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Research Report

Structural change in Europe's rural regions: Farm livelihoods between subsistence orientation, modernisation and non-farm diversification

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Farm livelihoods between subsistence orientation, modernisation and non-farm diversification

Edited by

Gertrud Buchenrieder and Judith Möllers

LEIBNIZ-INSTITUT FÜR AGRARENTWICKLUNG IN MITTEL- UND OSTEUROPA

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"The New Landscape of Global Agriculture"

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"Structural change in Europe's rural regions –

Farm livelihoods between subsistence orientation,

modernisation and non-farm diversification"

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The majority of the contributions emerge from two structured research frameworks. The first is the scientific network and research of an ongoing (2007-2009) EU-financed FP6 project on "Structural Change in Agriculture and Rural Livelihoods" (SCARLED). SCARLED addresses past and future key social and agricultural restructuring processes for a living countryside in the NMS of the EU. Methodologically, the topic is approached by comparative, structured multi-country farm surveys (in Bulgaria, Hungary, Poland, Romania, Slovenia) as well as case studies on rural development in selected regions of five established Member States (from Austria, Ireland, the new German Bundesländer, Spain, and Sweden). The other is the Graduate School "Prospects for small-scale farm structures in the New Member States of the European Union", which was installed at the Leibniz Institute for Agricultural Development in Central and Eastern Europe (IAMO) in 2007. It looks at the lessons to be learned from a selection of countries that spans from the EU-15 member states, Austria and Germany across the NMS Bulgaria, Hungary, Poland and Romania to the non-member region Kosovo. One contribution is an outcome of the EU tender project "Sustainability of Semi-Subsistence Farming Systems in New Member States and Acceding Countries (S-FARM)" funded and coordinated by the Institute for Prospective Technological Studies (IPTS) in Seville, Spain.

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Halle (Saale), July 20, 2009 *Gertrud Buchenrieder & Judith Möllers*

IAMO Graduate School
Prospects for small-scale farm structures in the New Member States of the EU
financed by the Leibniz Pact for Innovation and Research

SCARLED
Structural Change in Agriculture and Rural Livelihoods

IAMO
LEIBNIZ-INSTITUTE OF AGRICULTURAL DEVELOPMENT IN CENTRAL AND EASTERN EUROPE

Foreword to

Structural change in Europe's rural regions - Farm livelihoods between subsistence orientation, modernisation and non-farm diversification

Since 2004, the European Union (EU) has undergone an unprecedented enlargement, reuniting the Western and Eastern parts of the continent. Subsequently, the share of rural areas and of those employed in agriculture grew notably in the EU-27. Europe's rural areas represent 93% of the territory in EU-27 and about 58% of the population live in predominantly and significantly rural areas. Rural areas generate 45% of gross value added in EU-27 and 53% of the employment, but tend to lag behind urban areas for a number of important socio-economic indicators such as income, activity rates and access to services (EC, 2008). The new Member States (NMS) in Central and Eastern Europe have already undergone substantial sector restructuring and socio-economic transformation (Rozelle and Swinnen, 2004). Nevertheless, as regards the agricultural sector and rural livelihoods, a great number of them still display a tremendous disparity as compared to the EU15-average. For instance, the share of those employed in agriculture ranges from 4.8% in the Czech Republic to 42.7% in Romania. The EU15 employs, on average, about 4% of the workforce in the agricultural sector (Copus et al., 2006). In addition, the average farm size in the NMS10 (pre-2007) is approximately five hectares, and 27% of the land is cultivated by farms smaller than five hectares (Davidova, 2005). Often, the rural economy can not sufficiently support rural livelihoods. Especially, those living from (semi-) subsistence farming are prone to low productivity, low incomes and vulnerable livelihoods. Therefore, it is important that the ground is prepared for significant structural changes in the labour force, farming structures, and the wider rural economy. If structural change does not take place, rural areas in the NMS will continue to lose attractiveness and competitiveness.

Particularly in Eastern Europe we find the phenomenon of a re-orientation towards farming and the existence and persistence of a large number of tiny (semi-) subsistence farms. Effective rural policies have to consider that these farms do not necessarily react to the same policy signals as larger scaled (commercial) farms. When farming incomes are small, the functioning and continuous development of rural labour markets is important. Non-farm activities could play a decisive role for rural development by allowing families to overcome poverty and, in the medium term, possibly exit the farming sector and thus allowing more competitive farms to grow. Some of the developments that we observe and expect to happen in the NMS are comparable to earlier experiences in the EU-15. These experiences could give hints how successful change can be effectively implemented.

Structural change in agriculture[1], let alone in rural economies, is a complex phenomenon. Structural change affects rural livelihoods through changes in agricultural productivity and profitability, and in wider rural labour markets. There is little consensus on how to judge structural change. For instance, efficiency-increasing structural change, in terms of a better allocation of resources, might be desirable from a pure economic point of view. Yet, the decreased labour demand may make smaller-scale, part-time farm households to losers, especially if the wider rural labour market is weak. Furthermore, some argue, it is the smaller-scale subsistence and (semi-) subsistence farming households that contribute most to a living countryside. Whatever the effects of structural change in agriculture and rural livelihoods are and how they might be judged, understanding the driving factors, obstacles and pathways and their interactions is crucial. Therefore this mini-symposium aims at stimulating a discussion on possible developments and success factors of rural development in an enlarged Europe.

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[1] Structural change in agriculture is characterised by constant changes in the deployment of production factors. It manifests itself in a clear change in the structure of production. Within agriculture the size of the workforce and the number of farms are reduced. In relation to the national economy, the proportion of those employed in agriculture falls.

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List of abbreviations

AFS	Average farm size
AWU	Annual work units
BMW	Border, Midlands and Western, Ireland
CAP	Common Agricultural Policy
CEE	Central and Eastern Europe
CHP	combined heat and power units
CUB	Corvinus University Budapest
dena	Deutsche Energie-Agentur
EEG	Erneuerbare Energien Gesetz
ESU	European Size Unit
EU	European Union
FSS	Farm Structure Survey
GAMS	General Algebraic Modeling System
GDP	Gross domestic product
GVA	Gross value added
IAAE	International Association of Agricultural Economist
IAMO	Leibniz Institute for Agricultural Development in Central and Eastern Europe
IPTS	Institute for Prospective Technological Studies
JRC	Joint Research Center
KU Leuven	Catholic University Leuven, Centre for Transition Economic
LAG	Local action group
LEADER	Liaison entre actions de développement de l´économie rurale
LFA	Less favoured areas
MDG	Millennium Development Goals
MOLP	Muliobjective linear programing
NEP	National Energy Saving Plan
NMS	New member states
NUTS	Nomenclature des unités territoriales statistiques
OGA	Other gainful activities
PPP	Purchasing power parity
PPS	purchasing power standard
RDR	Rural Development Regulation
RES	Renewable Energy Strategy
RHS	Right-hand side
SCARLED	Structural change in agriculture and rural livelihoods
S-FARM	Sustainability of semi-subsistence farming systems in new member states and acceding countries
SFH	Semi-subsistence farm household
SGM	Standard gross margin

UAA	Utilised agricultural area
UNDP	United Nations Development Programme
UNEW	University of Newcastle upon Tyne
UNIKENT	University of Kent
UNWE	University of National and World Economy
USAMVB	Banat's University of Agricultural Sciences and Veterinary Medicine Timisoara
VIF	Variance inflation factor
WUDES	Warsaw University, Department of Economic Sciences

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Can we really talk about structural change? The issue of small-scale farms in rural Poland

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Abstract

From the beginning of transition to the market economy, Polish agriculture has undergone substantial structural changes. However, most of the macro-indicators characterizing the agricultural structure in Poland still point to profound socio-economic problems. According to the Central Statistical Office, in 2007 there were approximately 900,000 agricultural households, or 38% of all farms in Poland, that consumed more than 50% of the value of their agricultural production. Given this situation, the question arises whether we can truly talk about structural change in Polish agriculture or whether Poland merely faces two distinct groups of farm structures, small and large?

