The current issue and full text archive of this journal is available on Emerald Insight at:
https://www.emerald.com/insight/0972-7981.htm

Financial constraints and nonlinearity of farm size growth

Štefan Bojnec
Department of Economics, Faculty of Management Koper, University of Primorska, Koper, Slovenia, and
Imre Fertő
Lorand Eotvos Research Network, Centre for Economic and Regional Studies, Institute of Economics, Budapest, Hungary

Received 24 February 2023
Revised 27 April 2023
Accepted 14 May 2023

Abstract

Purpose – This article aims to investigate the financial constraints and nonlinearity of farm size growth.

Design/methodology/approach – Farm size growth is measured with land, labor and output using data from the Farm Accountancy Data Network (FADN) for Hungary and Slovenia. A dynamic panel model is applied to assess financial constraints and nonlinearity of farm size growth.

Findings – Results show that, except for land in Slovenia and output in Hungary, liquidity constraints are less important for farm size growth than endogenous factors based on farm size growth expectations and steady farm size restructuring. Smaller farms are growing faster than larger ones. The hypothesis that a higher level of subsidies would increase farm size is not supported for Hungary. When farms reach a certain size, the land area of the largest farms increases. Farm debts in Hungary are linked with land growth and in Slovenia with output growth.

Research limitations/implications – Further research on the impact of liquidity constraints and subsidies can be conducted at a disaggregate farm-type level to examine whether there is variability in the underlying interlinkages at the farm-type specialization level.

Practical implications – The implication that farm size growth is dependent on initial size and that smaller farms are growing faster than bigger ones indicates that it is not necessary to favor the fastest growing smaller farms thus supports the application of a non-discriminatory farm size policy for observing farm size structural changes.

Originality/value – The dynamic panel econometric model that incorporates cash flow as a measure of financial constraints provides insight into farm size growth in cross-country comparison in relation to potential farm liquidity constraints, farm debt and the nonlinearity of farm size, which information is of relevance to policy makers and practitioners.

Keywords Farm growth, Farm size, Nonlinearity of farm size, Liquidity constraints, Farm debt, Dynamic panel model, European union

Paper type Research paper

1. Introduction

There is a wealth of literature about the validity of Gibrat's (1931) law of proportional firm size growth – the proposition that the growth rate of firms/farms is independent of their initial

The authors are grateful to the two anonymous journal reviewers for all valuable comments and suggestions, which helped to improve the quality of the paper.

Funding: This work was supported: Professor Štefan Bojnec was supported by ARRS - Javna agencija za raziskovalno dejavnost Republike Slovenije = Slovenian Research Agency [grant numbers: N5-0094 and N5-0312]; Professor Imre Fertő was supported by NKFIH - Nemzeti Kutatási Fejlesztési és Innovációs Hivatal = National Research Development and Innovation Office [grant numbers: NKFI-1 128855 and NKFI-1 142441].

Journal of Advances in Management Research
Vol. 21 No. 1, 2024
pp. 153-172
Emerald Publishing Limited
0972-7981
DOI 10.1108/JAMR-02-2023-0053

size at the beginning of a period of examination. Empirical tests of this relationship have produced mixed results for different types of firms in the manufacturing and service sectors (Donati, 2016) and different typologies of farms in agriculture (Bojnec and Fertő, 2020, 2021b; Bojnec *et al.*, 2022). Farm size growth dynamics might lead to a change in farming structure if Gibrat's law does not hold, either due to the catching up of smaller farms that grow faster than larger farms, or because of greater farm size concentration (when larger farms grow faster than smaller ones). Potential violations of Gibrat's law might occur due to financing or liquidity constraints that are a consequence of restructuring in the banking sector and changes in lending behavior, particularly if small firms/farms are excluded from receiving loans (Oliveira and Fortunato, 2006; Fagiolo and Luzzi, 2006; Donati, 2016). Financial or liquidity constraints on small firm/farm growth may be due to a lack of affordable credit facilities at mainstream financial institutions that force the former to finance their growth from cash flow through retained earnings (Donati, 2016; Farooq *et al.*, 2021).

Farm growth requires investments which can be financed from the latter's own internal resources or from borrowed external capital leading to farm debts (Fertő *et al.*, 2020, 2021; Czubak *et al.*, 2021). If farms face liquidity constraints in terms of their growth, this implies that the latter can be financed solely from internal farm resources. However, financial constraints associated with limited or no access to external capital can slow down farm growth. Underdeveloped capital markets and asymmetric information might affect the choice of farms between the use of internal or external capital for promoting growth. Farms might also encounter specific challenges associated with economic risk and the structural characteristics of farm businesses (Mishra *et al.*, 2018; Saint-Cyr, 2022). For those farms that face constraints in their ability to raise funds externally, reapportioning cash flow can represent almost the only way to finance growth.

The literature on the relationship between financial constraints and investment is presently increasing (Fertő *et al.*, 2020, 2021). The gap in the literature is in another strand of research that focuses on the growth of farms (Akimowicz *et al.*, 2013; Bojnec and Fertő, 2020, 2021a, b). The in-depth analysis regarding understanding of the role of liquidity constraints, farm debts and nonlinearity in farm growth dynamics is basically non-existent. Therefore, the first contribution of the present paper is its investigation of the baseline relationship among financial constraints and farm growth for Hungarian and Slovenian farms between 2007 and 2015 using Farm Accountancy Data Network (FADN) datasets. The time-period is restricted with the comparable FADN data availability, while the two neighboring Central European countries – Hungary and Slovenia – were selected because of their different farm structures. They have been members of the European Union (EU) since 2004. Slovenia introduced Common Agricultural Policy (CAP) when it entered the EU, partly financed by the EU and partly by national funds, while Hungary introduced CAP gradually, financed from EU resources (Bojnec and Fertő, 2022). In addition, the farm structures in both countries are different. Slovenian agriculture is based on small-scale family farms and Hungarian agriculture on a dual farm structure with numerous small-scale family farms and a smaller number of large-size privatized commercial agricultural enterprises and key private holdings (Eurostat, 2020a, b, c). The second contribution is the applied augmented dynamic panel model controlled with a farm debt that impacts can be ambiguous depending on a farm growth cycle: debts can be a source for farm size growth, but they can constraint farm size growth. The third contribution is the augmented model with specified a squared farm size variable to control for potential nonlinearity of farm size growth. The fourth contribution is answer on the research question, which applies a cross-country comparative perspective, whether liquidity constraints, farm debts, farm size structure and its possible nonlinearity, additionally controlled with CAP subsidies, endogenous factors based on farm size growth expectations and steady farm size restructuring cause farm size growth. Farm size growth is defined as the natural logarithmic difference between the size of land, labor, or output variables in two consecutive years (Oliveira and Fortunato, 2008). Finally, the focus on the impact of liquidity constraints, farm debts and nonlinearity of farm size on farm growth using panel data analysis helps suggest managerial and policy implications for these neighboring countries.

The rest of the article is organized as follows. Section 2 presents an overview of the literature on farm size growth and liquidity constraints. Section 3 presents the data sample and dynamic farm growth model that was employed. Section 4 presents descriptive statistics and the results of econometric modeling. Section 5 discusses results and implications – including in terms of their broader importance and relevance to other areas – for the emerging markets literature and policy and practice on the relationship between farm size growth, liquidity constraints and nonlinearity in farm size growth. The final section, Section 6, summarizes the main findings and concludes.

2. Review of literature

Testing Gibrat's law has a long tradition, with mixed empirical results depending on the country, branch of farming/industry/sector, time/length of analysis, data and methodological approach, as well as the selection of control variables or other drivers of firm/farm growth (Bakucs *et al.*, 2013; Akimowicz *et al.*, 2013; Bojnec and Fertő, 2020, 2021a, b; Bojnec *et al.*, 2022). If Gibrat's law holds, stochastic models of firm/farm growth should prevail and assuming a proportionate effect, exogenous random changes will drive firm/farm growth (Geroski, 2005; Ward and McKillop, 2005).

A less investigated issue is the relationship between firm/farm size growth and liquidity constraints in relation to the difference between the cost of external and internal financing that pertains to constraints and asymmetric information in financial markets – with higher transaction costs for external capital being one reason for reapportioning internal cash flow from retained earnings to finance firm/farm growth (Donati, 2016). Fazzari *et al.* (1988) outlined a liquidity constraint hypothesis that applies to internal resources (measured in cash flow) that can affect firm/farm investment decisions and thus firm/farm growth. Different capital market structures can also affect farm investment and farm growth (Benjamin and Phimister, 2002). Small firms/farms can be among those which face financial constraints on their growth (Beck and Demirguc-Kunt, 2006; Kerstern *et al.*, 2017; Guiomar *et al.*, 2018). Donati (2016) investigated the effect of liquidity constraints on firm growth for the Italian manufacturing and service sector separately.

