111 EAAE-IAAE Seminar 'Small Farms: decline or persistence'

University of Kent, Canterbury, UK

26th-27th June 2009

Survival and Growth of Family Farms in a Transition Country – The Hungarian Case

ZOLTÁN L. BAKUCS[*], IMRE FERTŐ[**]

[*]research fellow, Institute of Economics, Hungarian Academy of Sciences, H-1112, Budapest, Budaörsi út 45. Email: bakucs@econ.core.hu

[**]senior research advisor, Institute of Economics, Hungarian Academy of Sciences, H-1112, Budapest, Budaörsi út 45. and Professor, Corvinus University of Budapest, H-1093, Budapest, Fővám tér 8. Email: ferto@econ.core.hu

ABSTRACT

The paper investigates the validity of Gibrat's Law in Hungarian agriculture. We use FADN data between 2001 and 2007 and employ quantile regression techniques to test the validity of Gibrat's Law across quantiles. The Law is strongly rejected for all quantiles, providing strong evidence that smaller farms tend to grow faster than larger ones. We provide a number of socio-economic factors that can explain farm growth. Of these we found that total subsidies received by farm and far operator's age are the most significant factors.

KEYWORDS: Gibrat's Law, family farm, quantile regression, transition agriculture
JEL CODES: P32, Q12, Q19

Survival and Growth of Family Farms in a Transition Country – The Hungarian Case

1. INTRODUCTION

There is a continuously growing literature on the agricultural transformation in Central an Eastern European countries (see survey BROOKS and NASH 2002; ROZELLE and SWINNEN 2004). The research has focused on various aspects of transition, including land reform, farm restructuring, price and trade liberalisation and etc. All these economic policy issues have a significant influence upon farm growth in any country. Because of the inherent instabilities associated with the transition period, and the relatively short time (in most Central Eastern European countries the dismantling of the centralised economic structures began only 15 - 16 years ago) farmers had to acquire much needed farm management skills, farm growth rates in a transition economy are expected to be more profoundly influenced by the economic environment. Most of the empirical studies on the farm growth and survival rates use GIBRAT's (1931) as a theoretical departure point in their analysis. Gibrat's Law of Proportionate Effect states that firm growth is a stochastic process resulting from many unobserved random variables; therefore the growth rate of firms (farms) is independent of their initial size at the beginning of the period. The purpose of this paper is to investigate whether Gibrat's Law holds for Hungarian family farms. The farm structure in developed market economies where all similar studies were set is very different from that in the transition economies. The proportion of small farms in transition economies in general, and in Hungary in particular, is much higher, thus this empirical research provides new insights into the farm growth literature. Previous research on Hungarian agriculture shows that the growth trajectory of family and corporate farms is similar Bakucs and Fertő (2009). However this study steps further incorporating farm specific variables to explain the survival and growth in Hungarian agriculture. More specifically, we focus exclusively on the family farms which are still at the centre of policy discussion. The paper is organised as follows: section 2 presents the theoretical background, section 3 discusses the methodology employed, section 4 presents the dataset and the empirical analysis, and finally, section 5 concludes.

2. LITERATURE REVIEW

Although there is a wealth of literature on whether Gibrat's Law holds on various agricultural sectors, to date no one has studied the law of proportionate growth in a transition economy. Most of the literature (see the recent reviews of SUTTON, 1997 and LOTTI et al., 2003) focuses on the growth of firms and to a lesser extent on the growth of farms. Most studies are limited on testing whether Gibrat's Law holds in a given sector or industry. There are two different approaches to test stochastic firm (farm) size and growth models. The first method is to test whether the size distribution of firms follows the lognormal distribution (e.g. ALLONSON, 2002 analysed the size distribution of farms in England and Wales concluding that the lognormal model is appropriately depicting size distribution). This approach was however criticised, because of the low power properties of the test, since it does not explicitly test the relation between growth rates and farm size.

