to the suppliers for accounts payable). Accounting for the presence of SBC is necessary for separating their effect from capital structure effect. Following SCHAFFER (1998), one cannot conclude that firms have SBCs simply because they continue to make losses, even several years in a row, or because they have large stocks of overdue debts. Firms can be loss-making, or have large debts in arrears, and still have hard budget constraints so long as neither their creditors nor the state are rescuing the firm with the injections of cash or subsidies.

First of all, the SBC, as discussed in section 3.2, is about rescuing firms in financial distress, e.g. firms with negative profit before tax. The source of the

[3] Book keeping system on Russian agricultural enterprises presents the data on subsidies and compensations that are balanced out with debts to the state budgets or debts to suppliers depending on the scheme of mutual payments. The further description and analysis is confined only to the level of actually received subsidies.
[4] Lines 590+610+620+630 of a balance sheet.

firm's losses do not matter in the paternalism model; it needs to be rescued whether or not it is economically unviable, e.g. has positive or negative operating profit, i.e. earnings before interest, profit tax, depreciation and other charges. Following SCHAFFER (1998), *EBITD* is a measure of the income generated by the firm that is available to pay obligations to creditors, the tax authorities, and is independent of the capital structure of the firm. Thus, we define farms in economic distress if sales profit minus depreciation is negative, *EBITD*<0 (line 050, financial statement plus line 640, form 5) and farms in financial distress if profit before tax (PBT) is negative, PBT<0 (line 140>0 in financial statement). Since profits are measured on an accruals, not a cash basis, neither *EBITD*<0, nor *PBT*<0 captures that a farm receives additional external financing. Yet, interest costs are accrued costs, not cash costs. Thus, farms that cover all its operating costs, i.e. *EBITD*>0, but highly indebted, i.e. PTB<0, do not have SBC, unless farms' losses cause it to receive a net cash injection from the bank or another creditor.

Dummy variable indicating the presence of SBC is constructed in a way that it takes value 1if a farm finds itself in both financial and economic distress and if the inflow of total debts plus gross subsidy exceeds the outflow of debts. As it was mentioned in section 2, about 80% of subsidies are granted from regional budgets and thus they are possibly the subject to negotiations between managers of loss-making farms and governance authorities. The main part of subsidies is granted to livestock production, which demonstrates low/negative profits. The average ratio of subsidies to revenue is twice higher on economically (financially) distressed farms than on others. Due to these reasons we attribute all subsidies to Kornai-type subsidies, e.g. subsidies granted to loss-making farms under SBC. Therefore gross subsidies are accounted when constructing a SBC dummy. About 65% of dairy farms in the sample were under SBCs in 1996-1998. In 1999 this percentage dropped substantially to 10%, because of a reduced share of financially and economically distressed farms. Descriptive characteristics can be found in the middle part of Table 2. All financial ratios are derived at the beginning of a corresponding year, thus referring to the initial financial conditions, under which the production runs.

Socio-economic farm characteristics. While this study focuses on the relationship between a farm's efficiency and financial indicators, it is important to account for the potential effects of other factors on efficiency. It is hypothesized that better working conditions improve efficiency. *Wages per worker* corrected for wage arrears represent working conditions on the farm. *Soil rating* depicts soil quality with the average score 100 for soils in Moscow region. This measure reflects differences in soil typography, uniformity, drainage, fertility and other quality attributes. It is likely that farmers with higher soil rating also may exhibit higher level of efficiency, perhaps reflecting the use of different types of technology. Years of transition in agriculture resulted in severe decline of heads of cows and their milk productivity, thus it is assumed that a higher managerial effort results in

higher partial input productivity leading to higher technical efficiency. *Milk per cow* indicates how well the livestock is managed. *Distance* from Moscow city to farm reflects access to urban markets. In this study it is hypothesized that farms located closer to Moscow city are more efficient (the farthest located farm is at 163 km) because they have lower transport/transaction costs[5]. Dummy variable *size* takes value 1 for large farms. Farm size is assessed by the acreage of agricultural land with its average value of 3500 ha. About 20% of farms in the sample have milk processing facilities[6]. It is expected that rather likely that farms having processing facilities at their disposal may run their production in a more efficient way. Therefore, *percentage of processed milk* (in kg of raw milk) is introduced among farm characteristics. Dummy variable for *ownership* type has a value 1 for farms with private ownership and 0 otherwise (municipal, state, mixed). It is expected to find that farms with private ownership are more efficient because shareholders may demonstrate more efforts in disciplining farm management. On the other hand, noting that ownership regulations hardly work in Russia, shareholders "on paper" may not reveal any efforts but rather exploit opportunistic behaviour.

