OWNERSHIP AND INVESTMENT BEHAVIOR IN TRANSITION: CASE OF CZECH COLLECTIVE AND CORPORATE FARMS

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ABSTRACT

Cooperative and corporate farms have retained an important role for agricultural production in many transition countries of Central and Eastern Europe. Despite this importance, their ownership structure and particularly the ownership's effect on their investment activity vital for efficient restructuring and the sector's future development are still not well understood. This paper aims to analyze the ownership-investment relationship using data on Czech farms from 1997 to 2008. We allow for ownership-specific variability in farm investment behavior analyzed by means of error-correction accelerator model. Empirical results suggest significant differences in the level of investment activity, responsiveness to market signals, investment lumpiness of investment as well as sensitivity to financial variables among farms with different ownership characteristics. Resulting increase in farm performance differences among farms can be expected to lead to farm restructuring in direction of lowering number of owners and increasing ownership concentration.

INTRODUCTION

The diversity of ownership structures that have emerged in agriculture in transition countries offer a unique opportunity to study the ownership effect on farm investment activity and thus to insinuate future farm structural development. The farm ownership constellations in most of the Central and Eastern European countries are assigned by their dual nature, i.e. by a large number of small individually or family owned farms and a small number of large-scale farms of a cooperative and corporate form. The large-scale farm, despite their relatively low numbers, remained cultivating a considerable share of agricultural land. For example, in Bulgaria and in Romania, the share of agricultural land cultivated by cooperative and corporate farms corresponds to nearly 50%, in the Czech Republic to around 70% and in Slovakia almost 90% (LERMAN et al., 2004; Ministerstvo zemědělství České Republiky, 2009, Ministerstvo Podohospodarstva Slovenskej Republiky, 2008). Despite their dominance in the sector, the complex ownership structures and governance of these farms, particularly their effect on investment decisions vital for the efficient restructuring and future development of the sector, have not received researchers' sufficient attention.

In comparison to firms with corporate governance in mature economies, the corporate farms' governance in transition countries was formed in conditions of weak legal protection of renewed property rights as well as minority shareholder interests. As a direct consequence of these conditions, the property rights reforms led to highly dispersed ownership of the corporate farms with a great representation of external as well as insider (employee and managerial) ownership. The following ownership development has been further cramped by only slowly emergent internal corporate environment and underdeveloped markets for agricultural ownership shares. This environment indicates high probability of inefficient property rights allocation and high agency costs which could be partially lowered by efficient management incentive and monitoring mechanisms. The new owners, however, dispose of knowledge with corporate bonding and control mechanisms limited only to their short transitional experience. Each of these aspects amplifies the agency problems of corporate governance in transition agriculture. The separation of ownership and control over the corporate farms and underdeveloped corporate mechanisms suggest that the most distinguishing characteristics of the corporate governance in transition agriculture is the large

scope for managerial discretion. The area in which the scope for managerial discretion comes to its greatest effect is in the generated internal funds distribution and decisions over productive investment.

Most empirical studies of the ownership-investment relationship were conducted for mature market economies (see, e.g., MORCK ET AL. 1988; MCCONNELL AND SERVAES, 1990; CHO, 1998; CHADDAD ET AL., 2005; GUGLER, 2005; DANIELSON AND SCOTT, 2007); only scarcely were these studies done for transition countries (MUELLER AND PEEV, 2007; GUGLER AND PEEV, 2007; DOMADENIK ET AL., 2008; BOKUSHEVA et al., 2009). The empirical results by MUELLER AND PEEV (2007) support the existence of the managerial discretion effect on investment in more than 10 selected Central and Eastern European countries. They ascribe the resulting over-investment to the corporate governance institutions and weak law enforcement in transition countries. DOMADENIK ET AL. (2008) analyzed the effect of the relationship between management and employed owners on the Slovenian firms' investment. Their hypothesis that managers and employees bargain over the allocation of generated internal funds between wages and investments and thus decrease funds for fixed investment in less liquid capital markets was not confirmed by the empirical data. In their study of firms investment behavior in 15 transition economies, GUGLER AND PEEV (2007) found a decline in the investment sensitivity to cash flow over the period 1993-2003. They attributed this trend to the decrease of agency problems as capital markets and corporate governance standards developed. BOKUSHEVA et al. (2009) found that Russian farms with higher share of owners among managers show a higher and positive relationship between investment and cash flow. They interpret this result as related to higher marginal productivity of capital in farms with higher managerial ownership. LÍZAL AND ŠVEJNAR (2001) found a positive relationship between investment and profitability in Czech (non-agricultural) cooperatives and to a lesser extend in small private firms and attribute this observation to these firms encountering financial constraints. In the case of cooperatives, however, this result could indicate not only encountering of credit constraints but also decision-making constraints related to labor-management and thus the cooperatives' internal governance.

With only a few investment studies on transition agriculture, the farm ownership-investment relationship in transition countries remains vastly unexplored. This study aims to reduce this research gap using unique survey data on ownership structure of Czech cooperative and corporate farms[1]. This data combined with investment, production and financial data from the Farm Accountancy Data Network for the time period 1997-2008 is used in an error-correction accelerator model framework.

OWNERSHIP AND INVESTMENT - THEORETICAL DISCUSSION

Principal-agent relationship's role in investment modeling

The modern theory of firm investment behavior is built upon its neoclassical foundation formulated by MODIGLIANI AND MILLER (1958) and JORGENSON (1963). The neoclassical investment theory considers a world of perfect capital markets and optimal accumulation of

[1] The reasons for focusing the study on collective and corporate farms only are manifold. As mentioned above, cooperative and corporate farms play an important role in many of the transition countries, while agency problems that are characteristic for corporate or joint ownership with delegated management is a likely source of non-optimal investment decisions and restructuring. One could argue for the suitability of a comparative analysis between individual farms and farms with joint ownership. However, such a comparison would introduce an investment effect of heterogeneous financial conditions (credit constraints) between large and small individual farms (see, e.g., BEZEMER, 2003), which, without concrete information on these conditions, would disturb the interpretation of the results on agency-investment relationship. To the convenience of this study, the ownership structure of corporate and cooperative farms is so diverse that this relationship can be well analyzed within the sample of these farms purely.

capital. It assumes that the short-run investment of a firm represents a lagged response to changes in underlying market conditions as well as the tax structure both affecting the cost of capital (JORGENSON, 1963). Later literature demonstrated the breakdown of the neoclassical investment model by acknowledging the investment role of asymmetric information between managers of the firm and the providers of external capital (banks), as well as agency costs arising from the divergent goals of managers and owners of the firm (MAIRESSE, ET AL., 1999).