A second approach is to test the relationship between farm size and growth through econometric methods. The empirical research considering the agricultural sector, yielded rather contradictory results. WEISS (1999) focusing on part and full time farms in Upper Austria rejected Gibrat's Law, and found that 'age, schooling and sex of the farm operator, size of farm family, and off-farm employment as well as initial farm size, significantly influence farm growth and survival'. SHAPIRO et al. (1987) analysed the growth of Canadian

farms using census data, and conclude that Gibrat's Law does not hold, that is, small farms tend to grow faster than large ones. On the other hand, UPTON and HAWORTH (1987) using British Farm Business Survey data, BREMMER et al. (2002) using Farm Accountancy Data Network (FADN) data for Netherlands and KOSTOV et al. (2005) using farm census and structural survey data for dairy farms in Northern Ireland, found no evidence (except for the small farms in the case of KOSTOV et al.) to reject Gibrat's Law. Based on economic theory, some papers in the empirical literature, attempt to explicitly model firm growth using a battery of possible factors. Some authors argue that firm manager characteristics are heterogeneous (e.g. LUCAS, 1978 and JOVANOVIC, 1982) or that the capacity and technology shift may cause sinking costs (CABRAL, 1995). These modells emphasise the importance of some social-economic variables that could theoretically explain the evolution of the relationship between firm size and growth. There are only a few such studies focusing on the farm sector. WEISS (1999) analysed the Upper-Austrian full and part time farms rejected Gibrat's Law, and found that besides the original farm size, the age, gender, education level of the farm operator, family size, and off-farm employment are significantly affecting farm growth and survival. HENNINGS AND KATCHOVA (2005) studied farm growth strategies in Illinois, United States. They concluded that financial management, cost cuts, resource management and income maximising strategies have positive influence upon farm capital growth rate.

An important issue in the farm growth studies, is the way, the farm size is defined. These include: acreage farmed, livestock number, total capital value, gross sales, total gross margin and net income. Output value measures however, are subject to inflation, and changes in relative prices. The use of physical input measure may also cause difficulties, since farms are characterised by a non-linear production technology, this changes in size involve changes in the mix and proportions of inputs used.

3. METHODOLOGY

The simplest way to test Gibrat's law is to run an OLS regression, and test the β1 coefficient associated with the logarithm of the lagged farm size (equation 1):

$$\log S_{i,t} = \beta_0 + \beta_1 \log S_{i,t-1} + \varepsilon \tag{1}$$

where $S_{i,t}$ is the size of farm i at time t, $S_{i,t-1}$ is the size of farm i at the previous period, and ε is a random variable, independent of $S_{i,t-1}$. If $\beta_1 = 1$, than growth rate and initial size are independently distributed and Gibrat's Law holds. If the coefficient is smaller than one, it follows that small farms tend to grow faster than large farms. On the other hand, a coefficient larger than one, means that larger farms grow faster than smaller farms do. The OLS analysis however is only capable to test whether Gibrat's Law holds globally for all farms, regardless of their size. Following KOSTOV et al., (2005) we employ modern quantile regression methods in order to distinguish between farms of different sizes. An important issue in the empirical analysis is the sample selection problem. Since growth rate is only possible to be measured for surviving farms (still operating in period t), and since slow growing farms are most likely to exit, it is easy to see that small, fast growing farms can easily be overrepresented in the sample, thus introducing bias in the results. This problem is of a particular importance in the present paper, since the proportion of small farms in transition economies in general, and in Hungary in particular, is much higher than in developed economies. HECKMAN (1979) introduced a two-step procedure to control for the selection problem. In step one, a farm survival model for the full sample (both surviving and exiting farms) is estimated, using a

probit regression. This equation is used to obtain a variable, the inverse of Mill's Ratio for each observation (equation 2):

$$P(f_i = 1) = F(\delta + \gamma \log S_{i,t-1} + \varphi \log S_{i,t-1}^2 + \mu \tag{2}$$

where $f_i = 1$ denotes survivor, $f_i = 0$ exit, and μ is the disturbance.

In the second step, this additional variable is introduced as a correcting factor into the quantile regression based on a sample that contains only the surviving farms.