Key words: structural change, small-scale farms, agriculture, Poland

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1 Introduction

Five years have passed since the accession of Poland to the European Union (EU) and the introduction of the Common Agricultural Policy (CAP) measures in Polish agriculture. Despite billions of Euros being allocated to measures of both Pillars (Pillar 1: market policy and Pillar 2: rural development policy) most of the macro-indicators characterizing the Polish agricultural sector still point to profound structural problems.

The first part of the contribution is focused on the general structural problems of the Polish agricultural sector. The next portion concerns the theoretical aspects of the term 'structural change' and some controversies over understanding this process in Poland. The analysis in the third section refutes the myth of average farm size being a measure of structural changes in Polish agriculture. The last portion presents various dimensions of structural changes that have occurred in Poland since EU accession. This analysis is based on the latest available data from the Farm Structure Surveys of 2005 and 2007.

2 Structural problems of Polish agriculture

Poland, due to its historical heritage of an abundance of small and highly fragmented private farms[1], began the transition process with an unfavorable agrarian structure. Since 1989 the total number of private farms has been constantly decreasing, in 2007 reaching slightly more than 2.5 million. Considering private farms, between 1990 and 2007, more than 330,000 of them possessing over 1 ha, and about 900,000 smaller than 1ha have disappeared. Since 1996 the acreage of total agricultural land utilized in private farms has dropped by 800,000 ha. A significant decrease of employment in agriculture, from over 25% in 1996 to less than 15% in 2007, has been also observed. The share of agriculture in gross value added has decreased twice between 1996 and 2007, to 4.3% (Table 1).

[1] Private farms are understood as an agricultural holding from 0.1 ha of agricultural land, being exclusive property or used by natural person or group of persons as well as an agricultural holding of person having no agricultural land or with agricultural land less than 0.1 ha who has at least: 1 head of cattle or (and) 5 heads of pigs or 1 sow or (and) 3 heads of sheep or goats or (and) 1 horse or (and) 30 heads of poultry or (and) 1 ostrich or (and) 5 females of fur animals (rabbits included) or (and) 3 heads of animals kept for slaughter or (and) 1 beehive.

Table 1 Agricultural structure in Poland (1990-2007)

	1990	1996	2000	2004	2006	2007
Private farms	3 829 000	3 066 535	2 854 374	2 839 664	2 594 579	2 575 113
including:						
< 1 ha	1 691 000	1 025 155	973 492	987 887	788 184	771 050
≥1 ha	2 138 000	2 041 380	1 880 882	1 851 777	1 806 395	1 804 065
Agricultural land (mln ha) in private farms	18.5[a]	15.2	15.5	14.3	14.1	14.4
Average area of agricultural land in private farm (ha)	-	4.96	5.43	5.04	5.43	5.59
Employment in agriculture (% of total employed persons – annual average) [b]	-	25.5[c]	25.8	15.6	15.3	14.8
Share in gross value added (current prices) of agriculture, hunting and forestry (%)	-	8.0[c]	4.9	5.1	4.2	4.3
"price gap" [e]	100	93.4[c]	74.0	65.7	64.4	69.0

Source: Statistical Yearbooks of Central Statistical Office, Statistical Yearbook of Agriculture and Rural Areas, Agricultural Census 1996 and 2002.

Notes: a) In agricultural holdings;
b) Data regarding employed persons on private farms in agriculture for 2002/2006 are not strictly comparable to those for previous years;
c) data for 1995;
d) Data are compiled Population and Housing Census 2002 as well as the Agricultural Census 2002, in the denominator — of the Agricultural Census 1996;
e) Index of price relations of sold agricultural products to goods and services purchased by private farms in agriculture – 1990=100

Structural adjustments in agriculture are in most cases analyzed in reference to agricultural employment and farm size. These two structural aspects may be joined in one simple measure – average utilized area (Rosner, 2001). Despite considerable changes, the average area of agricultural land utilized by private farms has exhibited surprising stability and increased by only 0.63 ha between 1996 and 2007. This is mainly due to a dual structural arrangement that has distinguished Polish agriculture during transition. Its elements consist of viable farms (estimated at 600-800,000) and the social agricultural sector (1.3-1.5 million). The latter group plays two roles: they contribute to the family's well-being, assuring the economic existence of its members; they absorb and keep hundreds of thousands persons who otherwise would be unemployed (Woś, 2003).

As a result of structural problems, Polish agriculture still has unfavorable relations between the share of agriculture in gross domestic product (GDP) and its share of total employment. Another interrelated problem refers to the excessive production capacities of the Polish agricultural sector compared to market demand (besides the possibility of exporting to EU markets, agricultural producers encounter difficulties in selling their products).

3 Ambiguity of structural changes in Polish agriculture

Traditionally, with regard to farming, the term 'structure' is understood as the allocation of land, and thus concerns mainly farm size. However, as a result of technological progress in agriculture, the importance of land resources has significantly diminished. Nowadays, a much broader approach prevails, encompassing economical factors of production[2], production trends, sales figures and types of connections with the market (Szemberg, 1998). Therefore, the main aspects of structural transformation in agriculture should refer to the optimal allocation of production factors, which are adequate to the specificity of the given farm. Moreover, besides changes inside the farm, structural transformation concerns the evolution of closer and further socio-economic environments within rural areas (Woś, 2003). Structural change in agriculture is a complex phenomenon, under which we should understand the whole picture of changing variables describing the agro-food sector and its wider role in the economy of rural areas.

During the debates over what is the most desirable structural change in Polish agriculture, the answer is generally accepted, and states that concentration is one of the main processes leading to an improvement in the structure of 'peasant farming' (Frenkel and Rosner, 1999).

Concentration of production is very often viewed as a simple function of land consolidation, but this is an unjustified simplification. Of course, concentration of land is a very important aspect of structural change, but it is neither the only nor always the main. Concentration of production may sometimes be achieved without enlarging the utilized area, e.g., it may be achieved by intensifying production in some farms and by various forms of formal and informal

[2] These are natural resources, physical capital, financial capital, human capital and social capital.

cooperation between agrarian producers, suppliers of inputs and the agricultural processing industry. Another simplification concerns the problem of land concentration, and the opinion that it can be solely achieved by increasing the average farm size. However, concentration should be interpreted more carefully. It is possible to achieve concentration through polarizing the area's structure: increasing the area of the smallest and the largest farms and reducing the area of the medium-sized farms. In this situation, concentration can take place without increasing the average farm size. One more simplification appears when the concept of agrarian structure transformation is reduced merely to change of utilized area. Meanwhile, structural change should include the evolution of farm functions with regard to the importance of farming as a main or supplementary source of family income (Frenkel and Rosner, 1999). This process particularly determines the emergence of different farm structures across the country, which is adjusted to specific local conditions.

4 The 'myth' of average farm size[3]

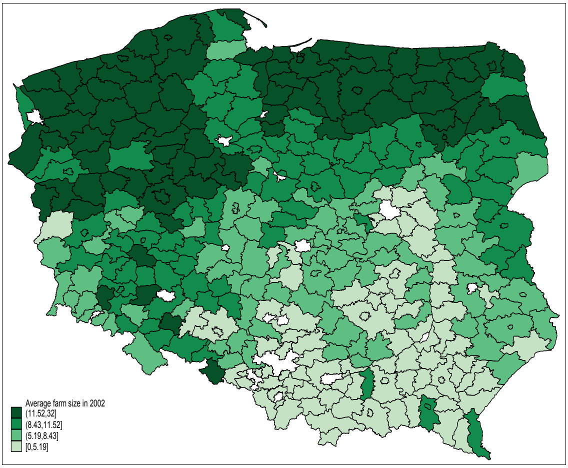
There is no such thing as average for Polish agriculture! This is true for many different indicators describing features of the Polish agricultural sector, but especially concerning the average acreage owned by farms. Data from the Agricultural Census conducted in 2002 reveal the spatial diversity of average farm size by Poviats (NTS-4[4]) (Figure 1). The north and west parts of Poland are characterized by much larger farms than the country's average (from 11.5 to 32 ha), due to the presence of bigger state-owned farms mostly privatized and taken over by private farms during transition. In the central and southwest regions, the size of farms is mostly close to the country average. In the southeast Poviats the majority of farms represent 'weak' agrarian structures with an area below the country's average.

