Performance of Different Institutional Units in the Czech Republic and the Role of External Financing

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Abstract

The paper analyses the relationship between the financial structure of the different institutional units in the Czech Republic and their performance, by testing several theoretical hypotheses. It employs Data Envelopment Analysis to estimate separately corporate and individual farms' technical efficiency, and investigates the effect of indebtedness on efficiency in a second stage, accounting for potential endogeneity.

No substantial differences were detected between individual and corporate farms. For both groups higher long-term indebtedness negatively affects farm performance (agency theory and adjustment hypothesis), while the latter is used for appraising loan applications (credit evaluation). Case studies to banks and farms confirmed these findings.

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1. Introduction

Despite the emergence of a great number of individual farms during the transition, corporate farms still cultivate the majority of the land area in the Czech Republic, 73 per cent (Curtiss 2002), and are the main agricultural producers. The performance of these farms relative to the other main institutional unit, the individual (family) farms, has been a subject of a large number of studies and has been central to the policy debate about the viability of corporate farms in the enlarged EU (Hughes 2000; Mathijs et al. 2001; Curtiss 2002; Davidova et al. 2003; Gorton and Davidova 2004). This paper contributes to this debate by analysing the relationship between the financial structure of the different institutional units in the Czech Republic and their technical efficiency. The quantitative results are expanded by a case study.

The paper employs a two-stage estimation of the effect of indebtedness on non-parametric estimates of technical efficiency. It, first, investigates the relative technical efficiency of corporate and individual farms applying Data Envelopment Analysis. Then it tests several hypotheses about the relationship between indebtedness and technical efficiency stemming from different theoretical approaches. The study accounts for the potential endogeneity of the financial variable with the efficiency scores, first, by testing for exogeneity of the financial variable in the Tobit model, following Smith and Blundell (1986), and second, by applying the estimator proposed by Amemiya (1978) in the cases where exogeneity is rejected. Finally, the paper reports results from semi-structured interviews with banks and corporate farms about the relationship between credit and performance carried out in February 2005.

The next section summarises the theoretical debate about the relationship between the farm financial structure and farm efficiency. Section 3 provides characteristics of the debt structure of the different institutional units in the Czech Republic. Section 4 describes the methodology and section 5 presents the results. Section 6 concludes.

2. Theoretical considerations

2.1. Performance of different institutional farming units

After more than a decade of transition, questions about whether or not one organisational farm type, namely individual farms, is more efficient than other types, such as corporate structures, are still topical (for a summary of the debate see Gorton and Davidova 2004). At the beginning of the transition process, the most common view was that once the centrally planned system had been dismantled, farm structures would go back to their 'normal' trajectory, namely smaller individual/family type farms (Csaki and Lerman 1996). On economic grounds, this assumption was based on the view that family farms are more efficient than co-operatives and other types of corporate farms because they have low transaction costs (Schmitt 1991). So far, the results from the empirical studies have not consistently supported this proposition (Mathijs and Vranken 2001, Mathijs et al. 1999; Curtiss 2002). Mathijs and Vranken (2001) argue that individual farms appear to be more efficient for crop production but such advantages disappear in the dairy sector. They justify their results with the propositions of Allen and Lueck (1998) that problems of 'factory style' farms are more severe where production is spatially diffused and sequential as in these cases the costs of supervising and monitoring of hired labour are higher, e.g. in crop farming. Table 1 summarises the results of some studies on Czech farms and illustrates well the debatable issue about the relative performance of the two institutional units in the Czech Republic.