In the OLS regression estimation, error terms are assumed to follow the same distribution irrespectively of the value taken by the explanatory variables. Since we can only analyse surviving farms, estimations are conditional on survival (*conditional objects*, LOTTI ET AL. 2003). Therefore, in this paper we use the more robust and more informative quantile regression estimation technique. Following LOTTI AT AL. (2003), the θth sample quantile, where $0 < \theta < 1$, can be defined as:

$$\min_{b \in R} \left[\sum_{i \in \{i: y_i \geq b\}} \theta |y_i - b| + \sum_{i \in \{i: y_i < b\}} (1 - \theta) |y_i - b| \right] \tag{3}$$

For a linear model $y_i = \beta' x_i + \varepsilon_i$, the θth regression quantile is the solution of the minimisation problem, similar to equation (3):

$$\min_{b \in R^k} \left[\sum_{i \in \{i: y_i \geq x_i b\}} \theta |y_i - x_i b| + \sum_{i \in \{i: y_i < x_i b\}} (1 - \theta) |y_i - x_i b| \right] \tag{4}$$

Solving (4) for b results a robust estimate of β. To obtain unbiased error terms, we bootstrap the variance-covariance matrix. The BIERENS and GINTHER's (2001) Integrated Conditional Moment (ICM) test is used to test the appropriateness of the quintile regression models' functional form.

4. EMPIRICAL ANALYSIS AND RESULTS

4.1. Data

The analysis is based on Hungarian Farm Accountancy Data Network (FADN) database. The Hungarian FADN system data were collected from farms above 2 European Size Units based on representative stratified sampling according to four criteria: legal form, farm size, production type and geographic situation. The database contains data of 1386 family farms in 2001 and 1571 family farms in 2007, respectively. But the number of common observations decreased to 512 farms between 2001 and 2007. This implies a considerable amount of the attrition of our panel data raising a sample selection bias issue which is rather common in the similar studies. The farm size is measured by net total revenue which was deflated to 2000. Table 1 presents the descriptive statistics of the data. Besides the farm size in 2001 and 2007 (Lsale2001 and Lsale2007), a number of socio-economic variables are used to explain family farm growth: farm operator's age (Fage2001), gender (Gender2001), a dummy variable indicating whether the farm operator was replaced (succession), a dummy variable representing the education level and a dummy variable for agricultural specialisation of farm operator (Educ2001, Educ2001agr), and finally, the total subventions received by the farm in 2001 (Ltotsub2001).

Table 1: Descriptive statistics of variables

	Mean	Standard deviation5	Minimum	Maxium
Lsale2007	8.894	1.126	4.204	11.510
Lsale2001	8.753	1.020	5.499	11.564
Age2001	47.128	9.967	20	82
Gender2001	0.898	0.302	0	1
Succesion	0.150	0.357	0	1
Educ2001agricultural	0.232	0.422	0	1
Educ2001	0.265	0.442	0	1
Ltotsub2001	6.403	1.071	2.197	10.647

Source: Own estimations based on the Hungarian FADN data

4.2. Empirical results

We present our results in following steps. First, closely related to farm growth issues is the bimodal farm size distribution hypothesis (see WOLF and SUMNER, 2001). The market economy institutions and structures in Hungary have fully developed by 2001 thus we test using Kernel density functions whether a shift towards a bimodal farm structure has taken place by 2007. Figure 1 shows that Kernel density function moved to right indicating a slight concentration in farm structure during analysed period, but the bimodality of Hungarian farm structure can be rejected independently from measures of size.

