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EFFECTS OF DEBT ON MOSCOW-REGION DAIRY FARM PERFORMANCE, 1996-2000

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Abstract

To study the impact of debts on the performance of Moscow-area dairy enterprises, some concepts of finance theory were adjusted to the different structure of debts in Russia and to the presence of soft budget constraints (SBCs). A two-stage approach was used: technical efficiency scores from Data Envelopment Analysis were regressed on financial characteristics, the presence of SBCs, and a set of socio-economic factors, using a truncated regression model. The results suggested that SBCs have a negative, and accounts payable, a positive impact on performance.

Keywords: agriculture, dairy farms, Russia, efficiency, debts, soft budget constraints, Data Envelopment Analysis

1 Introduction

The reform of Russian agriculture begun in the early 1990s resulted in a substantial decline of agricultural production and productivity in the years thereafter (Osborne and Trueblood, 2002; Svetlov, 2002). Due to low profits (negative in 1996-1998), about 88% of agricultural enterprises accumulated outstanding debts in the period 1995-2000. The high indebtedness of agriculture is one of the main problems needing government action in Russia (see Federal law 83-F3, Anonymous, 2002).

Despite mounting debts and blocked bank accounts of indebted farms (see Manellya, 2002) limiting regular activities, producers continued dealing with suppliers and even credit providers. This paradox is closely linked to the presence of soft budget constraints (SBCs) i.e. routine loan forgiveness (see Kornai, 2001). It remains an open question whether the accumulation of debts is a problem in itself or affects the performance of agricultural producers under debt-restructuring and subsidy programs. Highly indebted farms may not be aware of the impact of debt burden, since they are mostly concerned with their current problem of low (negative) profits. It is important to discover whether farm management plays a more decisive role in solving the debt problem than governmental action does (e.g. debt restructuring, subsidizing). If so, policy-makers should approach the problem through improving farm management.

In examining the impact of debts on performance, this paper considered different sources of debts (banks, state, suppliers), the differential role of debts in poorly and well performing enterprises, as well as the role of SBCs. Since the financial theories used in this study to explain the debt-performance relation mainly refer to corporate management, the degree of pure technical efficiency (PTE), an indicator of managerial efficiency, was used as the performance indicator. In transition economies the positive relation between farm size and performance is related to the quality of management rather than to the relationship between size and performance *per se* (Gorton and Davidova, 2004). Therefore the PTE, which is free of inefficiency due to non-optimal scale, was preferred. Moreover, unlike other profitability measures, PTE has the advantage of being independent of the market environment (i.e. prices) which is beyond the control of management. In addition, technical efficiency analysis provided more insight into overall performance of farm enterprises than did other regional studies (see e.g. Sotnikov, 1998; Sedik *et al.*, 1999). The empirical analysis focused on panel data from dairy enterprises in the Moscow region over the period 1996-2000.

The paper is organized as follows. The next section reviews theoretical financial concepts (agency cost, free cash flow, credit evaluation concept and adjustment concept). Referring to developments in Russian agriculture, Section 3 shows how financial concepts should be adjusted for the case of agricul-

ture in Russia. The methodological approach of two-stage modelling 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 Financial Concepts and Firm Performance: Theoretical Background

Many studies of debt structure and its relevance to performance (or conversely) are found in the empirical corporate finance literature (see for example McConnell and Servaes, 1995). The seminal work of Modigliani and Miller (1958) on the irrelevance of debt structure to firm value has prompted numerous continuations in the literature addressing its strong assumption of perfect capital markets. Economics literature provides arguments for a negative as well as positive impact of high indebtedness on firm performance. Various studies use the value of a firm (Tobin's Q), profitability or technical efficiency as performance indicators. Empirical evidence on the relation between debt and various performance measures is summarized alphabetically in Table 1.