Farm debts can be an additional driving force that limits access to finance and affects farm growth. Farm size and the size distribution of farms are heterogeneous between countries and between branches of farming within countries (Adamopoulos and Restuccia, 2014; Lowder *et al.*, 2016; Weersink, 2018). This has implications for farm restructuring and nonlinearity in farm size distribution can affect farm growth.

Several studies have analyzed the validity of Gibrat's law for farm size growth in developed (Akimowicz *et al.*, 2013), transition (Bojnec and Fertő, 2020, 2021a, b; Bojnec *et al.*, 2022) and both developed and transition economies (Bakucs *et al.*, 2013). However, no study has thus far investigated farm size growth focusing in relation to liquidity constraints, farm debts and nonlinearity of farm size. For non-agricultural businesses, Donati (2016) found heterogeneity in the impact of financial liquidity constraints on Italian firm growth in the service sectors: specifically, that small firm growth was sensitive to cash flow.

Earlier agricultural economics and finance-related work investigated nonlinear associations between agricultural productivity, access to credit from formal and informal sources and farm size (Feder, 1985; Akudugu, 2016), as well as the effect of input credit on smallholder farmers' output and income. Farm size and its growth can be driven or mitigated by various factors related to farms (Bakucs *et al.*, 2013; Akimowicz *et al.*, 2013; Bojnec and Fertő, 2020, 2021a, b), resilience in food processing supply chain networks and food supply value chain characteristics (Jose and Shanmugam, 2020; Sharma *et al.*, 2020; Prakash, 2022).

Farm size growth can require investment that is related to farm financial leverage and has implications for farm production performance. In relation to this process, EU country subsidies from CAP Pillar I and II payments can play an important role (Mamatzakis and Staikouras, 2020; Czubak *et al.*, 2021). Subsidies can contribute to firm/farm size growth, but there can be trade-offs with a potentially negative impact on efficiency and long-term growth (Bernini and Pellegrini, 2011; Bojnec and Latruffe, 2013; Cerqua and Pellegrini, 2014; Baráth *et al.*, 2020).

The focus of this study is the role of liquidity constraints, farm debts and nonlinearity of farm size on the growth dynamics of Hungarian and Slovenian farms. The role of liquidity constraints is investigated by examining cash flow sensitivity. This metric captures a firm's propensity to put aside money from its cash flow (Almeida *et al.*, 2004; Donati, 2016; Fertő *et al.*, 2020, 2021). This baseline liquidity constraint model is extended to an augmented model to analyze the impact of the debt variable on farm growth. Finally, a squared size variable is specified in the augmented model to investigate the potential effect of the nonlinearity of farm size on farm growth.

3. Data and methodology

The empirical analysis and comparison of farm growth and liquidity constraints, farm debts, nonlinearity of farm size and controlled with additional explanatory variables is based on farm-level data from Hungarian and Slovenian FADN datasets. The timespan of the unbalanced panel dataset used in the analysis is the period 2007–2015 for both countries.

There is no single measure of farm size in agriculture and research findings differ according to the proxy that is used. This proxy mainly depends on farm production specialization and technology. We apply both farm size measures: input farm size and output farm size.

The assessment of farm size using output value measures is subject to inflation and changes in relative prices. FADN data provides at least two possible measures of economic size of farm. First, FADN code SE005 is economic size of a holding expressed in 1,000 euro of standard output per a farm on the basis of the Community typology. Second, FADN code SE131 is total value of output of crops and crop products, livestock and livestock products and of other output, including that of other gainful activities of the farms. It captures sales and use of (crop and livestock) products and livestock and change in stocks of products (crop and livestock) and change in valuation of livestock, but excludes purchases of livestock and various non-exceptional products. FADN code SE131 was used as the output value measure for the economic size of farm, which was deflated to euros at constant prices using the statistical indices of agricultural output prices.

Physical input farm size measures are often characterized by nonlinear production technology and are affected by changes in the mix and proportion of inputs. Although statistics about input farm size generally refer to land in terms of utilized agricultural area (UAA in hectares) per farm, this indicator is often irrelevant for livestock farms. For this reason, in this paper farm input size is also captured as the amount of labor that a farm uses: i.e. the number of full-time equivalent workers employed per year on a farm (in Annual Working Units or AWUs; 1 AWU represents 1800 h per year), including both family and hired workers for both Hungarian and Slovenian farms.

Thus, two input farm size variables (hectares of UAA per farm – the FADN variable coded SE025 and number of AWU per farm – the FADN variable coded SE010) and one output – the FADN variable coded SE131, are used.

The cash flow variable is the FADN variable coded SE526 ("cash flow"), defined as the difference between farm receipts and expenditure for the accounting year, not taking into account operations related to capital, debts and loans. The debt variable is the FADN variable coded SE485 (total liabilities). The subsidy variable is the FADN variable coded SE605, defined as the total CAP subsidies for current operations linked to production but excluding investments. Cash flow, debt and subsidy variables were deflated to euros at constant prices using the statistical indices of harmonized consumer prices obtained from the Hungarian and Slovenian statistical offices.

Because our dependent farm size growth variables are in percentages, we normalize cash flow, debt- and subsidy variables by total assets (FADN code is SE436).

The FADN variable coded TF8 group includes the following eight types of farms: (1) field crops, (2) horticulture, (3) wine, (4) other permanent crops, (5) milk (or dairy), (6) other grazing livestock, (7) granivores and (8) mixed (EC, 2018). This sectoral variable reflects differences or heterogeneity in farm types.

FADN data for the unbalanced panel for the period 2007–2015 are derived for Hungary from around 17,500 observations, or around 1,950 farms per year, while for Slovenia from around 8,200 observations, or on average around 900 farms per year. If we had used a balanced panel, we would have lost 32% of the farms in the sample from Hungary and 80% of farms in Slovenia. For this reason, we decided not to use balanced panel data.

To investigate the effect of liquidity constraints on farm growth, controlled with specified explanatory variables, we estimate the following baseline model:

$$\text{growth}_{i,t} = \alpha_i + \beta_1 \ln S_{i,t-1} + \beta_2 \text{growth}_{i,t-1} + \beta_3 \text{CF}_{i,t-1}/\text{total assets}_{i,t-1} + \beta_4 \text{subsidy}_{i,t-1}/\text{total asset}_{i,t-1} + \eta \text{industry}_{it} + \delta \text{year}_t + \varepsilon_{i,t} \quad (1)$$

where $\text{growth}_{i,t}$ is the dependent farm size growth variable measured by input or output size variables calculated as the natural logarithmic difference between the size measures in two consecutive years and refers to farm *i* and time *t* (Oliveira and Fortunato, 2008).

$S_{i,t-1}$ is the size of firm/farm *i* at time $t-1$ calculated as the natural logarithm of land, labor, or output variables. If $\beta_1 = 1$ (i.e. if Gibrat's law holds), the probability distribution of growth is the same across sizes of farms, because the growth rate is independent of farm size. If, however, $\beta_1 < 1$, smaller firms/farms tend to grow faster than larger ones and vice versa: if $\beta_1 > 1$, larger firms/farms tend to grow faster than smaller ones.

$\text{CF}_{i,t-1}/\text{total assets}_{i,t-1}$ is the cash flow variable at time $t-1$, which is not in natural logarithm form due to some negative values. The sign of the regression coefficient of the cash flow term β_3 should be negative or not significant under the assumption that a farm can raise as much money as it desires at a given cost. A positive and significant cash-flow regression coefficient is usually interpreted as a sign of credit rationing and thus an indicator of financial constraints (Fazzari *et al.*, 1988).

To control for possible time shock, we add year dummies. To test for sectoral heterogeneity, we use sector/types of farms (industry_{it}) dummies.

CAP subsidies from Pillar I and II payments as additional sources of cash flow can help to mitigate financial constraints. The variable CAP $\text{subsidy}_{i,t-1}/\text{total asset}_{i,t-1}$ is considered at time t–1. CAP subsidies are excluded from CF. We test separate effects of these two variables, because the former is related to government policy, while the latter captures market-driven cash flow (Bojnec and Fertő, 2019a, b). CAP subsidies include Pillar I (direct payments) and Pillar II (rural development, agri-environmental, less favored areas and other rural development payments, including investment subsidies) payments to farms.