The issue of information asymmetries, also called adverse selection, refers to a situation when managers and other insiders know that their firm offers attractive investment opportunities, while potential suppliers of external capital do not dispose of sufficient information to assess the investment returns (e.g., STIGLITZ and WEISS, 1981; MYERS and MAJLUF, 1984). As a consequence, a firm may depend more on internal resources that are limiting in their amount which results in less optimal capital accumulation (under-investment). The second phenomenon that shattered the neoclassical fundament of the investment model applies to corporate (joint) ownership with separation of ownership and control. Information asymmetries between owners and managers, often referred to as moral hazard, give managers a scope for discretion that can be utilized for pursuing goals and interests that deviate from the goals and interest of owners and thus lead to non-optimal decisions from the owners perspective (JENSEN and MECKLING, 1976). Besides goal differences, also not having their personal wealth at stake, represents a reason for managers behaving less optimally than owners (given same information and qualification) (JENSEN, 1986; ANG, 1991). Also, seeking higher appraisal, manager's generally tend to present their work, and thus firm performance and market standing positively, which suggests growth potential leading to over-investment (GRABOWSKI AND MUELLER, 1972; MILLER AND PEEV, 2007). However, we can argue that in the case of transition, where capital markets are characterized by lower liquidity (DOMADENIK ET AL., 2008), and especially in the case of agriculture, which is characterized by significantly lower profitability than other sectors as well as lower attractiveness to banks, managerial discretion could be utilized toward higher investment only if there are alternative accessible investment sources (such as operational leasing), but will unlikely lead to over-investment. Managerial discretion could rather manifest itself in higher dependency on internal funds and decreasing relative productivity of the firm over time.

The differences in objectives and incentives together with the information asymmetries thus increases the importance of overall efficiency of corporate governance, including management monitoring. Nevertheless, both losses in decision optimality or improving corporate governance result in costs, agency costs, bore by corporate owners. Their levels can be assumed to be particularly high in transition economies, where the legal protection of shareholders (mainly minority shareholders) has been weak and the concept of active governance of firms to shareholders was new.

As outlined above, the mode in which corporate ownership structure affects investment the most is its provision of scope for managerial discretion and its effect on the incentive structure that reflects in managerial technical and investment performance. One way in which both asymmetric information between the firm and possible suppliers (lenders) of external capital and agency problems within the firm impact firm investment is the use of internal versus external financial resources. This implies an importance of financial variables (profit or cash flow) in the investment decision. In a perfect capital market or when no information asymmetries exist between a firm and a supplier of external finance, a firm should not be limited in its investment with high returns by lower internal funds since cost of external and internal finances equal and external capital is fully accessible (FAZZARI ET AL., 1988). In imperfect capital markets with information asymmetries, or with differential cost between internal and external finance, a firm investment activity will be more sensitive to generated

profit or cash flow (FAZZARI ET AL., 1988). Evidence of excessive sensitivity to cash flow has thus been often interpreted as suggesting the existence of credit constraints. However, KAPLAN AND ZINGALES (1997) argue that the sensitivity of investment to cash flow is also justified by the fact that external funds are more costly than internal funds for all firms as long as some transaction costs are involved. Similarly to POTERBA (1988), they also argue that, since current investment depends not only on the current but also on expected future changes in the desired stock of capital, it is possible that information on cash flow helps to forecast future profitability and investment opportunities, which, again results in higher investment sensitivity to cash flow. Nevertheless, most relevantly to our study, the investment sensitivity to cash flow as a proxy for internal funds may have a firm internal rationale. As outlined above, management aiming at personal appraisal is motivated to present optimistic firm results and follow a strategy of growth independent of the real returns on capital and investment. In this case, management is assumed to preferably finance (less efficient) investment projects from internal resources to avoid the projects' external (bank) scrutiny (JONES ET AL., 2005, MUELLER AND PEEV, 2007).

Ownership specific investment behavior

Since both information asymmetries between the firm and suppliers of external capital as well as firm internal principal-agent problems should result in a positive investment sensitivity to financial variables, the distinction between these two and possibly other sources of investment sensitivity to internal funds remains mostly ambiguous. Only a sufficiently detailed empirical data underpinning the firm ownership variability investigated within a relevant investment model and a comprehensive theoretical discussion can help to shed more light on the determinants of corporate farm[2] investment behavior and filter out the ownership effects.

The various forms of joint ownership can be outlined by differences in the degree of ownership dispersion (size of ownership shares and number of owners), imbalances in the share sizes among shareholders, or the distribution of ownership between external and internal owners. Each of these ownership characteristics impacts differently the joint governance.

Dispersed ownership represented by small ownership shares distributed among a large number of owners may provide insufficient incentives for any one investor to monitor and control the performance of the firm, whereas, where there are large dominant shareholders, the returns to active governance are greater (MAYER, 1996). The monitoring functions are then mainly delegated to internal or external controllers (e.g., members of the Board of Trustees). For the same reasons above, organizations with high ownership dispersion lack a strong back-coupling between the owners and controllers. In transition economies assigned by shareholders' low experience with corporate governance and lacking connection to relevant specialists, external controllers were often proposed by managing stuff, mostly from historic networks. Such constellation of management control can be assumed less rigorous than potential control performed by fully independent and qualified monitoring agents. Furthermore, the direct monitoring capacities of small shareholders can further be considered as hindered by information asymmetries between them and managers, as well as their bounded rationality, as ownership to agricultural assets was partially acquired by former employees in collective farms with technical qualification, low education and entrepreneurial knowledge. The interplay of all these factors related to dispersed ownership create an environment characterized by a larger scope for managerial discretion allowing the managers

[2] Cooperatives are treated in this study as farms with corporate governance, since either the obligation of connecting cooperative membership to work in the cooperative nor the one member-one vote voting rule are included in the actual commercial law of the Czech Republic (Law nr. 513/1991 of the Code of Law, Commercial Code). Most Czech agricultural cooperatives do not chose the rules traditionally defining producer cooperatives in academic literature.

to pursue their own interests, as well as by conditions for high managerial transaction costs[3] and lesser incentive for managerial performance.

