https://doi.org/10.17221/212/2019-AGRICECON

Investments of Czech farms located in less favoured areas after EU accession

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Citation: Zdeněk R., Lososová J. (2020): Investments of Czech farms located in less favoured areas after EU accession. Agric. Econ. – Czech, 66: 55–64.

Abstract: This paper investigates the development and structure of the fixed assets of Czech farms and their investment behaviour. We use data from a long-term (2003–2016) survey of farms and categorise farms into three groups according to their share of agricultural land in less favoured areas. The development of tangible fixed assets and their structural development points to the importance of investments to agricultural holdings. Above all, there is an extensive trend of investing in the land, but purchases of land are likely to affect the growth of the relative age of tangible fixed assets, especially the obsolescence of buildings that are not sufficiently modernised by farms. Results of the accelerated model indicate that there is an absence of soft budget constraints but a presence of capital imperfections and high importance of both operating and investment subsidies when deciding on investments in fixed assets.

Keywords: accelerated model; ageing; agriculture; assets; investments; subsidies

Czech agriculture differs in many respects from other EU countries. The main differences are larger average sizes of the agricultural enterprises, a high share of leased land and the high representation of corporations. Less Favoured Areas (LFAs, now Areas with Natural Constraints) are defined by limited resources. Given the limited availability of external inputs, current LFA production systems are typically characterised as low-income farming. An increase in income requires investment opportunities, whose rate of return is, however, higher than that of farmers' preferences (Pender 1998; Ruben and Pender 2004). Lack of investment capital and knowledge is considered a very limiting factor in the growth of labour productivity.

The aim of this paper is to evaluate the structure and age of tangible fixed assets in Czech farms after accession to the EU and to verify the augmented accelerator model with subsidies for investments taking into account the different LFAs.

PREVIOUS RESEARCH

Czech agriculture, with a value of fixed asset of EUR 2 180 per ha in 2015, is still well below the EU average (24th in EU28) and the amount of gross investment of EUR 235 per ha is also below the EU average (FADN 2018). The low level of investment affects the cost and efficiency of agricultural production and thus the overall competitiveness of agricultural production. It also negatively affects the long-term prospect of achieving food security. It is highly probable that countries with a high gross fixed capital formation in agriculture will be highly efficient compared to countries with low investment in agriculture (Giannakis and Bruggeman 2015). The relationship between agricultural investment and productivity is explored e.g. by Rosenzweig and Binswanger (1993), Roy and Pal (2002), Bathla (2017), Nilsson (2017), Quiroga et al. (2017).

Supported by the institutionally funded research at the University of South Bohemia, Faculty of Economics, Department of Accounting and Finances (RVO160).

https://doi.org/10.17221/212/2019-AGRICECON

In 2012–2016, loans to the agricultural sector in the Czech Republic grew, especially long-term investment credits. Investments in machinery and equipment declined in 2016. On the other hand, investment in buildings has increased as well as investment in the reconstruction of buildings and this is expected to not only have a beneficial impact on animal welfare and the quality of crop and livestock production but also on the protection of underground and surface water and climate protection (The Ministry of Agriculture 2017). In recent years, investment in the purchase of agricultural land has grown, which is related to the gradual decrease in the share of rented agricultural land in the Czech Republic (Lososova et al. 2017).

A lot of different research work deals with the effects of various types of subsidies on investment (Viaggi et al. 2011; Rizov et al. 2013; O'Toole and Hennessy 2015; Michalek et al. 2016). The main focus of the evaluation studies is to ensure causality between program measures and estimated effects (Bergschmidt 2009; Blandford et al. 2010; Margarian et al. 2010; Medonos et al. 2012). Programme effects might show time lags so evaluating agricultural investments often requires long timespans (Hoffmann et al. 1997).

It is possible that the subsidy has a direct effect on the level of investment (Latruffe et al. 2010) when decoupled subsidies are added to the internal funds available to the farmer and reduce the demand for external resources. O'Toole and Hennessy (2015) found that decoupled subsidies can reduce income risk and reduce the financial constraints faced by farms, especially small and medium-sized enterprises.