To analyze the impact of financial situation on farm growth we extend our baseline model with a $\text{debt}_{i,t-1}/\text{total assets}_{i,t-1}$ variable:

$$\text{growth}_{i,t} = \alpha_i + \beta_1 \ln S_{i,t-1} + \beta_2 \text{growth}_{i,t-1} + \beta_3 \text{CF}_{i,t-1}/\text{total assets}_{i,t-1} + \beta_4 \text{debt}_{i,t-1}/\text{total asset}_{i,t-1} + \beta_5 \text{subsidy}_{i,t-1}/\text{total assets}_{i,t-1} + \eta \text{industry}_{it} + \delta \text{year}_t + \varepsilon_{i,t} \quad (2)$$

Finally, to check for potential nonlinearity of farm size, we add a squared farm size variable to the augmented model:

$$\text{growth}_{i,t} = \alpha_i + \beta_1 \ln S_{i,t-1} + \beta_2 \text{growth}_{i,t-1} + \beta_3 \text{growth}^2_{i,t-1} + \beta_4 \text{CF}_{i,t-1}\Big/\text{total asset}_{i,t-1} + \beta_5 \text{debt}_{i,t-1}\Big/\text{total assets}_{i,t-1} + \beta_6 \text{subsidy}_{i,t-1}\Big/\text{total assets}_{i,t-1} + \eta \text{industry}_{it} + \delta \text{year}_t + \varepsilon_{i,t} \quad (3)$$

We employ the Generalized Method of Moments (*GMM*) estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998), also referred to as the *GMM-system estimator*. Windmeijer (2005) proposes a finite sample correction that provides more accurate estimates of the variance of the two-step GMM estimator (*GMM-SYS*). As the *t*-tests based on these corrected standard errors have been found to be more reliable, the regression coefficients are estimated using a finite sample correction. The lagged dependent variable is instrumented with its t–2 and the subsidy variable is also treated as endogenous using t–3 lag levels as instruments.

4. Results

Results are presented in four steps: first, we present descriptive statistics in the form of the mean values of the variables specified in our econometric model during the period of analysis. Second, we graphically present the distribution of farm size over the period of analysis. Third, we present farm size concentration between the first and last analyzed year using the Gini coefficient of concentration or the Gini index. Finally, we present our regression results for the baseline model specification and the augmented models for farm debt and squared farm size variables, respectively.

4.1 Descriptive statistics

Table 1 suggests that farm size growth in Hungary is independent of the measure of farm size, but the speed of farm size growth depends on the measure used for farm size: it is slowest for land size growth (0.1%), followed by labor size growth (0.7%) and it is fastest for output size growth (1.6%). This implies partial growth of land and labor productivity. In contrast, farm size growth in Slovenia depends on the measure of farm size that is employed: for the years under analysis, it increased by 1% for land size and by 1.5% for output size, but declined by 2% for labor size. These results imply an increase in land productivity and particularly in labor productivity, as more output has been produced with less labor. As can be seen from the standard deviations and the minimum and maximum values of the analyzed variables, the intervals for farm size adjustments in Hungary are larger than those in Slovenia, which may be explained by the bigger average farm size structure of the former country. This is further confirmed by the mean values for one-year lagged land, labor and output variables, as well as by their absolute standard deviations and minimum and particularly maximum values.

	N	Mean	Std. Dev	Minimum	Maximum
Hungary					
land growth	13,884	0.001	0.199	−5.23	3.18
labor growth	14,608	0.007	0.353	−4.59	4.18
output growth	14,531	0.016	0.561	−4.89	8.84
$land_{t-1}$	14,608	200.9	514.4	0.0	9650.7
$labor_{t-1}$	14,608	5.5	16.9	0.01	433.8
$output_{t-1}$	14,608	292,673	1,094,721	−287,885	3.21e+07
CF_{t-1}/total $asset_{t-1}$	14,608	0.158	0.212	−9.109	3.696
$Debt_{t-1}$/total $asset_{t-1}$	14,608	0.203	0.281	0.000	12.062
total $subsidy_{t-1}$/total $asset_{t-1}$	14,608	0.107	0.095	0.000	3.129
Slovenia					
land growth	5,683	0.010	0.010	−1.90	1.49
labor growth	5,685	−0.020	0.266	−3.80	2.70
output growth	5,668	0.015	0.424	−3.57	6.65
$land_{t-1}$	5,692	19.5	19.9	0.0	241.3
$labor_{t-1}$	5,692	2.0	1.6	0.09	46.1
$output_{t-1}$	5,692	45,710	60,385	−57,219	949,568
CF_{t-1}/total $asset_{t-1}$	5,692	0.075	0.091	−0.762	1.936
$Debt_{t-1}$/total $asset_{t-1}$	5,692	0.021	0.060	0.000	0.851
Total $subsidy_{t-1}$/total $asset_{t-1}$	5,692	0.050	0.065	0.000	2.129

Note(s): The number of observations (Ns) for the growth variables differs due to the following two reasons: farms without land when the land value is equal to zero and some farms experienced negative output values. In both cases, when the growth variable was defined as the natural logarithmic difference between the size measure in two consecutive years, these observations dropped out of the sample
Source(s): Authors' estimations based on Hungarian and Slovenian FADN data

Table 1.
Descriptive statistics

Farms in Hungary on average received almost two times as much in subsidies per total assets as those in Slovenia. The difference is also for the largest farms. Cash flow per total assets on Hungarian farms is also more than two times as great as that for farms in Slovenia. The differences in the corresponding values for standard deviation and maximum values are of a similar magnitude, while for the minimum value are of an even greater magnitude. Debt per total assets on Hungarian farms is almost ten times as great as that for farms in Slovenia. This is strongly due to the situation of the largest farms, where the difference in the corresponding maximum values is of an even greater magnitude.

4.2 Farm size structures

The number of farms has declined in both Hungary and Slovenia. According to Farm Structure Surveys, between 2013 and 2016 in Hungary the number of farm households declined from 486,741 to 429,990 or by −11.7% due to the concentration of farm households, while in Slovenia the number declined from 72,337 to 69,902, or by −3% (Eurostat, 2020a, b, c). At the same time, the average farm size in terms of UAA per farm household increased from 9.43 ha to 10.86 ha in Hungary and from 6.71 ha to 6.99 ha in Slovenia. At first glance it may appear that both countries predominantly have small-scale farms. However, unlike in Slovenia, where in addition to relatively small average farm size there is also greater equality of farm size distribution, in Hungary there is greater inequality in farm size distribution. For the latter, the smaller number of agricultural enterprises and key private holdings manage and operate a great majority of agricultural factor endowments and farm resources, as well as produce the majority of agricultural products – particularly crops which require more capital-and land-intensive technologies – vis-à-vis the relatively larger number of small private holdings.

The average farm size measure slightly declined for our FADN data samples in terms of land and labor inputs per farm, contradicting our theoretical expectation and statistical facts about total farm household population. Typically, a declining number of farms corresponds to an increase in farm size (Plogmann *et al.*, 2022). Farm size distribution for our FADN data samples suggests a very small increase in concentration in all size measures. Unlike Farm Structure Surveys, which are based on the population of farm households, FADN data are based on a sample of farms (EC, 2018). For Slovenia, where family farms prevail in the farming structure, in the FADN sample more viable farms are included, which are thus relatively larger than the average farm size in the country. A similar situation occurs with both Hungarian medium- and large-scale agricultural enterprises and key private holdings on the one hand and smaller family farms on the other. In a dual farm structure such as exists in Hungary, a crucial role is played by a smaller number of larger commercial, privatized agricultural enterprises and key private holdings. Consequently, for both countries farms in the FADN sample on average are larger and more likely to be viable than the national average of the total farm household population.

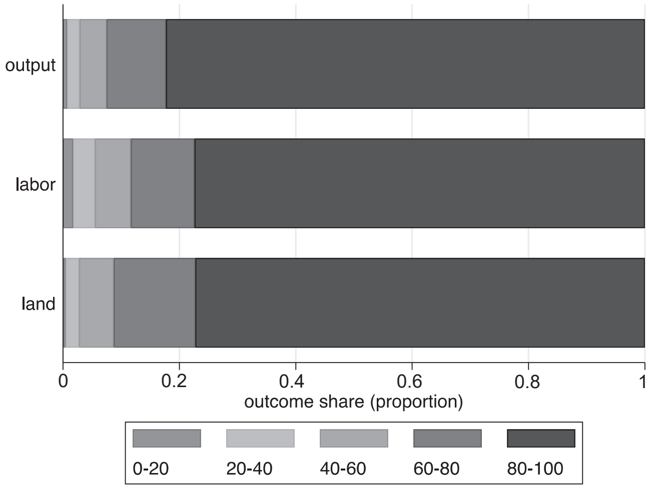
Due to the substantially smaller initial farm size in Slovenia vis-à-vis Hungary, the rates of growth/decline for land, labor and output in Slovenia do not suggest either considerable convergence or divergence towards the bigger farm size distribution that is characteristic of Hungary. The rather stable pattern of the development of farm size during the period of analysis suggests that it is more likely that farm size structures in Hungary and Slovenia will also be different in the future.