Comparison of the data from both Agricultural Censuses 1996 and 2002 reveal another interesting fact on the average farm size. Table 2 presents the relative changes of this measure (AFSyear – Average Farm Size in the given year) that have occurred between surveys. In 16% of Poviats, a decrease in average farm size was recorded. Subsequently, in 74% of Poviats, AFS increased by 0 – 20%,

[3] Average farm size in Poviat is calculated as a quotient of total acreage of agricultural land and total number of holdings.
[4] NUTS = Nomenclature des unités territoriales statistiques.

while in only 9% of Poviats it increased by more than 20%. At the same time, average farm acreage in the country increased by 6% (CSO, 2003).

Figure 1 Average farm size in Poviats (NTS-4) in 2002



Source: Own depiction based on data from the Agricultural Census 2002.

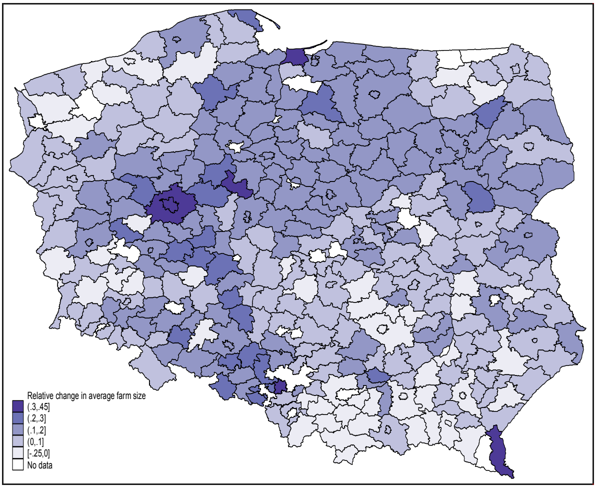
Table 2 Relative changes in average farm size (1996-2002)

$(AFS_{2002} - AFS_{1996})/AFS_{1996}$	No./share of Poviats
[-0.25, 0]	50 / 16%
[0, 0.1]	117 / 38%
[0.1, 0.2]	112 / 36%
[0.2, 0.3]	23 / 7%
[0.3, 0.45]	5 / 2%

Source: Own calculation based on data from the Agricultural Census 1996 and 2002.

Figure 2 confirms that the most significant changes in average farm size occurred in those parts of the country where the land from state farms was accessible. Unfortunately, in Poviats where the farm structure was already highly fragmented (in the southeast regions), a decrease of average size was recorded.

Figure 2 Relative changes in average farm size (1996-2002)



Source: Own depiction based on data from the Agricultural Census 2002.

Obviously, changes of average farm size are dependent on the changes in total number of farms belonging to the specific area groups. However, it is more complicated to indicate the area groups which have a significant influence on average farm size. This problem is tested by the following linear regression model:

(1) $$Y = \sum_{i}^{4} \beta_i \times \text{change\_}\textit{area group}_i$$

(2) $$Y = \sum_{i}^{7} \beta_i \times \text{change\_}\textit{area group}_i$$

Y = relative change in average farm size (AFS) in particular Poviat (AFS2002 - AFS1996) / AFS1996)

β_i = coefficient for the ith change_area_group

change_*area_group*$_i$ = change in share of private farms belonging to respective area group in total number of private farms in particular Poviat (number of farms_*area_group*$_{2002}$ / total number of Farms$_{2002}$ - number of farms_*area_group*$_{1996}$ / total number of Farms$_{1996}$)

Due to the existence of collinearity[5], one independent variable is removed in each model: change_15-50ha from model (1)d change_20_50ha from model (2). Both models are significant and explain: (1) – 43% and (2) – 48% of the variance of the relative change in average farm size (Table 3). The results of model (1) indicate that all variables influence significantly changes in 'AFS', but in the case of changes in number of farms from area groups 1-5 ha and 5-15 ha, dependency is negative and from the group over 50 ha, dependency is positive. In model (2), variables 'change_1-5ha', 'change_5-10ha' and '10-15ha' are significant and negatively influence changes in 'AFS', and variable 'change_50-100ha' is significant and positively influences 'AFS'(Table 3).

Both models give very similar results, and prove that between 1996 and 2002 only changes in the number of the smallest farms (negatively) and in the number of the largest farms (positively) significantly influenced relative changes in average farm size. This result also proves that in case of a simultaneous increase in the number of small and large farms (polarization of agrarian structure) in proper proportions, both effects can cancel each other out and the average farm area in Poland may remain relatively stable.

In fact, according to data presented in Table 4, between 1996 and 2002, the polarization of agrarian structure was observed: there was almost a 12% increase in the number of private farms possessing 1-2 ha, 27.7% of 20-50 ha farms, and 92% for farms larger than 50ha. Meanwhile, a decrease in the number of farms possessing 2-20 ha was noted.

However, since 2002, a tendency other than the polarization of acreage structure can be noticed. Positive changes in the number of private farms occurred in the medium area group (10-15 ha) and those above 20 ha. Calculation of dynamics based on data from the latest Farm Structure Survey 2007 clearly reveals the new trend in the structural arrangement in Polish agriculture. Between 2005 and 2007, there was a significant increase in the number of medium farms and a high increase in number of large farms (≥ 50 ha).

[5] High values of Variance Inflation Factor (VIF) indicate collinearity between independent variables. Elimination of selected variables reduced R^2 and adjusted R^2 only marginally.

Table 3 Determinants of changes in average farm size (AFS) in Poland (1996-2002)

Independent variable (t-Statistics) [p-value] (n=307)	**Model (1)**	**Model (1) (no collinearity)**	**Model (2)**	**Model (2) (no collinearity)**
Change_1-5ha	**-4.052088** (-3.60) [0.000]	**-1.956463** (-13.22) [0.000]	**-2.533633** (-2.08) [0.038]	**-2.636722** (-9.60) [0.000]
change_5-10ha	- - -	- - -	**-1.204524** (-1.00) [0.316]	**-1.304884** (-4.00) [0.000]
change_5-15ha	**-3.270636** (-2.95) [0.003]	**-1.214523** (-6.51) [0.000]	- - -	- - -
change_10-15ha	- - -	- - -	**-2.177446** (-1.63) [0.105]	**-2.289104** (-6.11) [0.000]
change_15-20ha	- - -	- - -	**-1.25419** (-1.09) [0.275]	**-1.330764** (-1.82) [0.070]
change_15-50ha	**-2.084029** (-1.88) [0.061]	- - -	- - -	- - -
change_20-50ha	- - -	- - -	**0.1140962** (0.09) [0.931]	- - -
change_50-100ha	- - -	- - -	**2.978105** (1.88) [0.062]	**2.887577** (2.42) [0.016]
change_>50ha	**1.701256** (1.55) [0.122]	**3.554282** (7.38) [0.000]	- - -	- - -
change_>100ha	- - -	- - -	**-2.381359** (-1.23) [0.220]	**-2.437566** (-1.34) [0.182]
_constant	**0.0621931** (7.91) [0.000]	**0.0629599** (7.99) [0.000]	**0.0690331** (8.43) [0.000]	**0.0690573** (8.45) [0.000]
R^2	**0.4401**	**0.4336**	**0.4799**	**0.4799**
Adjusted R^2	0.4327	0.4280	0.4677	0.4695
F-statistics (p-value)	59.35 (0.000)	77.31 (0.000)	39.41 (0.000)	46.13 (0.000)

