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Ownership and Investment Behaviour in Transition Countries

A Case Study of Collective and Corporate Farms in the Czech Republic

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, these farms' ownership structure, and particularly the ownership's effect on their investment activity, which is vital for efficient restructuring and the sector's future development, are still not well understood. This paper explores the ownership-investment relationship using data on Czech farms from 1997 to 2008. We allow for ownership-specific variability in farm investment behaviour analyzed by utilizing an error-correction accelerator model. Empirical results suggest significant differences in the level of investment activity, responsiveness to market signals, investment lumpiness, as well as investment sensitivity to financial variables among farms with different ownership characteristics. These differences imply that the internal structure of the Czech cooperative and corporate farms will be developing in the direction of a decreasing number of owners and an increasing ownership concentration.

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Introduction

Despite political efforts to invigorate individual and family farming in the transition countries of Central and Eastern Europe, large-scale farming has retained a significant position in agricultural production across the region.[1] Though not fully successful in their original intentions, privatization policies and property rights restitutions have nevertheless provided a wide scope for ownership and organizational adjustments that have resulted in a unique diversity of corporate farms' governance constellations. Given similar production orientations, it could be expected that over the more than twenty years of transition, ownership structures would demonstrate tendencies toward consolidation, possibly in two directions, indicating a trade-off between economies of scale and corporate governance (lower agency costs) through ownership concentration. The farm ownership constellations, however, have remained highly heterogeneous, which suggests a high probability of great variability in their performance and future prospects. Nevertheless, and in spite of the cooperative and corporate farms' dominance in the sector, their complex ownership and governance structures, particularly their effect on investment decisions vital to the efficient restructuring and future development of the sector, have not received sufficient attention from the academic community.

Compared to corporate firms in mature economies, corporate farms' governance in transition countries was formed in conditions of weak legal protection of renewed property rights and minority shareholders' interests, as well as strong bargaining positions of former collective

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[1] Relatively low in number, the large-scale farms of mainly a corporate and cooperative legal form continued to cultivate a considerable share of agricultural land. For example, in Bulgaria and in Romania, the share of agricultural land cultivated by cooperative and corporate farms is nearly 50%, in the Czech Republic approximately 70%, and in Slovakia almost 90% (Lerman et al., 2004; Ministry of Agriculture of the Slovak Republic, 2010; Ministry of Agriculture of the Czech Republic, 2010).

farms' management. These conditions hindered many claimants of historic ownership from withdrawing their property shares from agriculture (Schlüter, 2001). As a direct consequence, the property rights reforms initially led to highly dispersed ownership of the cooperatives and corporate farms with a great representation of insider (employee and managerial), as well as external ownership. Successive ownership development has been further cramped by only slowly emergent internal corporate environments and underdeveloped markets for agricultural ownership shares. This environment indicates a high probability of inefficient property rights allocation and high agency costs, which could be partially lowered by efficient firm governance instruments such as management bonding and monitoring mechanisms. The "new" owners, however, generally possess no knowledge of corporate bonding and control mechanisms, or their knowledge is limited only to their short experience accumulated post privatization. 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 characteristic of 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 firm performance and investment decisions, including generated internal fund use and distribution. The latter represents an issue often referred to as agency costs of free cash flow, which affects firm productive investment and restructuring. This relationship between large farm ownership structure and investment decisions lies at the heart of this study.

The ownership-investment relationship is theoretically approached by introducing an assumption of internal financial constraint. Typically, the investment literature considers risk-neutral managers and financial constraints imposed by external providers of finance. Some studies, such as that of Bierlen et al. (1998), recognize that these assumptions may not be appropriate for agricultural production and acknowledge that internally-imposed credit constraints may be important. However, these authors assume that lenders and borrowers are likely to use similar risk aversion-related factors when determining credit constraints. In studies on ownership-investment relationships in a corporate setting, the internal and external financial constraints are assumed to have divergent origins. Internal constraint is, namely, considered a result of information asymmetries and incentive conflicts between managers and owners, both allowing for and motivating managerial discretion over investment financing.

Empirical studies which examine the ownership-investment relationship and are built on similar assumptions were mostly conducted for mature market economies (e.g., Cho, 1998; Estrin and Jones, 1998; Hadlock, 1998; Chaddad et al., 2005; Gugler, 2005; Audretsch and Weigand, 2005; Ghosh et al. 2007; Danielson and Scott, 2007; Plunkett et al., 2010); only seldom were such studies carried out for transition countries (e.g., Prasnikar and Svejnar, 1998, 2003; Mueller and Peev, 2007; Gugler and Peev, 2007; Domadenik et al., 2003; Domadenik et al., 2008; Hobdari et al., 2009, 2010)), and concretely for agriculture (e.g., Bukusheva et al., 2009; Zinych, 2009). The empirical results by Mueller and Peev (2007), which were obtained by analyzing more than 10 selected Central and Eastern European countries, support the existence of a high managerial discretion effect on investment in transition economies. These authors ascribe the resulting over-investment to the corporate governance institutions and weak law enforcement in transition countries. In their studies on firm restructuring during the transition to a market economy, Prasnikar and Svejnar (1998, 2003) and Domadenik *et al.* (2003, 2008) analyzed whether widely-occurring employee ownership in transition constrained investment. Domadenik's *et al.* 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 from Slovenian firms. However, Prasnikar and Svejnar did find a trade-off between investment and wages related to employee ownership, and argue that employed owners' appropriate funds that are supposed to be used for depreciation investment. In their study of firms' investment behaviour in 15 transition economies, Gugler and Peev (2007) found a significant investment sensitivity to cash flow;

however, this had shown declining tendencies from 1993-2003. These authors attribute this trend to the decrease of agency problems related to the development of capital markets and corporate governance standards. Lízal and Svejnar (2002) found a positive relationship between investment and profitability in Czech cooperatives, and to a lesser extent in small private firms. They interpret this finding so that smaller and collectively-owned firms are more financially constrained. Hobdari et al. (2009) analyze the relationship between ownership and investment behaviour of Estonian firms in constrained and unconstrained financial regimes. Their results imply that ownership structure leads to differences in investment behaviour only in financially constrained regimes, where investment decreases with managerial and employee ownership. The authors attribute this result to insider owners' preference to divert resources in higher individual income rather than investment in the firm. In a later study, Hobdari et al. (2010) examine the same data from a different prospective. They identify access to capital to be important for investment rates and find that firms owned by insiders, especially non-managerial employees, are more prone to be liquidity constrained than others.

In the context of agriculture in transition countries, Bokusheva et al. (2009) found that Russian farms with a higher share of owners among managers show a higher and positive relationship between investment and cash flow; they interpret this result as being higher marginal productivity of capital in farms with higher managerial ownership. Another empirical study on large-scale farms' investment behaviour by Zinych (2009) investigates, among other issues, an investment effect of farm legal forms. Nevertheless, neither of the studies explores or discusses the possible link between the managerial ownership-related or legal form-related results and investment effects of agency problems associated with diverse governance mechanisms.[2]

As demonstrated above, with only a few investment studies on transition agriculture, the large-scale farm ownership-investment relationship remains vastly unexplored. The review of empirical studies also shows that despite some evidence of firm ownership-investment relationships in transition agriculture, its interpretation lacks the context of agency theory, which may offer vital insights on the lack of investment optimality in this type of farms. This study aims to assess the differential investment effect and long-run viability of various ownership forms, and thus to reduce the addressed research gap on an empirical case of Czech cooperative and corporate farms.[3] For this purpose, it uses unique survey data on ownership structure and data from the Farm Accountancy Data Network from 1997-2008.

The paper is structured as follows. The proceeding section outlines testable theory-derived predictions on the ownership-investment relationship. Section three describes the error-correction accelerator model chosen as the method of investment analysis, as well as data and relevant estimation techniques. Section four delivers the estimation results, their interpretation and discussion. The last section then concludes the paper with lessons

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[2] Other studies of investment behaviour of farms in transition countries of Central and Eastern Europe, for example, by Latruffe (2005) or Petrick (2004a, 2004b), focused on individual or family farms in Poland. These are, therefore, of a lesser relevancy for this study, which inquires into the specifics of large-scale (corporate) farms' investment behaviour.

[3] 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 (e.g., Bezemer, 2003), which, without concrete information on these conditions, would disturb the interpretation of the results on agency-investment relationship. For the convenience of this study, the ownership structure of corporate and cooperative farms is highly diverse. Therefore, this relationship can be well analyzed purely within the sample of these farms.

contributing to the debate in transition literature on the long-term performance of various ownership forms resulting from the extensive privatization/restructuring process, as well as to the more general debate in the corporate governance literature on the investment effect of governance through ownership.