Table 1 Overview of debt-performance relation

Study	Country, period	Sector	Performance measure	Effect of debts
Fu *et al.* (2002)	Taiwan, 1992-1997	small business	profitability	negative
Hadley *etal.*(2001)	England and Wales, 1984-1997	agriculture	technical efficiency	negative
Harvey *et al.* (2004)	18 countries in emerging markets	non-financial firms	value of firm	positive for firms with potentially high managerial agency costs
Holz (2002)	China, 1993-1999	industry	profitability	positive
Konings *et al.* (2002)	Bulgaria	industry	total factor productivity	negative
McConnell and Servaes (1995)	USA, 1976-1988	industry	value of firm	negative for firms with potentially high growth opportunities
Nasr *et al.* (1998)	USA, 1988-1994	agriculture	technical efficiency	positive
Paul *et al.* (2000)	New Zealand, 1969-1991	agriculture	technical efficiency	negative
Schulze *et al.* (2001)	Russia, 1999	agriculture	profitability	no effect
Sotnikov (1998)	Russia, 1990-1995	agriculture	technical efficiency	negative
Whittaker and Morehart (1991)	USA, 1987	agriculture	cost efficiency	no effect or small negative

The costs associated with debts provide an explanation for the debt-performance relation. The negative relation is associated with inefficiency due to increased costs. The agency cost concept hypothesises that monitoring, bonding, and adverse incentive costs are incurred in a borrower-lender relationship in order to resolve problems of asymmetric information between the two parties. An increase of debts also results in an increased probability of bankruptcy, which is costly to firms, and in higher interest costs. However, the costs are lower due to the tax benefit from the tax-deductible interest, suggesting a positive effect of debts on performance.

A firm's investment opportunity and managerial effort offer an alternative interpretation of the relation between debt and performance. When firms have a few positive net present value projects, i.e. have lower investment opportunity, debt prevents managers from starting projects with a negative net present value. This concept, known as "free cash flow" (Jensen, 1986) posits a disciplining role for debts, and also suggests a *positive* impact of debt on performance in case a firm has low investment opportunities, and a negative one in case there are many investment opportunities. Harvey *et al.* (2004) argued that the separation of insider control and ownership, rather than the investment opportunity, is the root of the agency problem. These authors stress that actively monitored debt creates value for

shareholders of firms that face potentially extreme agency costs associated with misaligned managerial incentives and overinvestment.

Agricultural bankers often use efficiency variables (i.e. operating costs per acre, yield per acre, profit per cow, etc.) along with various financial variables in evaluating creditworthiness (Barry *et al.*, 1995). The "credit evaluation" concept suggests that lenders prefer to finance more efficient farmers because these borrowers are lower credit risks (Ellinger *et al.*, 1992; Nasr *et al.*, 1998). Thus this concept entails a *positive* relationship between debt and performance, although the underlying causal relation may be the opposite of that.

Following these theories, different relations between debt and performance of firms can be expected. However, the hypotheses themselves are not mutually exclusive and lead to difficulty in pinpointing the exact relation between debt and efficiency (Hadley *et al.*, 2001).

3 Application of Financial Concepts to Russian Agriculture

This section raises a number of issues that are relevant to the application of financial theories to Russian agriculture under the condition of soft budget constraints.

The indebtedness of enterprises has been a problem from the beginning of reforms in many sectors of the Russian economy, and was particularly severe in the farming sector (Manellya, 2002; Yastrebova, 2002). Table 2 presents several variables illustrating the debt situation in Russian agriculture.

Table 2 Debts in agriculture (at the economy level)

	1995	1996	1997	1998	1999	2000	2001
Total debts to pay, 10^9 RUB of 2001	262	341	438	515	316	287	278
Total debts to receive, 10^9 RUB of 2001	61	60	64	73	54	48	49
Total net profit, 10^9 RUB of 2001	14	-92	-100	-131	26	21	26
Percentage of enterprises with outstanding (> 3 months) debts in total number of enterprises in agriculture, %	89	87	89	90	90	89	n.a.

Source: own calculations based on Goskomstat (2002) and Manellya (2002).