Regarding the use of internal versus external sources for investment financing, the less efficient governance related to dispersed ownership can lead to the avoidance of external scrutiny of investment projects, which is in line with the above presented argument by MUELLER AND PEEV (2007). Lesser external monitoring (e.g., by banks) then amplifies insufficient monitoring of management in firms with ownership dispersion (DOMADENIK ET AL., 2008)[4]. As a result of these factors, high ownership dispersion can be assumed to lead to higher investment sensitivity to financial variables then higher ownership concentration. In the conditions of (Czech) transition, however, most dispersed ownership is characteristic for farms where restituents' (new owners') property claims were (later in transition) transformed into shares as a form of securing a value of the restituted property (see CURTISS et al. 2006). For the agricultural companies, this was a form of securing their access to capital in the form of equity instead of debt that would expose the companies to bank scrutiny. Many of the small shareholders are thus former property claimants who did not succeed in their effort of monetary retribution of their property claims they were originally aiming to. The imposed shareholding as well as higher risk aversion then likely reflect in shareholders low interest in the farm future performance and thus investment activity. As the shareholders predominantly follow their interest of early reversal of their "investment" and payment of dividends, they do not rely on management to decide about investment activity, which may reduce the effect of internal information asymmetries and managerial discretion on investment, especially then their effect on investment sensitivity to internal funds.

Ownership concentration defines a situation in which investors decides to invest into higher shares and hence characterizes owners which likely have a higher entrepreneurial interest and more trust in the performance of the business. As these investors allocate more capital to the firm, they could also be assumed to be less risk averse than the small shareholders. The fact that they have more at stake is assumed to stimulate them to develop more efficient corporate governance structure, including better monitoring, controlling and incentive mechanism. In a similar vein, MAYER (1996: 11-12) argues: "Where there is concentrated ownership, there may be a greater willingness to discipline poorly performing management as well as more incentive to intervene and exercise 'voice' rather than 'exit'". If higher ownership shares also represent higher relative share in the legal capital per shareholders (i.e., there are less owners in the firm, or a number of dominant owners), it provides the shareholders with higher decision-making powers and higher returns on active individual owner's governance. However, as ownership and control are separated, this ownership characteristics still leads to a higher investment activity than if ownership and control are concentrated in the same hands. Nevertheless, more efficient control of managers' performance reduces managers' transaction costs and leads to more optimal investment decision than in dispersed ownership. Due to lower managerial transaction costs and more effective control of the farm operation, farms with more concentrated ownership are also expected to achieve higher performance than less ownership concentrated firms. More optimal investment and higher economic performance means higher returns on capital and lesser reason for avoiding bank control of the investment projects. Because of the owners' lower risk aversion, and better management monitoring,

[3] Managerial transaction costs are costs of free cash flow dispersion, replacement resistance, resistance to profit liquidation or merger, power struggles, excessive risk taking, excessive diversification, excessive growth, etc.

[4] DOMADENIK ET AL. (2008) do not refer in this context to the managers choices of avoiding bank scrutiny of investment projects, but refer to less liquid capital market that they see as an investment constraint in transition countries.

higher ownership concentration is expected to lead to more optimal investment projects and a higher use of external financing, thus lower investment sensitivity to internal funds.

The interest and concern divergence between external and internal owners can represent a source of investment behavior differences. The most important difference between the considerations of employed owners and external investors stems from the employed owners' linkage of firm performance to employment security. On the one hand, employment security stimulates higher labor performance, provides higher incentives to control over investment projects and monitor management performance; on the other hand, results in higher risk-aversion towards investment projects. DOW (2003) titled this behavior as "finance pessimism". Another problem of employee-owned firms closely allied with investment behavior lies in what JENSEN AND MECKLING (1976) (see also FURUBOTN, 1976) term "the horizon problem". This implies that when workers leave the firm after the termination of their work contract they lose their share of the value of any capital that has been accumulated by the firm and thus have insufficient incentives in projects with long payback periods. As a result, employed owners prefer current consumption to investment (JONES ET AL. 2005) or investment projects with short payback period. This investment conservatism of employee ownership can be expected to result in lower and less than optimal investment level. Also, the higher risk aversion of employed owners could lead to preferring external financing due to banks revising the quality of the investment project, which would lead to lower investment sensitivity to generated cash flows than in firms with higher share of external owners. Higher external ownership, on the other hand, can be assumed to provide the farms with a lesser management scrutiny that allows for managerial discretion and thus managers to carry easier through their investment interests.

METHOD OF INVESTMENT ANALYSIS

Investment model

Following MAIRESSE's et al. (1999) deliberation on the development of investment models and BOKUSHEVA's et al. (2009) discussion on investment models' suitability for the case of modeling investment behavior in transition agriculture, we chose to apply the error-correction accelerator model. This implies that we are not aiming to look for the "correct" investment model, but we select a model based on its theoretical specification and performance of the alternative models in previous applications. The advantage of the error-correction specification of the accelerator model is that it allows to separate the long run investment determinants from the short run investment adjustments and its quality of retaining information in the levels of output and capital stock (not only information in first differences). If data allow this specification then this characterization of investment behavior makes this model superior to other investment models applied to transition agriculture such as the basic accelerator model, adjustment cost or Euler equations. An alternative Tobin q model is less relevant for transition agriculture since the q (market) value of the corporate farms does not exist. Another advantage of the specification of the error-correction accelerator model is that it does not require any specification of adjustment cost. Due to spatial constraints on this paper, we describe the origin of error-correction accelerator model only briefly. See, e.g., MAIRESSE et al. (1999) for a more detailed description of this model.