Support for investments and the modernization of farms is a capital subsidy aimed at encouraging farms to make more gross investments in equipment, machinery and new production facilities, provided that this leads to increased production and productivity. This can be achieved in the form of a net investment that can bring additional production capacity to the company and in the form of substitutive investments that can modernise the production facilities of the company (Harris and Trainor 2005). Subsidies can, therefore, lead to an increase in productivity gains driven by investments due to better access to capital and the possibility of new production facilities (Serra et al. 2008). Investment subsidies can thus stimulate technological development and market adaptation as they can reduce investment costs and help firms make better use of returns of scale (Blancard et al. 2006). Effects on work are ambiguous as subsidies can be used to increase the workforce but may also lead to lower demand for work if subsidies increase labour productivity (McCloud and Kumbhakar 2008). The main argument is that the investment subsidy can motivate firms to invest. Ezcurra et al. (2011) documented a significant positive relationship between farm labour productivity and GDP per capita, investment per worker and average farm size and negative relation to LFA, the age of the farm owner, the share of land leased and the prevailing type of agricultural production.

DATA AND METHODS

The paper uses data from our own database of agricultural holdings from 2003 to 2016, which includes financial statements (balance sheet and profit/loss statement) and other production and economic data (in this paper, we use detailed data on land and subsidies). This database is collected by our own annual survey of farms. The initial year, 2003, was chosen due to the accession of the Czech Republic to the EU in 2004. In individual years, the size of the sample fluctuates from 85 to 149 enterprises; and their utilised agricultural area is 4–7% of the agricultural land of the Czech Republic.

Farms are broken down by share of land in Less Favoured Areas (LFA). According to the LFA, farms are classified according to the FADN (2008) methodology as follows: mountain areas (LFA M) – more than 50% of the utilised agricultural area in the LFA mountain; other LFAs (LFA O) – more than 50% of the utilised agricultural area in LFAs and the LFA M share is less than 50%; NON LFA – more than 50% of the utilised agricultural area is out of the LFA. The distribution of farms by LFA category is shown in Table 1. On average, about 1/5 of farms belong to LFA M, 2/5 to LFA O, and 2/5 farm to outside disadvantaged areas.

The sample structure differs to some extent from results based, for example, on the FADN database (Stolbova and Micova 2012). They report that the share of farms in LFA M was 14.6%, in LFA O 35.8% and 49.6% in NON LFA in the period 2007–2013. The differences may be due to the collection of data from the balance sheet and profit and loss account (i.e. double-entry bookkeeping), which are compiled almost exclusively by business corporations and cooperatives.

In terms of size classification, these are small and medium-sized enterprises, but in the classification according to the area of cultivated land, these are mostly large farms (represented by farms with the utilised agricultural area above 500 ha), which account for 95.6% on average. The average acreage of a farm is 1 740 ha (in LFA M 1 288 ha, in LFA O 1 741 ha and in NON LFA

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Table 1. Distribution of farms according to LFA categories

Year	2003	2005	2007	2009	2011	2013	2015	2016	Average
Number of farms	149	122	115	112	91	103	104	95	110.8
LFA M (%)	23.5	23.8	23.5	25.0	23.1	15.5	15.4	16.8	21.9
LFA O (%)	37.6	37.7	36.5	39.3	41.8	42.7	37.5	38.9	39.5
NON LFA (%)	38.9	38.5	40.0	35.7	35.2	41.7	47.1	44.2	38.6

LFA – Less Favoured Areas; M – mountain areas; O – other areas; NON LFA – more than 50% of the utilised agricultural area is out of LFA

Source: Authors' calculations on farm database

1 996 ha). According to the results of the structural survey on agriculture (CZSO 2016), the area of land for legal persons significantly exceeds the area of land for natural persons (average farmland was 130.3 ha in 2016, for legal persons it was 773.8 ha and for natural persons 44.4 ha). It follows that our results can only be generalised for the farms that are legal entities.

In terms of production orientation, 13% of farms are focused on crop production, 37% on livestock and 50% are mixed farms. This structure varies from one LFA category to another and respects the geographical distribution of farming (NON LFAs have a higher percentage of crop speciality farms, 27%; in LFA M, 64% of farms are orientated to animal production; LFA O is approximately equivalent to the overall average). In terms of the acreage of the farm, on average, the largest farms are with mixed production (1 907 ha), other farms focused on crop production (1 799 ha) and animal production (1 491 ha). The sample does not contain farms without farmland focused solely on livestock production.