On average, agricultural enterprises failed to collect approximately 32% of their revenues from customers in the period 1995-2001, which suggest that farms have severe problems in managing their debts. Nevertheless, it does not explain the high level of farm debts (to banks, suppliers, state), exceeding the level of debts from buyers 4-7 times. Having no resources to repay debts due to low profits (losses in 1996-1998), the enterprises encountered solvency problems. A low debt repayment capacity resulted in accumulation of large amounts of outstanding debts.

It is remarkable that the type of debt differs from that in Western agriculture where most debts are owed to commercial (agricultural) banks. Starting in 1996, when agricultural enterprises in Russia experienced losses for the second time since the beginning of reforms, the proportion of debts to the state increased. Creditors cannot determine the creditworthiness of a borrower having a high debt-to-asset ratio, since it indicates large debts to suppliers and the state, rather than to banks (Table 4). However, debts to banks in Russia are not similar to the type of debts analyzed in financial theories. This is because credit relations in Russia are established with agro-banks, which are appointed by the government and issue loans from state funds often on softer conditions (see also Yastrebova, 2002; Serova, 2003).

That the largest part of debts in Russian agriculture is owed to the state signals the presence of soft budget constraints (SBCs) that are often imposed by tax authorities in transition countries (see Schaffer, 1998). The presence of SBCs is also confirmed by the fact that non-profitable activities are also subsidized (see Bezlepkina *et al.*, 2004b) and that, on average in the period 1997-1999, worse performing farms received more subsidies (Uzun, 2002). This is in line with the concept of Kornai-type subsidies, i.e. granting subsidies to loss-making firms in order to guarantee their survival. Debt restructuring programs have been due since 1994 (see Serova, 2003). It may be assumed that the decline in net debts by 10 billion RUB in 2001 was also largely due to writing off debts, as profits increased by only 5 billion RUB (see Table 2).

Although Russian agricultural enterprises are categorized as corporate firms, typical characteristics of Russian agriculture render financial theories developed and tested for market economies. These characteristics are (a) poor credit market institutions; (b) excessive debt and prevalence of non-bank debts (see Table 2); (c) weak bankruptcy procedures; (d) Kornai-type subsidies and (e) soft budget constraints. Absence of bankruptcy threat and the possibility of renegotiating debts or receiving subsidies are effects of SBCs which loosen financial discipline and lower firm competitiveness (Kornai, 2001). Therefore it is important to take SBCs into account in studying the debt-performance relation in Russian agriculture.

Since the application of financial theories to Russian agriculture is so difficult, *a priori* expectations as to the effect of debts on performance are unclear. Different sources of debt might reveal different ways of influencing managerial efforts. Apart from there being different groups of creditors, debt 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 more strongly related to performance because they are related to production and finance decisions (Nasr *et al.*, 1998). Thus, it is reasonable to discriminate between debts to different creditors and take into account short-term versus long-term debts.

4 Methodology

4.1 Managerial Performance: DEA Pure Technical Efficiency

Data Envelopment Analysis (DEA) is a non-parametric method that uses a piece-wise linear convex hull approach for frontier estimation. A firm is fully efficient if it lies on the frontier. Various efficiency measures can be derived from linear programming (LP) models. Since the financial theories used in this study to explain the debt-performance relation mainly refer to corporate management, the degree of pure technical efficiency (PTE), as managerial efficiency, is used as the performance indicator. Agricultural enterprises in Russia inherited their large scale from the pre-reform period and were not able to adjust their scale to optimal size due to social reasons (for example, to avoid social conflicts when reducing the labour force). Therefore PTE is more appropriate for the purposes of the analysis because it is free of inefficiency due to non-optimal scale (scale inefficiency). In this study an input- oriented model with the objective of producing the observed outputs with as little inputs as possible is used (Fare *et al.*, 1994). With limited options of state support in input supply it can be assumed that enterprises will try to minimize costs to achieve pre-reform output levels.