The error correction econometric approach was introduced into investment modeling by BEAN (1981). The error-correction specification of the investment accelerator model nests the demand for capital equation, $k_{it} = a + y_{it} - \sigma j_{it}$ (JORGENSON, 1963) with the dynamic (accelerator) investment equation with an autoregressive-distributed lag of length two (ADL (2,2) function) In the equation for the firms' desired capital stock, k_{it} denotes the (natural) logarithm of the desired capital stock for firm i in period t, y_{it} denotes the logarithm of output

(or sales) and j_{it} denotes the log of the real user cost of capital. In the error-correction accelerator model dynamic adjustment in capital, Δk_{it}, is approximated by $I_{it} / K_{i,t-1}$, where I_{it} represents investment and K_{it} the capital stock for firm i at the end of period t. It also assumes that the variation in the user cost of capital, j_{it}, can be controlled for by including year-specific and firm-specific effects. The error-correction model can be written as follows:

$$\frac{I_{it}}{K_{i,t-1}} = \alpha_0 + \rho_0\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \theta_0\Delta y_{it} + \theta_1\Delta y_{i,t-1} + \phi_0\left(k_{i,t-2} - y_{i,t-2}\right) + \varphi_0 y_{i,t-2} + d_t + \eta_i + \nu_{it}\,. \quad (1)$$

The error correction coefficient, ϕ, captures the long run investment adjustment to the "desired level" of capital, d_t is a time dummy, η_i is an unobserved firm-specific effect and ν_{it} is an error term (transitory shock). The remaining parameters capture the short run dynamics. The variable $y_{i,t-2}$ is added to the error correction accelerator model to allow for a test of the assumption of constant returns to scale that is necessary for the imposed long-run proportionality in the model.

Since the commonly used accelerator model was developed for sectors other than agriculture, we need to consider some of the specifics of agriculture for the intended application. Characteristics, such as lower returns on capital, high sunk-costs of capital, and seasonality of production suggest possible investment conservatism and delays in adjustments of the desired stock of capital and slower responsiveness to market signals. Therefore, we also consider the error-correction accelerator model to nest dynamic investment equation with an autoregressive-distributed lag of length three (ADL (3,3) function). The resulting error-correction model has then the following form:

$$\begin{aligned}\frac{I_{it}}{K_{i,t-1}} &= \alpha_0 + \rho_0\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \rho_1\left(\frac{I_{i,t-2}}{K_{i,t-3}}\right) + \theta_0\Delta y_{it} + \theta_1\Delta y_{i,t-1} + \theta_2\Delta y_{i,t-2} \\ &+ \phi_1\left(k_{i,t-3} - y_{i,t-3}\right) + \varphi_1 y_{i,t-3} + d_t + \eta_i + \nu_{it}\end{aligned}\,. \quad (2)$$

Similarly to numerous investment studies, we further add current and lagged cash flow scaled by the previous period's value of fixed capital to the right-hand side of the investment equation to test the investment effect of these financial variables. This extension is analog for both equations (4) and (6), therefore, only the later is presented which yields following specification:

$$\begin{aligned}\frac{I_{it}}{K_{i,t-1}} &= \alpha_0 + \rho_0\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \rho_1\left(\frac{I_{i,t-2}}{K_{i,t-3}}\right) + \theta_0\Delta y_{it} + \theta_1\Delta y_{i,t-1} + \theta_2\Delta y_{i,t-2} + \phi\left(k_{i,t-3} - y_{i,t-3}\right) \\ &+ \varphi y_{i,t-3} + \gamma_0\frac{CF_{it}}{K_{i,t-1}} + \gamma_1\frac{CF_{i,t-1}}{K_{i,t-2}} + \gamma_2\frac{CF_{i,t-2}}{K_{i,t-3}} + d_t + \eta_i + \nu_{it}\end{aligned}\,. \quad (3)$$

In this error-correction specification of the accelerator model, we can test whether the cash flow (profit rate) plays the role of a long run determinant of investment, or whether it is only a short-run variable which can be interpreted as reflecting the transitory availability of funds for investment purposes. Nevertheless, the interpretation of the significance of investment effect of the cash flow variable is yet ambiguous. It can reflect the presence of financial constraints on investment due to asymmetric information between investors and the firm (e.g., FAZZARI, HUBBARD and PETERSEN, 1988), however, in the presence of adjustment costs, the level of cash flow to capital could contribute to the information on future profit or output expectations

(NICKELL, 1978) or investment opportunities that were not otherwise accounted by such things as sales growth (SAMUEL, 1996). Also, as discussed in the theoretical section, in the presence of agency costs arising from the divergent goals between managers and owners, the γ parameters could capture managers' strategy towards the use of available internal funds for investment projects. Therefore, analyzing the investment behavior in the context of the firm specific ownership structure and related financial conditions will allow to shed more light on the sources of the investment sensitivity to cash flow.

The theoretical predictions of firm and particularly ownership-specific adjustments in capital stock and differences in responses to various shocks, including availability of internal funds directs the next extension of the investment model. Long-run panel models with heterogeneous dynamics were estimated in previous studies. For example, Pesaran et al. (1999) specified a co-integrating long-run developments for various economies (countries), but allowed varying unit-specific short-run dynamics. In the context of investment behavior modeling, Bokusheva et al. (2009) allowed both short-run as well as long-run dynamics to vary across observations, concretely farms. We will follow this later approach and will allow investment behavior to vary across four ownership variables (Z_n, n = 1, ..., N; N = 3) - ownership concentration (Z_1), external ownership (Z_2), and owners' number (Z_3). This yields following model extension:

$$\begin{aligned}\frac{I_{it}}{K_{i,t-1}} &= \alpha_0 + \rho_0\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \rho_1\left(\frac{I_{i,t-2}}{K_{i,t-3}}\right) + \theta_0\Delta y_{it} + \theta_1\Delta y_{i,t-1} + \theta_2\Delta y_{i,t-2} + \phi_0\left(k_{i,t-3} - y_{i,t-3}\right) \\ &+ \varphi_0 y_{i,t-3} + \gamma_0\frac{CF_{it}}{K_{i,t-1}} + \gamma_1\frac{CF_{i,t-1}}{K_{i,t-2}} + \gamma_2\frac{CF_{i,t-2}}{K_{i,t-3}} + \sum_{n=1}^{N}\alpha_{0n}Z_{ni} + \sum_{n=1}^{N}\rho_{0n}Z_{ni}\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) \\ &+ \sum_{n=1}^{N}\rho_{1n}Z_{ni}\left(\frac{I_{i,t-2}}{K_{i,t-3}}\right) + \sum_{n=1}^{N}\theta_{0n}Z_{ni}\Delta y_{it} + \sum_{n=1}^{N}\theta_{1n}Z_{ni}\Delta y_{i,t-1} + \sum_{n=1}^{N}\theta_{2n}Z_{ni}\Delta y_{i,t-2} + \sum_{n=1}^{N}\phi_{0n}Z_{ni}\left(k_{i,t-3} - y_{i,t-3}\right) \\ &+ \sum_{n=1}^{N}\varphi_{0n}Z_{ni}y_{i,t-3} + \sum_{n=1}^{N}\gamma_{0n}Z_{ni}\frac{CF_{it}}{K_{i,t-1}} + \sum_{n=1}^{N}\gamma_{1n}Z_{ni}\frac{CF_{i,t-1}}{K_{i,t-2}} + \sum_{n=1}^{N}\gamma_{2n}Z_{ni}\frac{CF_{i,t-2}}{K_{i,t-3}} + d_t + \eta_i + v_{it}\end{aligned}, \quad (4)$$

A more detailed description of the variables and their data sources follows in the next section.