Table 2 here

6. Results

Calculation of efficiency measures is performed in OnFront 2.0 software (FARE and GROSSKOPF, 2000) for five years with a separate frontier for each year. Technical efficiency and its decomposition are presented in Table 3. Minimum scores are above 60%.

Table 3 here

Before presenting the results of Tobit regression analysis, it is useful to highlight some findings from technical efficiency results. The results suggest that expenses could have been reduced on average by 14% without affecting total output. A direct comparison of efficiency scores between years is not possible because different (annual) reference technologies are assumed. The percentage of efficient farms, e.g. farms with an efficiency score of unity, is assessed for each efficiency measure over years. The share of fully efficient enterprises under CRS in the first and last year of investigation reached 18%. Efficiency drops substantially in the year of financial crisis (1998); and there is a clear positive trend in efficiency before and right after 1998. A similar pattern is observed for other efficiency measures. More than half of the farms remain inefficient during the whole period with the percentage of efficient farms increasing in 1996-1997, significantly falling in 1998 and recovering in 1999-2000. Scale efficiency (SE) is higher than pure

[5] Cost of fuel contributes 12% on average to variable inputs cost, thus it is assumed that distance to the market substantially influences variable costs.
[6] Milk processing often represents milk pasteurization.

technical efficiency (PTE) indicating that inefficiency in management contributes most to overall technical inefficiency. Even though about 73% of farms overuse inputs each year, congestion-free efficiency is rather high (0.93) indicating that overuse of inputs does not lower farm efficiency as much as poor management does. Since about 65% of the farms demonstrate a unity PTE, it is concluded that managerial capacities are more or less similar on majority of farms, so perhaps it is the outside farm environment that lowers the impact of management resulting in relatively low PTE.

The shares of farms operating under constant (CRS), increasing (IRS) and decreasing (DRS) returns to scale in Table 4 indicate that farms did not improve their scale efficiency by year 2000 in comparison with reference year 1996. The whole period farms mostly operated under IRS with its almost twice-decreased share in 2000. Thus, one of the trajectories farms could follow to gain efficiency is decreasing size. The most noticeable change in distribution of farms by returns to scale is observed after year 1998, once again proving a significant impact of financial crisis on efficiency and indicating the influential role of farm environment.

Table 4 here

After the technical efficiency is computed, multivariate relationships between efficiency, financial ratios and other farm characteristics are tested using a Tobit regression. The benchmark model includes all disaggregated financial ratios, e.g. long-term debts on loans and other, short-term debts to banks and to other creditors, accounts payable to suppliers, state, and workers. The estimates on financial ratios are not highly significant for either of the ratio, except for SBC dummy. The hypothesis of disciplinary role of debts to commercial banks has no empirical support for settings of this study because none of the debts to banks has significant positive estimate. Instead of omitting any insignificant financial variable, the aggregated ratios are used. The nominators of several financial ratios were aggregated resulting in including total long-term debts, short-term debts to crediting institutions and total accounts payable. The results of four Tobit models for technical efficiency and its components can be found in Table 5. The log-likelihood measures indicate that the scale efficiency model has the best fit. According to Wald-test, random-effect tobit specifications are preferred over pooled tobit models.

Table 5 here

The models demonstrate no strong relation between capital structure and efficiency when debts to asset ratios are considered, except for the PTE (model 1). Accounts payable and managerial performance are positively related. This provides a weak evidence for a) debts to suppliers help to continue farm operation because they provide inputs and thus the farms that succeed to attract new trade credits are more efficient and b) debts to suppliers have a “hard” nature and thus discipline the management. Consistently significant negative estimates on SBC dummy

in all regressions provide strong evidence that loss-making farms that are nevertheless subsidized are less efficient. A negative estimate on subsidy to revenue ratio (significant for model 2 and 3) corresponds with initial expectations and supports recent developments in agriculture. Subsidies remain declining in agriculture but since 2001 the state promotes interest rate subsidizing programs, thus focusing more on credit then subsidies.