1. Ownership and investment - theoretical discussion

1.1 Principal-agent relationship in investment literature

Similar to the role of asymmetric information between the firm and the providers of external finance (e.g., Stiglitz and Weiss, 1981; Myers and Majluf, 1984), the conceptualization of agency theory that recognized costs borne by the firm arising from the divergent goals of managers and owners of the firm (e.g., Grabowski and Mueller, 1972; Jensen and Meckling, 1976) resulted in a recognition of financial constraints, which challenged the neoclassical theory of firm investment behaviour (Modigliani and Miller, 1958; Jorgenson, 1963).[4] The main adjustment to the neoclassical investment model concerned the consideration of the effect of differences in costs between firm internal and external finance (supply-side imperfection of the capital market) and non-optimality of investment decisions due to separation of ownership and control delegated to managers[5] (demand-side imperfection of the capital market). It is widely accepted among financial economists that external finance constraints originating in either of the two theoretical issues – information asymmetries and incentive conflicts between (i) the firm and financiers or (ii) the owners and managers – result in investment sensitivity to fluctuations in firm internal funds.

Under information asymmetries in capital market, 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). This is assumed to lead to a rejection of good investment projects' funding by the external financiers. An alternative reduction of the information asymmetries aimed at diminishing the finance constraint would result in an increase in the costs of external finance. As a consequence, for a firm with a potential for investment with positive present value, it may be more optimal to use internal resources. Fazzari et al. (1988) then argued that in perfect capital markets, a firm's investment demand should not be limited by or depend on internal funds, since the cost of external and internal finances is equal, and external capital is fully accessible. However, in imperfect capital markets, which increase the cost of external finance or in which access to finance is constrained by risk resulting from information asymmetries between the firm and the provider of financing, firm investment activity will be more sensitive to generated profit (cash flow). Under a limited cash flow, this situation is expected to lead to an accumulation of capital that could be considered lower than an optimal capital accumulation under perfect capital market conditions. Evidence of excessive sensitivity to cash flow has thus been often interpreted as suggesting the existence of credit constraints. However, as suggested above and explained in a more detail below, such sensitivity can also reflect the effect of managerial discretion resulting from the separation of firm ownership and control.

Agency theory and corporate governance literature posit that information asymmetries between owners and managers give managers a scope for discretion that can be utilized for

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[4] The neoclassical investment theory considers a world of perfect capital markets and optimal accumulation of 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 of which affect the cost of capital (user cost of capital) (Jorgenson, 1963).

[5] While the original thesis of separation of ownership and control was conceptualized by Berle and Means (1932), the managerial theory of the firm was formulated much later, by Marris (1963, 1964). The formal modelling of the managerial theory of investment was first offered by Grabowski and Mueller (1972).

pursuing goals and interests that deviate from the goals and interests of owners (Williamson, 1963; Grabowski and Mueller, 1972; Jensen and Meckling, 1976). Managerial discretion can thus lead to non-optimal decisions from the owners' perspective and to agency costs borne by corporate owners. One reason that managers behave less optimally than owners is that their personal wealth is not at stake (Jensen, 1986; Ang et al., 2000). Also, seeking higher appraisal, managers tend to present their work, and thus the firm's performance and its market standing, positively, and to follow a strategy of growth independent of the real returns on capital and investment[6] (Grabowski and Mueller, 1972). In contrast to information asymmetries in the capital market that result in under-investment, the firm internal information asymmetries provide incentives to over-investment (Mueller and Peev, 2007). Moreover, managers are assumed to prefer financing the less optimal projects from internally generated funds (bargain with owners over free cash flow) to avoid external scrutiny of less optimal investment projects (e.g., by banks), and to show the tendency to waste some of these funds on perquisites (Jensen and Meckling, 1976). Therefore, analogically to information asymmetries in the capital market, agency costs should result in investment sensitivity to generated internal funds.

The effects of managerial discretion on the use of funds and resources allocation can be assumed to be partially modified by the conditions that are characteristic for transition economies. The effect of credit constraints can be expected to be amplified by lower liquidity of capital markets, and agency costs by the weak protection of property rights and legal framework for corporate governance. Predictions of the managerial discretion effect can also be altered by the cramped internal fund generation in agriculture during transition (e.g., Doucha et al., 2002). The lower liquidity of capital markets and insufficient free cash flow can be perceived to limit the tendencies of managers to over-invest, even when a large scope of discretion is available, such as in the case of weak governance. Furthermore, the lower liquidity and high transaction costs of an unsuccessful credit application could increase managers' positions in bargaining over free cash flow. The investment effect of agency costs of joint ownership and delegated control can be assumed to be higher in transition, as managers will tend to address low productivity problems through investments (modernization) rather than farm-internal restructuring to avoid conflicts with employed owners.[7]

Despite any well-founded rationale for the expectation of a significant effect of agency costs on the investment behaviour of large farms in transition, their empirical investigation is challenged by many other factors that are possibly captured in the investment sensitivity to cash flow or other financial variables. As suggested above, the investment sensitivity to financial variables can simultaneously depict the effect of financial constraints from information asymmetries between the firm and suppliers of external finance, as well as constraints of less liquid capital markets. Furthermore, Kaplan and Zingales (1997) argued that the investment sensitivity to financial variables can also be purely justified by the fact that external funds are more costly than internal funds for all firms as long as some transaction costs are involved. Similar to Poterba (1988), they also argued that, since current investment depends on both current and expected future changes in the desired capital stock, it is possible that information on cash flow helps to forecast future profitability and investment opportunities. This, again, would result in higher investment sensitivity to cash flow. Despite the awareness of various sources of investment sensitivity to financial variables, the interpretation of empirical findings remains ambiguous. Only sufficiently detailed

[6] This is also in line with Schwalbach and Grasshoff's (1997) and Murphy's (1994) arguments and findings that managers' remuneration derives particularly from the size of the company.

[7] In many transition countries, privatization to employees was a widely-applied form of state ownership privatization (see, e.g., World Bank, 1996; Blanchard, 1998; Frydman et al., 2000). Also, in the case of privatization/transformation of agricultural assets in the Czech Republic, considerable shares were privatized based on years of employment in the collective farm (see, e.g., Divila 1996, 2001; Curtiss et al. 2006).

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 farms[8] investment behaviour and to filter out the ownership (agency) effects.

1.2 Ownership characteristics and investment - predictions

Various forms of joint ownership can be outlined by characteristics such as the degree of ownership dispersion (size of ownership shares and number of owners), imbalances in the share sizes among shareholders (large or majority versus small or minority shareholders), or the distribution of ownership and decision-making powers between external and internal owners (management and employees). These ownership characteristics form diverse environments for firm governance, including owners' approaches to risk and incentives to engage in active management monitoring, as well as incentives and discretionary scope for managers to maximize their personal utility on the expense of shareholders wealth. In this paper, particular attention will be paid to the investment effect of ownership dispersion versus concentration, and external versus internal (employee) ownership.

Dispersed ownership of a firm 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 or the quality of investment project; on the other hand, where there are large dominant shareholders, the returns to active governance are greater (Mayer, 1996). The lack of incentives to active governance, therefore, leaves the management of the dispersed-ownership firms with a larger scope for discretion and maximization of its own utility at the expense of the owners. Hence, dispersed ownership calls for greater attention to be paid to corporate governance mechanisms. Corporate governance scholars such as Schleifer and Vishny (1997) believe that through incentives and/or disciplining mechanisms, managers are effectively constrained from taking actions that are not in the best interest of the owners.[9] Dispersed ownership can thus be identified as an ownership characteristic that makes firms prone to suffer from high agency costs, or if a corrective corporate governance mechanism is applied, from costs of corporate governance implementation (Jensen and Meckling, 1976; Fama and Jensen, 1983, 1985). Both cost categories will affect the demand for capital, as they have an impact on the returns on investment. Nonetheless, the main motivation for dispersed ownership, which is the possibility of diversification and higher capital supply (Fama and Jensen 1985), should not be disregarded. A firm's rational decision for or against fast growth and/or diversification through increased equity brought in by external investors would then reflect the trade-off between the returns to scale and scope, and the associated agency costs of ownership dispersion.

