118th EAAE Seminar

"Rural development: governance, policy design and delivery"

Ljubljana, 25-27 August 2010

THE IMPACT OF NON-FARM INCOME ON THE INVESTMENT IN AGRICULTURE: EVIDENCE FROM HUNGARY AND SLOVENIA

Lajos Zoltán Bakucs[1], Štefan Bojnec[2], Imre Fertő[1,3] and Laure Latruffe[4,5]

[1] Institute of Economics, Hungarian Academy of Sciences, H-1112 Budapest, Budaorsi út 45, Hungary, email:bakucs@econ.core.hu

[2] University of Primorska, Faculty of Management, Cankarjeva 5, SI-6104 Koper, Slovenia, email: stefan.bojnec@fm-kp.si, stefan.bojnec@siol.net

[3] Corvinus University of Budapest, Fóvám tér 8, H-1093 Budapest, Hungary, email:ferto@econ.core.hu

[4] INRA, UMR1302 SMART, F-35000 Rennes, France, email: Laure.Latruffe@rennes.inra.fr

[5] Agrocampus Ouest, UMR1302 SMART, F-35000 Rennes, France

Corresponding author stefan.bojnec@siol.net

Paper prepared for presentation at the 118th seminar of the EAAE (European Association of Agricultural Economists), 'Rural development: governance, policy design and delivery' Ljubljana, Slovenia, August 25-27, 2010

THE IMPACT OF NON-FARM INCOME ON THE INVESTMENT IN AGRICULTURE: EVIDENCE FROM HUNGARY AND SLOVENIA

ABSTRACT

The article investigates the impact of non-farm income on the investment for Hungarian and Slovenian farms using FADN panel data for the years 2004-2008 and different econometric estimation approaches. We find that non-farm income is more important for Slovenian farms than for Hungarian farms. Farm gross investment is positively associated with real sales growth and cash flow implying the absence of soft budget constraint. Gross farm investment is negatively associated with non-farm income, but positively associated with investment subsidies. Specific results by country are found depending on growing vs. declining real sales and on farm indebtedness.

KEYWORDS: non-farm income, farm investment, soft budget constraint, panel data analysis

JEL classification: D81, D92, O12, Q12, C23

1. INTRODUCTION

There is a wealth of literature on the presence of capital market imperfections and their effects on firm investment in transition countries (e.g. Budina et al., 2000; Konings et al., 2003; Lizal and Svejnar, 2002; Rizov, 2004), and a few papers focusing on this issue for the agricultural sector in these countries (Petrick, 2004; Latruffe, 2005; Bojnec and Latruffe, 2007; Bakucs et al., 2009; Latruffe et al., 2010). This research provided evidence for existence of capital market imperfections during transition and after accession to the European Union (EU). In addition, some studies tested the persistence of soft budget constraint in transition economies. If soft budget constraint is still persistent that may lead to a postponed restructuring (Kornai, 2001 and 2003). Soft budget constraint may be more important in agriculture because government supports to the farm sector are much higher than to firms in manufacturing. Cross-country comparison of investment behaviour is limited in the agricultural economics literature (except Benjamin and Phimister, 2002). Previous empirical analyses on investment activity in agriculture are mainly based on the augmented accelerator model or Euler equations.

The aim of this current paper is to analyse the existence of soft budget constraint and the role of non-farm income on credit market imperfections in two different countries, Hungary and Slovenia, using the augmented accelerator model with dynamic panel estimations. Although credit market imperfections may play an important role in farm investment in these countries, a rare research focuses on the effects of non-farm income on farm investment in transition countries. The link between non-farm income and farm investment has been largely documented for developing countries. Previous research emphasised that the role of non-farm income may be in two opposite direction. On the one hand, non-farm income provides additional resources that help farmers overcome their financial constraints, and enable them to invest or expand their farm business (Rosenzweig and Wolpin, 1993; Reardon et al., 1994; Reardon, 1997; Deininger and Olinto, 2001). On the other hand, there may be a competition between on-farm activities and off-farm activities, in terms of labour or resources (Christensen, 1989; Ahituv and Kimhi, 2002; Holden et al., 2004). In this case, a greater degree of pluriactivity, that is to say a higher non-farm income, may reduce the incentives to produce and to invest on farm. Only one paper, by Hertz (2009), has investigated the role of non-farm income in farm investment in transition countries, namely in Bulgaria in 2003. The

author finds support for the first proposition, namely that non-farm income increases investment by relaxing capital market imperfections.