TABLE 1: Findings from studies about performance of corporate and individual farms in the Czech Republic

Study	Measure and method used	Production covered	Results			Period covered	Number of farms
			Individual farms	Companies	Co-operatives		
Mathijs *et al*. (1999)	Total technical efficiency - DEA	Crop farms	0.64	0.62	0.46		55
		Livestock farms	0.79	-	0.67	1996	30
		Mixed farms	0.56	0.58	0.59		142
Hughes (2000)	TFP - Thornqvist	All farms	0.95	1.00	1.09	1996	411
Mathijs *et al*. (2001)	Total technical efficiency - DEA	Crop farms	0.53	0.39	0.42	2000	699
Curtiss (2002)	TFP - SFA	Wheat farms	0.87	0.87	0.88		285
		Rapeseed farms	1.11	1.16	1.17	1996-98	216
		Sugar beet farms	0.98	1.02	1.09		126
Davidova *et al*. (2003)	TFP - Thornqvist	All farms	0.95	0.95 and 0.99	1.01	1999	823

2.2.   Relationship between farm performance and credit

Farm performance and external financing (credit) are closely interrelated. The most obvious relationship between these two variables is that credit helps farmers solve their cash flow problems. Credit is necessary for the smooth application of farm technologies, particularly in the New Member States (NMS) where farmers have a limited capacity for internal accumulation. The ERS/USDA (2002), in its study of the livestock sector in the economies in transition identified credit as a major constraint to producers and processors, limiting the possibilities for expansion and upgrading. It argued that the limited access to credit locked producers into their existing capital stock. Against this background, credit appears to be a positive determinant of performance. However, some theoretical frameworks propose a negative sign for the relationship between performance and credit.

Three main theoretical approaches have been employed to hypothesise this relationship. Nasr et al. (1998) transpose to the farming sector the free cash flow approach developed by Jensen (1986) for corporate firms. Jensen formulates a hypothesis about the benefits of debt as a motivating force for firm managers to become more efficient because of the threat of failing to service the debt. The free cash flow theory suggests that farmers who are indebted need to meet their repayment obligations and therefore are motivated to limit laxness or waste of resources.

The agency theory approach is based on Jensen and Meckling's (1976) agency cost concept and emphasises the lenders' costs of monitoring the borrowers, costs that might be transferred to borrowers. As a result, highly indebted farmers might be high cost and thus less efficient. The agency theory is a useful framework for conceptualising the negative impact of indebtedness on technical efficiency. However, there are other intuitive/empirical interpretations of the negative relationship during critical stages of farm adjustment to new economic conditions. For Russia, Sotnikov (1998) hypothesises a negative relationship between financial structure and technical efficiency as highly indebted farmers may not have access to credit for working capital and, consequently, cannot apply the necessary technological processes on time. This is consistent with the study of transition of New Zealand farms from a state of higher protection to more market exposure (Paul et al. 2000). According to the authors' adjustment hypothesis, farmers with lower financial exposure would adjust more easily to the change and would therefore be more efficient.

The third main approach, the credit evaluation approach, expects banks to prefer borrowers who are low risk, thus more technically efficient. This approach is based on the fact that, prior to granting a loan, banks evaluate the applications according to the applicants' probability of repayment. For this they rely on various variables that characterise applicants' creditworthiness, such as profitability, liquidity, solvency, repayment capacity, financial efficiency, collateral, management and other variables (Ellinger et al. 1992). Technical efficiency might therefore be among the variables taken into consideration either explicitly or embedded in other variables such as management and repayment capacity. The relationship postulated by the credit evaluation approach indicates potential endogeneity of indebtedness indicators and technical efficiency. Although O'Neill and Matthews (2001) argue that the positive impact of the debt to asset ratio on technical efficiency found for Irish farms might suggest an inverse causality, with the better managers more able to borrow, none of the previous studies have explicitly accounted for the endogeneity implied by this approach.

In summary, three approaches hypothesise an influence of indebtedness on technical efficiency but with a different sign and a different direction. They are summarised in Table 2. However, as Shankar et al. (2001) note, the hypotheses are not mutually exclusive. In particular, the credit evaluation approach might hold together with another approach. The credit evaluation approach would indicate an inverse causality and can be revealed by evidence of endogeneity between technical efficiency scores and indebtedness. The significance and sign of the parameter of the indebtedness variable in the regression of technical efficiency scores can indicate support for one of the other approaches.