Figure 1 Kernel density function
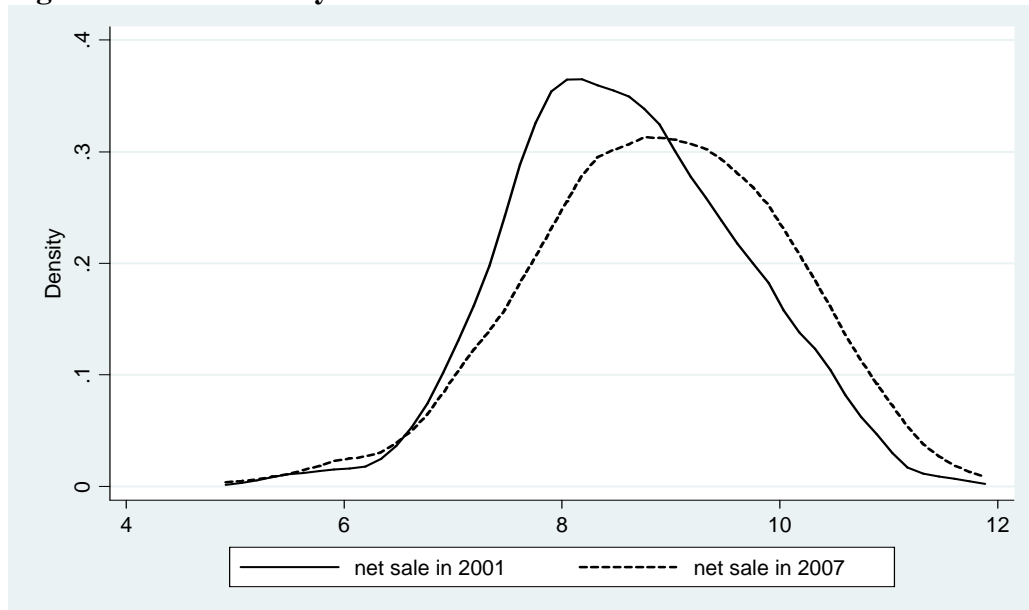
Source: Own estimations based on the Hungarian FADN data

Second, we test the Gibrat's Law using quantile regression. Table 2 presents quantile regression estimates for the family farms, the β_1 coefficient (see equation 1) is the coefficient estimate of Lsale2001. Estimates are significant, larger than 0 but smaller than 1. The $\beta_1 = 1$ null hypothesis (i.e. Gibrat's Law holds) is rejected for all quantiles. Rows 3 to 8 present coefficient estimates of the socio-economic variables meant to explain farm growth.

Table 2 Quantile regression estimates for different quintiles

|	q10	q25	q50	q75	q90
Lsale2001	0.765***	0.709***	0.695***	0.671***	0.509***
Fage2001	-0.014*	-0.010**	-0.010**	-0.013***	-0.012*
Gender2001	0.206	0.266*	0.259	0.028	-0.376
succesion	-0.237	0.266	0.220**	0.208*	0.186
Educ2001agr	-0.277	-0.031	-0.475*	-0.177	-0.247
Educ2001	0.362	0.082	0.473*	0.130	0.235
Ltotsub2001	0.076	0.163***	0.161***	0.105	0.165*
constant	1.179	1.347***	2.005***	3.375***	5.180***
Pseudo R2	0.2505	0.3033	0.3355	0.3162	0.2880
N	512	512	512	512	512

Source: Own estimations based on the Hungarian FADN data
Level of significance: * $p<0.1$; ** $p<0.05$; *** $p<0.01$ based on bootsrapped standard errors with 400 replications

The age of farm operator (Fage2001) has significantly negative effects for all quantiles, whilst the total subventions received (Ltotsubv2001) has positive influence upon growth. This latter variable is significant for 3 out of 5 quantiles only. The rest of the socio-economic explanatory variables generally have the expected sign (with the exception of the dummy variable indicating whether the farm operator has agricultural education), but are significant in only 1 or 2 quantiles. Finally, the constant (β_0) and the regression coefficient of determination is shown in the last two rows. β_0 and β_1 estimates are generally significant, and the R^2 coefficients show that the regressions explain a relatively large part of the variation in the dependent variable. Our empirical results provide strong evidence against Gibrat's Law. This confirms that in general smaller farms grow faster than larger farms. Empirical literature emphasise that smaller firms grow faster than larger firms, especially for small newborn firms (LOTTI et al. 2003).

Third, a useful tool to illustrate the β_1 and socio-economic explanatory variables quantile regression estimates, is to plot the coefficient value across the range of quantiles. Figure 2 presents quantile regression estimates along with 95% confidence intervals for all explanatory variables. It can be seen that β_1 confidence intervals are well below 1, across all quantiles, supporting the rejection of Gibrat's Law. The coefficient estimates and confidence intervals for explanatory variables is fairly stable across quantiles.