Source: Own calculation based on data from Central Statistical Office.
Note: Dependent variable = $(AFS_{2002} - AFS_{1996})/AFS_{1996}$

Table 4 Number of private farms (1996 – 2007)

	Total numbers (in thousands)				1996 = 100			2002 = 100		2005 = 100
	1996	2002	2005	2007	2002	2005	2007	2005	2007	2007
0-1 ha	-	976.9	946.6	771.05	-	-	-	96.9	78.9	81.5
1-2 ha	462.2	516.8	446.8	422.6	111.8	96.7	91.4	86.5	81.8	94.6
2-5 ha	667.6	629.5	585.1	614.3	94.3	87.6	92.0	93.0	97.6	105.0
5-10 ha	520.8	426.5	388.2	400.1	81.9	74.5	76.8	91.0	93.8	103.1
10-15 ha	217.2	152.5	167.6	166.6	70.2	77.2	76.7	109.9	109.2	99.4
15-20 ha	89.4	83.8	77.1	77.6	93.7	86.2	86.8	92.0	92.6	100.6
20-50 ha	75.2	96	98.7	102.8	127.7	131.3	136.7	102.8	107.1	104.1
≥ 50 ha	8.9	17.1	18.8	24.1	192.1	210.8	270.8	109.7	140.9	128.5
Total >1 ha	2041.3	1922.2	1782.3	1808.1	94.2	87.3	88.6	92.7	94.1	101.4

Source: Own calculations based on the data from Central Statistical Office.

As a result, during the considered period, average area of agricultural land in private farms grew by 9% (in comparison with 2.6% for period 1996-2002 and 0.8% for period 2002-2005) (Table 1). This effect is consistent with the results of econometric models presented above, and confirms that average farm size in Poland increases along with the growth in number of big farms only.

As it was argued, average farm size can be a misleading measure of structural change in Polish agriculture; however, it is very often used for making assessments of the level of agricultural sector performance. Especially confusing can be claims that, without in-depth study, accuse small (in terms of acreage) farming units of being responsible for the unfavorable agrarian structure. The mistake of such statements has a dual nature: first, it is hard to decide which farm should be called small; second, it is questionable if low productivity and efficiency can be attributed mostly to small, in term of acreage, farms[6].

5 Different dimensions of structural changes in Polish agriculture (2005-2007)

As 'the myth' of average farm size is refuted, another question arises about 'smallness' and 'largeness' of farms. Currently, there is a lack of precise criterion for placing farms in the given group. This is a crucial problem in the

[6] See discussion in Gorton and Davidova (2004).

discussion on structural changes in agriculture due to the fact that small structures do not necessarily react to the same policy signals as large farms. In this context, the efficacy of governmental measures aimed at structural transformation in agriculture or wider, at development of rural areas, can be questioned.

The general problem refers to the selection of criterions which could separate farms into different size groups. Two basic ones come to mind: production potential and incomes of private farm conducting agricultural activity. It seems that European Size Unit (ESU)[7] is a proper measure because it embraces production potential as well as incomes (Chlebicka et al., 2009).

Table 5 Holdings (in %) conducting agricultural activity by area groups and economic size

	0-4 ESU		4-12 ESU		≥ 12 ESU		Total
	2005	2007	2005	2007	2005	2007	
0 - 1 ha	98.9	99.1	0.7	0.5	0.4	0.4	100
1 - 5 ha	96.7	97.1	2.7	2.2	0.6	0.7	100
5 - 20 ha	50.6	51.7	41.5	40.2	7.9	8.1	100
5 - 10 ha	67.9	69.5	30.0	28.4	2.1	2.1	100
10 - 20 ha	23.2	22.7	59.6	59.4	17.1	17.9	100
20 - 50 ha	3.3	2.3	33.5	33.6	63.2	64.2	100
≥ 50 ha	1.6	0.7	4.8	3.3	93.6	96.0	100
Total	81.2	80.5	13.1	13.3	5.7	6.3	100

Source: Farm Structure Survey 2005 and 2007, CSO.

Farms between 2-4 ESU in Poland are officially called semi-subsistence farms[8]. In order to encompass the whole spectrum of features related to small-scale farms, it is reasonable to expand this definition by adding holdings generating 0-2 ESU. This is a very numerous group represented by more than 1.6 million farms. Holdings between 4-12 ESU can be classified as medium units in terms of economic size. According to various analysis, the threshold of 8 or 12 ESU

[7] European Size Unit (ESU) represents 1,200 EUR standard gross margin (SGM): http://ec.europa.eu/agriculture/rica/methodology1_en.cfm.

[8] Such definition is accepted in Rural Development Plan 2004-2006 and Rural Development Program 2007-2013.

enables farms to achieve income at the parity level[9], thus these units can be categorized as large (Józwiak, 2009).

In 2007, there were over 1.9 million small-scale farms (80.5% of the total number of farming holdings), 317,000 medium-scale farms (13%) and roughly 150,000 large-scale farms (6%). Table 5 presents the relation between area size and economic size of Polish farms. In the first group (0-4 ESU), 'area smallness' denotes 'economic smallness', however it must be stressed that some special production types generate large incomes from a small area (in group of farms possessing 0-10 ha, 3.2% constitute farms generating more than 12 ESU). Between 2005 and 2007, noticeable changes have occurred regarding economic size structure: the share of small farms (0-4 ESU) increased within the group of holdings possessing 0-10 ha, but dropped significantly within the group of medium and large farms in terms of acreage. This situation can be interpreted as a strengthening of the economic position of medium and large farms but a weakening of the position of small farms (0-10 ha). During the same period, within all acreage groups except 20-50 ha, the share of farms with medium economic size (4-12 ESU) has decreased. The share of the largest, in terms of ESU farms (≥ 12 ESU), has increased considerably in the group of farms possessing more than 10 ha, which can be interpreted as a tendency towards the commercialization of farms with medium and large area potential.

One more interesting fact can be noticed regarding trends in structural changes in Polish agriculture. Similar to the acreage criterion, between 2005-2007 slow growth of the share of medium and large farms (in terms of ESU) and a decline in the group of small units was observed (last row in Table 5). If the group of 0-4 ESU is divided into two more detailed categories (0-2 and 2-4 ESU) opposing tendencies are revealed: a decrease in the first group (69.4% to 67.9%) and increase in second group (11.8% to 12.5%). The growing number of semi-subsistence farms (2-4 ESU) may be related to the introduction of Rural Development Policy (Pillar 2 of the CAP) measure addressed to this specific category. From 2005-2007, the total value of support for semi-subsistence farms reached over 1 billion Zlotys.

In fact, land is still the most important factor of production in agriculture which determines farms' economic sizes; however its role constantly diminishes in favor of innovative solutions in the process of production (technical and product innovations). The measure of economic size (ESU) is more appropriate than area size to present diversity among various farming units, unfortunately the further analysis of structural changes will be based on acreage criterion due to the lack of data categorizing holdings according to ESU in 2005.

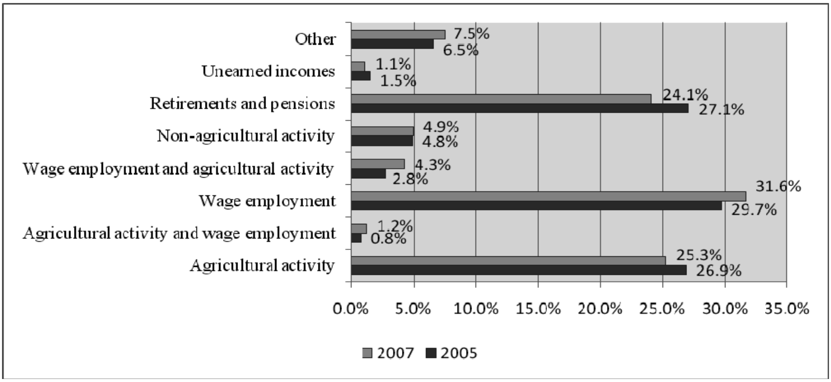
[9] Income achieved from farming at the level comparable to the country average net income achieved in other economic sectors (Goraj, 2005).