In this paper we aim to clarify whether non-farm income has an effect on farm investment in countries that have recently exited the transition phase and are now part of the EU. Moreover, our comparative analysis includes two countries with different historical-institutional developments and different farm structures: small-scale farms in Slovenia and large-scale farms in Hungary. During the communist system Hungarian agriculture was collectivised and the average farm size has been all the time among the largest in Europe. In Slovenia the collectivisation failed and small-scale farm structure has remained among the smallest in Europe. During transition farm structures have developed under emerging market conditions and policy changes. Our analysis is based on data from the Hungarian and Slovenian Farm Accountancy Data Networks (FADN) during the period 2004-2008. Previous research has provided evidence of capital market imperfections in these countries during transition (Bojnec and Latruffe, 2007; Bakucs et al., 2009). Our paper will highlight whether such imperfections persist after accession to the EU. In addition, we will explore whether non-farm income influence farmers' investment decisions.

2. METHODOLOGY

The starting point of our empirical analysis is the standard augmented accelerator model in the following specification (Fazzari et al., 1988):

$$\frac{I_{it}}{K_{it-1}} = \alpha_i + \alpha_1 \frac{Q_{it}}{K_{it-1}} + \alpha_2 \frac{CF_{it-1}}{K_{it-1}} + \varepsilon_{it} \quad (1)$$

where subscript i denotes the i-th farm and subscript t denotes the t-th period, while ε is stochastic element. I_{it} denotes gross investment of the i-th farm between periods t and $t-1$, which is calculated as the change in capital stock (net investment) plus depreciation in values; values in period t were deflated by the agricultural input price index for goods and services contributing to agricultural investment with the base year 2004. K_{it-1} is the stock of capital, measured by all tangible assets, in the period $t-1$; values in the current period t are deflated by the agricultural input price index with the base year 2004. Q_{it} is the change in output sales value between periods t and $t-1$; values in period t were deflated by the harmonized indices of consumer prices with the base year 2004. CF_{it-1} denotes the real cash flow of the i-th farm, defined as before tax profits plus depreciation; values in period t were deflated by the harmonized indices of consumer prices with the base year 2004. Dependent and explanatory variables are normalised by the stock of capital to control for size effects.

The positive regression coefficient α_2 on cash-flow variable is generally interpreted as a sign for credit rationing to test the soft budget constraint, as firstly proposed by Fazzari et al. (1988). Lizal and Svejnar (2002) proposed two interpretations of the soft budget constraint: first, the weak version when the coefficient α_2 is zero; firms have access to credit for investment irrespective of their profitability. Second, the strong version of the soft budget constraint, when the coefficient α_2 is negative; firms with poor financial performance can access bank loans more easily.

Following Konings et al. (2003) we estimate equation (1) in first differences to control for unobserved farm level fixed effect and possible measurement error:

$$\Delta \frac{I_{it}}{K_{it-1}} = \alpha_1 \Delta \frac{Q_{it}}{K_{it-1}} + \alpha_2 \Delta \frac{CF_{it-1}}{K_{it-1}} + \Delta \varepsilon_{it} \quad (2)$$

In the estimated econometric models the baseline model is the standard augmented accelerator model (equation (2)). We then extend our model specification to include in the explanatory variables non-farm income at period *t*-1 (related to capital to control for size effects). We also include investment subsidies to capital as an additional explanatory variable in a separate model.

In addition to full sample estimate, we use farm characteristics to classify farms by increasing vs. decreasing real sales, and by high debt and low debt farms (similar as Benjamin and Phimister, 2002, we define high debt and low debt farms with debt-to-asset ratio greater than 0.3 and less than 0.2, respectively) to test the sensitivity of our estimation. We also imposed outlier rules by removing farms from econometric estimates if the investment capital ratio is above 99% in absolute value (Benjamin and Phimister, 2002).

In the empirical analysis we use three econometric estimators. First, we employ standard static panel models using Hausman test to identify whether random or fixed effect model is appropriate. Second, we employ the generalized method of moments (GMM) estimator developed by Arellano-Bover (1995) and Blundell and Bond (1998), also referred to as GMM-system estimator. Windmeijer (2005) proposes a finite sample correction that provides more accurate estimates of the variance of the two-step GMM estimator. As the t-tests based on these corrected standard errors are found to be more reliable, the paper estimates the coefficients using the finite sample correction. Finally, we have an unbalanced panel dataset for the period between 2004 and 2008, thus to correct the unbalanced nature of our data we estimate equation (2) with a generalised version of bias corrected LSDVC estimator proposed by Bruno (2005a)[1]. The author defines a selection indicator r_{it} such that r_{it} =1 if (y_{it}, x_{it}) is observed and r_{it} =0 otherwise. From this the dynamic selection rule s (r_{it}, $r_{i,t-1}$) is created, that selects only the observations that are usable for the dynamic model, namely those for which both current values and one-time lagged values are observable. As it is good practice to check the sensitivity of empirical results, we will present and compare the results from the fixed effects estimator, GMM estimator, and LSDVC estimator.