The opposite ownership characteristic, ownership concentration, defines a situation in which investors decide to invest into higher shares, and hence characterizes owners who likely have a higher entrepreneurial interest and more trust in the performance of the business. The fact that owners have more at stake is assumed to stimulate them to develop a more efficient corporate governance structure, including better monitoring, controlling and incentive mechanisms for the firm's management. In a similar vein, Mayer (1996: 11-12) argues: "Where there is concentrated ownership, there may be a greater willingness to discipline

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[8] In this study, cooperatives are treated 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 choose the rules traditionally defining producer cooperatives in academic literature.

[9] In many cases, the monitoring functions are then delegated to internal or external controllers (e.g., members of the Board of Trustees, or Supervisory Committee). However, for the same incentive reasons as those mentioned above, organizations with high ownership dispersion lack a strong back-coupling between the owners and controllers.

poorly performing management as well as more incentive to intervene and exercise 'voice' rather than 'exit'." The more efficient control of managers' behaviour and activity then reduces managerial transaction costs[10] and leads to higher performance and a more optimal investment decision.[11] Higher economic performance means higher returns on capital and lesser reasons for avoiding bank scrutiny of the investment projects, resulting in lower investment sensitivity to internal funds.

When applying modern corporate governance concepts to agriculture in transition economies, transition ownership and financial market specificities need to be considered. In many cases, including Czech agriculture, ownership structures evolved under the supervision of the managers of former collective farms. The decisions of persons eligible to receive property shares (transformation claims) regarding how to handle these shares were, therefore, made in conditions of managerial discretion and hence cannot be considered optimal. The discretionary space given to former managers carrying out the transformation of former collective farms can be assumed to be utilized to sustain a large scale[12], an ongoing degree of discretion over the true value and the potential productivity of existing assets, and to secure their future managerial position. This information asymmetry provided management with a strong bargaining position, particularly in negotiations over small transformation claims, the settlement of which was accompanied by relatively high transaction costs to the eligible person. Therefore, despite high interest in financial settlement due to wealth constraints, decisions made by the eligible persons to transformation claims can be expected to be rather skewed towards leaving the property shares with (in other words, investing in) the successor companies and to be independent of allied agency costs detrimental to them as principals. Dispersed ownership in transition is, therefore, expected to provide for a larger scope for managerial discretion and higher agency costs than in a mature economy.

Contrary to farms aiming to sustain a large-scale, farms and managers who chose to increase ownership concentration have utilized the moment of transition to capital and production restructuring and lowering coordination costs. To lower the transaction costs of reorganization, these farms were formed by consolidating assets by approaching eligible persons to larger transformation claims, mainly claimants of historic property. Ancillary assets were then to a degree leased from the persons eligible to other (smaller) transformation shares. In the early stages of transition, new equity investments were non-existent and in the latter stages of transition are rather rare. Parts of the precursor collective farms encompassing either (i) less productive assets or (ii) property claimed by eligible persons from privatization who did not meet an agreement on lease or financial retribution of their property claims with successor farms, or did not want to become shareholders, were then subjected to liquidation. Farms with larger ownership concentration can be, in general, considered to be less affected by transition specifics and the theoretical concepts presented above.

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

[11] As ownership and control are separated, this ownership characteristic still leads to a higher than optimal investment activity than if ownership and control are concentrated in the same hands.

[12] The managers' interest in retaining large farm scale could relate to their subjective believe of large-scale economic superiority, but also other economic and social incentives such as high transaction costs of dismantling the real estate assets, impact of liquidation and resulting lost of transformation claim value to numerous claimants as well as employment on the managers' social standing, lack of liquidity for financial retribution of liabilities to persons eligible to transformation share or securing own employment with high social status. Some of these aspects are discussed below in the main text.

Due to the fact that the precursor collective farms did not develop in free market conditions but from several rounds of forced collectivization[13], successor farms that retained size close to the precursor collective farms' size can be assumed to suffer from diseconomies of scale. Retaining such size was then possible mainly by means of transforming liabilities to many persons eligible to mainly small transformation claims into equity. Therefore, rather than facilitating the acquisition of capital (equity) with the aim of increasing economies of scale, as would be expected in mature economies, dispersed ownership in transition is predicted to relate to diseconomies of scale.

Moreover, the supply (sustenance) of capital secured through dispersed ownership allowed the acquisition of existing but antiquated capital, which required a high degree of modernization and technological adjustment, and thus significant investment activity to facilitate future competitiveness of these farms. Still, for farms (managers) who believed in the economic superiority of a large scale, this could have been a rational decision, since dismantling the existing (real estate) assets was related to extremely high transaction costs and the purchase of new assets could be hindered by credit constraints, transaction costs of credit application and, in the case of successful debt financing, by higher risk of premature liquidation. The high need for investment into restructuring and modernization in farms with high ownership dispersion simultaneously represents the owners' high reliance on managerial expertise, which again increases the capacity for managerial discretion and its related agency costs.

The time of economic transition is further characterized by weaker corporate governance (e.g., Mueller and Peev, 2007), which again affects particularly corporate farms with more dispersed ownership. As mentioned above, new shareholders and especially shareholders to agricultural assets lacked experience with active corporate governance. Indeed, the monitoring capacities of small shareholders who were former employees in collective farms can be further considered as hindered by their highly specialized technical qualification, low education and low entrepreneurial knowledge. Also, the extremely small shares of average shareholders or the significant majority of owners in farms with dispersed ownership amplifies the effect of disincentive in active governance. Delegating the monitoring/controlling capacity to specialized agents could improve governance in such a situation. However, because of the small shareholders' lacking connection to relevant specialists, members of supervisory bodies were often proposed by managing staff, mostly from historic networks. Such management control can be assumed to be less rigorous than potential control performed by fully independent and qualified monitoring agents.

As already suggested, the interplay of all these factors related to dispersed ownership in transition creates an environment for greater managerial discretion and higher agency costs than would a similar firm ownership dispersion structure in a mature economy. This environment's effect on farm investment behaviour remains, however, ambiguous. The theory-derived investment effect of managerial discretion – overinvestment and higher investment sensitivity to cash flow – is not as clear-cut in the context of transition. Financial market environment in transition assigned by liquidity constraints – liquid capital market, together with population wealth constraints – are expected to limit management in its investment pursuits. Low farm liquidity, less collateralizable assets and lower performance[14] of farms with high ownership dispersion further constrain these farms' credit access or financing from internal funds. All these factors might reduce managers' capacity to

[13] Before the establishment of collective and state farms during the socialism, farms were owned only individually or considered as a family undertaking.

[14] In a situation of less liquid capital markets, financial constraints vary, with performance indicators characterizing the firm. Performance and financial constraints are assumed to be related. Farms performing better are assumed to be less limited by barriers to raising capital externally. This relationship has been suggested, e.g., by an empirical study by Medonos (2006).

overinvest, even in a situation of large scope for discretion, and could result in underinvestment rather than overinvestment[15].

Lastly, the prediction of higher investment sensitivity to internal funds in the case of larger scope for managerial discretion could be mitigated by the transition characteristics of small shareholders. As many of the small shareholders are former property claimants who did not succeed in their efforts of claiming property rights, withdrawing and obtaining monetary settlements for their property, the "imposed" shareholding is likely reflected in their low interest in farm future performance, and thus investment activity. From this it would follow that these shareholders would mainly pursue an early reversal of their "investment" (exit) and/or payment of dividends, and would not pursue growth opportunities[16]. This would suggest an imperceptible level of small-owners' reliance on information from management, which would modulate the effect of internal information asymmetries and managerial discretion on investment, mainly the investment sensitivity to internal funds.

Table 1 depicts the above-discussed effects of ownership dispersion and concentration on the firms' governance, scope of managerial discretion, and consequently on economic performance and investment. The positive and negative signs indicate the increasing and decreasing effects of ownership variables on the variables in the first column of the table, respectively. The number of the signs (one or two) imply the comparative strength of the effect (between mature and transition economy). For example, the higher the ownership dispersion, the lower is the owners' incentives to active governance. This effect is stronger in transition than it is in a mature economy.