TABLE 2: Theoretical approaches and hypotheses about the relationship between indebtedness and technical efficiency

Approach	Hypothesis
Free cash flow	(+) indebtedness ➜ technical efficiency
Agency theory Adjustment	(−) indebtedness ➜ technical efficiency
Credit evaluation	(+) indebtedness ⬅ technical efficiency

3. Characteristics of farm debts in the Czech Republic

The situation in the Czech Republic is specific from the point of view of the so-called 'transformation debts' inherited by some corporate farms that are successors of the former state and collective farms. In general, corporate farms have more liabilities than individual farms. In 2003, corporate farms in the Czech Farm Accountancy Data Network (FADN) had a debt to asset ratio of 0.46 whilst this ratio was 0.14 for individual farms (VUZE 2004). However, a high proportion of these debts stems from the reform process itself and consists of non-bank liabilities (77 per cent for the corporate farms in 2003). The producer co-operatives have non-bank long-term liabilities to the owners of co-operative assets who received shares during the land reform process, but decided not to farm individually and to leave their land and their shares of non-land assets within the new co-operatives. The limited liability companies are indebted to the state as they acquired assets from the former state farms. However, the co-operatives did not begin to pay back their debts to asset owners until 2000 and the limited liability companies pay very little interest on their loans from the state, so they exhibit low financial stress (Davidova et al. 2003). This is not the case for the *de novo* individual farms and some of the joint stock companies created post-reform since they have to pay their debts to the commercial lenders on tight schedules. This specific situation of farms in transition countries gives grounds for proposing that the relationship between the financial structure and technical efficiency might be different for the corporate farms compared to the *de novo* individual farms. On this basis, two propositions are advanced. First, the credit evaluation approach is expected to hold for individual but not for corporate farms due to the large share of non-bank debts in the debt portfolio of the latter. In other words, exogeneity of indebtedness is expected to be rejected for individual farms and accepted for corporate farms. Second, concerning the effect of indebtedness on technical efficiency, a different approach is hypothesised for individual farms, on the one hand, and for corporate farms, on the other. Individual farms are expected to be affected by high transaction costs of screening and monitoring, as they are smaller, more numerous, scattered in the rural areas and often without a credit history. For this reason, the agency theory approach is hypothesised to hold for individual farms. As for corporate farms, they are already highly indebted and might not be able to contract additional debts. Hence, for these farms the adjustment approach is expected to be valid. Hence, as both approaches propose a negative impact of indebtedness on technical efficiency, for both individual and corporate farms a negative sign of the relationship is hypothesised.

4. Methodology

Data Envelopment Analysis (DEA) is used for estimating technical efficiency. The study employs an input oriented single-output multi-input farm level model using FADN data. Total output in value is used as the single output variable. Four inputs are included: utilised agricultural area (UAA) in hectares (ha) as a land factor; annual work units (AWU) as a labour factor; depreciation plus interest as a capital factor; and the value of intermediate consumption as a variable input factor. Four frontiers are estimated, one for each specialisation, livestock and crop, and each management form, individual and corporate farms. The underlying assumption is that the production technology is different for different specialisations and legal forms. Individual and corporate farms might not have had access to the same technology. For example, managers of the limited liability companies have some managerial experience from the pre-reform period and access to machinery from the previous state farms at favourable conditions (Gorton and Davidova 2004). Estimating separate frontiers does not allow the relative performance of the technologies to be compared directly, but indicates how the individual observations lie on average in relation to the efficiency frontier of the relevant sub-sample.

The effect of credit on the efficiency scores is investigated with a Tobit model, which is required as the efficiency distribution is censored at one. A Tobit model is estimated for each of the four sub-samples (livestock/crop, individual/corporate). The dependent variable used in all regressions is an inefficiency score, computed as the inverse of the total technical efficiency score. Two financial explanatory variables are used in turn, the debt to asset ratio showing the long-term capital position, and the current debt to current asset ratio indicating the liquidity of the farm, namely the farm's ability to convert assets into cash quickly and to meet its operational needs. The use of two financial variables might give some insights into the possible differences in the sign and strength of the relationship where investment credit as opposed to credit for working capital is concerned. Based on previous research on farm efficiency in developing and transition countries (e.g. Sotnikov 1998; Brümmer 2001; Mathijs and Vranken 2001; Curtiss 2002) a number of other explanatory variables are included: land area (UAA) for crop farms and livestock units for livestock farms as a size variable; the ratio of capital (depreciation plus interest) to labour (AWU) and the ratio of land (UAA) to labour (AWU) as technology proxies; the percentage of hired labour and the percentage of rented land used to capture the quality of labour and the institutions for land tenure respectively; four regional dummies used as proxies for environment characteristics.