3. DATA

The data analysis is based on Hungarian and Slovenian FADN that includes farms above two European Size Units (ESUs; one ESU is equivalent to 2,200 euros of gross margin). The time span used for analysis is 2004-2008.

Table 1 presents some descriptive statistics of the data used. Gross investment in Hungarian and Slovenian FADN farms has increased, but varies by farms. The data shows disinvestments by some farms in Slovenia, but not in Hungary. Real sale growth and cash flow also on average increased, but vary by farms from negative to positive values. However, summary statistics suggest a positive association between gross investment and real sale growth on the one hand, and a positive association between gross investment and cash flow on the other. Some farms are without investment subsidy, because they did not invest. Not all our analysed farms have non-farm sources of income. The percentage of farms with non-farm sources of income in Slovenia is much greater (around 40%) than in Hungary (0.8%). The higher percentage of farms with non-farm income in Slovenia is a result of tradition of part-time farming during the previous system, evolution of farms in rural developments, and a greater development of non-farm activities in rural areas in Slovenia than in Hungary.

[1] We apply the Stata programme xtlsdvc developed by Bruno (2005b) using Blundell and Bond (1998) estimator.

Table 1. Descriptive statistics for the whole period 2004-2008

		Hungary (in euro)					Slovenia (in euro)				
Variable		Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Investment to capital	$\frac{I_{it}}{K_{it-1}}$	8367	0.096	0.220	0	11.633	2237	0.049	0.097	-0.206	1.738
Sale growth to capital	$\frac{Q_{it}}{K_{it-1}}$	8367	0.253	0.230	-0.939	8.004	2237	0.096	0.180	-0.360	7.035
Cash flow to capital	$\frac{CF_{it-1}}{K_{it-1}}$	8367	0.014	0.275	-10.784	3.593	2237	0.031	0.182	-1.076	6.973
Investment subsidy in period *t*-1 to capital		8367	0.004	0.029	0	1.080	2237	0.004	0.022	0	0.371
Non-farm income in period *t*-1 to capital		69	3.284	7.673	0.002	43.538	1350	0.023	0.192	0.001	7.017

We classified farms into sub-samples using five criteria: zero or strictly positive non-farm income, high or low debt, high or low farm size, and positive or negative real growth of farm sales (Table 2).

The percentage of farms with non-farm income in Slovenia is much higher than in Hungary. As the most striking finding, the Slovenian farms with non-zero non-farm income on average have higher net farm income than farms without non-farm income, and vice versa in Hungary. This finding implies that farm pluriactivity with non-farm supplementary activities and off-farm employment and incomes in Slovenia is an important source of higher farm households' net income, while Hungarian farms aims to achieve higher incomes through agricultural activities and farm specialization. Farms in Hungary and Slovenia are eligible for different kind of subsidies, which in Slovenia are higher on farms with non-farm incomes, and vice versa in Hungary. However, in Hungary and in Slovenia subsidies on investment are higher on farms without non-farm incomes. This is also consistent with gross investment, which is higher on farms without non-farm incomes. Farms combine different sources for their investment, including subsidies on investment.

The large majority of Slovenian farms are classified as non high debt farms (88.9%). This percentage for the Hungarian sample of farms is 20.1%. High debts are associated with investments. In Slovenia, the high debt farms invest 3.1 times more, while in Hungary 4.6 times more, than non high debt farms. The high debt farms are also at least twice as great as non high debt farms by each of the presented summary statistics (farm net income and total subsidies).

A slightly higher percentage represents farms, which are classified as non low debt farms: 2.9% in Slovenia and 32.8% in Hungary. They represent an extended sample of high debt farms, which is associated also with their investment activities. In Slovenia, the non low debt farms invest 3.2 times, while in Hungary 5.2 times more than the low debt farms. Non low debts farms have also more than twice as high net farm income as low debt farms. The former also receive much more subsidies than the latter.