In the paper, the proportion of fixed assets and their groups into total assets, relative age (*RA*) of assets (expressed as a share of accumulated depreciation to the gross value of assets) is evaluated. The value of the investments is not stated in the financial statements of the companies and is therefore calculated using the following relationship.

$$\begin{aligned}\text{Gross investment } (GI_t) = {} & \text{Tangible fixed assets}_t - \\ & - \text{Tangible fixed assets}_{t-1} + \text{Depreciation}_t + \\ & + \text{Net book value of fixed assets sold}_t\end{aligned} \quad (1)$$

The accelerator model is applied to farm panel data for the period 2003–2016. The standard accelerator model suggests that investment decisions are based on sales growth and the augmented accelerator model introduce financing constraints on investment behaviour measured with cash flow variable (Fazzari et al. 1988; Rizov 2004; Bojnec and Latruffe 2007; Bojnec and Ferto 2016; Model 1).

$$\frac{GI_{i,t}}{K_{i,t-1}} = a_0 + a_1 \frac{\Delta S_{i,t}}{K_{i,t-1}} + a_2 \frac{CF_{i,t-1}}{K_{i,t-1}} + b_t y_t + c_i f_{it} + u_{it} \quad (2)$$

In the following equation, dummy variables which correspond to the respective LFA categories are employed (Model 2).

$$\begin{aligned}\frac{GI_{i,t}}{K_{i,t-1}} = {} & a_0 + a_1 \frac{\Delta S_{i,t}}{K_{i,t-1}} + a_2 \frac{CF_{i,t-1}}{K_{i,t-1}} + d_1 LFAO_{i,t} \frac{\Delta S_{i,t}}{K_{i,t-1}} + \\ & + d_2 LFAO_{i,t} \frac{CF_{i,t-1}}{K_{i,t-1}} + d_3 LFAM_{i,t} \frac{\Delta S_{i,t}}{K_{i,t-1}} + \\ & + d_4 LFAM_{i,t} \frac{CF_{i,t-1}}{K_{i,t-1}} + b_t y_t + c_i f_{it} + u_{it}\end{aligned} \quad (3)$$

where: *GI* – gross investment; Δ*S* – change in sales value between period *t* and period *t* – 1; *CF* – cash flow defined as profit before tax plus depreciation; *i* – index for farms and *t* for particular years; *LFAO* and *LFAM* – dummies for location of farms in LFA category; *y* – vector of time dummies to control unobserved shocks; *f* – vector of individual farms; *u* – residual term with i.i.d. $N(0, \sigma^2)$. All variables are normalised by the beginning-of-period capital stock (measured by tangible assets, *K*) in time *t* – 1 to control for size effects.

The coefficient of cash-flow variable is generally interpreted as a sign for credit rationing and this cash-flow variable may allow the soft budget constraint to be tested. The weak version of the soft budget constraint is when the coefficient on cash-flow variable is zero, which means that companies have access to loans for investment regardless of their profitability. The strong version of the soft budget constraint is if the coefficient of the cash-flow variable is negative suggesting that low-performing companies have easier access to bank loans (Fazzari et al. 1988; Bakucs et al.

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2009). The regression coefficient of change of sales is zero under the assumption of perfect competition and constant return to scale, thus a positive sign on the change of sales variable implies the presence of imperfect competition in the output market (Bojnec and Ferto 2016).

Similarly, like Ferto et al. (2011), we extend the model specification to include investment subsidies (*IS*) related to capital stock as an additional explanatory variable in a separate model (Model 3 and Model 4 extended with LFA dummies).

$$\frac{GI_{i,t}}{K_{i,t-1}} = a_0 + a_1 \frac{\Delta S_{i,t}}{K_{i,t-1}} + a_2 \frac{CF_{i,t-1}}{K_{i,t-1}} + a_3 \frac{IS_{i,t-1}}{K_{i,t-1}} + b_t y_t + c_i f_{it} + u_{it} \quad (4)$$