As the main interest is on the financial management of the different institutional units and its implications for technical efficiency, the financial variables are of central importance. The main methodological problem is the potential endogeneity in respect to the credit evaluation approach. For this reason, exogeneity of the indebtedness variable is tested with the test proposed by Smith and Blundell (1986). In case of rejection of exogeneity, the estimator used is the one proposed by Amemiya (1978). The method relies on applying the generalised least squares to the relationship between the Tobit model's structural parameters and its reduced form parameters. The instruments used are based on Rajan and Zingales' (1995) study of the determinants of the capital structure of public firms in the G-7 countries: the value of total output in natural logarithm, the ratio of fixed to total assets and a farm specific cost-revenue ratio.

The study draws data from the 1999 Czech FADN dataset. The useable records include 753 farms. From these 753 farms, two sub-samples are constructed depending on whether farms specialise in crop or livestock, defined here as farms for which at least 65 per cent of the value of total agricultural output comes from crop or livestock. The extracted livestock sub-sample contains 88 farms and the crop sub-sample, 256 farms. The farms in each specialisation are also split according to their management form into individual and corporate sub-samples. The final four sub-samples used, individual livestock, individual crop, corporate livestock and corporate crop, consist of 53, 221, 35 and 35 farms respectively.

An additional qualitative investigation of the relationship between performance and credit was carried out through interviews with farms and banks, conducted in the Czech Republic in February 2005. The objective of these case studies was to give additional insights into the reality faced by Czech farms in the rural credit market. Banks with a history of lending to agriculture were selected for the case study, while the farms interviewed had had some loans from banks in the past three years. This work is in progress, and so far only two banks and two corporate farms have been interviewed.

5. Results

5.1. Results from the empirical study

The efficiency estimates presented in Table 3 reveal that, contrary to some theoretical expectations related to transaction costs, overall, corporate farms appear to be more totally technically efficient than individual farms. This is consistent with Hughes' (2000) Total Factor Productivity (TFP) findings for the Czech Republic. The main total technical efficiency differences between the individual and corporate farms appear in livestock production where the corporate farms are much more efficient (total technical efficiency scores 0.55 and 0.83 respectively). The differences in average total efficiency estimates between the two management types in crop production are small.

TABLE 3: Descriptive statistics of DEA total technical efficiency

Farm specialisation and form		Mean	Standard deviation	Minimum	Share of farms with efficiency score of 1 (%)
Individual	Livestock	0.55	0.16	0.29	3.8
	Crop	0.67	0.18	0.21	6.3
Corporate	Livestock	0.83	0.15	0.55	25.7
	Crop	0.69	0.22	0.34	8.6

The test of the three theoretical hypotheses about the relationship between credit and technical efficiency was done with a Tobit model as explained earlier. Results of the model are presented in Table 4, and are limited to the variables of interest, that is to say debt to asset ratio and current debt to current asset ratio. As the dependent variable is the inefficiency score, the parameters with negative signs indicate sources of efficiency and vice versa. In the table, a row shows whether exogeneity of the financial variable was rejected or accepted. Exogeneity of debt to asset variable was rejected for all sub-samples. This rejects our initial proposition that the credit evaluation would only hold for individual farms. It suggests that ten years after the beginning of the transition process individual and corporate farms have started to be treated equally by lenders and have both been subject to strict loan evaluation. However, the results of the model including the current debt to current asset ratio reveal that exogeneity is accepted for all individual farms and for the livestock corporate farms. This suggests that lenders might evaluate more strictly the applications for investment credit and have a looser approach to short-term loans for working capital (the latter have often been guaranteed with the future crop). The results do not reveal a statistically significant relationship of the current debt to current asset ratio with inefficiency scores for all sub-samples. However, a significant impact of the debt to asset ratio, thus of the long-term financial structure, is identified for all farm groups. The debt to asset ratio is a source of inefficiency for all farm groups except for

the individual crop farms where the increase in indebtedness is positively related to technical efficiency. In other words, the increase in investment debts negatively influences the technical efficiency of corporate farms and of individual livestock farms. This suggests that, either due to the agency theory argument for individual farms or to adjustment hardships for corporate farms, the relation between the financial structure and technical efficiency is negative.