4.2 Two-Step Empirical Model

In the second stage, the pure technical efficiency is regressed on financial characteristics such as debt-to-asset ratio (with total debts broken down by creditor), soft budget constraints, and other socio-economic farm characteristics. To overcome the problems of data censoring (Greene, 2000), a Tobit regression model is used extensively (see Nasr *et al.*, 1998). However, more recently it has been argued that the problem in the second-stage regression is a truncation rather than censoring problem (Simar and Wilson, 2003). The censoring problem is that some data are not observed, whereas in case of DEA efficiency scores, the observations with negative values and values greater than 1 do not exist. This study employs the truncated regression model. The choice of socio-economic indicators is explained in Section 5.2.

5 Data

5.1 Data Source

Panel data of large-scale specialized dairy farms in the Moscow region were obtained from data on Russian farms collected by the state statistical committee. The sample of specialized dairy farms included farms for which marketable milk production made up more than 2/3 of agricultural revenue. The unbalanced panel set contained 688 annual observations from 130-144 farms over the period 1996-2000. On average, in the sample agricultural land amounted to about 3200 ha, the average number of employees per enterprise was 250 and there were about 800 dairy cows. On these farms, on av-

erage 72% of revenue came from milk and 12% from beef production. The amounts of other livestock production (egg, pork production) and cultivation (potato, grain, vegetables and other) were 7% and 9%, respectively.

5.2 First-stage variables

Five inputs and two outputs were distinguished in the first stage calculation of technical efficiency. Outputs were milk and others (beef, pork, poultry meat, eggs, cereals, potato, vegetables). Variable input represented aggregated input costs for marketable output. Implicit quantities of variable input and the two outputs were obtained as the ratio of costs and revenues and their price indices. Other inputs in the first stage were labour, land, capital, and livestock. Descriptive characteristics are presented in Table 3.

Table 3 Descriptive statistics of DEA-model variables

Variable	Mean	Std Dev	Minimum	Maximum
Milk, 10^3 RUB of 1996	3170	3435	148	29072
Other output, 10^3 RUB of 1996	949	1058	22	10005
Variable input, 10^3 RUB of 1996	3179	3683	153	33565
Labour, number of workers	220	104	24	760
Sown land, hectares	2501	1234	138	9136
Depreciation, 10^3 RUB of 1996	446	491	15	5560
Heads of livestock	1687	928	237	7357

5.3 Second-Stage Variables

Financial characteristics. The data from balance sheets on debts were available in differing degrees of detail for the period 1996-2000. Debts were decomposed by their maturity and creditors (see Table 4).

Table 4 Debt structure of Moscow region dairy enterprises in 1996 and 2000

	In % to total debts		In % to each subcategory	
	1996	2000	1996	2000
Total debts	100	100		
Long-term debt	18	10	100	100
to banks	17	7	96	66
on other loans	1	3	4	34
Short-term debts	82	90	100	100
to banks	3	2	17	25
on other loans	15	4	83	75
Accounts payable	64	84	100	100
to suppliers	33	43	53	52
to employees	8	4	12	4
to social funds	5	13	8	15
on tax	9	19	14	23
to others	8	5	13	6

Short-term debts prevailed over long-term debts, with debt to suppliers being the largest component. In finance literature, debt structure is usually represented by the ratio of total debt and total assets (total debt ratio) or current debts to total assets (current debt ratio, see e.g. Barry *et al.*, 1995). The problem of different repricing methods for different assets is noted in (Pederson *et al.*, 1998) for the earlier period 1993-1994. As follows from Table 5, current and fixed assets depict different develop-

ment in the period 1996-2000 when the Consumer Price Index is used as a deflator. This is because current assets (accounts receivable and inventories) were valued at current prices, whereas fixed assets are restated using other pricing methods (historical or book). Due to this it has been observed that farms reported not only increases in capital stock from year to year – which implies the use of inflators from the Ministry of Finance (see Goskomstat, 2004) – but also decreases. This decrease in capital values was observed in the later years, after it was realized that costs of capital were overinflated and therefore enterprises started to evaluate their assets with the help of experts. The inconsistency in total assets among enterprise balance sheets could also be due to incomplete reporting of the values of leased land, since it was noted in the data that only a few farms reported the values of their land on the balance sheet. Table 5 presents values of debts, assets and debt-asset ratios.