Regarding to the size of farms, in Slovenia the larger farms invested four times more and have also more than four times higher net farm income and received twice as much as subsidies than smaller ones. In Hungary larger farms have more than twice times higher net farm income, subsidies and investments than smaller ones.

Table 2. Descriptive statistics by sub-samples

	Hungary		Slovenia	
	Mean (in euro)		Mean (in euro)	
	farms without non-farm income	farms with non-farm income	farms without non-farm income	farms with non-farm income
Net farm income	84475.77	48855.52	24549.02	29909.14
Total subsidies – excluding those on investment	12180.78	5232.087	10030.27	11898.76
Subsidies on investment	940.4731	599.4203	3460.836	1731.359
Gross investment	16613.75	7515.696	17443.38	16486.7
N	9663 farms with non high debt	69 farms with high debt	2008 farms with non high debt	1350 farms with high debt
Net farm income	64775.2	161587.6	26403.92	53631.31
Total subsidies - excluding those on investment	8117.496	28099.31	10668.61	20909.6
Subsidies on investment	590.8386	2319.284	2666.05	11655.28
Gross investment	9657.73	43963.71	16674.02	51592.55
N	7777 farms with non low debt	1955 farms with low debt	3262 farms with non low debt	37 farms with low debt
Net farm income	145648.3	54187.34	59364.33	25742.73
Total subsidies - excluding those on investment	24785.14	5944.097	27857.83	10278.9
Subsidies on investment	1999.338	419.1045	9965.093	2553.662
Gross investment	36127.03	6976.017	51181.5	16054.54
N	3196 farms with size<median	6536 farms wish size>median	96 farms with size<median	3262 farms with size>median
Net farm income	92337.26	142097.4	9920.242	43487.6
Total subsidies - excluding those on investment	29252.66	44490.58	5944.384	15618.51
Subsidies on investment	2239.15	3494.228	889.9946	4641.091
Gross investment	37719.16	62188.61	6775.955	27341.58
N	4848 farms with size<mean	4884 farms with size>mean	1679 farms with size<mean	1679 farms with size>mean
Net farm income	98690.27	207913.4	13562.43	53570.7
Total subsidies - excluding those on investment	31196.5	64653.12	6659.162	19209.15
Subsidies on investment	2296.463	5655.13	1305.169	5751.167
Gross investment	40868.95	94428.38	8332.648	34898.66
N	8073 farms with negative sale growth	1659 farms with positive sale growth	2205 farms with negative sale growth	1103 farms with positive sale growth
Net farm income	103664.8	125704.5	19969.87	29559.75
Total subsidies - excluding those on investment	35502.87	37759.3	10365.47	10957.86
Subsidies on investment	4359.25	1952.111	1596.005	3261.53
Gross investment	56814.23	45806.03	13728.25	18471.2
N	3707	6025	1000	2358

N: number of observations. Farm size is measured by land area. We define high debt and low debt farms with debt-to-asset ratio greater than 0.3 and less than 0.2, respectively.

These summary statistics clearly indicate the similarities and differences in the financial and investment structures of the Slovenian and Hungarian farms. Gross farm investment is associated to net farm income and subsidies on investment. Non-farm income is much more important in Slovenian than in Hungarian farms.

4. ECONOMETRIC RESULTS

The standard augmented accelerator model confirms a positive association between farm investment and real sale growth and cash flow variables, respectively (Table 3). Therefore, our econometric results reject the validity of the soft budget constraint for Hungarian and Slovenian farms. However, they reveal the presence of capital market imperfections for both samples. The farm investments are negatively associated with non-farm income. This supports the second hypothesis suggested in the literature, namely a competition between farm and non-farm activities. However, in this case for Hungary the regression coefficient for real sales become insignificant, while the regression coefficient for cash flow variable changes the sign. On the contrary, in the case of Slovenia, the positive association for cash flow variable strengthened in importance. This suggests that in Hungary non-farm income reduces incentives for farm investments while in Slovenia real farm sales and real cash flows remain significant for farm investments. Farm investments are positively associated with investment subsidies in Slovenia, but not in Hungary.