Data and variables

Data on farm investment, production, capital and financial variables originate from the official balance sheets, income statements and supplementary forms of the Farm Accountancy Data Network of the Czech Republic (FADN CZ) survey for the years 1997-2007. Data on farm ownership structure comes from a structured data collection in the Czech Republic in 2004. This data survey was organized and funded by the Institute for Agricultural Development in Central and Eastern Europe (IAMO), Halle, Germany, jointly with the Research Institute for Agricultural Economics (VUZE), Prague, Czech Republic. The sample contains 117 agricultural companies with combined crop and animal production of a legal entity status (cooperatives, JSC and LLC) for a minimum of 7 years of consecutive annual data between 1997-2008; from these, data on 41 farms are available for the entire period of 11 years.

The empirical model variables are all expressed in real values and contain following information:

K - farm stock of capital; it includes all long-term tangible, intangible and financial assets; k denotes natural logarithm of K;

I - value of gross investment between sequential periods calculated as the change in capital stock (representing net investment) plus depreciation and amortization;

y - logarithm of farm total sales; Δy_i is the change in y_i between two following periods;

CF - value of the farm's cash flow that is available at the end of a given period for purchasing new capital stock at the beginning of a following period; the cash flow indicator is unavailable in the double-entry accounting, therefore, it is calculated as retained earnings (profit or loss) plus depreciation and amortization;

Z_n - n-vector of ownership variables (n = 3) that are time-invariant as data on ownership structure are available only for the year 2003. These variables are defined as dummy variables taking the value of 1 for values larger or equal to median, 0 otherwise. First ownership variable, Z_1, denotes an average (per owner) share in farm's equity, shortly *ownership concentration*. Z_2 represents *external ownership*, i.e. a share of external investors to the total number of owners. Z_3 denotes the *number of owners number*. [5]

TD - farm transformation indebtedness towards eligible persons to assets from restitutions and asset transformation (in the case of former collective farms). This dummy variable will be used purely as a control variable, i.e. variable controlling for possibly related variability in asset valuation (degree of capital depreciation) and credit constraints. It is incorporated in the model in the same way Z-variables are.

d_t - time dummy variables that are included to account for time-specific shocks common to all farms.

Estimation method

The above specified model characterizes a dynamic process in which the dependent variable, current investment to capital ratio, is influenced by its past levels. Besides the autoregressive-distributed lag, the investment model includes explanatory variables that cannot be considered strictly exogenous. The lagged investment to capital ratio can be assumed to be correlated with firm-specific effects. Also, growth in output (sale) may be correlated with these effects, and the current change in output (sale) is likely to be correlated with shocks to investment via the production function (Bond, et al. 2003). In this case a pure occurrence of firm-specific (unobserved) effects, correlated or uncorrelated with other variables on the right-hand side of estimated equation, requires more than traditional data within-firm transformation or first differentiation, which can be applied in the case of simpler panel model specifications. The reason for this is that estimates on such transformed data are not consistent on short time series (e.g., Mairesse a kol., 1999; Roodman 2009a). Most advanced method of solving this econometric issue is the fully efficient Generalized Method of Moments (GMM). For the estimation of empirical models with autocorrelation and other possible endogeneities in explanatory variables, Arellano and Bover (1995) and Blundell and Bond (1998) suggest a use of system GMM, which allows a combination of two equations and two samples of instrumental variables on transformed and untransformed data, which can be more efficient

[5] Ownership variables are generally assumed to be endogeneous to the performance and the market value of the firm, which again should stimulate investments and therefore this endogeneity should be controlled for in the model. These theories are generally applied to firms traded on the stock exchange or firms in mature economies with full property rights legal enforcement, develop capital market and investors culture. The corporate ownership structure in the Czech agriculture is mainly a result of the transformation and privatization process dominated by former management and new owners' restructuring objectives and strategies. Due to the still underdeveloped capital market and assumed managerial discretion, little (particularly efficiency-driven) dynamics in the ownership structure and thus dismissible endogeneity in the ownership variables is assumed.

than first-difference GMM[6]. Because of the relatively large number of instruments compared to the number of observation, we estimate one-step system GMM. We apply the programming package provided by Roodman (2009a) designed for statistical software STATA.

RESULTS

Table 1 presents parameter estimates of the error-correction accelerator model without ownership variables derived from a dynamic investment equation with an autoregressive-distributed lag of length two (ADL (2,2)) and three (ADL (3,3)) (see equation 3). A comparison of the estimates of these two models shows that accounting for ADL (3,3) dynamics improves the model significantly. The test of the presence of the lag three effect (test of the joint significance of ρ_1, θ_2, and γ_2) reveals that these parameters are jointly significant at 5 % significance level, i.e., they contribute highly significant information to the model. Therefore, we further interpret Model 2 only.