5.1 Sources of incomes

The whole picture of structural changes in the Polish agricultural sector would be incomplete without an analysis of the evolution of farm functions with regard to the importance of farming as a main or supplementary source of income for the family. This issue is crucial for understanding the role of agriculture in the wider context of economic changes in rural areas and even nationwide.

In general, the total number of farming households can be divided into three groups according to the importance of agriculture for income generation: (1) about 25% of farms oriented towards agricultural activity as a main source of income; (2) those with combined sources – 5.5%; (3) farms treating agriculture as additional source of incomes or as a 'hobby' or 'lifestyle' – roughly 70% (Figure 3).

Figure 3 Structure of households conducting agricultural activity by the main source of income



Source: Own depiction based on the data from Central Statistical Office.

The role of agriculture as a source of income diminished between 2005 and 2007 (Figure 3). Combined sources of incomes, agricultural and wage employment, and only wage employment increased in importance. The share of non-agricultural activity stayed at an almost unchanged level. A significant decline of importance of retirements and pensions and unearned incomes can be noticed.

As progress of diversification of income sources and marginalization of agriculture is visible, the question arises how this process is distributed among different farm structures. First, it is worth stressing that the total number of holdings conducting agricultural activity decreased by 3.5% for the period 2005-

2007 (last row in Table 6). Second, the greatest number of holdings that ceased farming is belonging to the category of the smallest farms (0-1ha). Meantime, the total number of farms from medium acreage categories increased slightly and from the group of the largest units increased by roughly 15%.

An analysis of the dynamics of changes in income strategies (Table 6) delivers very interesting information about the pace and directions of structural transformation in Polish agriculture. The total number of farming holdings existing due to agricultural activity diminished in all area groups up to 20 ha, but tiny farms gave up agricultural activity most often.

Table 6 Households conducting agricultural activity and achieving over 50% of their total income from the following sources

Source of income	2007 (2005=100)						
	Total	0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	≥ 50
Agricultural activity	90.8	36.4	87.1	93.9	96.6	101.5	113.7
Agricultural activity and wage employment	157.1	148.7	155.3	157.2	146.7	242.3	132.6
Wage employment	102.8	88.4	111.7	118.2	111.9	102.1	113.0
Wage employment and agricultural activity	149.0	137.3	152.3	149.2	145.5	178.0	131.0
Non-agricultural activity	98.0	89.6	99.3	104.7	104.2	130.7	115.7
Retirements and pensions	85.8	82.6	89.9	89.4	75.1	47.8	79.4
Unearned incomes	72.0	75.6	71.3	61.9	67.0	39.5	43.6
Other	111.4	116.9	107.0	113.2	115.9	133.6	145.3
Total	96.5	84.0	101.9	103.3	99.9	103.9	114.7

Source: Own calculation based on data from Central Statistical Office.

In the same timeframe, the increased role of diversified sources of incomes, especially amongst farms possessing 20-50 ha, as well as in all acreage groups, the total number of farms achieving incomes from combined sources increased significantly. This proves that improving macroeconomic conditions in Poland and better job opportunities encouraged farmers to seek additional sources of income outside agriculture. In fact, non-farm employment did not bring about significant structural change (bottom row in Table 6). This leads to the conclusion that wage employment may help smaller farms survive and in this way small-scale, part-time farming structures persist.

It is somewhat interesting that in the case of wage employment as a category of dominating source of income, a decrease of the number of farms in the smallest acreage group (0-1 ha) is noted. Persons running these farms are not officially classified as farmers according to the national insurance law[10] in Poland, and additionally they do not receive direct support from Pillar 1 of the CAP. The lack of financial incentives can be recognized as a reason to get rid of tiny farms. It is characteristic that the number of holdings achieving incomes mainly from retirements and pensions decreased considerably. It is very likely that this situation is related to ongoing demographic changes among farmers (see Table 10).

Table 7 Agricultural households consuming more than 50% of the value of their agricultural production

	Total	0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	≥ 50
2005	1014951	496473	409056	72685	28999	7056	681
2007	908171	407802	394207	71786	25874	7668	835
	2007 (2005=100)						
	89.5	82.1	96.4	98.8	89.2	108.7	122.6

Source: Own calculation based on data from Central Statistical Office.

Another dimension of structural changes in Polish agriculture is related to the purpose of agricultural production. According to Table 5 there were, in 2005, over 1 million households with people running a private farm, in which the majority of the value of production was consumed. Bearing in mind that in medium area groups insignificant growth in the total number of private farms is noted, a diminishing number of farms producing mainly for the household`s consumption indicates a moderate increase of the level of commercialization.

5.2 Changes in the acreage of private farms

As land is one of the most important production factors in agriculture, structural transformation should be demonstrated by changes in land allocation between different area groups. Figure 4 depicts the relative stability in land distribution for the medium acreage groups and a slight increase for the largest groups. The group of 50-100 ha constitutes an exemption and the share of land owned by farms from this category increased considerably.

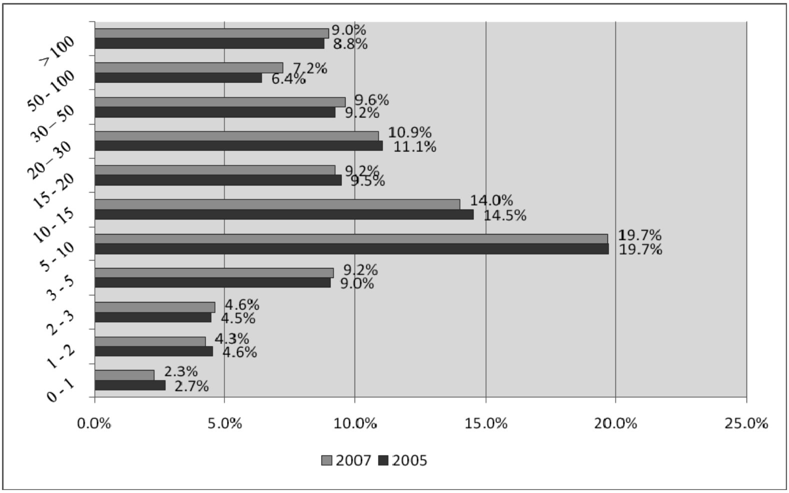
Between 2005 and 2007, the acreage of set-aside and fallow land decreased substantially, especially for the smallest and the largest area groups. Due to the entitlements of fallow land to be supported by direct payments[11] at the basic

[10] The national insurance law for farmers is more preferential than for other professional groups in Poland.

[11] It involves the payment of uniform amounts per eligible hectare of agricultural land: http://ec.europa.eu/agriculture/markets/sfp/index_en.htm.

rate, a great number of farmers decided to utilize their set-aside and fallow land for production in order to receive so-called Complementary National Direct Payments[12].

Figure 4 Acreage (ha) of private farms by area groups of agricultural land in 2005 and 2007



Source: Own depiction based on data from Central Statistical Office.

Table 8 Set-aside and fallow land area

	Year	Total	0 - 1	1 - 5	5 - 10	10 - 20	20 - 50	≥ 50
Set-aside and fallow land area (ha)	2005	1028568	82186	307029	132296	86643	49380	371034
	2007[a]	440938	23436	146684	77335	52494	30818	110172
	2007 (2005=100)							
Set-aside and fallow land area (ha)		42.87	28.52	47.78	58.46	60.59	62.41	29.69

Source: Own calculation based on data from Central Statistical Office.