Different farm size distribution between Hungary and Slovenia in our FADN samples is also confirmed by Figures 1 and 2. The structures of land in UAA per farm, labor in AWU per farm and output in euro at constant prices per farm in Hungary are much more unequally distributed than in Slovenia: 20% of the largest farms in Hungary operated on more than three-quarters of UAA, employed a slightly higher share of AWU on farms (close to 80%) and produced more than 80% of output on farms. Comparatively, in Slovenia the shares for the 20% of the largest farms are much smaller: the latter operated on more than 50% of UAA, employed less than 40% of AWU on farms and produced slightly less than 60% of output. Consequently, all other smaller sized farms in Slovenia are relatively more important in terms of UAA, AWU and output structures than those in Hungary (Bojnec and Fertő, 2021b).

Considerable differences between the countries' farm structures are observed according to the TF8 typology of farms. As clearly illustrated in Figure 3, in Hungary field crops are the most important ones (51.1%), followed by mixed (12.8%) and granivore farms (10.5%). The share of the remaining types of farms varies between 3.5% for wine and 7.8% for permanent crops. In Slovenia, other grazing livestock farms are the most important (43.5%), followed by mixed (24.6%) and field crops (12.7%). The share of the remaining types of farms varies between 1.6% for horticulture and 7.1% for other permanent crops. These empirical facts reflect the greater role of large-scale crop farms in Hungary and smaller livestock and mixed farms in Slovenia.

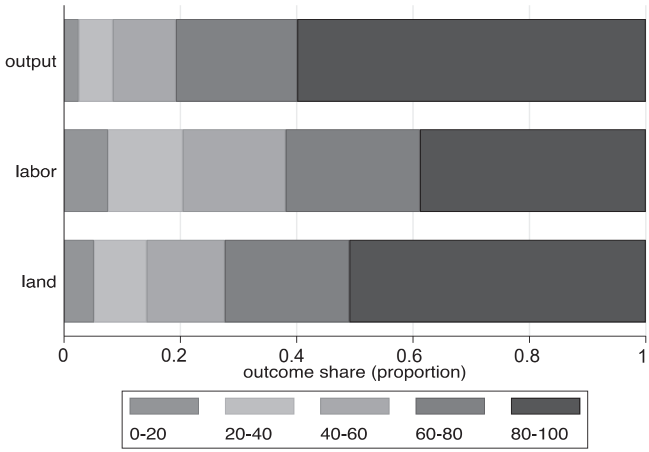
4.3 Farm size concentration over time

The Gini coefficient of concentration (Gini index) was used to represent the frequency distribution of farm size inequality in Hungary and Slovenia. A Gini coefficient of zero expresses perfect equality, or no farm size concentration, with farm size values being the same. A Gini coefficient of one expresses maximal inequality among farm size values (i.e. if only one farm size group is responsible for all the farm inputs or farm outputs – all other farm sizes are responsible for none –, the Gini coefficient will be very nearly one).



Source(s): Authors' estimations based on Hungarian FADN data

Figure 1.
Distribution of farm size measures in Hungary, 2007–2015

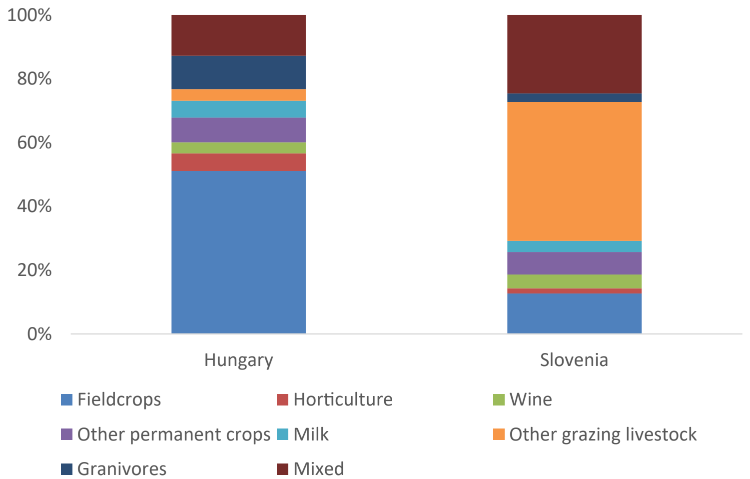


Source(s): Authors' estimations based on Slovenian FADN data

Figure 2.
Distribution of farm size measures in Slovenia, 2007–2015

Land in UAA in ha per farm in Hungary is more concentrated among bigger farms than in Slovenia, where farms on average are much smaller (Table 2). Land farm size structures have been rather stable over time. Between 2007 and 2015, there was slight de-concentration in Hungary and slight concentration in Slovenia.

Rather stable developments in the evolution of the Gini coefficient of concentration can also be seen for labor in terms of AWU farm size. Again, there is a gap in labor in terms of AWU farm size between Hungary and Slovenia, with labor associated with AWU farm size being more concentrated in the former than in the latter.



Source(s): Authors' estimations based on Hungarian and Slovenian FADN data

Figure 3.
Distribution of types of farms in Hungary and in Slovenia, 2007–2015

Table 2.
Gini indices of farm size in Hungary and Slovenia in 2007 and 2015

	Hungary		Slovenia	
	2007	2015	2007	2015
Land	0.74	0.72	0.27	0.32
Labor	0.74	0.74	0.43	0.40
Output	0.77	0.80	0.54	0.54

Source(s): Authors' estimations based on Hungarian and Slovenian FADN data

Farm size concentration is greatest in the case of output in both countries. Output farm size concentration slowly increased in Hungary, while the concentration of output remained at the same level in Slovenia.

To sum up, farm size in Hungary is more concentrated than in Slovenia. Hungarian farm size structure has stabilized for all three farm size measures without substantial structural change during the period of analysis. While land farm size changes may be related to changes in government policy, farm size output may also be affected by high price instability (see, for example, Hassouneh *et al.*, 2015).

4.4 Econometric results

We present econometric results in three steps: first, for the baseline model specification; second, for the augmented model with extended baseline model for the debt-to-assets variable and finally, a robustness check for farm size nonlinearity with the specified farm size square variable.

4.4.1 Baseline models. A variance inflation factor (VIF) tests a slightly higher than 1 suggest that multiple independent variables are moderately correlated in the baseline regression models for Hungary and for Slovenia. According to the p-value of Wald test ≤ 0.01 the selected set of predictor variables is significant at 1% level (Table 3). The quality of the model's fit is also checked with Hansen's J-statistic specification tests and Arellano–Bond test

Variable	Land	Labor	Output
Hungary			
$growth_{t-1}$	−0.036***	0.085***	0.698***
$size_{t-1}$	−0.950***	−1.385***	−2.429***
CF_{t-1}/total $asset_{t-1}$	−0.028**	−0.011	0.153**
total $subsidy_{t-1}$/total $asset_{t-1}$	−0.028	0.050	−0.155
Constant	4.086***	1.175***	26.025***
N	11,424	11,977	11,888
year-fixed effects	yes	yes	yes
sector-fixed effects	yes	yes	yes
AB1	0.001	0.001	0.0018
AB2	0.263	0.252	0.7526
Hansen test	0.437	0.128	0.8068
number of instruments	100	100	37
Wald tests (*p*-value)	0.000	0.000	0.000
VIF test	1.35	1.30	1.32
Slovenia			
$growth_{t-1}$	0.039**	−0.125	0.132***
$size_{t-1}$	−1.143***	−1.110***	−1.650***
CF_{t-1}/total $asset_{t-1}$	0.007	−0.127***	−0.035
total $subsidy_{t-1}$/total $asset_{t-1}$	0.016***	0.141***	−0.077
Constant	3.227***	0.663**	17.084***
N	3,867	3,868	3,854
year-fixed effects	yes	yes	yes
sector-fixed effects	yes	yes	yes
AB1	0.324	0.064	0.111
AB2	0.209	0.172	0.835
Hansen test	0.683	0.723	0.278
number of instruments	100	67	100
Wald tests (*p*-value)	0.000	0.000	0.000
VIF test	1.71	1.70	1.75

Note(s): * significant at 10%; ** significant at 5%; *** significant at 1%

Table 3. Baseline model results of farm size growth for Hungary and Slovenia

for first-order (AB1) and second-order (AB2) autocorrelation. The Hansen test results (>0.05) for all baseline regression models do not reject the null hypothesis that the instruments are valid for all the specifications used. The Arellano–Bond test results for autocorrelation reject the null hypothesis of the absence of first order (AB1) autocorrelation (<0.00) for Hungary, but not for Slovenia. However, they do not reject the null hypothesis of the absence of secondorder (AB2) autocorrelation (>0.05) for baseline regression models for Hungary and for Slovenia. In short, the regression tests for baseline regression models indicate acceptable specification quality.