Similar to the differences between ownership concentration and dispersion, insider (employee) ownership and outsider investor ownership are characterized by different incentive structures and costs of managerial control. When compared to employee ownership, external ownership can be assumed to provide for lesser internal scrutiny due to the lack of day-to-day operation and management monitoring. If investors choose to become more actively engaged in a company's operation and monitoring of management, they would face higher costs of such engagement in governance than would insider owners. Insider owners also have the specialization advantage over many external owners, making their monitoring more effective. Furthermore, there is an advantage assigned to employee ownership, which stems from an alignment of ownership and employment, and thus employed owners' stronger incentive to contributing to firm performance (Dow, 2003). On the one hand, employment security stimulates higher employee performance; on the other hand, it results in financial pessimism such as higher aversion towards riskier investment projects and investment projects that introduce labour-saving technologies (Dow, 2003; Jones et al., 2005). Both performance incentives and risk aversion result in stronger incentives to monitor managerial performance and control over investment projects. Nevertheless, they have different impacts on long-run investment; in other words, on capital adjustment to growth opportunities. While the performance objective stimulates optimal long-term investment, risk concerns impact the choice of investment projects depending on their riskiness and the time horizon of their returns. In this context, employed owners are hypothesized to prefer certain current consumption of generated internal funds over their use for investment in projects with uncertain long-term returns.

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[15] Empirical results by Hobdari et al. (2009) support this hypothesis through their finding for Estonian firms showing that ownership concentration is important in determining the financial regime in which a firm operates. Firms with lower ownership concentration are more financially constrained than firms with higher ownership concentration.

[16] The choice between dividends or exit strategy might have changed slightly with increased direct payments after EU accession towards the dividend collecting strategy.

Table 1. Effect of ownership dispersion versus concentration on corporate governance, performance and investment

	Mature economy		*Agriculture in transition*	
	Ownership dispersion ←	**Ownership concentration** →	**Ownership dispersion** ←	**Ownership concentration** →
Owners' incentives to active governance	-	++	--	+
Costs of active governance	+	--	++	-
Scope for managerial discretion	+	--	++	-
Economic (technical) performance	**0***	**0***	-	+
- due to scope for managerial discretion	-	++	--	+
- due to capital supply (economies of scope or scale)	+	-	-	+
Optimality of investment activity	-	+	-	+
- due to managerial discretion	-**	++	--	+
- due to small vs. large owners' characteristics (transition-specific)			-	+
- due to financial constraints (transition-specific)			-	+
Investment sensitivity to internal funds	+	-	+	--
- due to managerial discretion	+	-	++	--
- due to small vs. large owners' characteristics (transition-specific)			--***	-
- due to financial constraints (transition-specific)			+	-

Notes: * This situation represents the trade-off between agency costs and capital supply through equity in the case of ownership structure optimization. ** Larger scope for managerial discretion characterizing dispersed ownership is predicted to result in overinvestment due to managers' growth pursuit. *** This would correspond with the case when small shareholders' exit strategy or strategy of maximum dividend payments reduces or eliminates the effect of the larger scope for managerial discretion on the use of internal funds for investments.

Source: Own figure.

Also, the horizon problem (Jensen and Meckling, 1976; Furubotn, 1976), discussed mainly in the context of cooperatives, could contribute to what Dow (2003) calls finance pessimism of employee ownership. This problem arises when the owner's residual claim on the net income generated by an asset is shorter than the productive life of that asset. This creates an investment environment that discourages owners from following up and contributing to growth opportunities (Cook, 1995). Like risk aversion, the horizon problem results in employed owners' preference of current consumption to investment, that is, the distribution of enterprise surplus as current labour income and fringe benefits rather than reinvesting the surplus in the firm for future growth (e.g., Furubotn and Pejovich, 1970, and Vanek, 1970).

This investment conservatism of employee ownership can be expected to result in a lower and less than optimal investment level[17] and lower investment sensitivity to internal funds.

The insider owners' risk-aversion could be further assumed to motivate the avoidance of bank financing investment projects to prevent the risk of premature liquidation of the firm by the bank in the case of project failure. This would, contrary to previous predictions on investment sensitivity to internal funds, suggest the use of internally-generated funds for investment than for consumption. However, when the firm has a large number of owners lowering the effectiveness of and incentives to control over management, employed owners will, in line with their higher risk-aversion and performance interest, prefer additional scrutiny of proposed investment projects proposed by an external financial institution. Likewise, this would apply to a situation when the firm operates in volatile industries. Since generalities of the farms in our sample are farms with a high number of owners, and agriculture belongs to the highly volatile sectors, it is predicted that farms with a higher share of employee ownership will prefer external financing of investment projects over internal financing. A higher share of employee ownership will hence be expected to be assigned by lower investment sensitivity to internal funds.

It is further hypothesized that in Czech agriculture the financial pessimism of employee ownership will be amplified by higher risk aversion of employed owners with wealth constraints and small alternative employment opportunities manifested in rural areas more than urban areas. This could reflect in a stronger tendency to favour current residual claims consumption over risky future consumption. This situation could lead employed owners to forego the use of internal funds for investment with longer-return period and result in even lower investment sensitivity to internal funds than would be expected in mature economies. The stronger apprehension for the loss of employment could also result in higher incentives to economic performance in transition. However, the generally large size of the workforce characteristic for agricultural companies with insider owners could defuse this effect.[18]

The external owners' costs of active governance are also expected to be higher in transition. Among the reasons for this argument is that the privatization process does not attract investors with a high interest in and understanding of the sector, and that privatization allows the transformation of property claims from restitutions into shares. Other factors reducing the effectiveness of governance was the gradually developing level of accounting standards and transparency, as well as communication and information technologies. The scope for managerial discretion over free cash flow related to external ownership is, therefore, expected to be larger in transition than in mature economies.

Moreover, the effect of the horizon problem is predicted to be larger for transition agriculture. The main reason is embodied in the fact that many insider owners became shareholders in agricultural enterprises based on their employment status during socialist times. Acquiring shares as an employee after the privatization process during the transition period has been rare because of the non-tradable nature of shares and issues of internal shares valuation. The employed owners are therefore expected to be of a higher age, which results in the horizon problem being a more urgent issue.

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[17] The horizon problem, similar to the free-rider problem, can result in investment disincentives or non-optimality, and is specific to untradable (non-transferable or illiquid), insecure or unassigned property rights (to residual claims) issues common to producer cooperatives. The Czech cooperative farms, however, represent cooperatives that can be described as mature producer cooperatives, which, during transition, opted for remaining cooperative organizations, but with outside equity (external shareholding). These cooperatives, in many cases, also introduced a proportionality strategy to internally-generated capital. Therefore, this study does not deal with cooperatives as such, but with the question of the investment effect of the share of employee ownership in total ownership.

[18] The employed owners' incentive to higher performance decreases with increasing size of the workforce which is also closely related to the cost of collective decision-making (Alchian and Demsetz, 1972; Hansmann, 1996). This factor is not discussed in more detail, since there is no clear relationship between the absolute size of the employed owners' workforce and the share of employee ownership.

The discussed investment effects of employee versus external ownership are summarized in Table 2. The signs in the table are to be interpreted similar to Table 1; for example, the positive sign connecting "owners' incentives to active governance" in the first row and "employee ownership" in the first column implies that the higher the share of employee ownership, the higher are the owners' incentives to active governance. The double sign in the respective column for transition economies indicates that this effect is stronger in transition than in a mature economy. A negative sign and zero indicate the opposite relationship and neutral effect, respectively.

Table 2. Effect of employee ownership versus external ownership on corporate governance, performance and investment

	Mature economy		*Agriculture in transition*	
	Employee ownership	**External ownership**	**Employee ownership**	**External ownership**
	←	→	←	→
Owners' incentives to active governance	**+**	**-**	**++**	**--**
- due to job security (incentive optimism)	+	-	++	--
- due to risk aversion (financial pessimism)	+	-	++	--
Costs of active governance	**--**	**+**	**-**	**++**
Scope for managerial discretion	**--**	**+**	**-**	**++**
Economic (technical) performance	**+**	**-**	**+**	**-**
- due to scope for managerial discretion	+	-	++	--
- due to job security (incentive optimism)	+	-	++	--
- due to risk aversion	+	-	++	--
- due to horizon and free-rider problem	-	+	--	++
Optimality of investment activity	**0**	**0**	**0**	**0**
- due to scope for managerial discretion	+	-	++	--
- due to job security (incentive optimism)	+	-	++	--
- due to risk aversion	-*	++	--*	+
- due to horizon and free-rider problem	-*	++	--*	+
Investment sensitivity to internal funds**	**-**	**+**	**--**	**++**
- due to scope for managerial discretion	--	+	-	++
- due to job security (incentive optimism)	-	+	--	++
- due to risk aversion	-	+	--	++
- due to horizon and free-rider problem	-	+	--	++

Note: * Underinvestment; ** Larger number of employed owners is assumed.