$$\begin{aligned} \frac{GI_{i,t}}{K_{i,t-1}} = {} & a_0 + a_1 \frac{\Delta S_{i,t}}{K_{i,t-1}} + a_2 \frac{CF_{i,t-1}}{K_{i,t-1}} + a_3 \frac{IS_{i,t-1}}{K_{i,t-1}} + \\ & + d_1 LFAO_{i,t} \frac{\Delta S_{i,t}}{K_{i,t-1}} + d_2 LFAO_{i,t} \frac{CF_{i,t-1}}{K_{i,t-1}} + \\ & + d_3 LFAO_{i,t} \frac{IS_{i,t-1}}{K_{i,t-1}} + d_4 LFAM_{i,t} \frac{\Delta S_{i,t}}{K_{i,t-1}} + \\ & + d_5 LFAM_{i,t} \frac{CF_{i,t-1}}{K_{i,t-1}} + d_6 LFAM_{i,t} \frac{IS_{i,t-1}}{K_{i,t-1}} + \\ & + b_t y_t + c_i f_{it} + u_{it} \end{aligned} \quad (5)$$

Following Bakucs et al. (2009), farms with an investment to capital ratio above 99% were removed from the regression model. We employ panel models using the Hausman test to identify whether a random or a fixed-effect model is appropriate. Because our database is an unbalanced panel, we employ as a random effect model the Swamy-Arora estimator.

RESULTS AND DISCUSSION

Tangible fixed assets (TFA) increased during the reported period from EUR 1.76 million in 2003 to EUR 3.68 million in 2016. The average growth rate of TFA was 4% per year, according to the LFA classification, the TFA grew most rapidly in farms operating in LFA M (7.2% per year).

Structure of fixed assets. The share of TFA in total assets increased in all LFA categories, in LFA O by 3.8%, in NON LFA by 2.36% and in LFA M by 1.41%. However, the structure of TFA changed significantly during the period under review. The share of buildings in total assets dropped from 40% in 2003 to less than 31% in 2016. The share of buildings declines most quickly in NON LFA [–1 percent point (pp) per year], while in other areas the decrease is moderate (LFA M –0.5 pp per year, LFA O –0.26 pp per year). The share of machines and equipment in total assets slightly increased from 10% to almost 13%, values and their development are similar in particular areas. Significant changes can be observed in the increase in the share of land. Its share to total assets increased from 1.8% in 2003 to 15.5% in 2016. The most dynamic is the development of this share for the NON LFA farms, where in 2016 the share of land was 19.43%. Exponential functions best describe this dynamic trend (Figure 1). For comparison, CZSO (2016) stated that the percentage of leased agricultural land decreased significantly between 2000 and 2016 for both natural persons (by 21.9 pp) and legal entities (by 16.5 pp).

The share of land owned on the total utilised agricultural land is added into the graph. The farms in the Czech Republic were characterised by a high share of leased land (Lososova and Zdenek 2013) – in our sample 98.6% in 2003. The Farm Structure Survey (CZSO 2016) report states that the proportion of owned agricultural land is declining as the size of the farm increases (with farms over 500 ha of utilised agricultural area dominating our database). In the past, farmers were not willing to offer real market prices to owners. But the situation has changed considerably in recent years, and many prosperous farmers are now willing to pay the adequate price for the land (Severova et al. 2017). In addition, the price of land is also affected by the demand for long-term and speculative (short-term) non-agricultural investors. Speculative purchases of land in the V4 countries, where the price of the land is still noticeably lower than in old EU countries by foreign investors, are mentioned in Szabo et al. (2018). Moreover, the price of agricultural land rent also grew at a rapid pace and doubled from 2012 to 2016 (Lososova et al. 2017).

A closer look at the acquisition of agricultural land over the years is provided in Figure 2. It is clear that the proportion of farms that farm exclusively on leased land fell from 34% in 2003 to 3% in 2016. In 2003, the peak of the distribution (59.7%) was in the range of 0–5% of the owned land, while in 2016 the peak of the distribution (22%) is in the range of 15–20% of the owned land.

The development of agricultural land prices is modelled with the exponential trend also by Severova et al. (2017). They showed that the average market price has increased from EUR 2 066 per ha in 2004 to EUR 5 956 per ha in 2015. They predict that farmland prices should keep increasing significantly in the following years.