The regression results of the baseline model show that lag farm size measures ($S_{i,t-1}$) are negatively associated with farm size growth. This finding suggests the rejection of Gibrat's law and reinforces earlier findings, particularly for Hungary and to a lesser extent for Slovenia, that smaller farms have grown faster than bigger ones.

Farm size growth in the year of analysis is affected by farm size growth in the previous year. Except for land farm size growth in Hungary, which association is significant and negative (the regression coefficient is −0.036 or −3.6%) and labor size growth in Slovenia, which association is insignificant, all other regression coefficients are significant and positive. In the case of Hungary, positive farm size growth is more typical in relation to farm size output growth (0.698 or 69.8%) than for farm size labor growth (0.085 or 8.5%), while in the case of Slovenia farm size output growth (0.132 or 13.2%) is more likely than land farm size growth (0.039 or 3.9%). Land farm size growth in Slovenia is positive at a 5% significance level. The magnitude of the regression coefficients for farm size growth variables for Hungary and Slovenia confirm that farm size growth was driven by endogenous factors based on farm size growth expectations and steady farm size restructuring.

Interestingly, the cash flow to total assets variable was found to be negative or insignificant for Hungary for land and labor farm size measures and for Slovenia for all farm size measures. These results suggest that Hungarian farms, in relation to land and labor farm size growth, do not face liquidity constraints – a finding that is also valid for Slovenian farm size growth in terms of land and labor inputs and output growth. On the other hand, some liquidity constraints for Hungarian farms are identified in the case of output growth, which may be related to some bottlenecks and imperfections in farm output markets.

Surprisingly, subsidies to total assets do not have significant effect on land, labor and output size growth for Hungarian farms, nor have a significant effect on Slovenian output farm size growth. However, they do have a significant and positive effect on land and labor inputs farm size growth for Slovenian farms.

4.4.2 Augmented models with a debt variable. In the augmented models, our special focus is on the debt-to-assets variable. The regression tests for the augmented models with the debt-to-assets variable indicate good specification quality. The regression coefficient for the debt-to-assets variable is significant and positive for output farm size growth in Slovenia and (to a lesser extent, at a 10% significance level) for land farm size growth in Hungary (Table 4). While in Hungary indebted farms are likely to invest in land farm size expansion, in Slovenia more indebted farms increase output.

Other regression results reinforce the findings of the baseline model. Farm size growth in Hungary and Slovenia is explicitly driven by endogenous factors; a process that is based on farm size growth expectations, with the exception of significant and negative land farm size growth in Hungary and insignificant labor farm size growth in Slovenia and farm size restructuring. We thus reject the validity of Gibrat's law for farm size proportional growth, as significant and negative farm size regression coefficients in the one-year lagged variable, $S_{i,t-1}$, suggest unequal farm size growth with the faster growth of smaller rather than larger farms during the eight-year period of analysis.

Except for the significant and positive regression coefficient for land farm size growth in Slovenia, all other regression coefficients pertaining to cash flow to total assets are negative or insignificant, suggesting that Hungarian and Slovenian farms do not face liquidity constraints on farm size growth. Liquidity constraints on land farm size growth in Slovenia suggest possible imperfections in land markets as well as in the financial system.

The effect of land and labor inputs on farm size growth in Slovenian farms was driven by subsidies to total assets, which have a significant and negative impact on the farm size output growth. Subsidies to total assets were not important for farm size growth in Hungary, irrespective of farm size measures.

4.4.3 Augmented models with estimations of nonlinearity of farm size. The nonlinearity of farm size is specified with a squared farm size variable in the augmented model (Table 5). In general, the regression tests for the augmented models with estimations of the nonlinearity of farm size indicate acceptable specification quality, except for the VIF test for output farm size augmented regression models for Hungary and for Slovenia that indicates significant multicollinearity.

The regression coefficients pertaining to the squared farm size confirm that after farms reach a certain size, farm size growth in Hungary in terms of land and output strengthens, but not labor. In Slovenia, the land area of the largest farms increases and vice versa for labor, while insignificant effects are found for output.

Variable	Land	Labor	Output
Hungary			
$growth_{t-1}$	−0.027**	0.130***	0.229***
$size_{t-1}$	−0.963***	−1.488***	−1.708***
CF_{t-1}/total $asset_{t-1}$	−0.025***	−0.032	0.033
$Debt_{t-1}$/total $asset_{t-1}$	0.029*	0.022	−0.125
total $subsidy_{t-1}$/total $asset_{t-1}$	−0.035	−0.044	−0.108
Constant	4.128***	2.184***	20.741***
N	11,424	11,977	11,888
year-fixed effects	yes	yes	yes
sector-fixed effects	yes	yes	yes
AB1	0.000	0.0136	0.0025
AB2	0.533	0.2163	0.4470
Hansen test	0.335	0.5952	0.1949
number of instruments	133	33	33
Wald tests (*p*-value)	0.000	0.000	0.000
VIF test	1.35	1.31	1.33
Slovenia			
$growth_{t-1}$	0.030**	0.058	0.127***
$size_{t-1}$	−1.127***	−1.177***	−1.632***
CF_{t-1}/total $asset_{t-1}$	0.017**	−0.091***	−0.034
$Debt_{t-1}$/total $asset_{t-1}$	0.039	0.079	0.414***
total $subsidy_{t-1}$/total $asset_{t-1}$	0.010***	0.133***	−0.066***
Constant	308.031***	0.563***	16.571***
N	3,867	3,868	3,854
year-fixed effects	yes	yes	yes
sector-fixed effects	yes	yes	yes
AB1	0.366	0.001	0.002
AB2	0.215	0.539	0.675
Hansen test	0.697	0.553	0.122
number of instruments	133	100	133
Wald tests (*p*-value)	0.000	0.000	0.000
VIF test	1.68	1.67	1.72

Note(s): * significant at 10%; ** significant at 5%; *** significant at 1%

Table 4. Augmented model results of farm size growth for Hungary and Slovenia

The debt-to-assets variable is insignificant for all farm size growth measures for Hungary, significant and positive for output farm size growth in Slovenia, but negative for land farm size growth.

Regression coefficients pertaining to cash flow to total assets are negative or insignificant, suggesting that Hungarian and Slovenian farms do not face liquidity constraints on farm size growth.

Subsidies to total assets do not contribute to farm size growth in Hungary, but only to labor farm size growth in Slovenia, with a negative impact on land and to a lesser extent on output farm size growth.

5. Discussion

The impact of earlier farm size growth on later farm size growth is mixed, but largely positive and significant. This finding confirms the importance of endogenous factors and farm size restructuring on farm size growth. However, the eight-year period of analysis is not long enough for observing considerable farm size structural changes.