The coefficient on wages corrected for wage arrears are positive in all models. It is concluded that efficiency depends on performance of employees, which is first of all stimulated by the level of their earnings. To avoid unnecessary reasoning about importance of this factor for farm performance, it is enough to mention that average national wages in agriculture in 1996-2000 are slightly more then twice lower than wages in overall economy and almost three times lower than in industry. In accordance with expectations, farms that manage a highly productive herd generally have better management skills, which are likely used to improve the overall technical efficiency (model 2), not just productivity of the dairy herd. The ownership dummy, soil quality, percentage of processed milk and distance to Moscow are insignificant in most of the regressions with some exceptions for congestion-free efficiency. Processing and distance depict negative estimates leading to the conclusion that milk processing is associated with a higher overuse of inputs and that the farthest located farms tend to overutilize inputs at greater level. The last finding is straightforward explainable for labor with limited working possibilities in Moscow city due to travelling distance and for land that has lower opportunity costs in comparison with land near Moscow. Although not highly significant, the estimates on distance and soil quality have expected signs. The estimates on size dummy are significantly negative in most of the regressions, except for scale efficiency, demonstrating that farm management is more efficient on smaller farms, e.g. farms with smaller agricultural land area in this context. A further examination in the model of scale efficiency confirms that a larger size does lead to a higher scale efficiency. But this positive effect is over-dissipated by its negative impact on pure technical efficiency, implying that a larger farm is much more difficult to manage.

7. Conclusions and discussion

In transition economies, the economists have studied the capital structure in two directions: as resulting factor and as explanatory factor. This paper complements the last studies by analysing the role of debts and subsidies in agricultural farm performance. The empirical application is done for dairy producers in Moscow Region.

Studying the impact of capital structure on firm performance in a transition economy is complicated by the existence of soft budget constraints. The analysis in this paper shows that debt to asset ratio does not fully depict the financial situa-

tion on Russian farms. No strong relation between capital structure and efficiency is found. However, a strong support of a negative role of soft budget constraint is observed. Loss-making farms that accumulate high debts and are nevertheless get external finance by means of credits, loans, supply of inputs and subsidies are less efficient. This finding is in line with the Jensen's free cash flow concept of financial theory that excess cash flows cause management laxness. However, it should be noted, unlike in study of NASR *et al.* (1998), debt to asset ratio does not reveal this conclusion for Russian agriculture settings.

One of the policy implications for finding a negative role of excessive finance of loss-making farms is that the state should define measures for improving farm governance to make managers responsible for the financial state of farms. Secondly, since accounts payable help running farm operations, next to hardening budget constraints to discipline farm working mechanism, the state should elaborate the alternatives for legal commercial (not trade) credit sources in agriculture. In light of these policy recommendations and recent changes in agricultural credit promoting programs in Russia, the forthcoming research can focus on analyzing the efficiency of subsidizing interest rate programs introduced in 2000-2001. Other important message to policy makers is that the state should bear in mind the priorities for developments in agriculture when designing support programs. It is very unlikely that current subsidizing programs are helpful in agriculture keeping insolvent farms afloat, since subsidies are lower then losses of these farms and much lower then their debts. Thus, it is rather efficient to focus on subsidizing subsidy rate and it is inefficient to provide Kornai-type subsidies.

The finding of this study signals about a necessity to hard the budget constraints, which is in line with studies of CARLIN *et al*. (2000), Konings *et al*. (2002). However, this fact should not be exaggerated. Theoretical paper by CHE (2000) points to the link between existence of SBCs and macroeconomic situation. When budget constraints are soft because of concerns for macrostability, a commitment to hard budget constraints is neither sufficient nor necessary for encouraging firms to improve their performance. Thus, an extension of this study would be on incorporating macroeconomic environment in the modeling framework to test the relevance of this assumption.