Source: Own figure.

2. Method of investment analysis

2.1 Investment model

Following the Mairesse et al. (1999) deliberation on the development of investment models and the Bokusheva et al. (2009) discussion on investment models' suitability for the case of modelling investment behaviour 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 advantages of the error-correction specification of the accelerator model are that it allows the separation of the long-run investment determinants from the short-run investment adjustments, as well as 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

behaviour makes this model superior to other investment models applied to transition agriculture such as the basic accelerator model, or 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 the 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 modelling 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:

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

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 v_{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 must 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, as well as slower responsiveness to market signals. Therefore, we also consider the error-correction accelerator model to nest the dynamic investment equation with an autoregressive-distributed lag of length three (ADL (3,3) function). The resulting error-correction model then has the following form:

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

Similar 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 applies to both equations (1) and (2). Therefore, only the latter is presented, which yields the following specification:

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

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 that can be interpreted as reflecting the transitory availability of funds for investment purposes. Nevertheless, interpreting the significance of the investment effect of the cash flow variable is still ambiguous. It can reflect the presence of financial constraints on investment due to asymmetric information between investors and the firm (e.g., Fazzari *et al.*, 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 for 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 investment behaviour in the context of the firm-specific ownership structure and related financial conditions will allow more light to be shed on the sources of the investment sensitivity to cash flow.

The theoretical predictions of firm-specific and particularly ownership-specific adjustments in capital stock and differences in responses to various shocks, including the 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 development for various economies (countries), but allowed the varying of unit-specific short-run dynamics. In the context of investment behaviour modelling, Bokusheva et al. (2009) allowed both short-run as well as long-run dynamics to vary across observations, concretely farms. We will follow this latter approach and will allow investment behaviour to vary across three ownership variables (Z_n, $n = 1, \ldots, N$; $N = 3$) - ownership concentration (Z_1), external ownership (Z_2), and owners' number (Z_3). This yields the 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 data sources follows in the next section.

2.2 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, together with the Research Institute for Agricultural Economics (VUZE), Prague, Czech Republic. The sample contains 117 agricultural companies with a 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 11-year period.

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

K Farm stock of capital: 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 is the change in *y* 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 The *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 the median, 0 otherwise. The first ownership variable, Z_1, denotes an average (per owner) share in a farm's equity, or *ownership concentration*. The second ownership variable, Z_2, represents *external ownership*, i.e. a share of external investors to the total number of owners. The third variable, Z_3, denotes the *number of farm owners*.[19]

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. a 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 that *Z*-variables are.

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

The data used for estimations is kept in nominal prices[20].

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[19] Ownership variables are generally assumed to be endogenous 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, a developed capital market and an 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.

[20] The main reasons for retaining the data in nominal prices are as follows: The analyzed agricultural companies are assigned by different production structures, i.e. they differ in their asset structure (share of machinery, equipment and buildings) as well as their product structure. While prices for each capital input and output have changed at different rates, mostly average price indexes are known for the sector. The average price indices' used for deflating the data to real terms could thus lead to firm-level distortions of the investment (capital)-to-sale ratio. The traditional motivation behind expressing the data in real prices is the comparability of investment and sales over time. In the case of this study, the aim is not to analyze the development of the real investment volume, but analyzing the investment variability due to ownership differences. The time-specific fluctuation in investment due to price

2.3 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 the 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 et al., 1999; Roodman 2009a). The 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 using the 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 than first-difference GMM[21]. Because of the relatively large number of instruments compared to the number of observations, we estimate a one-step system GMM. We apply the programming package provided by Roodman (2009a) designed for statistical software STATA.

3. Results

3.1 Pooled error-correction accelerator model estimates

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). Comparing the estimates of these two models shows that accounting for ADL (3,3) dynamics improves the model significantly. Testing 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 the 5% significance level. Therefore, we further interpret Model 2 only.

changes, which could be reduced using averaged (firm-neutral) price indices, can be depicted by the time dummy variables. To our opinion, it is, therefore, unnecessary to deflate the data and thus introduce a possible bias.

[21] In the literature, the "first-differenced" GMM proposed by Arrelano and Bond (1991) is also called Difference GMM. Both titles 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). The advantage of applying system GMM as well is that it allows for the inclusion of time-invariant regressors, in our case ownership variables, that would disappear in first difference GMM (see Roodman, 2009a).

Table 3. 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(2, 2) 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
$k_{t-s} - y_{t-s}$	Π_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: Estimates of 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-1}/K_{t-2} 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 I_{t-1}/K_{t-2} , of Δy_t, and CF_t/K_{t-1} in Model 1 and first differences of lag 1 of I_{t-1}/K_{t-2} , of Δy_t, and CF_t/K_{t-1} in Model 2. The estimates of the lagged dependent variables in Model 1 and Model 2 are found in the range between their OLS (upward-biased) estimates and within group (or fixed effect) (downward-biased) estimates, which is an indication of good consistent estimates (see Bond, 2002 and Table A-6 in the Appendix).

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. Similar to the study by Bokusheva et al. (2009) for Russian farms, this effect is found to be significantly negative, with a range between -1 and 0, which implies a cyclical development of investment activity oscillating around and approximating to zero over time. The cyclical development of investment activity can be well explained by the lumpiness of investment (indivisibility and large size of acquired assets) and limited financial resources due to less liquid capital markets and simultaneously lower productivity of agriculture, which leads, therefore, to lower attractiveness of the sector for lending. The decreasing tendency in the cyclical development 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), $\Delta y_t, \Delta y_{t-1}, \Delta y_{t-2}$, incorporated in the model to proxy a response to changes in product demand, and hence to increasing or diminishing market opportunities. The strongest positive investment response is the response to the most intermediate changes; it slightly weakens with the further lags 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 behaviour, 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 vice versa (see, e.g., Bond et al., 2003). This behaviour is confirmed by the highly significant negative coefficient estimate. Farm investment activity is thus congruent with the long-run efficient

adjustment to the "desired" future level of capital. However, the size of adjustment is unexpectedly low. The parameter suggests a 7% approximation rate in capital stock to long-run capital optimum over the analyzed period.[22] Such a low capital adjustment rate was also found by Bokusheva et al. (2009) for Russian farms. This implies high capital adjustment costs in transition agriculture.

The three γ parameters embody investment sensitivity to the level of generated internal funds. This sensitivity is particularly high and significant with respect to cash flow-to-capital ratio of the intermediately preceding year, and weakens with the number of lags. The test of the joint significance of the three γ parameters further implies that the investment sensitivity to internal funds is not only transitory, but captures a long-run relation. The most common interpretation of these parameters would be that the analyzed farms depend on their own financial resources. Nevertheless, cash flow levels could also translate into an expectation of future profits, and the significant parameters then imply an investment reaction to this expectation. In the context of transition agriculture, it is still plausible to expect that the γ parameters capture, at least to a degree, persistent financial constraints and high costs of capital market transactions; it is also possible that they capture farms' cautious behaviour towards bank credits due to both unsettled property rights to agricultural assets and to a fear of premature bankruptcy in the case of investment project failure due to volatile market conditions.

The last parameter to be discussed is the parameter with respect to the scale factor, y_{t-2}, the value of which is not significantly different from zero. This implies that the long-run elasticity of capital to sales is unity. The production function is thus characterized by theory-consistent constant returns to scale.

3.2 Ownership-specific heterogeneity in investment behaviour

The estimation results of the error-correction accelerator model with ownership-specific heterogeneity in farm investment behaviour will be interpreted in connection to a mean statistics analysis of investment and performance differences between the examined ownership groups. Table 4 provides respective mean statistics for the ownership groups and results of the two-sample t-tests. Table 5 presents parameter estimates of the error-correction models with ownership-specific variability in investment behaviour. The advantage of the investment model analysis is the simultaneous consideration of all three ownership variables, which allows the investment effect (short- and long-run) of each of the ownership variables to be filtered out, while controlling for the effects of the remaining variables. Models 3 and 4 in the table are the most parsimonious versions[23] of the model as defined in equation 4; the only difference between the models is the addition of the variable 'transformation indebtedness' in Model 4, which should help to control for supplementary credit constraints.

[22] 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%.

[23] 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.