Variable	Land	Labor	Output
Hungary			
$growth_{t-1}$	−0.029***	0.125***	0.003
$size_{t-1}$	−1.086***	−1.463***	−1.025***
$size^2_{t-1}$	0.020**	−0.052	0.047***
CF_{t-1}/total $asset_{t-1}$	−0.025***	−0.024	0.009
$Debt_{t-1}$/total $asset_{t-1}$	0.026	0.019	−0.003
total $subsidy_{t-1}$/total $asset_{t-1}$	−0.044*	−0.048	−0.026
constant	4.246***	2.255***	5.599***
N	11,424	11,977	11,888
year-fixed effects	yes	yes	yes
sector-fixed effects	yes	yes	yes
AB1	0.006	0.0134	0.0008
AB2	0.5561	0.2579	0.9517
Hansen test	0.3079	0.4834	0.2745
number of instruments	133	33	33
Wald tests (p-value)	0.000	0.000	0.000
VIF test	2.62	1.38	13.24
Slovenia			
$growth_{t-1}$	−0.003	0.011	0.126***
$size_{t-1}$	−1.000***	−1.147***	−1.451***
$size^2_{t-1}$	0.162***	−0.125***	−0.009
CF_{t-1}/total $asset_{t-1}$	−0.001	−0.105***	−0.020
$Debt_{t-1}$/total $asset_{t-1}$	−0.010**	0.038	0.414***
total $subsidy_{t-1}$/total $asset_{t-1}$	−0.002**	0.121***	−0.065*
constant	250.882***	0.491***	15.966***
N	3,867	3,868	3,854
year-fixed effects	yes	yes	yes
sector-fixed effects	yes	yes	yes
AB1	0.284	0.017	0.002
AB2	0.266	0.764	0.972
Hansen test	0.682	0.701	0.115
number of instruments	133	100	133
Wald tests (p-value)	0.000	0.000	0.000
VIF test	3.37	1.74	14.24

Note(s): * significant at 10%; ** significant at 5%; *** significant at 1%

Table 5. Nonlinearity model results of farm size growth for Hungary and Slovenia

In our analysis, the regression coefficients pertaining to the farm size variable $S_{i,t-1}$ are always negative and significant, showing that the law of proportional effect does not hold, thus the validity of Gibrat's law is rejected, regardless of the measure of farm size. The faster growth of smaller rather than bigger farms does not necessarily imply the policy targeting of faster-growing small farms. The relationship between farm size and productivity can be negative, as efficiency limitations may apply to overly small farms, affecting their survival (Gautam and Ahmed, 2019).

The association of the farm size variable $S_{i,t-1}$ for land and particularly labor farm size growth is stronger in Hungary than in Slovenia and vice versa for output farm size growth. The nonlinearity effect of the farm size square variable is low compared to first-order farm size. After a certain farm size, an increase in land in both countries and output in Hungary is probable, but a decline for labor in Slovenia.

In comparison to the findings of Donati (2016), a substantial difference is found for the impact of the cash-flow regression coefficient $CF_{i,t-1}$ on firm/farm size growth. This was found to be positive and significant only for output farm size growth in the baseline model for Hungary and land farm size growth in the augmented model for Slovenia, while in the case of Italian service sectors it was found to be largely positive and significant, suggesting financial or liquidity constraints for the latter, particularly for firms belonging to the low and mid-level technology sectors. However, our finding of a negative sign and statistically insignificant regression coefficient for the cash flow term suggests that farms can raise as much money as they desire at a given cost and that for Hungarian and Slovenian farms (except in relation to output farm size growth in Hungary and land farm size growth in Slovenia), access to external finance is unproblematic and farms do not face financial constraints.

Farms in Hungary on average are more indebted than in Slovenia. The debt-to-assets variable included in the augmented model suggests that debts have been used for renting or buying land in Hungary and to increase output and, to a lesser extent, to increase land per farm in Slovenia.

CAP subsidies can serve as an additional source of cash flow and help to mitigate financial constraints for farms, although this effect (subsidies-to-assets variable) was found to be positive and significant only for land and labor farm size growth in Slovenia. This finding is consistent with Saint-Cyr (2022) on heterogeneous farm size dynamics and impacts of CAP subsidies.

Liquidity constraints might differ according to farm size and have not been analyzed explicitly. For example, Donati (2016) found mixed results concerning liquidity constraints in relation to firm size and the branch of the manufacturing and service industry. The former may have a constrained impact on the growth of small firms, but less on the growth of medium-sized firms and those operating in knowledge-intensive business services. These findings suggest that information in the credit market for small firms is asymmetrical, which may increase their susceptibility to credit rationing.

The modernization, green and digital transformation of farms that will lead to their growth and the maintenance or improvement of their competitiveness requires finance for investment (De Haas and Popov, 2023). In these processes, agricultural policies that can influence farm size may play an important role (Piet *et al.*, 2012) such as in the case of farm growth intentions of family farms in mountain and less favored areas (Huber *et al.*, 2015). In addition, improvements in financial and market institutions and better value chain organization related to farm input and output markets may be important means of adjusting farm growth and competitiveness (Mishra *et al.*, 2018).

The lessons learned from our study that may apply to other areas are linked to potential limits on farm size growth due to diseconomies of scale (Johnson and Ruttan, 1994), which also depend on the type of farming and potential limits to the increase in large farms in land-abundant countries (Deininger and Byerlee, 2011). During the period of analysis, neither Hungary (a more land-abundant county) nor Slovenia (less abundant) experienced substantial farm growth independent of measures of farm size. Farm diversity with modest changes in farm size growth can be also linked to different forms of farm multifunctionality in rural areas (van der Ploeg *et al.*, 2009; Unay-Gailhard and Bojnec, 2015; Chmielinski *et al.*, 2019; Thiermann and Bittmann, 2023).

Therefore, potential liquidity constraints may be important for farm survival in the long term, but the analysis of this would require a large balanced panel data set. Consequently, it is important for emerging market literature, policy and practice to investigate the relationship between liquidity constraints, farm growth and farm survival in relation to family farm succession and the declining role of part-time farming (Shahzad and Fischer, 2022). Different financial mechanisms, financial instruments and micro-financial institutions may be important means of mitigating potential farm liquidity constraints on the farm's growth and survival (Anwar *et al.*, 2020).

6. Conclusions

The farm size structure and farm size distribution of farms in Hungary and Slovenia are considerably different. Slovenia typically has smaller farms and only a few bigger ones, which in Hungary would be classified as medium sized. Hungary has a typical dual farm size structure, with many smaller individual farms and some bigger commercial farms classified as agricultural enterprises and key private holdings. On average, both types of Hungarian farms (individual and commercial ones) are larger than their equivalents in Slovenia.

Despite relatively stable farm size structures in Hungary and Slovenia during the period of analysis, results show a significant and positive effect for endogenously driven farm size growth and steady farm size restructuring. Farm size growth has explicitly been driven by endogenous factors; a process that is based on farm size growth expectations, except for land farm size growth in Hungary and labor farm size growth in Slovenia.

The empirical results presented here suggest rejection of Gibrat's law for farm size proportional growth, as significant and negative farm size regression coefficients (generated by comparing the current year to prior years) suggest unequal farm size growth, with the faster growth of smaller farms than larger ones, but with no significant convergence between smaller and larger farms. The second-order farm size square variable effect is smaller for land and output farm size growth in Hungary and for land farm size growth and labor farm size decline in Slovenia after a certain farm size.

Subsidies were found to be less important for farm size growth, only being significant in terms of maintaining jobs and farm labor employment in Slovenia and increasing operational land farm size.

Our results only partly confirm the claim that capital markets and asymmetric information problems can affect financial constraints in relation to whether farms use internal or external sources of finance to promote farm size growth. Farm size growth in terms of land and labor inputs for Hungary and labor input and output for Slovenia does not appear to be dependent on farm cash flow due to the potentially limited access of farms to external capital markets. For farms that face such constraints, cash flow can represent almost the only way to finance growth. In the case of Hungary, cash flow increases output farm size growth, and in the case of Slovenia, it increases land farm size growth, suggesting financial constraints.

Farm debts limit farm growth in Hungary, where they are linked to land farm size growth. In Slovenia, they are linked to output farm size growth and with a slight decline in land farm size growth.

Among the study limitations are the presentation of results at the aggregated farm level and the unbalanced panel-data-based empirical analysis of farm restructuring over a relatively short restricted period 2007–2015. Future research can thus investigate the impact of liquidity constraints linked to cash flow and farm debts and the potentially mitigating effects of financial constraints in the form of subsidies and should be conducted at a disaggregated farm-type level using the updated data with the years after 2015 to provide additional evidence and implications for policy and practice. It can be conducted particularly for more capital-intensive types of farming such as the dairy sector, to examine whether there is variability in the underlying interlinkages at the farm-type specialization level. Finally, except for periods in which radical institutional, policy and agrarian reforms occur, substantial farm size structural changes are not short-term processes, but rather long-term evolutionary ones. Their examination requires balanced panel data of a much longer duration that can capture the different endogenous and exogenous factors that may determine farm size growth and farm survival and contribute to considerable farm size structural changes and thus to the convergence, divergence or stasis of farm size distribution over time.

References

Adamopoulos, T. and Restuccia, D. (2014), "The size distribution of farms and international productivity differences", *The American Economic Review*, Vol. 104 No. 6, pp. 1667-1697, doi: 10.1257/aer.104.6.1667.

Akimowicz, M., Magrini, M.B., Ridier, A., Bergez, J.E. and Requier-Desjardins, D. (2013), "What influences farm size growth? An illustration in Southwestern France", *Applied Economic Perspectives and Policy*, Vol. 35 No. 2, pp. 242-269, doi: 10.1093/aepp/ppt008.