In this paper the degree of farm inefficiency is assessed. Number of farms with unity overall technical efficiency is not high reaching 18% in the first and last year of the studied period. Scale efficiency is higher than pure technical efficiency indicating that inefficiency in management contributes at most to overall technical inefficiency. Even though about 73% of farms overuse inputs each year, congestion-free efficiency is rather high (0.93) indicating that surplus of inputs does not lower farm efficiency as much as poor management does. There is a clear positive trend in efficiency before and right after the financial crisis of 1998 in Russia. Other finding contributing to the discussion on efficient production scale and further restructuring of farms is that farm management is more efficient on smaller

farms. The analysis shows that higher scale efficiency is dissipated by little less efficient managerial capacity to handle larger farms, which may suggest that owners should take actions restructuring or dividing larger farms, for example, spinning off less-related operations from each other in "super-farms".

Technical efficiency of dairy producers is highly determined by working environment: higher wages and lower wage arrears stimulate increase in efficiency. This potential key to efficiency improvement should not be overlooked by farm managers in using to create more competitive working environment in agriculture, but also by policy-makers lobbying the agrarian interests.

It should be also noted that the measures of farm performance may be overstated when only marketable part of production is analyzed. It is rather likely that farms market the outputs of a better quality and thus enjoy higher revenues per unit. However, the technical efficiency measure is a relative measure to the best practice frontier (best performing farm). It is not surprising to find higher efficiency scores in comparison with other studies performed at the oblast level, since the sample in this study is rather homogeneous by construction. One remark can be made is that in other studies the technical efficiency scores for Moscow region are higher in comparison with other regions signaling about a relatively better performance of agricultural producers.

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Table 1. Debts and subsidies: Composition on Moscow Region dairy farms, 1996-2000

	1996		1997		1998		1999		2000	
Total obligations, %	*100*		*100*		*100*		*100*		*100*	
Total long-term debt, %	18	*100*	15	*100*	12	*100*	10	*100*	10	*100*
Credits and loans, %	17	96	14	91	11	92	8	77	7	66
Other long-term obligations, %	1	4	1	9	1	8	2	23	3	34
Total short-term debt, %	82		85		88		90		90	
Short-term debts on credit and loans, %	18	*100*	16	*100*	10	*100*	8	*100*	6	*100*
To banks, %	3	17	3	21	5	49	4	47	2	25
Other loans, %	15	83	13	79	5	51	4	53	5	75
Accounts payable, %	64	*100*	69	*100*	77	*100*	82	*100*	84	*100*
To suppliers, %	33	53	39	57	45	58	42	52	43	52
To employees, %	8	12	8	12	7	9	5	6	4	4
Social funds, %	5	8	7	9	9	12	12	15	13	15
To government (tax), %	9	14	11	16	14	18	17	21	19	23
To others, %	8	13	4	5	3	4	5	6	5	6
Total obligations to revenue, %	80		126		146		89		81	
Total subsidies, ths. Rubles of year 1996	337		486		275		88		101	
Share of subsidies in agricultural revenue, %	9.1		12.7		10.3		2		2.4	
Subsidies to Crops, in % to total	26		19		16		18		41	
Subsidies Livestock, in % to total	73		81		83		81		47	
Subsidies for milk, in % to total	42		56		62		59		20	
Subsidies for milk, in % to live-stock subsidies	67		72		77		78		60	
Regional subsides, % to total	75		92		89		84		82	
Federal subsidies, % to total	25		8		11		16		18	

Table 2. Descriptive statistics of variables

Variable	Units of measurement	Mean	Std Dev	Mini-mum	Maxi-mum	obser-vations
Inputs and Outputs						
Milk	1000 Roubles of 1996	3170	3435	148	29072	700
Other output	1000 Roubles of 1996	949	1058	22	10005	700
Variable input	1000 Roubles of 1996	3179	3683	153	33565	700
Labor	Number of workers	220	104	24	760	700
Land	Hectares	2501	1234	138	9136	700
Capital	1000 Roubles of 1996	446	491	15	5560	700
Heads of livestock	heads	1687	928	237	7357	700