TABLE 4: Results from the Tobit model on the total technical inefficiency score: exogeneity test and estimated parameter of the indebtedness variables

	Individual farms		Corporate farms	
	Livestock	Crop	Livestock	Crop
Debt to asset ratio				
H_0: exogeneity	rejected ***	rejected ***	rejected ***	rejected *
Parameter	2.16 **	-6.41 *	1.46 *	1.35 *
	(1.03)	(3.58)	(0.87)	(0.79)
Current debt to current asset ratio				
H0: exogeneity	accepted	accepted	accepted	rejected *
Parameter	0.01	-0.02	0.07	0.64
	(0.24)	(0.08)	(0.11)	(0.50)

*,**,*** : 10, 5, 1 percent significance. Standard errors into brackets.

5.2.   Results from the case studies

The case studies were aimed at providing additional insights into the hypotheses about the relationship between credit and performance in the conditions of the Czech transition. For both banks studied, staff at the head offices in Prague was interviewed. Both banks started lending to agriculture in 1990. Five percent of Bank A's portfolio were in agriculture, while lending to farmers accounted for less than one percent of the portfolio of Bank B (see Table 5). On the farm side, both farms interviewed were corporate mixed farms (see Table 6). Farm 1 operated an area of 1,250 hectares. It cultivated cereals and rapeseed, and had beef and dairy cattle. It was located in the less favoured area of West Moravia. This farm had received a subsidised investment loan for a tractor from a commercial bank. Farm 2 had 850 hectares and produced cereals, sugar beet and eggs, in the lowland along the river Labe. This farm had received two loans in the past three years, both times from a commercial bank. Both loans were subsidised and were for a harvester and for working capital. Both farms benefited from preferential loans disbursed by the Support and Guarantee Fund for Agriculture and Forestry (SGFAF). The farms were charged 1 percent and 3 percent interest rate respectively, which was lower than the 5.3 percent average market rate (Ministry of Finance 2003).

The first part of the interviews aimed at gathering detailed information about the lending process. Banks were asked about the procedure for evaluation of farmers' loan applications, the types of costs they charged to farmers, and how the loans were monitored. Farmers were asked about their loan characteristics, about the way their applications were evaluated, the number of visits to the banks and the waiting time during the application

process, the additional costs they were charged, and how they were monitored. This part of the interview looked for indication about the existence, or the lack, of agency costs, and tried to identify whether the credit evaluation approach was adequate to interpret the relationships between lenders and borrowers in the Czech Republic.

Overall, the results of the quantitative analysis were confirmed by the case studies, as both banks reported to consider farm performance when evaluating applications. Farms also recognised that their performance was at the basis of the appraisal process, suggesting that the credit evaluation was an appropriate approximation of the reality. Farm indebtedness level at the time of application has also played an important role in the application's evaluation as acknowledged by both banks and Farm 1. This gives some support for the adjustment hypothesis, as corporate farms are known to be highly indebted and this could prevent them from receiving further credit. In addition, the agency costs transferred to farmers seem to be not negligible, as both banks gave details of several fees and costs charged to farmers during the application process, namely administrative and insurance fees, and costs for screening and monitoring. Both farmers confirmed these facts and Farmer 2 also reported four visits to the bank before getting a loan.

The second part of the interview consisted of a broader discussion about banks' relations with farmers and about farmers' opinion regarding the use of credit and the loan applications. Banks and farmers were also presented with several statements and asked to choose the most appropriate. The interviews with banks suggested that, although the staff considered farmers as reliable borrowers who usually repay their debt on time, they admitted having insufficient information and experience for lending to the farming sector. Loans to farms have only been a marginal part of the banks' operations and banks have not had separate statistical data about the loans to agriculture. For this reason it was not possible to get precise figures (average interest rate, average loan value, etc) about these loans. Overall, the interviews showed that the agency theory and adjustment hypothesis approaches were more appropriate to represent the situation faced by corporate farms in the Czech Republic. Both farm managers were concerned about the high costs of credit which they thought might threaten their business, supporting the agency theory approach. But the adjustment hypothesis seemed to be the prevailing approach, as for example both farm managers stressed that the loans that they received were vital for the survival of their business.