Notes: a Fallow land only - includes arable land not used for production purposes, but maintained in good agricultural and environmental condition.

[12] On top of the EU funded direct payments, the new Member States may pay complementary national direct payments during a transitional period.

5.3 Manpower transformation

Structural change in agriculture is also characterized by constant changes in the deployment of labor. In 2007 there were roughly five million persons, including family labor force and employees, engaged in work on private farms (a decrease of 1.5% in comparison to 2005). A different picture emerges when a full-time employment measure (Annual Work Units[13]) is used – data in Table 9 indicates that in 2007 there were over 2.2 million full-time workers. This number stayed almost unchanged since 2005; however different tendencies can be noticed for various area groups.

Table 9 Full-time employment in private farms by area groups of agricultural land

	Year	Total	0 - 1	1 - 5	5 - 10	10-20	20 - 50	≥ 50
Full-time employment in thousands of AWU [a)]	2005	2246.9	219.8	783.4	551.8	433.3	207.2	51.4
	2007	2245.8	198.2	796.8	556.9	426.2	209.3	58.6
AWU / private farm	2005	0.91	0.29	0.81	1.44	1.78	2.11	2.75
	2007	0.94	0.31	0.81	1.41	1.75	2.05	2.73
	2007 (2005=100)							
Full-time employment in thousands of AWU [a)]		99.95	90.17	101.71	100.92	98.36	101.01	114.01

Source: Own calculations based on data from Central Statistical Office.
Note: *a* Including employees and neighbors` help.

A decrease of full-time employment can be observed in the group of the smallest farms (nearly 10%) and medium ones (10-20 ha) (~1.6%) and significant increase is noticeable in the group of the largest farms (14%). All these changes are closely related to changes in the total number of private farms (Table 4). Considering the number of fully-employed per one private farm, small changes are visible (Table 9). It is worth stressing that the rate of 'AWU/farm' is disproportionately distributed among acreage groups. Indeed, larger farms employ absolutely more labor force per holding, however smaller farms, especially from the groups of 1-5 ha and 5-10 ha, engage much more workforce in relation to the acreage of utilized land. This relationship did not change considerably between 2005 and 2007.

[13] Annual work unit (AWU) means the equivalent of full-time employment. It is calculated by dividing the total annual number of hours worked by the average annual number of hours worked in full-time jobs. The annual work unit used in Poland equals 2120 working hours per a year, i.e., 265 working days per 8 working hours a day. To calculate the labor input expressed in AWU (in accordance with the Eurostat methodology) the assumption was applied that more than 1 AWU cannot be attributed to 1 person, even if the actual amount of work was higher.

A very important aspect influencing the pace of structural transformation in agriculture is the demographic structure of persons running farms. According to Table 10, over 35% of persons were, in 2007, aged 55 or older. In the same timeframe, only 1.2% of farmers were younger than 24 years old. More than 60% of people running farms were aged 25 to 54 years old.

Table 10 Persons running (%) private farms conducting agricultural activity by age groups in 2005 and 2007

a – 2005 b – 2007		Total = 100	0 - 1	1 - 5	5 - 10	10 – 20	20 – 50	≥ 50
to 24 years old	a	1.4	11.0	35.7	24.3	20.6	7.5	0.6
	b	1.2	7.7	34.0	28.4	20.7	8.1	1.1
25 – 34 years old	a	11.3	18.7	37.6	21.1	14.8	6.6	1.2
	b	11.1	13.4	39.7	22.7	15.6	7.0	1.6
35 – 44 years old	a	22.2	23.0	39.2	18.4	12.7	5.7	1.0
	b	21.5	19.7	40.7	19.6	13.0	5.9	1.2
45 – 54 years old	a	30.9	27.5	37.5	17.9	11.6	4.6	0.9
	b	30.9	22.1	40.3	19.1	12.3	5.1	1.1
55 – 64 years old	a	17.2	37.8	40.9	11.9	6.7	2.2	0.5
	b	19.2	34.9	42.7	12.8	6.6	2.5	0.6
65 and above	a	17.1	51.1	39.9	6.6	1.9	0.4	0.1
	b	16.1	47.2	42.6	7.4	2.1	0.6	0.1

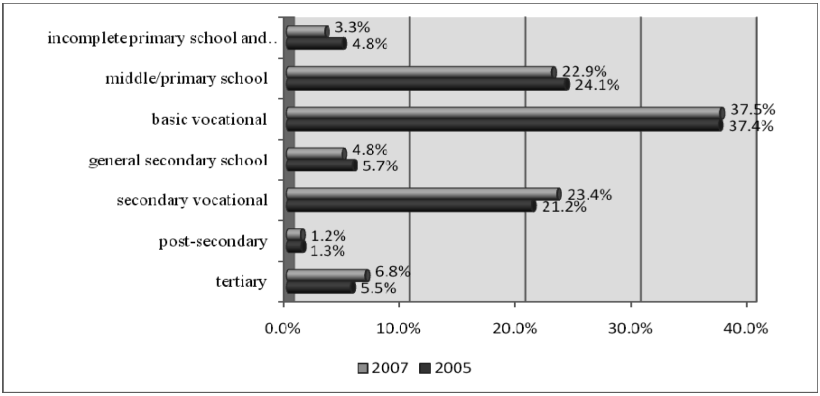
Source: Own calculation based on data from Central Statistical Office.

It is very often argued that the interest of young people in farming will be diminishing in the coming years mainly due to better job opportunities offered by other sectors, mostly in bigger cities. However, the profession of farmer gained prominence and attractiveness among graduates of agricultural schools between 2000 and 2007 (Bujak, 2009). In fact, demographic factor can become the main one responsible for structural changes in agricultural employment in Poland.

The last important aspect of manpower transformation is related to the managerial capabilities of persons running farms. Managerial capability is crucial for adaptive reactions to increasing dynamics in any economic sector, including agriculture. It can be assumed that the higher the level of education is, the better managerial capabilities characterize the given person. In Poland, more than 26% of farmers (627,000) in 2007 were educated at the basic level (incomplete primary, primary or middle school) and a further 37.5% (897,000) were educated at the basic vocational level (Figure 5). Less than 7% of all farmers had tertiary education. The dynamics of changes in educational level is quite slow, though some positive tendencies can be noticed. Between 2005 and

2007, the number of farmers with the lowest education decreased and the number of farmers having secondary vocational and tertiary education increased.

Figure 5 Structure of holdings conducting agricultural activity by education level of person running



Source: Own calculation based on data from Central Statistical Office.

In all acreage groups above 1ha, an increase in the number of farms run by persons with the highest education levels (secondary, post-secondary and tertiary) was observed (Table 11). There was a significant decrease in the number of small farms, with the lowest education of the managing farmer, but positive changes affected mostly medium and large farms.

Observed dynamics of growth in farmers' education level is very important for an increase in labor productivity, and simultaneously with increasing non-farm employment opportunities due to overall economic growth can accelerate employment shifts. Education is also crucial for the absorption of innovative solutions by farmers, which leads to improvements in the process of food production.

Table 11 Holdings conducting agricultural activity by education level of person running and area groups of agricultural land

Level of education	2007 (2005 = 100)						
	Total	0 - 1 ha	1 – 5 ha	5 – 10 ha	10 – 20 ha	20 – 50 ha	≥ 50 ha
Tertiary	118.5	96.4	128.1	126.8	152.2	140.4	124.9
Post-secondary	91.5	71.1	102.2	107.9	109.1	151.3	110.1
Secondary vocational	106.5	89.0	113.5	118.3	110.5	112.5	117.0
General secondary school	81.4	65.2	86.6	111.8	105.5	127.7	112.6
Basic vocational	97.0	84.9	101.7	102.6	99.3	99.3	106.6
Middle/primary school	92.0	86.7	95.4	94.5	89.2	93.6	103.3
Incomplete primary school, no education	66.6	68.7	72.9	57.0	41.0	45.7	28.9
Total	96.5	84.0	101.9	103.3	99.9	103.9	113.1

Source: Own calculation based on data from Central Statistical Office.