Financial ratios (at the beginning of year)						
Total liabilities to total assets	ratio	0.091	0.112	0.002	1.00	688
Current liabilities to total assets	ratio	0.081	0.097	0.001	1.00	688
L-t debt to total assets	ratio	0.011	0.027	0	0.402	688
S-t debt to banks to total assets	ratio	0.002	0.006	0	0.036	688
Accounts payable to total assets	ratio	0.065	0.088	0.001	1.000	688
Subsidies						
Subsidies to revenue	ratio	0.072	0.066	0	0.416	700
Farm socio-economic characteristics						
Size	Dummy=1 for large	0.55	0.50	0	1	700
Distance	100 km	0.81	0.39	.06	1.63	700
Soil rating	score (0…2)	96	19	57	192	700
Dairy productivity	1000 kg per cow	3.1	1.2	0.7	7.3	700
Wages per worker	1000 Roubles of 1996	6.98	3.48	0.39	49.36	700
Share processed milk	Ratio	0.06	0.19	0	1	700
Ownership dummy	Dummy=1 for private	0.85	0.36	0	1	700

Table 3. Decomposition of technical efficiency and percentage of fully efficient farms

Year	Overall technical efficiency			Pure technical efficiency			Scale efficiency			Congestion efficiency		
	Fi(x,y|C,S)			Fi(y,x|V,S)			Si(y,x|S)			Cni(y,x|V)		
	Mean	St.dev.	Fi=1, %	Mean	St.dev.	Fi=1, %	Mean	St.dev.	Si=1, %	Mean	St.dev.	Cni=1, %
1996	0.85	0.10	18	0.88	0.09	58	0.97	0.05	19	0.93	0.07	24
1997	0.86	0.09	16	0.90	0.08	66	0.96	0.06	18	0.94	0.07	31
1998	0.81	0.10	10	0.85	0.10	60	0.95	0.06	11	0.90	0.09	15
1999	0.84	0.11	18	0.90	0.09	64	0.95	0.06	22	0.94	0.08	27
2000	0.88	0.09	18	0.91	0.08	72	0.97	0.04	20	0.94	0.07	27

Table 4. Shares of farms with CRS (scale efficient), IRS and DRS (%)

year	Farms under CRS	Farms under DRS	Farms under IRS	Total
1996	19	8	73	100
1997	18	14	67	100
1998	11	11	79	100
1999	22	25	53	100
2000	20	41	39	100

Table 5. Random-effect Tobit regressions

	Pure technical efficiency		Technical efficiency		Scale efficiency		Congestion-free efficiency	
	Model 1		Model 2		Model 3		Model 4	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t
l-t debt to assets	0.131	1.11	0.185	1.58	0.032	0.47	0.080	0.85
s-t debt to assets	-0.057	-0.51	-0.023	-0.2	0.021	0.33	-0.068	-0.73
debt payable to assets	***0.071***	1.94	0.042	1.18	-0.030	-1.43	0.020	0.67
subsidy to revenue	-0.067	-1.49	**-0.119**	-2.61	**-0.063**	-2.5	-0.034	-0.92
dummy SBC	**-0.018**	-2.65	**-0.033**	-4.78	**-0.019**	-4.94	**-0.015**	-2.62
wages	**0.011**	10.07	**0.014**	12.86	**0.003**	5.53	**0.007**	7.45
share processed milk	0.011	0.56	0.005	0.25	-0.008	-0.68	**-0.035**	-2.17
dairy productivity	0.003	0.87	**0.007**	2.09	0.003	1.61	0.003	1.06
soil quality	0.028	1.28	0.023	1.16	-0.002	-0.12	0.011	0.65
distance	***-0.020***	-1.69	-0.017	-1.58	0.002	0.29	**-0.036**	-3.86
dummy size	**-0.031**	-3.57	-0.013	-1.58	**0.019**	3.66	**-0.037**	-5.38
dummy ownership	0.009	0.83	0.008	0.79	-0.002	-0.31	0.012	1.47
constant	**0.816**	28.19	**0.758**	28.11	**0.938**	55.07	**0.919**	40.6
Number of observations	688		688		688		688	
Log likelihood	847		838		1237		986	
Wald chi-2	198		345		120		195	