Table 1: GMM estimates of the error-correction accelerator investment model for Czech cooperative and corporate farms in 1997-2007

Dependent variable I_t/K_{t-1}		Model 1 - Basic AR(3, 3) error correction model (s = 2)		Model 2 - AR(3, 3) error correction model (s = 3)	
Indep. var.	Coef.	Coef. estimate	*P*-value	Coef. estimate	*P*-value
Constant	α_0	0.110	0.156	0.258	0.065
I_{t-1}/K_{t-2}	ρ_0	-0.142	0.077	-0.323	0.022
I_{t-2}/K_{t-3}	ρ_1	-	-	-0.199	0.013
Δy_t	θ_0	0.062	0.195	0.134	0.040
Δy_{t-1}	θ_1	0.029	0.545	0.108	0.061
Δy_{t-2}	θ_2	-	-	0.102	0.112
$k_{t-s} - y_{t-s}$	ϕ_0	-0.053	0.001	-0.065	0.011
y_{t-s}	φ_0	-0.004	0.560	-0.013	0.212
CF_t/K_{t-1}	γ_0	0.280	0.073	0.208	0.000
CF_{t-1}/K_{t-2}	γ_1	0.232	0.002	0.300	0.001
CF_{t-2}/K_{t-3}	γ_2	-	-	0.098	0.447
# of obs.		850		689	
Overall fit (F-test)		12.52	0.000	11.02	0.000
AR(2) test		-0.89	0.371	-0.94	0.348
Hansen test		93.58	0.522	88.80	0.312

Note: Coefficients for time dummies are not included in the table. [1)]Instruments used: a) for first differences equation - lags 1 to 3 (2 to 3) of I_{t-1}/K_{t-2}, Δy_t, and CF_t/K_{t-1} in Model 1 (in Model 2); b) for level equation - all remaining explanatory variables (untransformed) included in the equation including time dummies and first differences of lags 2 of I_{t-1}/K_{t-2} , Δy_t, and CF_t/K_{t-1}. The estimates of lagged dependent variables are found in the range between their OLS estimates and within group (fixed effect) estimates, which is an indication of good estimates (see BOND, 2002).

The first two parameters following the constant refer to the short run effect of the past growth in capital stock on the current investment activity. Similarly to the study by BOKUSHEVA et al. (2009) for Russian farms, this effect is found significant negative, however, in the range between -1 and 0, which implies a cyclical development of investment activity oscillating around and approximating to zero over time. The cyclicity in investment activity can be well

[6] In the literature, the "first-differenced" GMM proposed by Arrelano and Bond (1991) is also called Difference GMM. Both titles are refer to the estimation procedure using first-differences of the data in order to eliminate the fixed effects. System GMM augments Difference GMM by estimating simultaneously in differences and levels; each equation being distinctly instrumented (Roodman, 2009b). Advantage of applying system GMM also is that it allows to include time-invariant regressors, in our case ownership variables, that would disappear in first difference GMM (Roodman, 2006: 31).

explained by capital market constraints in transition agriculture and relative dependency on internally generated funds that need to be accumulated over few years for larger investments. The decreasing tendency in the lumpiness of investment over time could refer to improving credit market conditions or bettering performance of the farms due to structural adjustments.

The following three parameters capture the transitory investment effects of the past growth in output (sales), Δy_t, Δy_{t-1}, Δy_{t-2}. The strongest positive investment response to changes in sales (to increasing or diminishing market opportunities) is the response to the most intermediate changes; it slightly weakens with the time distance of the sale changes.

The next variable is the error correction term introducing the long-run investment adjustment to the optimal capital level. Under the assumption of optimal investment behavior, the coefficient ϕ is expected to be negative, since the actual capital level lower than its "desired level" should be followed by higher future investment and conversely (see, e.g., BOND et al., 1997: 5). This behavior is confirmed by the highly significant negative coefficient estimate. Farm investment activity is thus in congruence with the long-run efficient adjustment to the "desired" future level of capital, however, the size of adjustment is unexpectedly low. The parameter suggest 7% approximation rate in capital stock to long run capital optimum over the analyzed period[7]. Such low capital adjustment rate was also found by BOKUSHEVA et al. (2009) for Russian farms. This could imply high capital adjustment costs in transition agriculture or transition-specific capital valuation errors embedded in the data (e.g., discrepancies between capital depreciation and use in production that vary across farms).

The three γ parameters embody investment sensitivity to the level of generated internal funds or signals on future profitability. They imply relatively high investment sensitivity to cash flow to capital ratio, however, the sensitivity weakens with the lag of the financial variable. The test of their joint significance also imply that they do not capture only the transitory effect of financial constraints on farm investment. The cash flow level could translate into an expectation of future profits and the significant parameter then imply an investment reaction to this expectation. In the context of transition agriculture, it is still reasonable to expect that the γ parameters capture, at least to a degree, persistent financial constraints but possibly also farms' cautious behavior towards bank credits due to unsettled property rights to agricultural assets and due to a fear of bankruptcy in the case of investment project failure in volatile market conditions.

The last parameter to be discussed is the parameter with respect to the scale factor, y_{t-2}. Its value not significantly different zero implies that the long run elasticity of capital to sales is unity. The production function is thus characterized by constant returns to scale which is a production function characteristic that is consistent with the theoretical assumptions of the investment accelerator model.

Before presenting and interpreting the ownership variable effect in the framework of the error-correction model, Table 2 provides mean statistics of investment, ownership and other variables for farm groups build based on the three ownership characteristics of our interest. P-values from the t test indicate, in which variables the farm groups of distinct ownership characteristics differ significantly. Investment activity level given by the ratio It/Kt differs significantly only between farms with lower and higher number of owners. Farms with lower number of owners display a significantly higher investment activity than farms with higher number of owners. They are also assigned by higher sales to capital ratio and higher cash flow to capital ratio. This could imply that the higher investment activity could be related to the number of owners directly, but it could also imply that farms with lower number of owners

[7] For industries in mature market economies, Mairesse et al. (1999) find the capital stock error correction to be of a value between 20 to 35%.

perform better and the higher returns to capital stimulate higher investment rate or both. In line with our theoretical discussion, the lower investment activity of farms with higher number of owners could suggest their lower interest in the farm future performance, since for many of these owners becoming shareholders represented the only alternative to losing ownership claims (or their significant value).

The two groups of farms with different share of external ownership vary significantly in sales to capital and cash flow to capital ratios. The higher performance indicators related to lower share of external owners in the total number of owners does not seem to have an impact on investment activity. The higher performance could in this case also relate to the significant differences between these two groups in the number of owners.