Table 4. Mean statistics comparison and two-sample t-test for farm ownership groups

	Owners' number			Ownership concentration[1)]			External ownership[2)]		
	< median	≥ median	*p*-value*	< median	≥ median	*p*-value*	< median	≥ median	*p*-value*
I_t/K_{t-1}	0.137	0.119	0.059	0.121	0.135	0.143	0.128	0.128	0.947
S_t/K_t	1.021	0.896	0.000	0.991	0.935	0.035	0.980	0.906	0.012
I_t/S_{t-1}	0.126	0.130	0.754	0.112	0.142	0.024	0.131	0.127	0.825
CF_t/K_{t-1}	0.180	0.133	0.000	0.143	0.171	0.001	0.168	0.136	0.001
$\Delta S_t/K_{t-1}$	0.004	0.006	0.829	-0.004	0.012	0.091	0.003	0.009	0.595
K_t [3)]	36.431	80.237	0.000	49.775	63.592	0.000	56.490	62.674	0.023
S_t [3)]	30.828	69.628	0.000	43.678	53.434	0.000	48.493	52.912	0.077
Owners' nr.	85	555	-	402	234	0.000	188	501	0.000
Ext. own. [2)]	0.652	0.839	0.000	0.794	0.705	0.000	0.605	0.894	-
Transf. debt[4)]	0.439	0.142	0.000	0.385	0.203	0.000	0.378	0.179	0.000
Cap. con. I[1)]	0.753	0.149	0.000	-0.017	0.900	-	0.606	0.113	0.000
Cap. con. II[5)]	0.111	0.126	0.001	0.076	0.166	0.000	0.134	0.116	0.000

Note: * P-value for a two-sample t-test; [1)] per owner share in equity (in thousands of CZK); [2)] share of the number of external owners in total number of owners; [3)] in millions of CZK; [4)] indebtedness rate from ownership transformation (debts toward eligible persons from transformation in value of total assets); [5)] per owner share in legal capital (in millions of CZK).

As Table 4 illustrates, investment activity level given by the ratio I_t/K_{t-1} differs significantly only between farm groups distinguished by the number of owners. Farms with a larger number of owners display significantly lower investment activity than farms with a smaller number of owners. The former are also assigned by lower scores in performance indicators – sales-to-capital ratio (output productivity) and cash flow-to-capital ratio (profitability or liquidity). This result suggests that the scale and scope achieved through equity investment by a large number of small owners did not provide for sufficient economies that would outweigh the agency costs related to dispersed ownership. Indeed, as the significance of the scale parameter φ_{01} in Table 5 indicates, the group of farms with a larger number of owners is characterized by decreasing returns to scale. Thus, joint farm ownership by a large number of shareholders, which has contributed to preserving large-scale farms, does not prove to be motivated by economies of scale.

In Table 4, further observed lower investment activity of farms with larger number of owners could be a rational response to lower returns to capital. However, as theories suggest, dispersed ownership provides a larger scope for managers maximizing their own utility, which is rather assumed to result in overinvestment. The observed investment activity seems to reflect the transition-specific incentive problem of dispersed ownership rather than managerial discretion. The lower investment activity could actually be a result of owners' low interest in the farm's future performance, since for many of these owners becoming shareholders represented the only alternative to losing the value of their transformation claims. These owners' lower interest in farm future performance and prospects could also explain why the expected higher scope for managerial discretion does not significantly reflect in higher investment sensitivity to cash flow.[24] This situation rather leaves managers with a

[24] This effect is captured in the statistical insignificance of parameters γ_{01}, γ_{11}, or γ_{21}, which are, however, not included in the most parsimonious model presented in Table 5.

small scope for discretion over investment, but with a large scope for discretion over other activities that could increase their personal benefits and contribute to lower overall performance of the farm.

Furthermore, the parameters ρ_{01}, and ρ_{11}, which capture the investment response to the past investment level indicate that the higher number of owners reduces the generally observed cyclical development of investment; in other words, increases current investment response to the past level of investment. This could relate to the larger size of capital stock in this group of farms, i.e. the lower relative lumpiness of investment and lower investment to capital ratio (see Table 4). As depicted in parameter θ_{01}, a larger number of owners also reduces investment responsiveness to changes in sales.

Comparing groups of farms with lower and higher ownership concentration shows ambiguous results regarding their performance differences. Contrary to expectations, farms with higher capital concentration display significantly lower their sales to capital ratio. Conversely, and in line with expectations on ownership concentration-related performance, these farms are assigned by significantly higher cash flow-to-capital ratio. One possible explanation of the unexpected differences in the sales-to-capital ratio could be different production structures, i.e. different capital versus labour-intensity of the production, for example due to different representation of more labour-intensive animal production in the production structure. However, comparing the shares of revenues from animal production in total revenues did not reveal any significant differences. Therefore, the lower sales-to-capital ratio assigning the groups of farms with higher capital concentration could be a result of higher capital value or capital undervaluation (with respect to the productive use of the asset) in farms with lower capital concentration.[25] The cash flow to capital ratio, however, clearly shows higher performance of farms with higher capital concentration.

The argument of possible differences in capital valuation between the two groups of farms with respect to capital concentration is supported by a comparison of other indicators in Table 4. The group of farms with higher ownership concentration displays higher investment activity when expressed in investment to capital ratio as well as investment to sales ratio; however, only the latter is found to be statistically significant. In line with the optimal investment decision, this result would suggest higher marginal productivity of capital in farms with higher capital concentration. Moreover, examining the investment activity over time reveals that farms with higher capital concentration show significantly higher investment activity, given by the investment to capital ratio in the first part of the observed period, i.e., in 1998-2003 compared to 2004-2008 (see Table A-5 in the Appendix). This could increase the value of capital in these farms when compared to significantly more depreciated capital used in farms with lower capital concentration.

These systemic differences in capital valuation or capital depreciation between farms with higher and lower capital concentration, which affects the investment-to-capital ratio and sales-to-capital ratio, also have implications for the estimates of the error-correction accelerator model. The systemic capital value 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 also be captured 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, which reflects an inverse long-run

[25] More ownership-concentrated farms are likely to be farms which did not acquire all original assets of the former farm they were successor to, but mainly the more productive assets, and thus also assets with higher bookkeeping value. This offloading of unproductive assets was likely mainly done with the objective to restructure and enhance efficiency.

The divergences of book and real value of assets in the Czech Republic were also derived by the empirical study by Colombo and Revoltella (2003). Also, as Medonos (2006), from his investment analysis of Czech farms derived, farms with a rapid growth strategy decrease their assets' bookkeeping value faster to generate funds for reinvestment.

investment response to productivity of capital (sales-to-capital ratio). If this is significantly undervalued for farms with higher capital concentration due to high value capital when compared to farms with lower capital concentration, the parameter of the error-correction term, ϕ_{02}, could imply that farms with higher capital concentration overinvest. Indeed, this parameter is positive and larger than parameter ϕ_0, which indicates that capital concentration leads to the long-run adjustment of capital stock that is not congruent with optimal adjustment. In other words, this group of farms exceeds the optimal adjustment to the long-run capital optimum. As a result of capital valuation, this parameter needs to be interpreted with caution; its inclusion in the model is, however, important, as it filters out significant systemic ownership-specific variability in the data and thus improves the estimates of the remaining parameters.

The estimates further disclose that there is an ownership concentration-specific investment activity response to past growth in capital stock. The value of the respective parameter, ρ_{12}, suggests that farms with higher ownership concentration will invest significantly less in the current period if they invested in the previous period. This could imply that farms with more concentrated ownership invest in larger (relative to their capital stock), i.e. more lumpy, assets, since on average their investment activity is not lower than the investment activity of farms with lower ownership concentration. Furthermore, farms with higher ownership concentration show weaker investment responses to changes in sales. As Table 4 illustrates, these farms show significantly higher growth in sales than the group of farms with lower ownership concentration. Together with a lower investment response to the changes in sales, this would suggest that farms with higher ownership concentration follow a strategy of fast growth independent of short-term market signals.

In line with theoretical predictions, parameter γ_{02} indicates that increasing capital concentration lowers farm investment sensitivity to internally-generated funds.[26] This could validate our prediction that better corporate governance and better performance of the farms with higher capital concentration reduces managers' tendency to prefer internal funds over debt, and contributes to optimizing the capital structure. Yet this result could also relate to the higher value of assets in these farms, which could be accepted by banks as collateral and thus reduce credit constraints. Conversely, parameter γ_{02} indicates the opposite for the investment sensitivity to past cash flow to capital. This result, which shows a positive relationship between investment activity and past cash flow, suggests that current and past cash flow to capital can represent different information in the investment model. While the current level of cash flow seems to represent currently available internal funds or current financial constraints, the past level of cash flow to capital depicts a longer-term effect on current investment, possibly as a proxy of future (expected) financial performance.