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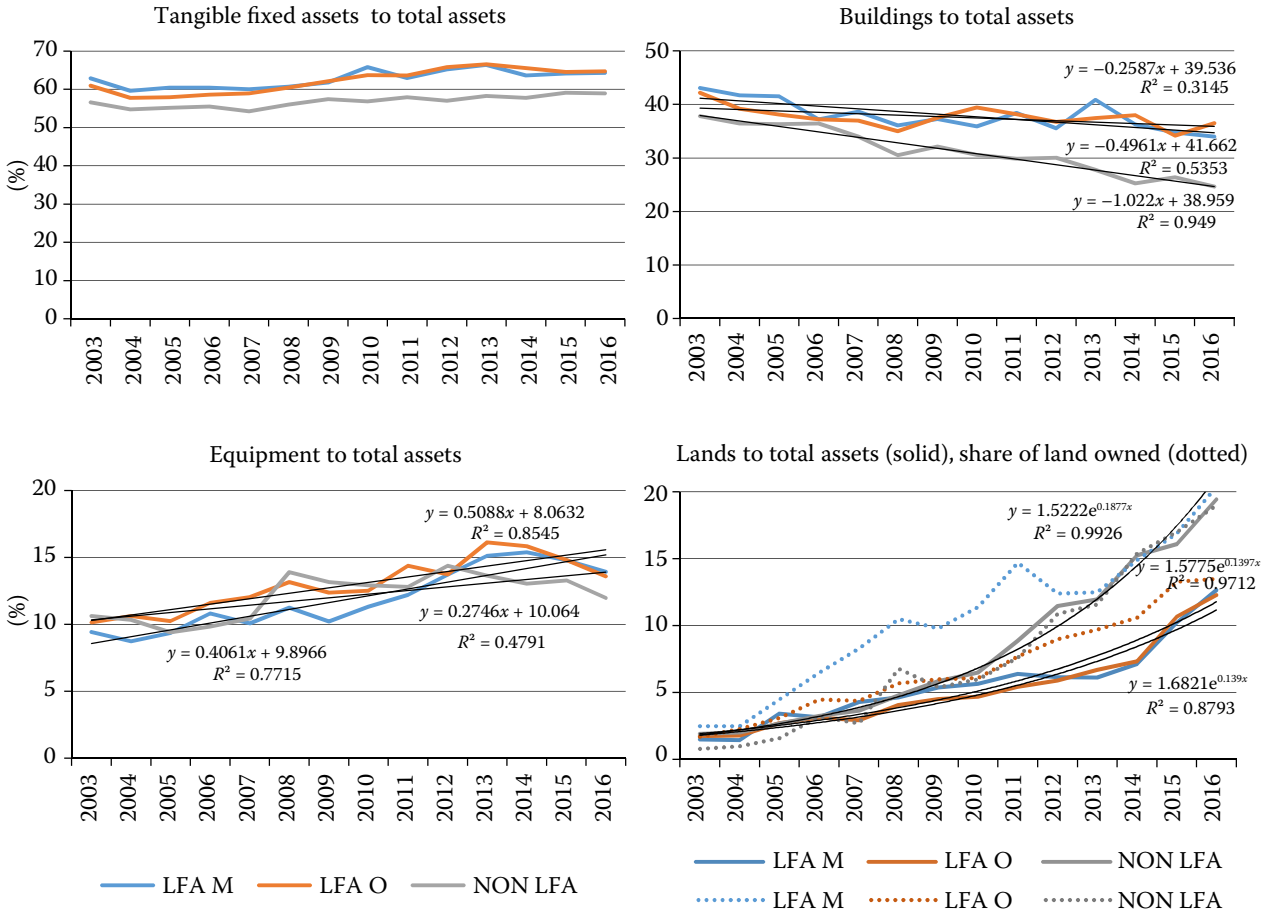

Figure 1. Share of components of tangible fixed assets on total assets

Source: Authors' calculations on farm database

The relation between the acreage of agricultural land and its value (recorded in the accounting – that is historical value) for each LFA category is shown in Figure 3. As a result of the growth of market prices of land, the progressive increase in the value of the land is the result.

The share of intangible fixed assets in assets is negligible (its share in any area in any year does not exceed 0.6%), therefore we do not refer to it in this paper. Similarly, we omit the evaluation of long-term financial assets, which accounted for 2.17% of assets on average.