6 Conclusions

When assessing structural changes in the Polish agricultural sector, one must be very careful in interpreting the basic and generally accepted measure of average farm size. The results of analysis indicates that in the case of Poland, average farm size increases only along with the growth in number of the largest farms (≥ 50 ha). Meanwhile, during the 1990s, the polarization of agrarian structure was observed, with an increase in total area occupied by the smallest and the largest farms, and a reduction in medium-sized farms. In this situation, the concentration of land took place without increasing the average farm area. Since 2002, different tendencies have been noticed - average farm size has increased substantially due to the growing number of medium-sized and large farms.

It is generally accepted that structural change in Polish agriculture can be achieved through production concentration, which is very often understood solely as land consolidation. Despite agricultural land being the most important factor of production in agriculture, acreage criterion constantly loses its importance in favor of innovative solutions applied in production. As a result, small-scale in terms of acreage does not necessarily mean small-scale in terms of economic size. However, analysis reveals the fact that the economic position of small farms (0-10 ha) weakened between 2005 and 2007, and the medium-sized and large farms exhibited moderate tendencies to commercialization.

Analysis of structural changes should include the evolution of farm functions with regard to the role of farming being a main or supplementary source of income for the family. From 2005-2007 progress with the diversification of income sources was significant within all acreage groups and the marginalization of agriculture was noticeable within the small and medium-sized groups.

The main symptom of structural transformation in agriculture refers to the constant changes in the deployment of labor. Only for the group of the smallest farms can the decrease of full-time employment be noticed. Larger farms employ more labor in absolute values, whereas smaller farms engage much more labor in relation to utilized area.

Demographic changes will likely be of key importance for the pace of structural transformation in Polish agriculture. The age structure of persons running farms indicates that over 35% of them were aged 55 or older in 2007.

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The role of farm activities for overcoming rural poverty in Romania

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Abstract

During the last two decades the agricultural sector in Romania has faced many changes and challenges. This paper links the most critical issues that the country faces with the recorded development of the agricultural structures, the overall economic development of the country and the evolution of poverty in rural areas. Earlier research on rural poverty attributes agriculture with an important role in poverty reduction or improving standards of living. In recent years, Romania has successfully reduced both development gaps and poverty rates. Though the agricultural sector served as a social buffer for several million people in the 1990s, in the background lies a very fragmented land property in which most rural households hold subsistence or semi-subsistence farms. These farms are often managed by retired elderly people lacking basic agricultural training. The authors aim to identify and present the triggers of future development in the rural economy, as well as the role that farming can play in poverty reduction and in fostering community development.

Keywords: poverty, agriculture, rural economy, transition, development

Table of contents

1 Poverty in Romania[1]

The literature discusses several indicators for measuring poverty. Absolute measures use a threshold of daily disposable money and allow us to compare figures from different countries for longer time periods. Relative measures refer to countries' average incomes and show poverty in relation to country specific standards of living. Inequality indices like Gini coefficients show the dispersion of income among the population. Each indicator has its pros and cons (Petrovici and Gorton, 2005); therefore representatives from all three groups are used to describe the phenomenon of poverty in Romania.

In September 2000 the world's leaders agreed upon eight Millennium Development Goals (MDGs) to be achieved by 2015. The first goal is to "eradicate extreme poverty and hunger". In 2003 the first Romanian MDGs Report substantiated this first goal for Romania to halve the severe poverty rate[2] by 2009 (Government of Romania, 2003). Already in 2008, the United Nations Development Programme (UNDP) in Romania could indicate a reduction of the severe poverty in Romania for the last five years, from 10.5% in 2002 to 4.1% in 2006 (Figure 1). Though in the same period, severe poverty also decreased in rural areas from 17.5% to 7.1% (Figure 1), the discrepancy between rural and urban regions still persists.

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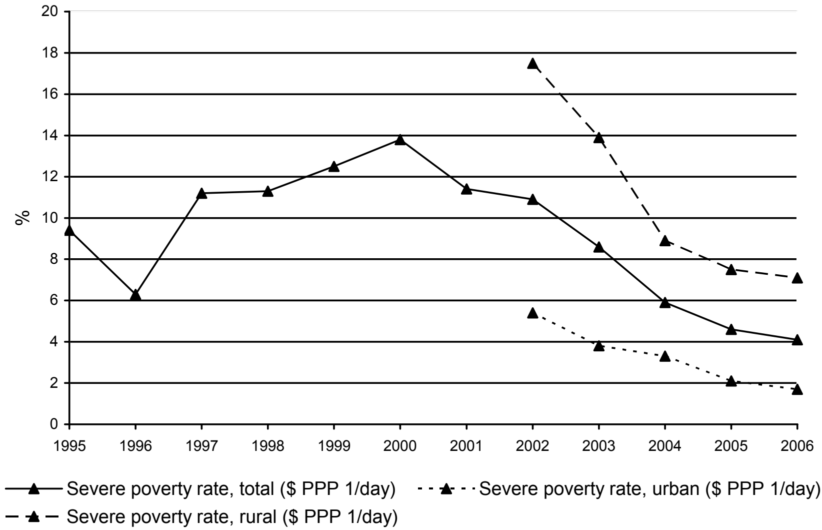
For an extended version of the article, see Salasan and Fritzsch (2009).

[2] Severe poverty rate: proportion of population living from less than $ PPP 1/day (UNDP 2008).

Figure 1 Severe poverty rate in Romania



Source: UNDP Romania (2008)

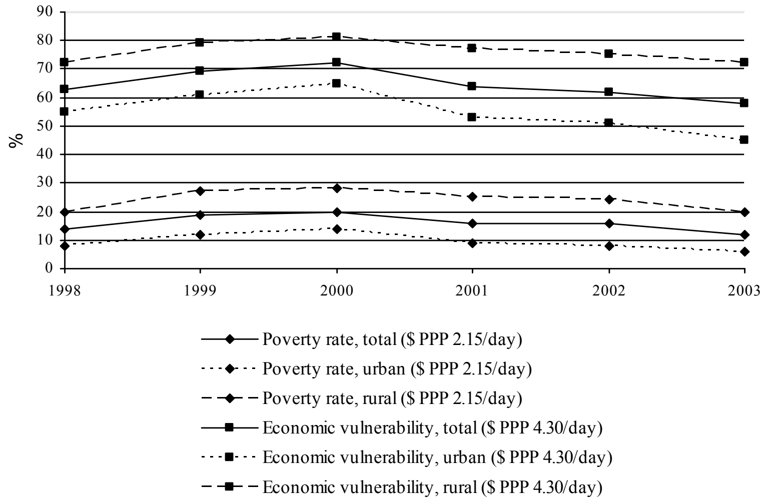
Alam et al. (2005) propose using an absolute poverty line of $ PPP 2.15 per capita and day because this would better approximate basic needs in regions where the climate requires expenditures for heating and warm clothing. In addition, a second line is drawn at $ PPP 4.30 per capita and day to signify "economic vulnerability"[3]. Both indicators show that Romania has greatly progressed in poverty reduction during recent years (Figure 2) but the share of economically vulnerable people remains unsatisfactorily high and requires further action.

The Gini coefficient is still low in Romania and increased only slightly from 0.27 in 1998 to 0.29 in 2003 (Alam et al. 2005). These low coefficients show that although there are only small income differences in Romania, the gap between rich and poor is widening. This is also underpinned by the inequality of

[3] According to Alam et al. (2005), people who are not absolutely poor but could become poor in cases of economic crises are "economic vulnerable".

income distribution index[4], which stood at 4.5 in 2000 and increased to 5.3 in 2006 (Eurostat 2008a).

Figure 2 Poverty rate and economic vulnerability in Romania



Source: Alam et al. (2005).