Akudugu, M.A. (2016), "Agricultural productivity, credit and farm size nexus in Africa: a case study of Ghana", *Agricultural Finance Review*, Vol. 76 No. 2, pp. 288-308, doi: 10.1108/AFR-12-2015-0058.

Almeida, H., Campello, M. and Weisbach, M.S. (2004), "The cash-flow sensitivity of cash", *The Journal of Finance*, Vol. 59 No. 4, pp. 1777-1804, doi: 10.1111/j.1540-6261.2004.00679.x.

Anwar, M., Nidar, S.R., Komara, R. and Layyinaturrobaniyah, L. (2020), "Rural bank efficiency and loans for micro and small businesses: evidence from West Java Indonesia", *International Journal of Emerging Markets*, Vol. 15 No. 3, pp. 587-610, doi: 10.1108/IJOEM-11-2017-0494.

Arellano, M. and Bover, O. (1995), "Another look at the instrumental variable estimation of error-components models", *Journal of Econometrics*, Vol. 68 No. 1, pp. 29-51, doi: 10.1016/0304-4076(94)01642-D.

Bakucs, L.Z., Bojnec, Š., Fertő, I. and Latruffe, L. (2013), "Farm size and growth in field crop and dairy farms in France, Hungary and Slovenia", *Spanish Journal of Agricultural Research*, Vol. 11 No. 4, pp. 869-881, doi: 10.5424/sjar/2013114-3994.

Baráth, L., Fertő, I. and Bojnec, Š. (2020), "The effect of investment, LFA and agri-environmental subsidies on the components of total factor productivity: the case of Slovenian farms", *Journal of Agricultural Economics*, Vol. 71 No. 3, pp. 853-876, doi: 10.1111/1477-9552.12374.

Beck, T. and Demirguc-Kunt, A. (2006), "Small and medium-size enterprises: access to finance as a growth constraint", *Journal of Banking and Finance*, Vol. 30 No. 11, pp. 2931-2943, doi: 10.1016/j.jbankfin.2006.05.009.

Benjamin, C. and Phimister, E. (2002), "Does capital market structure affect farm investment? A comparison using French and British farm-level panel data", *American Journal of Agricultural Economics*, Vol. 84 No. 4, pp. 1115-1129, doi: 10.1111/1467-8276.00372.

Bernini, C. and Pellegrini, G. (2011), "How are growth and productivity in private firms affected by public subsidy? Evidence from a regional policy", *Regional Science and Urban Economics*, Vol. 41 No. 3, pp. 253-265, doi: 10.1016/j.regsciurbeco.2011.01.005.

Blundell, R. and Bond, S. (1998), "Initial conditions and moment restrictions in dynamic panel data models", *Journal of Econometrics*, Vol. 87 No. 1, pp. 115-143, doi: 10.1016/S0304-4076(98)00009-8.

Bojnec, Š. and Fertő, I. (2019a), "Do CAP subsidies stabilise farm income in Hungary and Slovenia?", *Agricultural Economics – Czech*, Vol. 65 No. 3, pp. 103-111, doi: 10.17221/190/2018-AGRICECON.

Bojnec, Š. and Fertő, I. (2019b), "Farm household income inequality in Slovenia", *Spanish Journal of Agricultural Research*, Vol. 17 No. 4, pp. 1-11, e0112, doi: 10.5424/sjar/2019174-13996.

Bojnec, Š. and Fertő, I. (2020), "Testing the validity of Gibrat's law for Slovenian farms: cross-sectional dependence and unit root tests", *Economic Research-Ekonomska Istraživanja*, Vol. 33 No. 1, pp. 1280-1293, doi: 10.1080/1331677X.2020.1722722.

Bojnec, Š. and Fertő, I. (2021a), "Does human capital play an important role in farm size growth? The case of Slovenia", *New Medit*, Vol. 20 No. 1, pp. 57-69, doi: 10.30682/nm2101d.

Bojnec, Š. and Fertő, I. (2021b), "The growth of farms: a Hungarian-Slovenian comparison", *Post-communist Economies*, Vol. 33 No. 1, pp. 79-93, doi: 10.1080/14631377.2020.1727265.

Bojnec, Š. and Fertő, I. (2022), "Do different types of common agricultural policy subsidies promote farm employment?", *Land Use Policy*, Vol. 112 No. 6, pp. 1-12, 105823, doi: 10.1016/j.landusepol.2021.105823.

Bojnec, Š. and Latruffe, L. (2013), "Farm size, agricultural subsidies and farm performance in Slovenia", *Land Use Policy*, Vol. 32, pp. 207-217, doi: 10.1016/j.landusepol.2012.09.016.

Bojnec, Š., Fertő, I. and Podruzsik, S. (2022), "What drives family farm size growth in Hungary?", *Heliyon*, Vol. 25 No. 8(11), pp. 1-10, e11890, doi: 10.1016/j.heliyon.2022.e11890.

Cerqua, A. and Pellegrini, G. (2014), "Do subsidies to private capital boost firms' growth? A multiple regression discontinuity design approach", *Journal of Public Economics*, Vol. 109 C, pp. 114-126, doi: 10.1016/j.jpubeco.2013.11.005.

Chmielinski, P., Pawlowska, A., Bocian, M. and Osuch, D. (2019), "The land is what matters: factors driving family farms to organic production in Poland", *British Food Journal*, Vol. 121 No. 6, pp. 1354-1367, doi: 10.1108/BFJ-05-2018-0338.

Czubak, W., Pawłowski, K.P. and Sadowski, A. (2021), "Outcomes of farm investment in Central and Eastern Europe: the role of financial public support and investment scale", *Land Use Policy*, Vol. 108 C, pp. 1-11, 105655, doi: 10.1016/j.landusepol.2021.105655.

De Haas, R. and Popov, A. (2023), "Finance and green growth", *The Economic Journal*, Vol. 133 No. 650, pp. 637-668, doi: 10.1093/ej/ueac081.

Deininger, K. and Byerlee, D. (2011), "The rise of large farms in land abundant countries: do they have a future?", Policy Research Working Paper 5588, The World Bank, Washington, DC.

Donati, C. (2016), "Firm growth and liquidity constraints: evidence from the manufacturing and service sectors in Italy", *Applied Economics*, Vol. 48 No. 20, pp. 1881-1892, doi: 10.1080/00036846.2015.1109044.

EC (2018), *Farm Accountancy Data Network: an A to Z of Methodology*, European Commission, Brussels.

Eurostat (2020a), "General agricultural census 2010. Luxembourg: eurostat – European statistics", available at: https://ec.europa.eu/eurostat/

Eurostat (2020b), "Farm structure survey 2016: Hungary. Luxembourg: eurostat – European statistics", available at: https://ec.europa.eu/eurostat/cache/metadata/EN/ef_esqrs_hu.htm

Eurostat (2020c), "Farm structure survey 2016: slovenia", Eurostat – European Statistics, Luxembourg, available at: https://ec.europa.eu/eurostat/cache/metadata/EN/ef_esqrs_si.htm

Fagiolo, G. and Luzzi, A. (2006), "Do liquidity constraints matter in explaining firm size and growth? Some evidence from the Italian manufacturing industry", *Industrial and Corporate Change*, Vol. 15 No. 1, pp. 1-39, doi: 10.1093/icc/dtj001.

Farooq, U., Gang, F., Guan, Z., Rauf, A., Chandio, A.A. and Ahsan, F. (2021), "Exploring the long-run relationship between financial inclusion and agricultural growth: evidence from Pakistan", *International Journal of Emerging Markets*, ahead-of-print No. ahead-of-print, doi: 10.1108/IJOEM-06-2019-0434.

Fazzari, S., Hubbard, R. and Petersen, B. (1988), "Financing constraints and corporate investment", *Brookings Papers on Economic Activity*, Vol. 1988 No. 1, pp. 141-195, doi: 10.2307/2534426.

Feder, G. (1985), "The relation between farm size and farm productivity: the role of family labor, supervision, and credit constraints", *Journal of Development Economics*, Vol. 18 Nos 2-3, pp. 297-313, doi: 10.1016/0304-3878(85)90059-8.

Fertő, I., Bojnec, Š., Fogarasi, J. and Viira, A.H. (2020), "Agricultural soft budget constraints in new European Union member states", *Journal of Institutional Economics*, Vol. 16 No. 1, pp. 49-64, doi: 10.1017/S1744137418000395.

Fertő, I., Bojnec, Š., Fogarasi, J. and Viira, A.H. (2021), "The investment behaviour of dairy farms in transition economies", *Baltic Journal of Economics*, Vol. 21 No. 1, pp. 60-84, doi: 10.1080/1406099X.2021.1920754.