Relative age of tangible fixed assets. The relative age of tangible fixed assets increased from 48.7% in 2003 to 53.1% in 2016. As the relative age of TFA increases, the volume of investment in tangible fixed assets is not sufficient to cover its depreciation. While in LFA O and NON LFA, the development of the relative age of TFA roughly corresponds to the overall average, in LFA M it is fairly stable (50.0% in 2003 and 50.4% in 2016).

A significant increase in relative age occurred in buildings, with relative age increasing from 34.3% to 45.4%. Both the values and the growth trend in LFA M and LFA O are very similar where relative age increased by a 0.5 pp per year. For enterprises located in NON LFA, the starting relative age is lower, but the growth rate is higher (1.4 pp per year) – the relative age of the buildings is 48.1% as a consequence. Mazouch and Krejci (2016) liken investments to demography – an occasional growth of investment represents a burden for the future. A short-run benefit in the form of big investments (for example as a result of an operational program) and therefore a drop in the average age is compensated in the long-run when the surviving part of the old investment pulls the average age up.

The relative age of the machines and equipment is relatively stable and is around 75%. A slight decrease in the age of the machines and equipment is evident only in LFA M (76.3–71.2%); in LFA O, the relative age of machines is relatively stable throughout the monitored period; in the NON LFA, the relative age increased from 73.9% (2003) to 78% (2016). So our results do not generally meet with the conclu-

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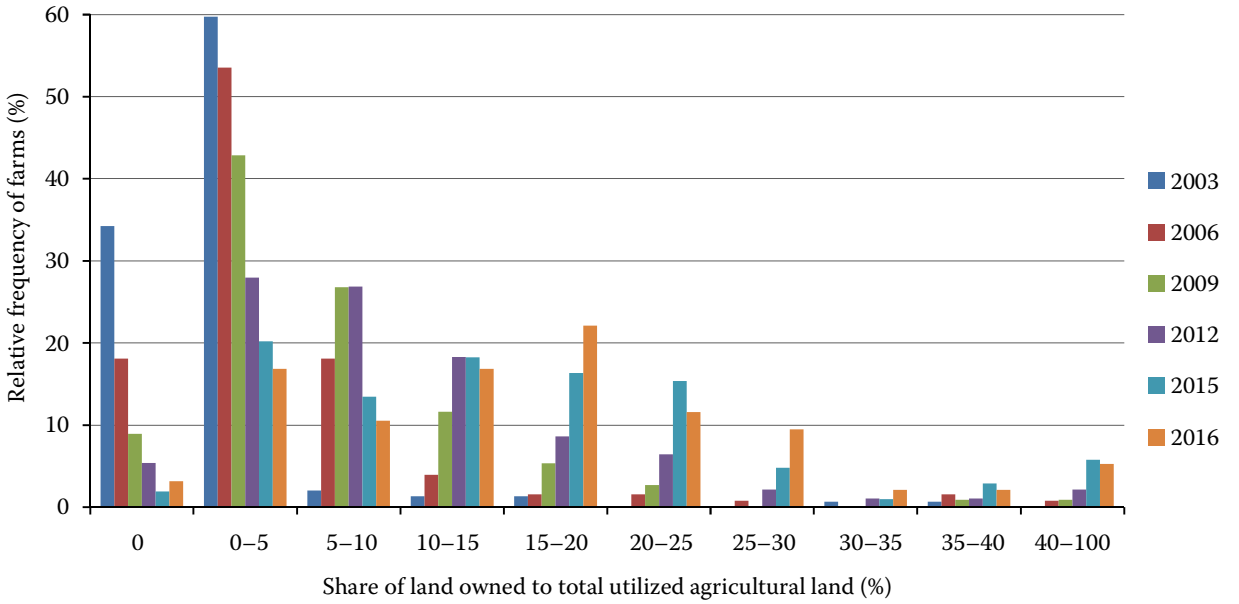

Figure 2. Distribution of farms according to the share of land owned

Source: Authors' calculations on farm database

sions of Krejci et al. (2015), whose presented results show the decreasing average age of machinery and equipment. But for machinery and equipment, it implies that a stable age in the industry means using adequate investment to avoid possible future problems (Mazouch and Krejci 2016).