We use real sales as a farm characteristic to classify farms into two sub-samples: farms with increasing real sales (growing farms) vs. farms with declining real sales (shrinking farms). The positive association between farm investment and real sale growth remains valid in all cases for the growing farms with increasing real sales. In the standard augmented accelerator model for Hungary, the regression coefficient for real sale growth becomes insignificant and close to zero, while for Slovenia it becomes negative and insignificant also in all other cases for farms with the declining real sales. Except for Hungary with non-farm income model specifications, the regression coefficient for cash flow variable remains more stable with the positive significant sign. This implies an absence of soft budget constraints but the presence of capital market imperfections. Interestingly, the regression coefficients for investment subsidies are positive and significant for both farms with increasing and farms with declining real sales in Hungary and Slovenia. The regression coefficients for the association between farm investment and non-farm income are mixed. For Hungary, they are of the negative sign and significant, but with the insignificant negative sign for the cash flow variable. For Slovenia, the regression coefficients for the non-farm income are positive, but insignificant for farms with declining real sales and significant for farms with increasing real sales. This finding confirms the significance of non-farm incomes, in addition to real sales and cash flow, for the growing Slovenian farms in terms of growth in real sales.

Table 3. Fixed effect model results for the full sample and for sub-samples depending on increasing vs. decreasing real sales

	Standard augmented accelerator (equation (2))	Including investment subsidy at *t*	Including non-farm income at *t*-1	Including investment subsidy at *t*-1	Standard augmented accelerator (equation (2))		Including investment subsidy at *t*		Including non-farm income at *t*-1	
	Full sample	Full sample	Full sample	Full sample	Farms with negative sale growth	Farms with positive sale growth	Farms with negative sale growth	Farms with positive sale growth	Farms with negative sale growth	Farms with positive sale growth
HUNGARY										
Sale growth $_{t,t-1}$	0.126***	0.147***	0.171	0.125***	0.003	0.209***	0.124***	0.197***	0.496*	0.237***
Cash flow $_{t-1}$	0.085***	0.079***	-0.039***	0.081***	0.044**	0.076***	0.046**	0.071***	-0.245	-0.085
Investment subsidy		2.543***		-0.173**			2.068***	3.026***		
Non-farm income			-0.004**						-0.007**	-0.003**
Constant	0.056***	0.042***	0.038	0.058***	0.085***	0.028***	0.052***	0.024***		0.046
N	5911	5911	54	5911	2737	3174	2737	3174	28	26
R^2	0.0015	0.1134	0.2496	0.0011	0.0031	0.0070	0.1888	0.0728	0.2246	0.2445
Hausman test (p-value)	0.0000	0.0000		0.0000						
SLOVENIA				Invsubsidy $_{t-1}$	negative sales	positive sales	negative sales	positive sales	negative sales	positive sales
Sale growth $_{t,t-1}$	0.314***	0.267***	0.177**	0.327***	-0.081	0.551***	-0.001	0.459***	-0.060	0.766***
Cash flow $_{t-1}$	0.076***	0.081***	0.475***	0.075***	0.675***	0.497***	0.611***	0.485***	0.908***	0.167*
Investment subsidy		1.450***		0.527**			1.137**	1.493***		
Non-farm income			-0.478***						0.510	1.440*
Constant	0.022***	0.020***	0.031***	0.019***	0.013	-0.011	0.008	-0.008	-0.019	-0.049**
N	1407	1407	840	1407	661	746	661	746	396	444
R^2	0.1192	0.2049	0.0963	0.1306	0.2898	0.1657	0.3138	0.2367	0.4454	0.1716
Hausman test (p-value)	0.0000	0.0000	0.0000	0.0000						

Dependent variable: gross investment$_{t,t-1}$ to capital. All explanatory variables are divided by capital. N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels.

Following Benjamin and Phimister (2002) we impose outlier rules to exclude farms if their investment capital ratio is above 99% in absolute value (Table 4). The regression coefficients for real sale growth are of a positive sign and significant in all specified cases. The regression coefficient for the cash flow variable remains with the similar sign, but in the case of non-farm income it becomes insignificant. For Slovenia, the regression coefficients are slightly lower. The regression coefficients for investment subsidy are of a similar sign, but the negative sign is insignificant. For Slovenia, it becomes also of a negative sign and insignificant. Finally, the regression coefficient for non-farm income remains of a negative sign and significant.