Table 5 Assets and liabilities (beginning year) of sample enterprises

	1996		2000	
	Average	St.dev.	Average	St.dev.
Total liabilities, 10^6 RUB of 1996	1813	1301	2027	2536
Total assets, 10^6 RUB of 1996:	81020	45781	17083	14680
fixed	77729	44395	13417	11302
current	3291	2132	3666	5798
Profit before tax, 10^6 RUB of 1996	-815	2374	969	2482
Liabilities to total assets	0.03	0.02	0.15	0.14
Liabilities to current assets	0.60	0.38	0.76	0.65
Liabilities to total sales	0.63	0.72	0.71	0.91

Although the average total debt ratio was relatively low, debt management and repayment problems existed for some enterprises. This is revealed by the total debt-to-sales ratio, indicating the number of years required to repay the existing debt, based on current sales. Total liabilities-to-net profits ratio is also often used in finance literature (Barry *et al.*, 1995), but is less applicable to Russian farms that are frequently characterised by negative ratios. A negative debt-to-profit ratio implies that given current profits, the farms are never able to repay their liabilities (Pederson *et al.*, 1998). Ratios of debt to current assets or to total sales indicated a growth of debts in the period 1996-2000, although the growth was smaller than when total assets are used. Current debt ratio was measured more accurately than total debt ratio and was therefore used in the further analysis.

Accounting for the presence of SBCs was necessary to separate their effect from the effect of debt structure. 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 overdue debts. Firms can make losses, or have large debts in arrears, and still have hard budget constraints as long as neither their creditors nor the state rescue them with continual injections of cash or subsidies.

Following (Schaffer, 1998), we defined farms in *economic* distress as farms with a negative value of sales profit plus depreciation, whereas farms in *financial* distress were those with a negative value of profit before tax (*PBT*). A dummy variable indicating the presence of SBC was constructed in such a way that it took value 1 if a farm found itself in both financial and economic distress and if the inflow of total debts, corrected for accounts receivable, exceeded the outflow of debts. Implicitly, the state subsidy policy was taken into account by the SBC dummy, because the *PBT* accounts for subsidies (except those granted due to extraordinary situations such as weather or pest disasters). Therefore, it is assumed here that under SBC the subsidies are granted to loss-making farms. For Moscow region dairy farms, this assumption is justified because (a) the main part of subsidies is granted to livestock production, which is unprofitable; (b) about 80% of subsidies came from regional budgets, so they were more likely the subject of negotiations between managers of loss-making farms and regional government; and (c) the average ratio of subsidies to revenue was approximately twice as high for economically (financially) distressed farms as it is for other farms. About 65% of dairy farms in the sample were operating under SBCs in 1996-1998. In 1999, this percentage dropped substantially, to 10%.

Socio-economic farm characteristics. While this study focuses on the relationship between farm efficiency and financial indicators, it is important to account for the potential effects of other factors

on efficiency (see also Sotnikov, 1998; Sedik *et al.*, 1999; Voigt and Uvarovsky, 2001). Efficiency is likely to be determined by the degree of employee motivation and effort, which can be measured indirectly via the level of wages. Having recognised that wages in Russian agriculture are very low, different studies argued that increasing wages could provide the necessary incentive for employees to improve their productivity (Schulze *et al.*, 2001; Voigt and Uvarovsky, 2001; Bezlepkina *et al.*, 2004a). *Wages per worker* corrected for wage arrears partly accounted for employee effort. *Soil rating* delineated soil qualities in the Moscow region as to differences in soil typography, uniformity, drainage, fertility and other attributes. It is likely that farms with a higher soil rating also exhibit a higher level of efficiency, which however could partly reflect only the use of better production methods. The *distance from the city of Moscow to farms* reflects access to urban markets. In this study it was hypothesized that farms located closer to urban Moscow were more efficient (the farthest farm is located 163 km away) because they have lower transport/transaction costs. Following Voigt and Uvarovsky (2001), Bezlepkina *et al.* (2004a), the number of employees in agriculture was used as a size variable. In this study, a negative relation between size and managerial efficiency was expected, implying difficulties in managing large enterprises.