The effect of external ownership-related factors (weaker incentives to active governance and costs of active governance, lower risk aversion, detachment from labour and performance objectives, smaller horizon and free-rider problem) is expected to have a mainly negative effect on farm performance, an ambiguous effect on optimality of investment, and a positive effect of investment sensitivity to cash flow.

The results of the two-sample t–tests, as well as estimates of the error-correction accelerator model support these predictions. The group of farms with higher share of external ownership displays significantly lower scores of cash flow-to-capital, as well as sales-to-capital ratios, while exhibiting no differences in investment activity levels. This finding provides support for the hypotheses that external owners have weaker incentives to control management than employed owners, whose employment security is at stake, and that ownership among employees increases performance, especially with a decreasing share of external owners.

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[26] 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.

The error-correction model estimates do not depict any external ownership-specific rate of investment adjustment to long-run capital optimum, but does depict a significant impact of the share of external ownership on investment response to past changes in sales and investment sensitivity to internal funds. The negative significant sign of the parameter θ_{23} suggests that investment decisions of farms with a higher share of external ownership respond less sensitively to past changes in sale (market) signals than investment decisions of farms with a lower share of external ownership. The positive sign of the statistically significant (at the 10% significance level) parameter γ_{03} implies that investment activity of farms with a higher share of external ownership is more sensitive to generated internal funds[27] than in the case of a higher share of employee ownership. The latter result is congruent with both the managerial discretion hypothesis, as well as the financial pessimism and horizon problem hypotheses. In line with the managerial discretion hypothesis and in connection with the previously discussed result of lower performance indicators (Table 4), farms with a higher share of external owners will have a lower probability of successful credit application, and thus a lower incentive to apply for a credit, since its rejection would reveal the low performance fact to the owners and thus lower their willingness to support financing investment projects from internal funds. The negative parameters θ_{03} and θ_{23}, which refer to the external ownership-specific investment response to changes in sales, again support the above hypotheses. These parameters suggest that, contrary to external ownership, a higher share of employee ownership increases investment responses to changes in sales, which is in line with the hypothesis that employed owners respond more sensibly to market volatility, which can be a result of their higher risk aversion, as well as stronger incentives to control for investment decisions' optimality.

[27] Hobdari et al. (2010) find similar results for Estonian firms. Outsider-owned firms display sensitivity to both measures of availability of finance (internal and external) and suggest that these firms could suffer from high levels of managerial discretion and control.

Table 5. 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 (without control variable *TD*)		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 *(number of owners)*	α_{01}	-	-	-	-
$Z_1 * I_{t-1}/K_{t-2}$	ρ_{01}	1.423	0.010	1.424	0.014
$Z_1 * I_{t-2}/K_{t-3}$	ρ_{11}	0.740	0.033	0.809	0.069
$Z_1 * \Delta y_t$	θ_{01}	-	-	-0.667	0.092
$Z_1 * y_{t-2}$	φ_{01}	-0.022	0.003	-0.027	0.014
Z_2 *(cap. ownersh. conc.)*	α_{02}	-	-	-	-
$Z_2 * I_{t-2}/K_{t-3}$	ρ_{12}	-0.569	0.004	-0.526	0.062
$Z_2 * \Delta y_t$	θ_{02}	-0.325	0.138	-0.737	0.233
$Z_2 * \Delta y_{t-1}$	θ_{12}	-0.416	0.104	-0.676	0.043
$Z_2 * \Delta y_{t-2}$	θ_{22}	-0.571	0.238	-0.916	0.048
$Z_2 * (k_{t-3} - y_{t-3})$	Π_{02}	0.231	0.020	0.312	0.016
$Z_2 * CF_t/K_{t-1}$	γ_{02}	-	-	-0.971	0.046
$Z_2 * CF_{t-1}/K_{t-2}$	γ_{12}	0.412	0.017	1.218	0.008
Z_3 *(external ownership)*	α_{03}	-	-	-	-
$Z_3 * \Delta y_t$	θ_{03}	-	-	-1.122	0.147
$Z_3 * \Delta y_{t-2}$	θ_{23}	-0.555	0.061	-0.765	0.037
$Z_3 * CF_t/K_{t-1}$	γ_{03}	0.131	0.279	0.442	0.072
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.

4. Summary and concluding remarks

Empirical results from an error-correction accelerator model estimated on Czech cooperative and corporate farms from 1997-2008 show that ownership structure has a significant impact on farm investment behaviour. Ownership constellations assigned by higher agency costs and a higher scope for managerial discretion reflect a higher sensitivity of investment to internal funds, thus representing internal credit constraints.

Scale and scope achieved through the transformation of former collective farms into farms with (equity investment by) a large number of small share owners was found not to provide for sufficient economies that would outweigh the agency costs related to highly-dispersed ownership. Therefore, joint farm ownership by a large number of shareholders, which contributed to preserving large scale farms, does not prove to be motivated by economies of scale. The observed lower investment activity of the farms with a larger number of owners could be a rational response to lower returns to capital and an indication of the need for restructuring. However, the strategy of dispersed ownership allowed the value of ownership shares to be secured and, due to agricultural policy transfers (direct payments), possibly even increase. Moreover, this strategy certainly secured employment for many former employees, but particularly management. Nevertheless, without further effective restructuring, which requires an active share market and supporting institutions, farms with high ownership dispersion cannot be expected to successfully compete in the sector in the long-run. Without the active open share market, this form of ownership could facilitate restricted insider share–trading, thus allowing mainly management to acquire a majority of shares and control over time.

The group of farms with higher external ownership shows significantly higher investment sensitivity to cash flow to capital ratio, while at the same time being less productive and less profitable. Owners of farms with a higher share of external ownership thus seem to be more constrained in their control over management than farms with higher share of employee ownership. The empirical results are thus in line with the theoretical expectation that external ownership provides more scope for managerial discretion, which can lead to less optimal investment decisions and overall economic performance, and thus higher agency costs borne by the owners. Employee ownership, which is found to contribute to the performance of the farms, is, however, not warranted in the future, as employee ownership was a result of transformation laws. Share of employed owners can rather be expected to decrease with the retirement of currently employed owners, since retirees are interested in the financial settlement of ownership shares, and since it facilitates an internal share of buy-outs by managers seeking ownership concentration.

Results on the investment effect of ownership concentration suggest its significant contribution to investment performance. Relying 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.

Some of the empirical results confirmed our predictions that considered the transition specificities of the given ownership forms and corporate environment, which challenged the empirical prove of the theoretically derived investment effect of managerial discretion. The analysis could be further challenged by the argument that the ownership structure is not exogenous, since the process of farm transformation was subjected to former managers' discretion. The resulting ownership structure and its investment impact could thus reflect also managers' abilities, possibly their ideologies, degree of social responsibility or preferences. Despite these challenges regarding the conclusions on the investment effect of managerial discretion, the empirical results deliver great insights for the future developments of Czech farm structure under competitive pressure. Depending on the strength of the competitive pressure, farms with highly dispersed ownership among a large number of owners will require marked restructuring that might be possible through the liquidation or

gradual buy-outs of small shareholders, 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 point to higher future ownership concentration of today's cooperative and corporate farms. Developing institutions to support the agricultural share market, which could attract investors from outside the current farms, could contribute to the speed and effectiveness of farm ownership restructuring.

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Appendix

Table A.1 Czech farm structure (number of farms of respective legal forms in numbers and average size of cultivated agricultural land) between 1989 and 2009.

	Individual private farms		Cooperatives		Joint Stock Companies		Limited liability companies		State farms	
	Number	Size	Number	Size	Number	Size	Number	Size	Number	Size
1989	-		1,024	2,561	-	-	-	-	174	6,261
1995	19,648	38.9	1,105	1,507	223	1,206	945	756	80	660
2000	20,115	42.2	723	1,465	519	1,502	1,171	669	-	-
2004	32,231	20.7	678	1,424	657	1,394	1,662	560	-	-
2009	29,430	34.9	585	1,440	652	1,348	2,044	427	-	-

Source: Ministry of Agriculture of the Czech Rep. (1994, 1996, 2001, 2005, 2010).

Table A.2 Czech farm structure (percentage share of cultivated land by farms of respective legal forms in total agricultural land) between 1989 and 2009.