Table 4. Fixed effect model results for the full sample without farms for which the investment capital ratio is above 99% in absolute value

	Standard augmented accelerator (equation (2))	Including investment subsidy at *t*	Including non-farm income at *t*-1	Including investment subsidy at *t*-1
HUNGARY				
Sale growth $_{t,t-1}$	0.101***	0.118***	0.236***	0.101***
Cash flow $_{t-1}$	0.053***	0.050***	-0.111	0.052***
Investment subsidy		2.381***		-0.044
Non-farm income			-0.004***	
Constant	0.057***	0.045***	0.063***	0.058***
N	5883	5883	54	5883
R^2	0.0016	0.1106	0.1935	0.0014
Hausman test (p-value)	0.0000	0.0000	0.0000	0.0000
SLOVENIA				Invsubsidy $_{t-1}$
Sale growth $_{t,t-1}$	0.339***	0.282***	0.249***	0.337***
Cash flow $_{t-1}$	0.023*	0.030**	0.090***	0.022*
Investment subsidy		1.231***		-0.292
Non-farm income			-0.099***	
Constant	0.018***	0.018***	0.025***	0.019***
N	1403	1403	837	1403
R^2	0.1316	0.2221	0.0967	0.1279
Hausman test (p-value)	0.0000	0.0000	0.0000	0.0000

Dependent variable: gross investment$_{t,t-1}$ to capital. All explanatory variables are divided by capital. N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels.

Moreover, we split our FADN sample into two sub-samples depending on farm indebtedness to classify farms as high debt vs. low debt farms that can be considered to differ in their financial constraints. Similar as Benjamin and Phimister (2002) we define high debt and low debt farms with debt-to-asset ratio greater than 0.3 and less than 0.2, respectively.

Gross farm investment is positively associated with real sale growth, but the regression coefficients are insignificant for Slovenian high debt farms as well as for Hungarian high debt farms in the case of the standard augmented accelerator model, with investment subsidies and when estimated by OLS (Table 5). The regression coefficients for the cash flow variables, except for Hungary when estimated by OLS and for Slovenia for high debt farms estimated by OLS, are of a positive sign and significant. The regression coefficients for the investment subsidy variable are mixed. For Hungary they are of a positive sign and significant, except when lagged investment subsidy variable is used. For Slovenia, for high debt farms the regression coefficients are insignificant, while for low debt farms they are significant, but of the opposite signs: a positive sign for investment subsidy and a negative sign for lagged investment subsidy. The regression coefficients for non-farm income are of a negative sign, but significant only for high debt farms for Hungary and low debt farms in Slovenia.

Table 5. Fixed effect model results for the sub-samples depending on indebtedness

	Standard augmented accelerator (equation (2))		Including investment subsidy at *t*		Including investment subsidy at *t-1*		Including non-farm income at *t*-1	
	Farms with high debt	Farms with low debt	Farms with high debt	Farms with low debt	Farms with high debt	Farms with low debt	Farms with high debt	Farms with low debt
HUNGARY								
Sale growth $_{t,t-1}$	0.073	0.160***	0.100**	0.172***	0.074	0.160***	-0.202	0.186
Cash flow $_{t-1}$	0.097***	0.169***	0.102***	0.162***	0.102***	0.172***	-0.028	-0.106
Investment subsidy			2.774***	2.258***	0.181	0.085		
Non-farm income							-0.006*	-0.001
Constant	0.101***	0.033***	0.078***	0.024***	0.100***	0.032***	0.297***	0.039
N	1214	3939	1214	3939	1214	3939	11	36
R^2	0.0065	0.0085	0.0637	0.0876	0.0056	0.0090	0.4121	0.0445
SLOVENIA								
Sale growth $_{t,t-1}$	0.271	0.337***	0.982	0.325***	0.288	0.335***	0.364	0.212***
Cash flow $_{t-1}$	1.128***	0.023*	1.091**	0.031***	1.120***	0.023*	2.062	0.105***
Investment subsidy			-2.061	1.135***	0.331	-0.470**		
Non-farm income							-3.440	-0.115***
Constant	0.041	0.018***	-0.074	0.014***	0.036	0.020***	0.028	0.027***
N	20	1361	20	1361	20	1361	16	808
R^2	0.3203	0.1211	0.3734	0.2189	0.3225	0.1125	0.1027	0.0684

Dependent variable: gross investment$_{t,t-1}$ to capital. All explanatory variables are divided by capital. N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels.

The re-estimated adapted standard augmented models by the dynamic panel data model (GMM-SYS) confirm the positive and significant association between farm gross investment and farm real sale growth (Table 6). Farm gross investment is positively associated with cash flow, but the regression coefficients in the standard augmented accelerator model as well as with the additional investment subsidy variable are insignificant for Slovenia. Farm gross investment is found to be positively and significantly associated with investment subsidies both for Hungary and Slovenia. The negative and significant association between gross farm investment and non-farm income is confirmed only for Slovenia. These results reject the validity of the soft budget constraints for Hungarian farms and to a lesser extent for Slovenian farms, and confirm the presence of capital market imperfections and the competition between farm and non-farm activities.