Finally, we estimate the ICM test statistics to check the appropriateness of the quantile regressions' functional form (table 3.). Several c values are used, since the ICM test statistics is actually a ration of 2 probability measures estimated over a hypercube, whose dimensions are 2c. Asymptotically, any choice of c is equivalent, however the choice of c has strong influence on the small sample properties (see KOSTOV et al., 2005; BIERENS and GINTHER, 2001 for further details on the test). None of the test statistics computed is significant at 5%, supporting the estimated quantile regression and its conclusions.

Figure 2 Quantile regression coefficients and confidence intervals for each regressor
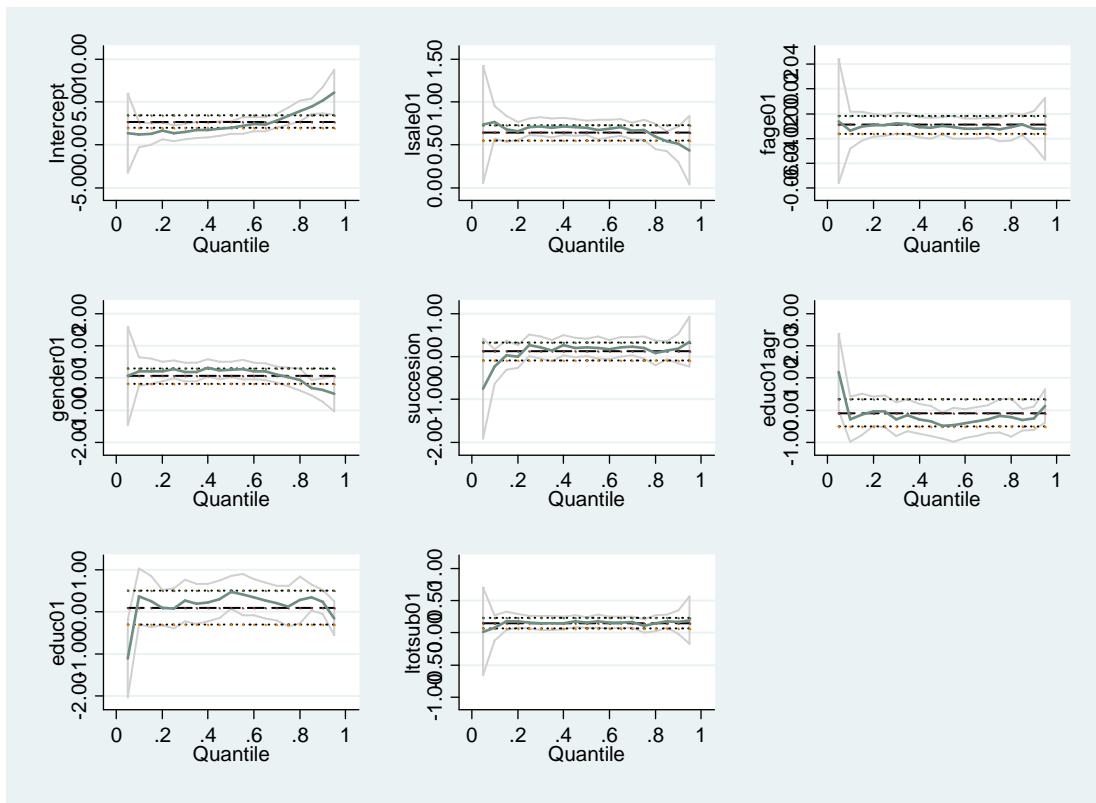
Source: Own estimations based on the Hungarian FADN data

Table 3 ICM tests

		c	
quantiles	1	5	10
1	0.3080	1.2778	1.0383
2	0.2575	1.1319	1.1089
3	0.2124	1.0666	0.9745
4	0.2826	1.0381	0.9649
5	0.3648	.6704	0.8323
6	0.1767	1.1112	1.0933
7	0.2432	.8295	0.9481
8	0.3130	1.1948	1.1589
9	0.6117	1.3155	1.0771

Note: critical values 10 per cent: 3.23; 5 per cent: 4.26

5. CONCLUSIONS

In this paper we analyse the concentration process in the Hungarian farms sector, and test the validity of the Law of Proportionate Effects (Gibrat's Law) for Hungarian family farms between 2001 and 2007, and provide a number of socio-economic factors meant to explain farm growth. Previous studies found that Gibrat's Law holds when larger farms, but fails to

hold when smaller farms are considered. This is mostly due to methodological and sample issues. We used quantile regression techniques, meant to overcome various methodological issues present with OLS 2 step Heckmann or other estimation methods. Our results strongly reject Gibrat's Law for family farms, indicating that smaller farms grow faster than larger ones. Subsidies have significantly positive effect upon growth, whilst social and educational characteristics of farm operator provide insight into factors determining family farm growth.