About 20% of the farms in the sample had milk processing facilities (often pasteurization). It was expected that farms having processing facilities at their disposal would be more flexible in choosing marketing strategy and thereby be more efficient. Therefore, *percentage of processed milk* (in kg of raw milk) was introduced as a farm characteristic. Dummy variable for *ownership* type had a value 1 for farms in private ownership and 0 otherwise (municipal, state, mixed). It was expected that farms in private ownership would be more efficient because shareholders might make more effort to discipline farm management. On the other hand, noting that ownership regulations hardly function in Russia (Liefert and Swinnen, 2002), shareholders "on paper" may not make any such efforts but rather only exploit the opportunistic behaviour of management.

6 Results

Pure technical efficiency was calculated using OnFront 2.0 (Fare and Grosskopf, 2000) for each year and each farm, assuming a separate frontier for each year. Other measures such as overall technical efficiency at various returns-to-scale and scale efficiency are presented in Appendix (Table A.1 and A.2).

To summarize the results of technical efficiency analysis, it could be concluded that even though the efficiency scores were relatively high due to homogeneity of the sample, the percentage of farms with efficiency scores of unity was rather low (see Table A.1 in Appendix). Evolution of efficiency scores for the period 1996-2000 reflected efficiency improvement after the financial crisis of year 1998. Since the scale efficiency (SE) was higher than pure technical efficiency (PTE), it indicated that it was poor management which lowered overall technical efficiency rather than operation at inefficient scale. Over the whole period the farms mostly operated at increasing returns-to-scale (IRS). A decreasing fraction of farms operating under decreasing returns-to-scale (DRS) indicated that the farms were becoming bigger. However, since the farms actually continued declining in size, finding fewer farms under DRS implied that over time the optimal size of the enterprises was getting smaller. Enterprises were not adjusting their size accordingly with respect to these changes in optimal size.

The benchmark truncated regression model included the financial ratios derived relative to current assets with the nominators being debts by the type of credit provider and by debt term (see Table 4). The estimates of financial ratios were not significant for either of the ratios and are not reported here. Instead of omitting any insignificant financial variable, aggregated ratios were used. The nominators of several financial ratios were aggregated resulting in an aggregate of long-term debts, short-term debts to credit institutions and accounts payable. This resulted in the estimates reported in Table 6. To account for the panel data, year dummy variables were introduced.

Two models are presented, with the total debts-to-current assets ratio (Model II) and by its decomposition (Model I). The presence of SBCs negatively influenced managerial performance. That is, receiving external finance (including subsidies) while having negative profits was not conducive to managerial incentive in the enterprise. The results of both models suggested that debts, which were mainly the loans from suppliers in the form of trade credit (see Table 4), were positively related to managerial efficiency. If management had a relatively good reputation suppliers would usually con-

tinue to provide inputs in spite of existing debt levels being high at the beginning of a year relative to current assets. In addition, the positive estimate of accounts payable can be observed in case the debts to suppliers have a "hard" nature and thus discipline the management. This result is in line with the studies advocating Jensen's free cash flow concept and its modifications (McConnell and Servaes, 1995; Nasr *et al.*, 1998; Harvey *et al.*, 2004). In other words, it might be more harmful for enterprises to lose their suppliers in case they have a poor reputation, than to have no access to bank loans. This explanation is valid since the nature of debts ("bad" or "commercial") was accounted for under the SBCs dummy variable.