	Individual private farms	Cooperatives	Joint Stock Companies	Limited liability companies	State farms
1989	-	70.4	-	-	29.2
1995	21.6	47.0	7.6	20.2	1.5
2000	23.5	29.3	21.6	21.7	-
2004	24.8	25.3	22.5	21.9	-
2009	28.1	23.4	22.6	22.9	-

Source: Ministry of Agriculture of the Czech Rep. (1994, 1996, 2001, 2005, 2010).

Table A.3 Statistics of basic variables for 1997-2008

	Number of observation	Mean	Stand. dev.	Min	Max
I_t/K_{t-1}	1016	0.126	0.147	-0.548	1.797
S_t/K_t	1016	0.959	0.419	0.052	3.938
I_t/S_{t-1}	1016	0.128	0.225	-4.999	1.352
CF_t/K_{t-1}	1016	0.157	0.132	-0.306	1.027
$\Delta S_t/K_{t-1}$	1016	0.005	0.153	-0.904	1.123
K_t	1016	56.733	40.995	3.829	262.170
S_t	1016	48.612	35.875	1.073	309.016
CF_t	1016	7.747	7.062	-13.694	48.574
Number of owners*	121	327	388	2	3200
External ownership* [1)]	121	0.744	0.202	0.070	0.980
Transformation indebtedness* [2)]	121	0.283	0.306	0.000	1.388
Capital (equity) concentration* [3)]	121	0.372	1.307	-1.935	12.538
Legal capital concentration* [4)]	116	0.125	0.099	0.005	0.420

Note: * Data from 2003 only; [1)] Share of external owners in total number of owners; [2)] Share of transformation liabilities (debt to persons with property claims in the company's assets) in total liabilities; [3)] Per owner share in equity (in thousands CZK); [4)] Per owner share in legal capital (in thousands CZK).

Table A.4 Correlation between ownership variables Zs (year 2003)

Correlation between continuous ownership variables	Ownership concentration	Share of external owners	Number of owners	Transformation indebtedness
Ownership concentration	1.000			
Share of external owners	-0.312	1.000		
Number of owners	-0.123	0.397	1.000	
Transformation indebtedness	-0.140	-0.353	-0.357	1.000
Spearman correlation between ownership dummy variables	Ownership concentration (dummy)	Share of external owners (dummy)	Number of owners (dummy)	Transformation indebtedness (dummy)
Ownership concentration (dummy)	1.000			
Share of external owners (dummy)	-0.229	1.000		
Number of owners (dummy)	-0.131	0.476	1.000	
Transformation indebtedness (dummy)	-0.313	-0.374	-0.487	1.000

Table A.5 Mean statistics comparison and two-sample t-test for farm ownership groups for time periods 1997-2002 and 2003-2008 (in real prices of 1997).

	Owners' number			Ownership concentration[1)]			External ownership[2)]		
	< median	≥ median	*p*-value*	< median	≥ median	*p*-value*	< median	≥ median	*p*-value*
1997-2002									
I_t/K_{t-1}	0.107	0.106	0.972	0.093	0.116	0.016	0.104	0.106	0.857
S_t/K_t	1.011	0.863	0.000	0.969	0.905	0.070	0.969	0.860	0.005
I_t/S_{t-1}	0.112	0.120	0.454	0.103	0.126	0.033	0.109	0.126	0.177
CF_t/K_{t-1}	0.146	0.108	0.000	0.111	0.142	0.002	0.137	0.102	0.001
$\Delta S_t/K_{t-1}$	0.000	0.006	0.711	-0.009	0.012	0.124	0.003	-0.002	0.740
K_t [3)]	36.069	82.284	0.000	50.896	64.408	0.000	57.485	65.322	0.040
S_t [3)]	29.881	70.215	0.000	43.969	52.078	0.007	49.253	53.761	0.221
CF_t	4.248	8.729	0.000	5.057	7.389	0.000	6.985	6.305	0.249
2003-08									
I_t/K_{t-1}	0.167	0.130	0.025	0.149	0.152	0.865	0.149	0.148	0.947
S_t/K_t	1.032	0.932	0.012	1.017	0.968	0.212	0.990	0.955	0.417
I_t/S_{t-1}	0.139	0.139	0.994	0.121	0.157	0.137	0.150	0.129	0.457
CF_t/K_{t-1}	0.215	0.156	0.000	0.175	0.197	0.073	0.194	0.169	0.052
$\Delta S_t/K_{t-1}$	0.006	0.006	0.975	0.000	0.013	0.000	0.003	0.017	0.318
K_t [3)]	36.892	77.651	0.000	48.248	62.597	0.000	55.366	59.330	0.305
S_t [3)]	31.902	68.997	0.000	43.332	54.898	0.000	47.749	51.991	0.208
CF_t	6.708	11.600	0.000	7.483	10.323	0.000	8.888	9.227	0.627

Note: * P-value for a two-sample t-test; [1)] per owner share in equity (in thousands CZK); [2)] share of the number of external owners in total number of owners; [3)] in millions CZK; [4)] indebtedness rate from ownership transformation (debts toward eligible persons from transformation in value of total assets); [5)] per owner share in legal capital (in thousands CZK).

Table A.6 OLS and Fixed Effect estimates of Model 1 and Model 2.

Dependent variable I_t/K_{t-1}		Model 1 - Basic AR(2, 2) error correction model (s = 2)				Model 2 - AR(3, 3) error correction model (s = 3)			
		OLS		Fixed effect		OLS		Fixed effect	
Indep. var.	Coef.	Coef.	*P*	Coef.	*P*	Coef.	*P*	Coef.	*P*
Constant	α_0	0.144	0.049	2.842	0.000	0.197	0.027	2.651	0.001
I_{t-1}/K_{t-2}	ρ_0	-0.082	0.042	-0.372	0.000	-0.096	0.038	-0.407	0.000
I_{t-2}/K_{t-3}	ρ_1	-	-	-	-	-0.096	0.052	-0.481	0.000
Δy_t	θ_0	0.080	0.034	0.122	0.006	0.105	0.018	0.113	0.031
Δy_{t-1}	θ_1	0.077	0.058	0.144	0.008	0.090	0.071	0.130	0.051
Δy_{t-2}	θ_2	-	-	-	-	0.114	0.025	0.220	0.005
$k_{t-s} - y_{t-s}$	$\square_0$	-0.060	0.000	-0.491	0.000	-0.050	0.001	-0.527	0.000
y_{t-s}	φ_0	-0.006	0.330	-0.249	0.000	-0.011	0.158	-0.228	0.001
CF_t/K_{t-1}	γ_0	0.231	0.000	0.175	0.005	0.252	0.000	0.222	0.002
CF_{t-1}/K_{t-2}	γ_1	0.180	0.001	0.174	0.005	0.234	0.001	0.257	0.001
CF_{t-2}/K_{t-3}	γ_2	-	-	-	-	-0.011	0.877	-0.008	0.914
# of obs.		850		850		689		689	
Overall fit (F-test)		16.36	0.000	18.40	0.000	18.27	0.000	13.41	0.000

Comparative Analysis of Factor Markets for Agriculture across the Member States

245123-FP7-KBBE-2009-3

The Factor Markets project in a nutshell

Title	Comparative Analysis of Factor Markets for Agriculture across the Member States
Funding scheme	Collaborative Project (CP) / Small or medium scale focused research project
Coordinator	CEPS, Prof. Johan F.M. Swinnen
Duration	01/09/2010 – 31/08/2013 (36 months)
Short description	Well functioning factor markets are a crucial condition for the competitiveness and growth of agriculture and for rural development. At the same time, the functioning of the factor markets themselves are influenced by changes in agriculture and the rural economy, and in EU policies. Member state regulations and institutions affecting land, labour, and capital markets may cause important heterogeneity in the factor markets, which may have important effects on the functioning of the factor markets and on the interactions between factor markets and EU policies. The general objective of the FACTOR MARKETS project is to analyse the functioning of factor markets for agriculture in the EU-27, including the Candidate Countries. The FACTOR MARKETS project will compare the different markets, their institutional framework and their impact on agricultural development and structural change, as well as their impact on rural economies, for the Member States, Candidate Countries and the EU as a whole. The FACTOR MARKETS project will focus on capital, labour and land markets. The results of this study will contribute to a better understanding of the fundamental economic factors affecting EU agriculture, thus allowing better targeting of policies to improve the competitiveness of the sector.
Contact e-mail	info@factormarkets.eu
Website	www.factormarkets.eu
Partners	17 (13 countries)
EU funding	1,979,023 €
EC Scientific officer	Dr. Hans-Jörg Lutzeyer