Investments and accelerator model. The low efficiency of TFA generally requires the building of effective investments. The development of gross investments is characterised by sharp fluctuations (also mentioned by Krejci et al. 2015) in individual years with a slightly increasing tendency, which is 4% for the whole surveyed period. The increase according to the LFA classification is evident in LFA M (EUR 49 458 per year) and in LFA O (EUR 24 495 per year). A negative trend can be ob-

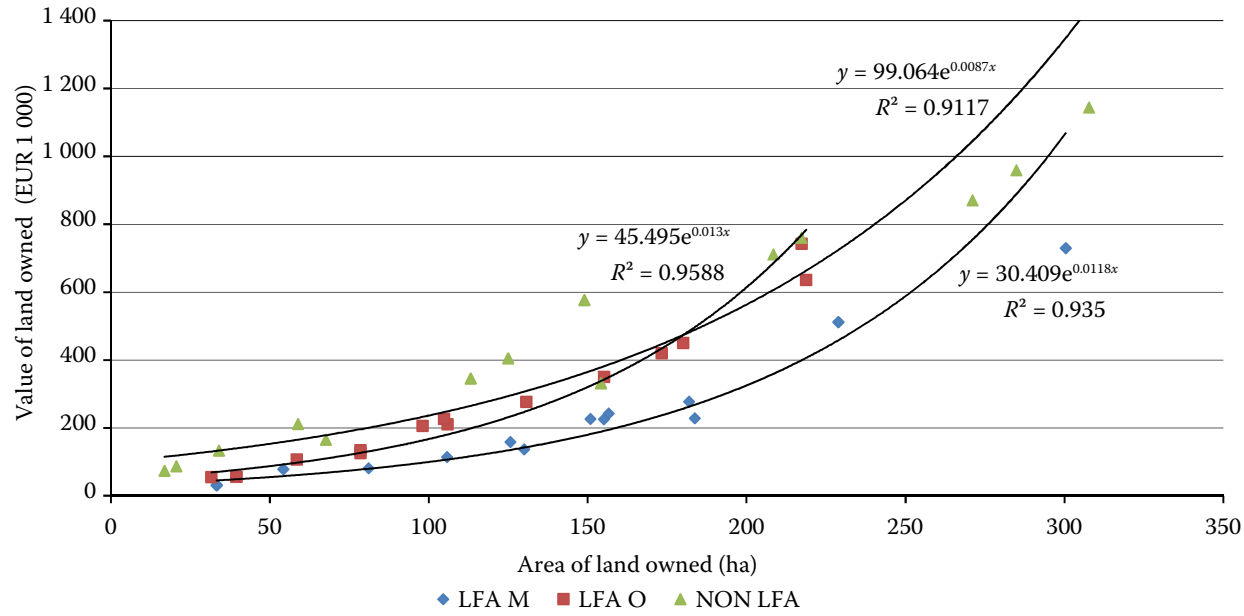

Figure 3. Relationship between area of land owned and its value

Source: Authors' calculations on farm database

https://doi.org/10.17221/212/2019-AGRICECON

served in NON LFA, where the average farm investment volume decreased by EUR 10 555 per year.

Investment subsidies for the acquisition of fixed assets are used by 16.2% of farms. In 2003, only 4% of farms benefited from this type of subsidy – it was support from so-called pre-accession programs. Over time, fluctuations occurred; in 2015, 63% of surveyed farms in the LFA M area were supported. Using a logistics model, Hlavsa et al. (2017) showed that locating a farm in LFA M increased the chances of receiving support from the Modernization measure. The volume of investment subsidies provided to agricultural holdings has increased since 2003 and peaked between 2009 and 2011; in recent years a decline in investment subsidies has occurred. The trend for the whole reporting period has NON LFA and LFA M moderately rising, only in LFA O does support decline slightly.

Subsidy on part of the loan interest (provided by The Supporting and Guarantee Agricultural and Forestry Fund) is used to a very large extent; in our sample, 72.5% of farms receive it (most often used in NON LFA (75.5%); on the other hand, it is used only by 68% of farms in LFA M).