Table 6 Truncated regression: PTE as dependent variable

	Model I		Model II	
	coefficient	t-value	coefficient	t-value
Total debts to current assets			0.054	4.22
Long-term debt on loans to current assets	0.202	3.36		
Short-term debt on loans to current assets	-0.039	-0.58		
Accounts payable to current assets	0.041	3.04		
Dummy SBC	-0.032	-2.38	-0.033	-2.40
Wages	0.032	10.28	0.033	10.24
Percentage of processed milk	0.094	2.53	0.088	2.34
Soil quality	0.049	1.68	0.050	1.67
Distance	-0.062	-4.15	-0.060	-3.99
Size	-0.116	-2.20	-0.116	-2.16
Dummy ownership	0.004	0.23	0.005	0.34
Dummy year 1997	0.049	2.75	0.046	2.54
Dummy year 1998	0.027	1.50	0.025	1.43
Dummy year 1999	0.070	3.32	0.067	3.23
Dummy year 2000	0.061	2.96	0.058	2.89
Constant	0.715	15.37	0.711	15.33
Number of observations	688		688	
Log likelihood	979		974	

The significantly positive relation between long-term debts and managerial efficiency was interpreted in a similar way, although long-term debts likely served as investments rather than to finance current production. The parameter estimate associated with indebtedness on short-term loans was not significant at the critical 5% level.

The wage coefficient corrected for wage arrears was positive in both model specifications. Average national wages in agriculture in 1996-2000 were slightly more than 50% below the average wage level in the Russian economy and almost 70% below the level in industry (Goskomstat, 2002). Although employee incentive was also determined by other benefits besides wages (see Pallot and Nefedova, 2003; Gorton and Davidova, 2004), the results showed that higher wages and/or lower wage arrears improved the performance of employees.

The percentage of processed milk and soil quality had a significant and positive effect (at the 10% significance level for soil quality) on performance. Better soil quality resulted in better performance through higher quality of grazing pastures, which are important in dairy production. As the results demonstrated, access to processing facilities helped operators improve their performance by lowering costs of transportation of milk to dairies or more attractive urban markets. The negative impact on performance of transport distances to Moscow was directly explained by higher transport costs. Indirectly, it could be a result of less beneficial relations between the farm managers and regional authorities where farms are further away from Moscow. This is because land in remote areas has lower opportunity costs in comparison with land near Moscow.

The parameter associated with size was significant (at 5%) and negative in all regressions, implying that farm management was more efficient on smaller farms. This means that farms with a smaller number of workers showed better performance. The finding that some dairy farms were too large, or

used resources less than optimally to be able to enjoy the benefits of economies of scale was supported by the results for scale efficiency (see Table A.2 in the Appendix 1).

The most noticeable change in the distribution of farms by returns-to-scale was observed after 1998, the year of financial crisis. The results for the year dummies indicated a significant positive impact of financial crisis on efficiency. The ownership dummy estimate was not significant (at 5%), possibly due to unsuccessful restructuring that failed to change the internal farm organization (Macours and Swinnen, 2000; Liefert and Swinnen, 2002).

7 Discussion and conclusions

This paper analysed the role of debts on farm performance for a sample of dairy enterprises in the Moscow region over the period 1996-2000. Studying the impact of debt on firm performance in a transition economy was complicated by the existence of soft budget constraints and the different nature of debts there. Unlike in western economies, in Russia the main (trade) credit providers are suppliers and the state. While the negative impact of debts on efficiency in other studies is explained by the negative role of the SBCs (for example see Sotnikov, 1998; Konings *et al.*, 2002), their presence was directly revealed in the empirical analysis in this paper by introducing a SBC dummy variable. Unlike in the study by Nasr *et al.* (1998), debt was reflected by the ratio of debt to current assets (and total sales) rather than to total assets. This was meant to provide a more accurate reflection of the debt situation in the enterprises, since fixed assets were poorly measured in Russian agriculture.

A positive effect of debt payables on managerial performance was observed. Since the relation between suppliers and producers seemed vital to farming, the positive relation between debts and performance might be explained by a stronger discipline imposed by the suppliers. In other words, it might be more harmful for the enterprises to lose their suppliers because of a poor reputation rather than to lose access to bank loans. This finding coincided with arguments provided in finance literature, where debts exhibit a positive effect when high (agency) costs are expected due to missing managerial incentives (see Harvey *et al.*, 2004). The positive impact of accounts payable on performance was eliminated from the overall negative impact of the SBCs, which revealed in the significantly negative estimate of the SBC dummy variable.