Table 2: Mean statistics comparison and two-sample t-test for farm ownership groups

	Capital ownership concentration[1)]			External ownership[2)]			Owners' number		
	< median	≥ median	*p*-value*	< median	≥ median	*p*-value*	< median	≥ median	*p*-value*
I_t/K_t	0.121	0.135	0.143	0.128	0.128	0.947	0.137	0.119	0.059
S_t/K_t	0.991	0.935	0.035	0.980	0.906	0.012	1.021	0.896	0.000
I_t/S_t	0.112	0.142	0.024	0.131	0.127	0.825	0.126	0.130	0.754
CF_t/K_{t-1}	0.143	0.171	0.001	0.168	0.136	0.001	0.180	0.133	0.000
$\Delta S_t/K_{t-1}$	-0.004	0.012	0.091	0.003	0.009	0.595	0.004	0.006	0.829
Owners' nr.	402	234	0.000	188	501	0.000	85	555	-
Ext. own. [2)]	0.794	0.705	0.000	0.605	0.894	-	0.652	0.839	0.000
Transf. debt[3)]	0.385	0.203	0.000	0.378	0.179	0.000	0.439	0.142	0.000
Cap. con. I[1)]	-17	900	-	606	113	0.000	753	149	0.000
Cap. con. II[4)]	76	166	0.000	134	116	0.000	111	126	0.001

Note: * P-value for a two-sample t-test; [1)] per owners share in equity (in thousands CZK); [2)] share of the number of external owners/investors in total number of owners (in thousands CZK); [3)] indebtedness rate from ownership transformation (debts toward eligible persons from transformation in value of total assets); [4)] per owner share in legal capital.

The comparison of farm groups based on capital concentration reveals an important capital structure characteristic that might have a considerable impact on the investment modeling results. Based on the theoretical predictions, it is expected that higher ownership concentration would be related to more optimal investment activity. In transition agriculture that is generally assigned by underinvestment and credit constraints, higher investment activity is expected to be more optimal. The difference in the investment to capital ratio is, however, insignificant. Moreover, the sales to capital ratio is higher for the group of farms with lower per owner share in equity. The investment to sales and cash flow to capital ratios, on the other hand, confirm the predicted effect of ownership concentration on investment activity. These results are possible if there are systemic differences in capital value (capital depreciation) between farms with higher and lower capital concentration, i.e. lower capital value in group of farms with lower capital concentration increases the investment to capital ratio. The capital depreciation differences between farms are generally assumed to be depicted by the unobserved firm-specific effect term η_i in the investment model. In our case, however, this will be captured also in the capital concentration variable and all its cross terms. The most significant effect can be expected in the parameter of the capital concentration specific error-correction term. This is due to the fact that farms with higher ownership concentration could be found with less optimal capital adjustment to long run capital stock optimum, possibly

even overinvestment, due to their higher investment activity but significantly lower sales to capital ratio which determines the long run optimum.

The advantage of the investment model analysis that follows is the simultaneous consideration of all three ownership variables, which allows to depict the investment effect of each of the ownership variables while controlling for the effects of the remaining variables. Table 2 presents parameter estimates of the error-correction models with ownership-specific variability in investment behavior. Model 3 in the table is the most parsimonious version[8] of the model as defined in equation 4. In Model 4, we, in addition, control for the investment effect of transformation indebtedness, which is found to improve the overall fit of the model. Therefore, we further interpret the estimates of this model.

The estimates of the capital concentration-specific variability in the investment model parameters disclose that higher ownership concentration increases the cyclical investment activity response to past growth in capital stock. Farms with higher per owner shares in equity (capital concentration) respond less to changes in sales and their investment activity is less sensitive to internally generated funds in the year of investment. On the other hand, investment activity of farms with higher capital concentration is more sensitive to past cash flow to capital ratio, which could imply their higher responsiveness to future profit signals. On the whole, the higher investment lumpiness, lower investment sensitivity to current cash flow and sales signals, as well as higher investment sensitivity to past cash flow point out to higher ownership concentration being related to higher credit financing of investment projects[9] that is conditioned on past profitability, lowers dependency of investment of current profits and can cause spikes in investment. These results suggest that managers of farms with higher ownership concentration perform better and have lesser reasons to avoid external scrutiny to gain access to financing. Higher capital ownership concentration can thus be considered as an element of a more efficient governance structure.

The last significant parameter in this group of farms implies capital concentration-specific long run capital stock adjustment to capital optimum. This parameter suggests that capital concentration increases the value of this parameter to an extent that observed investment in this group of farms could be considered to exceed the long run optimum capital level. As discussed above, however, there are significant differences between the groups of farms with lower and higher capital concentration in active capital valuation (depreciation), which results in relative overvaluation of capital in the group of farms with higher capital concentration and lower output to capital ratio (see discussion of Table 2). Therefore, this parameter needs to be interpreted with caution; its inclusion in the model, however, is important, as it filters out information on this significant ownership-specific variability and thus improves the estimates of the remaining parameters.

The group of farms with higher external ownership shows significantly lower investment response to past changes in sales and significantly higher investment sensitivity to cash flow to capital ratio. Management of farms with higher share of external owners can have multiple reasons to use internal funds instead of seeking credit. Being less productive (smaller sales to capital ratio) and less profitable (smaller cash flow to capital ratio) could limit their application success. A rejection of credit application after disclosing performance indicators to external scrutiny could provide signals to owners that would further discourage them from

[8] Due to the large number of parameters in the complete model, we aimed for the most parsimonious model. We step-wise eliminated all variables with p-value higher than 0.3.

[9] Our data confirm that group of farms with higher ownership concentration has significantly higher credit indebtedness (10.4% compared to 6.9% in the group of farms with lower ownership concentration). The gap in the credit indebtedness between the groups with higher and lower capital concentration has increased over the years.

using internal funds for investment. Also given that external ownership was a form of settling transformation indebtedness after owners unsuccessful attempt to withdraw their ownership claims from the company or cooperative, being able to finance investment projects from generated profits instead of distributing dividends is unanticipated. This set of arguments suggests less efficient governance structure and managers higher scope of discretion in farms with higher share of external owners.