Results of regression models are presented in Table 2. In all models, the dependent variable is gross investment to capital. Results of the Hausman tests allow using random effect models. The regression coefficients of change of sales in all models are insignificant from zero which do not deny the assumption of perfect competition or the constant return to scale. The standard augmented accelerator model confirms a positive relationship between cash flow variable and farm investment which imply an absence of soft budget constraint but the presence of capital market imperfections. This effect of the cash flow variable supports the hypothesis that the availability of internal financial funds has a significant positive impact on decisions of whether to invest. This result is comparable to an earlier studies focusing on investment activity of farms in Central and Eastern Europe, e.g. Zinych and Odening (2009) in Ukraine; Ferto et al. (2011) in Hungary, Slovenia and France; Bo-

Table 2. Results of regression models

Variable	Model 1	Model 2	Model 3	Model 4
Change of sales	–0.013 (0.020)	–0.009 (0.031)	–0.013 (0.020)	–0.010 (0.031)
Cash flow	0.435*** (0.037)	0.469*** (0.046)	0.432*** (0.037)	0.466*** (0.046)
Investment subsidies	–	–	0.703*** (0.164)	0.652*** (0.243)
LFA O # Change of sales	–	0.051 (0.048)	–	0.046 (0.048)
LFA O # Cash flow	–	0.055 (0.047)	–	0.070 (0.050)
LFA O # Investment subsidies	–	–	–	–0.169 (0.368)
LFA M # Change of sales	–	–0.027 (0.041)	–	–0.021 (0.041)
LFA M # Cash flow	–	–0.073 (0.048)	–	–0.085* (0.051)
LFA M # Investment subsidies	–	–	–	0.411 (0.404)
R^2	0.172	0.185	0.187	0.201
Hausman test (*P*-level)	0.109	0.503	0.246	0.505

***P-level < 1%; **P-level < 5%; *P-level < 10%; standard errors are reported in parentheses below the regression coefficients; intercept and coefficients of time dummies are not presented; number of observation in each model N = 1 004; LFA – Less Favoured Areas; M – mountain areas; O – other areas; NON LFA – more than 50% of the utilised agricultural area is out of LFA

Source: Authors' calculations on farm database

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jnec and Ferto (2016) in Slovenia. Farm investments are positively associated with investment subsidies. This means that investment subsidies are important for decisions on investments, similarly as in France, Hungary and Slovenia (Ferto et al. 2011).

The first coefficients in Models 2 and 4 relate to the NON LFA, while the remaining coefficients estimate the difference of the coefficients on each variable across different kinds of less favoured areas. In LFA O, their coefficients are positive but insignificant for the change of sales and cash flow; for the investment subsidies, the coefficient is negative but insignificant. In LFA M, the coefficients of change of sales and cash flow are negative; statistically significant is only the coefficient of investment subsidies in Model 4.

CONCLUSION

The development of tangible fixed assets and their structural development points to the efforts of farms to modernise machinery and upgrade technologies. Above all, there is an important trend in investing in their own land. Czech farms still utilise a high share of rented land compared to other EU countries. Land rent prices in the period 2012–2016 grew by 18% per year (Lososova et al. 2017). For these reasons, it is not surprising that farms invest in agricultural land and the share of land value to total assets has increased to 20% (in NON LFA). Purchases of land are likely to affect the growth of the relative age of tangible fixed assets, especially the obsolescence of buildings that are not sufficiently resourced by farms.

The low efficiency of fixed assets requires the building of effective investments. The volume of investment depends on available own sources of funding, access to bank loans and the volume of grants. Favourable development of agricultural profitability and declining interest rates on loans have had an impact on the growth of loans in agriculture, and long-term investment loans are growing faster (Lososova et al. 2017).

Estimated parameters of the accelerated model indicate that there is a lack of soft budget constraints but the presence of capital imperfections and the high importance of investment subsidies when deciding to invest in fixed assets. There are no significant differences in the sensitivity of investment to change in sales, cash flow and investment subsidies among different types of less favoured areas.

The high dependence of investment subsidies on cash flow confirms the results of earlier studies demonstrating the growing influence of operating subsidies on the revenues and profits of farms (Lososova and Zdenek 2013). As it turns out, investment activity is influenced significantly by the shift of operating subsidies into the cash flow. Thus, it can be stated that the incentive for the renewal of tangible fixed assets in agriculture is not only the possibility of drawing grants for investment projects but rather the overall economic situation of the company together with the operating subsidies and bank loan conditions.

Acknowledgement. The authors thank Justin Calvin Schaefer for English proofreading and two anonymous reviewers for helpful comments.

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Received: July 16, 2019
Accepted: October 2, 2019