One of the policy implications for finding the negative role of excessive financing of loss-making farms, i.e. of SBCs, is that the state should define measures for improving farm governance. Hardening SBCs would imply fewer and smaller subsidies to highly indebted farms, strengthening the threat of bankruptcy, and eliminating soft bank loans and soft taxation. Removing soft budget constraints or even bankrupting highly insolvent enterprises would require state support to accommodate the redundant labour force (see also Serova, 2003).

The managerial efficiency of dairy enterprises was positively affected by the working environment, defined in this study as higher wages and lower wage arrears. This potential key to efficiency improvement should not be overlooked by either farm managers or policy-makers. A remote enterprise location (possibly due to lower opportunity costs of land) and large scale negatively contributed to managerial performance. The calculations of technical efficiency measures at different returns-to-scale assumptions resulted in finding fewer farms with DRS. Even though enterprises continued declining in size in the period 1996-2000, over time the optimal size of enterprises also became smaller, so enterprises were not adjusting their size accordingly, given the change in optimal size.

In transition economies, the positive impact of farm size on performance is related to the quality of the management rather than to the relationship between size and efficiency *per se* (Gorton and Davidova, 2004). Therefore using the PTE measure, which was adjusted for the inefficiency caused by size effect, is preferred. The results suggested that, ceteris paribus, larger enterprises were more difficult to manage. It should be noted that the different indicators of technical efficiency presented in this study may be overstated because only the marketable part of production is analysed. It is rather likely that farms market outputs of better quality and thus enjoy higher revenues per unit. This overvaluation of output can, however, cancel out non-reported values of output exchanged in barter transactions.

The sample of farms used in this study was rather homogeneous by construction, so it was not surprising to find higher efficiency scores here in comparison to studies performed at the regional level (for example see Sotnikov, 1998; Sedik *et al.*, 1999; Arnade and Gopinath, 2000). Although the PTE was rather high for most dairy enterprises, the results were consistent with other studies of dairy farms

in the Moscow region. By means of cluster analysis, Bezlepkina *et al* (2004a) classified 10% of these farms as successful in 2001. In this study, overall technical efficiency (TE) classified 16% of the dairy farms as overall technically efficient in the period 1996-2000. Both methods, cluster analysis and TE, accounted for scale inefficiency.

Although the PTE is less applicable in real life (for example in bank-borrower relations), unlike widely available profitability measures, it has the advantage of being independent of the market environment which is beyond the control of management. For example, price variability due to output quality or marketing channel has a direct impact on revenues and costs, and thus on profitability, which therefore does not fully indicate managerial effort. Using profitability measures in debt-performance analysis, Holz (2002) showed the disadvantage of this measure as an accounting concept, in that it does not necessarily reflect efficiency levels as much as economic or redistributive policies, and this suggests therefore the wisdom of using efficiency instead.

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Appendix 1

Table A.1 Breakdown of technical efficiency and percentage of fully efficient farms

Year	Overall technical efficiency[1)] TE			Pure technical efficiency PTE			Scale efficiency SE		
	Mean	St.dev.	% of farms with TE=1	Mean	St.dev.	% of farms with PTE=1	Mean	St.dev.	% of farms with SE=1
1996	0.85	0.10	18	0.88	0.09	58	0.97	0.05	19
1997	0.86	0.09	16	0.90	0.08	66	0.96	0.06	18
1998	0.81	0.10	10	0.85	0.10	60	0.95	0.06	11
1999	0.84	0.11	18	0.90	0.09	64	0.95	0.06	22
2000	0.88	0.09	18	0.91	0.08	72	0.97	0.04	20

[1)] *TE=PTE*SE. Overall technical efficiency is a product of pure technical efficiency and scale efficiency* ((Fare *et al.*, 1994)).

Table A.2 Number of farms at CRS (scale efficient), IRS and DRS (%)

Year	Farms at CRS	Farms at DRS	Farms at 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