Table 6. Dynamic Panel Model (GMM-SYS) results for the full sample

	Standard augmented accelerator (equation (2))	Including investment subsidy at *t*	Including non-farm income at *t*-1
HUNGARY			
Sale growth $_{t,t-1}$	0.233***	0.227***	
Cash flow $_{t-1}$	0.529***	0.457***	
Investment subsidy		2.954***	
Non-farm income			
Constant	-0.027*	-0.030**	
N	5911	5911	
Wald test (p-value)	0.0000	0.0000	
Sargan test (p-value)	0.5729	0.1741	
Arellano-Bond test for Ar(2) (p-value)	0.7925	0.2325	
SLOVENIA			
Sale growth $_{t,t-1}$	0.320***	0.252**	0.211*
Cash flow $_{t-1}$	0.074	0.054	0.601***
Investment subsidy		0.946***	
Non-farm income			-0.613***
Constant	0.013	0.018	0.005
N	1407	1407	840
Wald test (p–value)	0.0043	0.0004	0.0000
Sargan test (p-value)	0.0250	0.0197	0.1620
Arellano-Bond test for Ar(2) (p-value)	0.0152	0.0116	0.2753

Dependent variable: gross investment$_{t,t-1}$ to capital. All explanatory variables are divided by capital. N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels.

The sample selection models based on the bootstrapped standard errors estimates provide all significant regression parameters at 1% significance level (Table 7). The positive association between gross farm investment and real sale growth is confirmed. Farms in both countries based their investment decisions on market conditions. The positive association between gross farm investment and cash flow also rejects the validity of the soft budget constraints but confirms the presence of capital market imperfections. Finally, the results for Slovenia indicate that investment subsidies are positively associated with gross farm investment, while non-farm income is negatively associated with gross farm investment. Therefore, we cannot confirm that non-farm income in the Slovenian farms is invested into farm activities, but they are likely to contribute to the well-being of farm households' members.

Table 7. LSDVC sample selection models results for the full sample

	Standard augmented accelerator (equation (2))	Including investment subsidy at *t*	Including non-farm income at *t*-1
HUNGARY			
Sale growth $_{t,t-1}$	0.154***	0.175***	
Cash flow $_{t-1}$	0.228***	0.233***	
Investment subsidy		2.656***	
Non-farm income			
N	5883	5883	
SLOVENIA			
Sale growth $_{t,t-1}$	0.314***	0.279***	0.162**
Cash flow $_{t-1}$	0.063***	0.065***	0.565***
Investment subsidy		1.471***	
Non-farm income			-0.570***
N	1407	1407	840

Dependent variable: gross investment$_{t,t-1}$ to capital. All explanatory variables are divided by capital. N: number of observations. ***/**/*: statistically significant, respectively at the 1%, 5%, and 10% levels, based on bootstrapped standard errors with 500 replications.

5. CONCLUSION

We use an adapted augmented accelerator model of gross farm investment for a panel data of Hungarian and Slovenian farms for the years 2004-2008 to investigate the impact of non-farm income on gross farm investment. We use different econometric estimation approaches to test the sensitivity and robustness of our econometric results.

We find different nature of farms in Hungary and Slovenia. Non-farm income is more important for Slovenian than for Hungarian farms, and the Slovenian farms with non-farm income on average have higher net farm income than farms without non-farm income, and vice versa in Hungary. Similarly investment subsidies in Slovenia are higher on farms with non-farm income, and vice versa in Hungary. On average smaller Slovenian farms are of more multifunctional activities, while on average larger Hungarian farms are more specialised into agricultural activities.

Both for Hungary and Slovenia subsidies for investments are higher on farms without non-farm income. Gross farm investment is also higher on farms without non-farm income. Farm indebtedness is associated with farm investment. Farm engaged in investment are greater by size than farms without investment. Farms combine different sources for their investment, including subsidies on investment.

Farm gross investment is positively associated with real sale growth suggesting that farm investment decisions are based on market conditions. The association is also positive with cash flow, implying the absence of the soft budget constraints and the presence of capital market imperfections limiting investment expenditures. Gross farm investment is negatively associated with non-farm income, but a positively associated with investment subsidies. This reveals that, in opposite to the majority of findings from studies in developing countries and transition countries, non-farm income is not used as a substitute to credit to cover investment expenditures in the presence of capital market imperfections. By contrast, our results suggest that in the specific period of post-accession to the EU, there is a competition between farm and non-farm activities in Hungarian and Slovenian activities. Although public programmes to support farm investment (investment subsidies) seem to be successful in enhancing investment in these countries, policies should take into account the role of growing off-farm

employment opportunities in farmers' decisions, as this situation may result in disinvestments and slower restructuring in the farming sectors.