Gautam, M. and Ahmed, M. (2019), "Too small to be beautiful? The farm size and productivity relationship in Bangladesh", *Food Policy*, Vol. 84 C, pp. 165-175, doi: 10.1016/j.foodpol.2018.03.013.

Geroski, P.A. (2005), "Understanding the implications of empirical work on corporate growth rates", *Managerial and Decision Economics*, Vol. 26 No. 2, pp. 129-138, doi: 10.1002/mde.1207.

Gibrat, R. (1931), *Les Inegalites Economiques*, Librairie du Recueil Sirey, Paris.

Guiomar, N., Godinho, S., Pinto-Correia, T., Almeida, M., Bartolini, F., Bezák, P., Biró, M., Bjørkhaug, H., Bojnec, Š., Brunori, G., Corazzin, M., Czekaj, M., Davidova, S., Kania, J., Kristensen, S., Marraccini, E., Molnár, Z., Niedermayr, J., O'Rourke, E., Ortiz-Miranda, D., Redman, M., Sipiläinen, T., Sooväli-Sepping, H., Šūmane, S., Surová, D., Sutherland, L.A., Tcherkezova, E., Tisenkopfs, T., Tsiligiridis, T., Tudor, M.M., Wagner, K. and Wästfelt, A. (2018), "Typology and distribution of small farms in Europe: towards a better picture", *Land Use Policy*, Vol. 75 C, pp. 784-798, doi: 10.1016/j.landusepol.2018.04.012.

Hassouneh, I., Serra, T. and Bojnec, Š. (2015), "Nonlinearities in the Slovenian apple price transmission", *British Food Journal*, Vol. 117 No. 1, pp. 461-478, doi: 10.1108/BFJ-03-2014-0109.

Huber, R., Flury, C. and Finger, R. (2015), "Factors affecting farm growth intentions of family farms in mountain regions: empirical evidence for Central Switzerland", *Land Use Policy*, Vol. 47, pp. 188-197, doi: 10.1016/j.landusepol.2015.04.006.

Johnson, N.L. and Ruttan, V.W. (1994), "Why are farms so small?", *World Development*, Vol. 22 No. 5, pp. 691-706, doi: 10.1016/0305-750X(94)90044-2.

Jose, A. and Shanmugam, P. (2020), "Supply chain issues in SME food sector: a systematic review", *Journal of Advances in Management Research*, Vol. 17 No. 1, pp. 19-65, doi: 10.1108/JAMR-02-2019-0010.

Kerstern, R., Harms, J., Liket, K. and Maas, K. (2017), "Small firms large impact? A systematic review of the SME finance literature", *World Development*, Vol. 97 C, pp. 330-348, doi: 10.1016/j.worlddev.2017.04.012.

Lowder, S.K., Skoet, J. and Raney, T. (2016), "The number, size, and distribution of farms, smallholder farms, and family farms worldwide", *World Development*, Vol. 87, pp. 16-29, doi: 10.1016/j.worlddev.2015.10.041.

Mamatzakis, E. and Staikouras, C. (2020), "Common agriculture policy in the EU, direct payments, solvency and income", *Agricultural Finance Review*, Vol. 80 No. 4, pp. 529-547, doi: 10.1108/AFR-04-2019-0047.

Mishra, A.K., Kumar, A., Joshi, P.K. and D'Souza, A. (2018), "Cooperatives, contract farming, and farm size: the case of tomato producers in Nepal", *Agribusiness*, Vol. 34 No. 4, pp. 865-886, doi: 10.1002/agr.21563.

Oliveira, O. and Fortunato, A. (2006), "Firm growth and liquidity constraints: a dynamic analysis", *Small Business Economics*, Vol. 27 No. 2, pp. 139-156, doi: 10.1007/s11187-006-0006-y.

Oliveira, B. and Fortunato, A. (2008), "The dynamics of the growth of firms: evidence from the services sector", *Empirica*, Vol. 35, pp. 293-312, doi: 10.1007/s10663-008-9065-4.

Piet, L., Latruffe, L., Mouël, C.L. and Desjeux, Y. (2012), "How do agricultural policies influence farm size inequality? The example of France", *European Review of Agricultural Economics*, Vol. 39 No. 1, pp. 5-28, doi: 10.1093/erae/jbr035.

Plogmann, J., Mußhoff, O., Odening, M. and Ritter, M. (2022), "Farm growth and land concentration", *Land Use Policy*, Vol. 115, pp. 1-10, 106036, doi: 10.1016/j.landusepol.2022.106036.

Prakash, G. (2022), "Resilience in food processing supply chain networks: empirical evidence from the Indian dairy operations", *Journal of Advances in Management Research*, Vol. 19 No. 4, pp. 578-603, doi: 10.1108/JAMR-12-2021-0376.

Saint-Cyr, L.D.F. (2022), "Heterogeneous farm-size dynamics and impacts of subsidies from agricultural policy: evidence from France", *Journal of Agricultural Economics*, Vol. 73 No. 3, pp. 893-923, doi: 10.1111/1477-9552.12488.

Shahzad, M.A. and Fischer, C. (2022), "The decline of part-time farming in Europe: an empirical analysis of trends and determinants based on Eurostat panel data", *Applied Economics*, Vol. 54 No. 42, pp. 4812-4824, doi: 10.1080/00036846.2022.2036687.

Sharma, J., Tyagi, M. and Bhardwaj, A. (2020), "Parametric review of food supply chain performance implications under different aspects", *Journal of Advances in Management Research*, Vol. 17 No. 3, pp. 421-453, doi: 10.1108/JAMR-10-2019-0193.

Thiermann, I. and Bittmann, T. (2023), "Should I stay or should I go? The impact of nature reserves on the survival and growth of dairy farms", *Journal of Environmental Management*, Vol. 328, pp. 1-10, 116993, doi: 10.1016/j.jenvman.2022.116993.

Unay-Gailhard, İ. and Bojnec, Š. (2015), "Farm size and participation in agri-environmental measures: farm-level evidence from Slovenia", *Land Use Policy*, Vol. 46, pp. 273-282, doi: 10.1016/j.landusepol.2015.03.002.

van der Ploeg, J.D., Laurent, C., Blondeau, F. and Bonnafous, P. (2009), "Farm diversity, classification schemes and multifunctionality", *Journal of Environmental Management*, Vol. 90 suppl.2, pp. S124-S131, doi: 10.1016/j.jenvman.2008.11.022.

Ward, A.-M. and McKillop, D.G. (2005), "The law of proportionate effect: the growth of the UK credit union movement at national and regional level", *Journal of Business Finance and Accounting*, Vol. 32 Nos 9 and 10, pp. 1827-1859, doi: 10.1111/j.0306-686X.2005.00649.x.

Weersink, A. (2018), "The growing heterogeneity in the farm sector and its implications", *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, Vol. 66 No. 1, pp. 27-41, doi: 10.1111/cjag.12163.

Windmeijer, F. (2005), "A finite sample correction for the variance of linear efficient two-step GMM estimators", *Journal of Econometrics*, Vol. 126 No. 1, pp. 25-51, doi: 10.1016/j.jeconom.2004.02.005.

About the authors

Štefan Bojnec (PhD) is Professor of Economics and the Head of Department of Economics at the Faculty of Management, University of Primorska, Slovenia. His interests are different aspects of economics, business and management. He has published in world leading journals such as *Journal of Cleaner Production, International Journal of Contemporary Hospitality Management, Industrial Management and Data Systems, China Economic Review, Applied Economics, Food Policy, Land Use Policy, Journal of Common Market Studies, Journal of Institutional Economics and the World Economy*. In 2008, he received the Slovenian state Zois recognition for important scientific achievements in the field of economics. Štefan Bojnec is the corresponding author and can be contacted at: stefan.bojnec@fm-kp.si

Imre Fertő (PhD) is the General Director of the Center for Economic and Regional Studies and the Professor at the Czech University of Life Sciences. He holds a PhD in Economics from Hungarian Academy of Sciences and a PhD in agricultural economics from University of Newcastle upon Tyne. Recently, his research focuses on international agricultural trade, technical efficiency and local food. He published numerous articles in various international journals, including *World Economy, Journal of Agricultural Economics, Agricultural Economics, Agribusiness, Canadian Journal of Agricultural Economics, Ecological Indicators, European Review of Agricultural Economics, Applied Economics, Economics Letters, European Planning Studies, Food Policy, Journal of Common Market Studies* and *Journal of Institutional Economics.*