REFERENCES

BAKUCS L.Z. AND FERTŐ, I. (2009). Gibrat's Law Revisited in a Transition Economy: The Hungarian Case. *Empirical Economics Letters*. Vol 8. (3)

BIERENS, H.J., GINTHER, D.K. (2001): Integrated Conditional Moment Testing of Quantile Regression Models. *Empirical Economics, Vol. 26*, pp. 307 – 324.

BREMMER, J., OUDE LANSINK, A.G.J.M., OLSON, K.D., BALTUSSEN, W.H.M. AND HUIRE, R.B.M. (2002): Analysis of farm development in Dutch agriculture and horticulture. Paper presented at 13th Congress of International Farm Management Association (IFMA), Wageningen, The Netherlands, 7 – 12 of July.

BROOKS, K., NASH, J. (2002): The Rural Sector in Transition Economies. In: GARDNER, B. AND RAUSSER, G.C. (eds.). Handbook of Agricultural Economics. Vol. 2A. Amsterdam: North-Holland, pp.1547-1592.

Cameron, C.A. and Triverdi, P.K. (2009) Micoeconometrics using Stata. College Station: Stata Press

GIBRAT, R. (1931): Les Inegalites Economiques. Librairie du Recueil Sirey. Paris.

HECKMAN, J.J. (1979): Sample selection bias as a specification error. *Econometrica, Vol. 47(2)*, pp. 153 – 161.

HENNINGS, E. – KATCHOVA, A.L. [2005]: Business Growth Strategy of Illionois Farms: A Quantile Regression Approach. Presentation on AAEA Congress, Providence, July 24-27.

JOVANOVIC, B. [1982]: Selection and Evolution of Industry, *Econometrica*, Vol. 50, PP. 649–670.

KOSTOV, P. M. PATTON, S. MCERLEAN, J. MOSS (2005): Does Gibrat's law hold amongst dairy farmers in Northern Ireland?, paper presented at EAAE 11th Congress, Copenhagen, 24-27 August.

LOTTI, F., SANTARELLI, E., VIVARELLI, M. (2003): Does Gibrat's Law hold among young, small firms? *Journal of Evolutionary Economics, Vol. 13(3)*, pp. 213 – 235.

LUCAS, R. E. [1978]: On the Size Distribution of Business Firms. *Bell Journal of Economics, Vol. 9*, pp. 508–523.

RIZOV, M., MATHIJS, E. 2003. Farm Survival and Growth in Transition Economies: Theory and Empirical Evidence from Hungary. *Post-Communist Economies*, Vol. 15 (2) pp. 227-242.

ROZELLE, S. SWINNEN, J.F.M. (2004): Success and Failure of Reform: Insights from the Transition of Agriculture. *Journal of Economic Literature*, Vol. 42 (2), pp. 404-456.

SHAPIRO, D., BOLLMAN, R.D., EHRENSAFT, P. (1987): Farm size and growth in Canada. *American Journal of Agricultural Economics, Vol. 69,* pp. 477 – 483.

SUTTON, J. (1997): Gibrat's Legacy. *Journal of Economic Literature, Vol. 35*, pp. 40 – 59.

UPTON, M., HAWORTH, S. (1987): The growth of farms. *European Review of Agricultural Economics, Vol. 14,* pp. 351 – 366.

WEISS, C.R. (1999): Farm Growth and Survival: Econometric Evidence for Individual Farms in Upper Austria. *American Journal of Agricultural Economics, Vol. 81,* pp. 103 -116.

WOLF, C.A., SUMNER, D.A. (2001): Are Farm Distributions Bimodal? Evidence from Kernel Density Estimates of Dairy Farm Distributions. *American Journal of Agricultural Economics, Vol. 83(1),* pp. 77 – 88.