References

Arellano, M. and O. Bover (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics* 68: 29-51.

Ahituv, A., Kimhi, A. (2002). Off-farm work and capital accumulation decisions of farmers over the life-cycle: the role of heterogeneity and state dependence. *Journal of Development Economics* 68(2): 329-353.

Bakucs, L. Z., Fertő, I. and Fogarasi, J. (2009). Investment and financial constraints in Hungarian agriculture. *Economics Letters* 104: 122–124.

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* 84: 1115–1129.

Blundell, R. and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* 87: 115–143.

Bojnec, Š. and Latruffe, L. (2007). Investment of Slovenian farms in the transition context. In: Agricultural economics and transition: "What was expected, what we observed, the lessons learned". EAAE Seminar. Budapest: Corvinus University.

Bruno, G.S.F. (2005a). Approximating the bias of the LSDV estimator for dynamic unbalanced models. *Economics Letters* 87: 361–366.

Bruno, G.S.F. (2005b). Estimation and inference in dynamic unbalanced panel data models with a small number of individuals. *The Stata Journal* 5: 473–500.

Budina, N., Garretsen, H. and de Jong, E. (2000). Liquidity constraints and investment in transition economies. The case of Bulgaria. *Economics of Transition* 8: 453–475.

Christensen, G. (1989). *Determinants of Private Investment in Rural Burkina Faso*. Ph.D. Thesis, Cornell University, United States.

Deininger, K. and Olinto, P. (2001). Rural nonfarm employment and income diversification in Colombia. *World Development* 29(3): 455-465.

Fazzari, S., Hubbard, G. and Petersen, B. (1988). Financing constraints and corporate investment. *Brookings Papers on Economic Activity* 19: 141–195.

Hertz, T. (2009). The effect of nonfarm income on investment in Bulgarian family farming. *Agricultural Economics* 40(2): 161-176.

Holden, S., Shiferaw, B. and Pender, J. (2004). Non-farm income, household welfare, and sustainable land management in a less-favoured area in the Ethiopian highlands. *Food Policy* 29(4): 369-392.

Konings, J., Rizov, M. and Vandenbussche, H. (2003). Investment and financial constraints in transition economies: micro evidence from Poland, the Czech Republic, Bulgaria and Romania. *Economics Letters* 78: 253–258.

Kornai, J. (2001). Hardening the budget constraints: The experience of the post socialist countries. *European Economic Review* 45: 1573–1599.

Kornai, J., Maskin, E. and Roland, G. (2003). Understanding the soft budget constraint. *Journal of Economic Literature* 41: 1095–1136.

Latruffe, L. (2005). The impact of credit market imperfections on farm investment in Poland. *Post-Communist Economies* 17: 350–362.

Latruffe, L., Davidova, S., Douarin, E. and Gorton, M. (2010). Farm expansion in Lithuania after accession to the EU: The role of CAP payments in alleviating potential credit constraints. *Europe-Asia Studies* 62(2): 351-365.

Lizal, L. and Svejnar, J. (2002). Investment, credit rationing and soft budget constraint: Evidence from Czech panel data. *Review of Economics and Statistics* 84: 353–370.

Petrick, M. (2004). Farm investment, credit rationing, and governmentally promoted credit access in Poland: A cross-sectional analysis. *Food Policy* 29: 275–294.

Reardon, T. (1997). Using evidence of household income diversification to inform study of the rural nonfarm labor market in Africa. *World Development* 25(5): 735-747.

Reardon, T., Crawford, E. and Kelly, V. (1994) Links between nonfarm income and farm investment in African Households: Adding the capital market perspective. *American Journal of Agricultural Economics* 76(5): 1172-1176.

Rizov, M. (2004). Firm investment in transition. Evidence from Romanian manufacturing. *Economics of Transition* 12: 721–746.

Rizov, M., Gavrilescu, D., Gow, H., Mathijs, E. and Swinnen, J. (2001). Transition and enterprise restructuring: The development of individual farming in Romania. *World Development* 29(7): 1257-1274.

Rosenzweig, M. and Wolpin, K. (1993). Credit market constraints, consumption smoothing, and the accumulation of durable production assets in low-income countries: investments in bullocks in India. *Journal of Political Economy* 101(2): 223-244.

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics* 126: 25-51.