Table 3: GMM estimates of the error-correction accelerator investment model for Czech agricultural enterprises in 1997-2007

Dependent variable I_t/K_{t-1}		Model 3 - AR(3, 3) error correction model with ownership-specific dynamics		Model 4 - AR(3, 3) error correction model with ownership-specific dynamics (incl. control variable *TD*)	
Indep. var.	Coef.	Coef. estimate	*p*-value	Coef. estimate	*p*-value
Constant	α_0	0.062	0.319	0.061	0.508
I_{t-1}/K_{t-2}	ρ_0	-0.513	0.007	-0.648	0.004
Δy_t	θ_0	-	-	1.658	0.063
Δy_{t-2}	θ_2	0.505	0.057	0.710	0.040
$k_{t-3} - y_{t-3}$	ϕ_0	-0.165	0.009	-0.222	0.008
CF_t/K_{t-1}	γ_0	0.683	0.020	0.870	0.022
Z_1 *(cap. ownersh. conc.)*	α_{01}	-	-	-	-
$Z_1 * I_{t-2}/K_{t-3}$	ρ_{11}	-0.569	0.004	-0.526	0.062
$Z_1 * \Delta y_t$	θ_{01}	-0.325	0.138	-0.737	0.233
$Z_1 * \Delta y_{t-1}$	θ_{11}	-0.416	0.104	-0.676	0.043
$Z_1 * \Delta y_{t-2}$	θ_{21}	-0.571	0.238	-0.916	0.048
$Z_1 * (k_{t-3} - y_{t-3})$	ϕ_{01}	0.231	0.020	0.312	0.016
$Z_1 * CF_t/K_{t-1}$	γ_{01}	-	-	-0.971	0.046
$Z_1 * CF_{t-1}/K_{t-2}$	γ_{11}	0.412	0.017	1.218	0.008
Z_2 *(external ownership)*	α_{02}	-	-	-	-
$Z_2 * \Delta y_t$	θ_{02}	-	-	-1.122	0.147
$Z_2 * \Delta y_{t-2}$	θ_{22}	-0.555	0.061	-0.765	0.037
$Z_2 * CF_t/K_{t-1}$	γ_{02}	0.131	0.279	0.442	0.072
Z_3 *(number of owners)*	α_{03}	-	-	-	-
$Z_3 * I_{t-1}/K_{t-2}$	ρ_{03}	1.423	0.010	1.424	0.014
$Z_3 * I_{t-2}/K_{t-3}$	ρ_{13}	0.740	0.033	0.809	0.069
$Z_3 * \Delta y_t$	θ_{03}	-	-	-0.667	0.092
$Z_3 * y_{t-2}$	φ_{03}	-0.022	0.003	-0.027	0.014
TD (transf. indebtedness)	α_{04}	-	-	-1.380	0.212
$TD * \Delta y_t$	θ_{04}	-	-	-1.534	0.045
$TD * y_{t-2}$	φ_{04}	-	-	0.133	0.202
# of obs.		529		529	
Wald test (F-test)		4.25 (23)	0.000	2.70 (30)	0.000
Wald test of joint significance*		2.13 (11)	0.026	2.34 (17)	0.005
AR(2) test		-0.61	0.539	-0.61	0.539
Hansen test		47.15	0.794	37.71	0.900

Note: Coefficients for time dummies are not included in the table. Instruments used: a) for first differences equation - lags 1 to 3 of I_{t-1}/K_{t-2}, lags 1 of Δy_{t-2}, and CF_{t-1}/K_{t-2} in both models; b) for level equation - constant, Δy_t, Δy_{t-1}, $k_{t-3} - y_{t-3}$, Z_n, (plus *TD*) time dummies and first differences of lags 1 of I_{t-1}/K_{t-2}, Δy_{t-2}, and CF_{t-1}/K_{t-2} in Model 3 (Model 4). * Wald test of joint significance of ownership-specific investment variability.

The parameters on the investment effect of the third ownership variable imply that increasing number of owners reduces cyclical investment trend. This could relate to the larger size in

capital stock of these farms and lower investment to capital ratio (see Table 2). Larger number of owners also reduces responsiveness to changes in sales. Due to the high correlation with the size of capital stock, we also find the scale parameter, φ_{03}, to vary with the number of owners. Within the group of farms with higher number of owners, the returns to scale decrease with increasing size. Lower profitability and returns to capital indicators (Table 2) suggest that farms with highly dispersed ownership structure do not perform as well as farms with smaller number of owners.

CONCLUSIONS

Empirical results from error-correction accelerator model estimated on Czech cooperative and corporate farms from 1997-2008 show that ownership structure significantly affects farm investment behavior. Farms with lower number of owners display a significantly higher investment activity than farms with higher number of owners. Together with indication of higher productivity and profitability, lower number of owners could be considered to contribute to efficiency of cooperative and corporate farms' governance. Group of farms with higher external ownership shows significantly higher investment sensitivity to cash flow to capital ratio, while being, at the same time, less productive and less profitable. Owners of farms with higher share of external ownership thus seem to be to a higher degree constrained in their control over management. The empirical results thus are in line with theoretical expectation that external ownership provides with more scope for managerial discretion that can lead to less optimal investment decisions and overall performance, and thus higher agency costs. Results on the investment effect of ownership concentration, on the other hand, suggest its significant contribution to investment performance. Relaying to a higher degree on credit financing of investment projects, farms with higher per owner shares in farm equity display far highest profitability among considered groups of farms. This observation supports the theoretical expectation that higher ownership concentration provides incentives to more effective joint ownership governance.

Despite their congruence with theoretical predictions, the empirical results could be affected by transition specifics of the farm structures and characteristics of equity shareholders. Small shareholder in farms with high number of owners are likely shareholders who despite their efforts did not succeed in financial settlement of their transformation claims, and for whom becoming shareholders represented the only alternative to losing ownership claims or their significant value. This could result in their lower interest in the farm future performance reducing farms' investment activity. One could also argue that the whole process of farm transformation was subjected to former managers' discretion and the resulting ownership structure hence reflects their managerial abilities, possibly their ideologies, degree of social responsibility or preferences. Nevertheless, if nothing more, the empirical results deliver great insides that can suggest future developments of the Czech farm structure under competitive pressure. Depending on the strength of the competitive pressure, farms with highly dispersed ownership among large number of owners will require marked restructuring that might be possible after bankruptcy or gradual small shareholders buy-outs leading to higher ownership concentration. External owners will be required to implement tools of more efficient corporate governance, which is likely to be realized only with incentives from higher shares at stake. All results thus verge toward increasing future ownership concentration of today's cooperative and corporate farms. Developing institutions in support of the agricultural share market that would attract investors from outside the current farms could contribute to the speed and effectiveness of the farm ownership restructuring.