TABLE 5: The banks interviewed in the case studies: characteristics and loan process

	Bank A	Bank B
Type	Foreign commercial	Foreign commercial
Location of head office	Prague	Prague
Lends to agriculture since:	1990	1990
Loans to agriculture (share of the portfolio size)	5%	< 1%
Evaluation of farmers' loans applications using:	Farm turnover, performance, management Existence of collateral Current indebtedness Credit history	Farm subsidies Current indebtedness Credit history
Other fees and costs outside the interest rate, charged to farmers	Administrative fees Insurance fees Costs for evaluating creditworthiness	Administrative fees Costs for evaluating creditworthiness Costs for developing a business plan Fees for visits to the farm
Visits to the farms during the loan process	Sometimes	More than 2

TABLE 6: The farms interviewed in the case studies: characteristics and credit history

	Farm 1	Farm 2	
Type	Corporate	Corporate	
UAA	1,250 ha	850 ha	
Production	Cereals, rapeseed, cattle	Cereals, sugar beet, laying hens	
Loans			
Bank type	Commercial	Commercial	Commercial
Loan type	Investment	Investment	Working capital
Loan value (euros)	135,020	101,260	84,390
Interest rate per year	1%	3%	3%
Subsidised loan?	Yes	Yes	Yes
Collateral or guarantees	Machinery	Machinery	Building
	Third-party guarantee	Third-party guarantee	Third-party guarantee
Application			
Evaluation of the application	Farm performance	Farm performance	Farm performance
	Current indebtedness	Existence of collateral	Existence of collateral
	Credit history	Credit history	Credit history
Number of visits to the bank	1	4	4
Waiting time	7 days	1 day	10 days
Costs charged during the loan application	Costs for developing a business plan	Costs for developing a business plan	Costs for developing a business plan
	Administrative fees	Costs for collateral evaluation	Costs for collateral evaluation
	Insurance fees	Administrative fees	Administrative fees

6. Conclusion

The paper aimed at studying the performance of corporate farms and individual farms in the Czech Republic, and at exploring the role of credit on performance. The non-parametric DEA method was used to estimate technical efficiency. Farms were classified according to specialisation and management type and a separate frontier for each specialisation and management type was estimated. At the second stage, a Tobit model was used to investigate the variables that may explain the variability in efficiency, focusing on the impact of financial structure on farm performance and accounting for potential endogeneity between financial variables and technical efficiency. Additionally, a case study was done in the Czech Republic to farmers and banks.

The results of DEA point estimates indicate that, overall, corporate farms in the Czech Republic are more clustered towards their technically efficient frontier than the individual farms. This suggests that management experience and practices in the post-reform individual farms are on average still deficient in comparison to the successors of the former state and collective farms in the sense that they are more heterogeneous and there are farms lagging substantially behind the best practice. With regard to the Czech farm structures, although the indebtedness of the corporate farms has been high on the political agenda in the Czech Republic, particularly in view of the viability of these farms with their rescheduled debts in the enlarged Union, the analysis did not detect substantial differences in the relationship of financial exposure with technical efficiency between the two management types. Both seem to be treated equally by the lenders, thus for both management types the credit evaluation approach holds at least for the long-term financial structure. The effect of long-term indebtedness on farm technical efficiency is negative. It is claimed here that this is due to the agency theory argument for the individual farms and to the adjustment argument for the corporate farms. Additionally, this research found empirical evidence of the credit evaluation approach for investment loans. The case studies presented in this paper abound in these senses, as they highlighted the high borrowing costs faced by farms (agency theory), the necessity of credit to survive (adjustment hypothesis), and the consideration of performance for granting loans (credit evaluation).

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