The at-risk-of-poverty-rate[5] has increased by 3% before social transfers (from 21% to 24%) and by 1% after social transfers (from 17% to 18%) as presented in Table 1. The situation is only marginally better for males than for females. When comparing the Romanian figures to that of the Euro area or to the EU-25,

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[4] "Inequality of income distribution: The ratio of total income received by the 20% of the population with the highest income (top quintile) to that received by the 20% of the population with the lowest income (lowest quintile). Income is based on equivalised disposable income." (Eurostat 2008b, p. 534)

[5] "The at-risk-of-poverty rate is defined as the share of persons with an equivalised income that is below the at-risk-of-poverty threshold, set at 60% of the national median disposable income. This rate may be expressed before or after social transfers, with the difference measuring the hypothetical impact of national social transfers in reducing poverty risk. Retirement and survivor's pensions are counted as income before transfers and not as social transfers." (Eurostat 2008b, p. 220)

the Romanian situation appears rather comparable, showing that relative to the median disposable income of the basis region, i.e., EU-25 Euro area and Romania, poverty is no worse in Romania than in the EU-25 or the Euro area.

These figures may be misleading because they neglect that Romanian living conditions are still below EU standards. Therefore, total consumption expenditures are considered to scale these figures. Data from Table 2 confirms that the Romanian situation appears to be far from the European standard at the end of 2005. Moreover, the share of expenditures for food and non-alcoholic beverages in Romania in 2005 was, with 44.2%, very high and greatly exceeded the average for the EU-27 (16.9%) (Eurostat, 2008a).

Romania progressed significantly in poverty reduction in recent years. It is questionable, however, whether this success can be attributed to agriculture. What is unquestionable is that poverty is still an issue in Romania. Which role agriculture could play in reducing it further will be discussed Section 4.

Table 1 At-risk-of-poverty rate (%)

	Before social transfers						After social transfers					
	Total		Male		Female		Total		Male		Female	
	2000	2005	2000	2005	2000	2005	2000	2005	2000	2005	2000	2005
EU-25	23	26	22	25	24	27	16	16	15	15	17	17
Euro area	n.s.	24	n.s.	23	n.s.	26	n.s.	15	n.s.	14	n.s.	17
Romania	**21**	**24**	**21**	**23**	**22**	**24**	**17**	**18**	**17**	**18**	**18**	**18**

Source: Eurostat (2008b, p. 224).

Table 2 Total consumption expenditure of households

	As a proportion of GDP (%)			Per capita (PPS)		
	1995	2000	2005	1995	2000	2005
EU-27	56.8	57.6	57.0	8,300	10,900	12,700
Euro area	56.5	57.0	56.6	9,600	12,300	14,000
Romania	**n.s.**	**69.1**	**68.5**	**n.s.**	**3,400**	**5,300**

Source: Eurostat (2008b, p. 232)

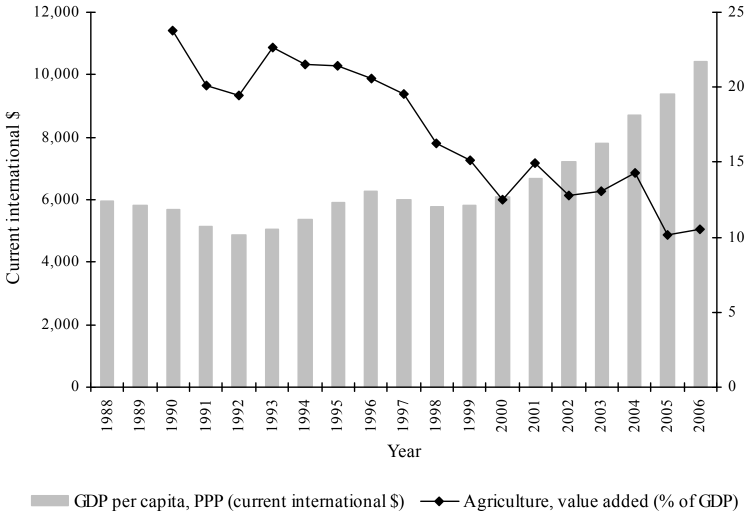
Note: GDP = gross domestic product; PPS = purchasing power standard

2 Economic development in Romania and the role of the agricultural sector

The Romanian economy started its transition process from quite a low level of economic development (Figure 3). This may be a reason why it did not face such a sharp slump in economic activities as other transition countries. Nevertheless, the secondary sector and especially those industries that were oriented towards east European markets were severely affected by the loss of their input or product markets. Thus, a significant portion of the labour force was released. During the first ten years of transition, and more so in the second third of this time, most governmental programmes concentrated on easing the social hardships of restructuring. The released labour force was supported through professional re-orientation and the development of entrepreneurial skills. Important resources were absorbed and consumed with no significant results since most of the unemployed faced long-term unemployment. Most of these people went back to their native home places, which were rural areas in most cases. The already very low developed tertiary sector received very little public incentives and very low public support. During the first six years of economic transition, it was almost impractical to get credit given the high interest rates, combined with the thin capitalisation of the economic activities.

Agriculture followed the development of the overall economy with a breakdown in the beginning of the 1990s, a recovery period in the mid-1990s, and a second slowdown at the end of the 1990s. Existing agricultural cooperatives were smashed and important infrastructure like buildings and irrigation facilities fell into disrepair. In parallel, the former state agricultural companies that lacked investments went bankrupt and the privatisation process started far too late to save large former operations. The agricultural research facilities suffered from the land restitution with no protection, and most of them were liquidated. The national input market for fertilisers, seeds and planting materials, and breeding animals decreased and imports did not compensate for this. The entire situation increased the pressure on agriculture, causing a negative trade balance for agricultural products. The agricultural sector received much of the labour force from the secondary sector due to very fragmented land property. This positive migration flow caused even further fragmentation, as for many families, regardless of the size and technology employed, farming was the only available economic activity. Thus, a dominant subsistence and semi-subsistence sector emerged. The slow land restitution process, the legislative environment, the low access to credit, and the only punctual political support basically in terms of input subsidies and production premiums not only blocked a farm consolidation process, but favoured the persistence of small and non-market-oriented farm holdings. In 2000, Romanian agriculture had its worst year, with just US$ 4,103 million value added.

Figure 3 Share of agriculture in GDP (%) and GDP/capita (PPP) in Romania

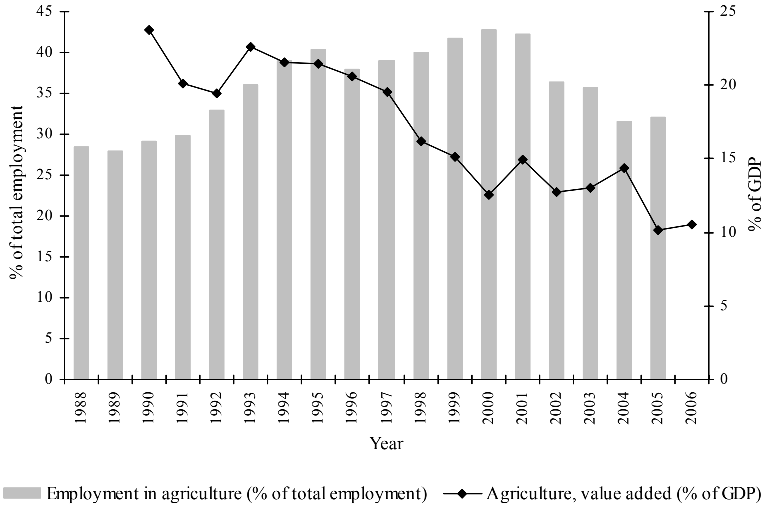


Source: WDI (2008).
Note: GDP = gross domestic product; PPP = purchasing power parity

Foreign direct investments were rare and unimportant during the first ten years of transition. Beginning in 2000, when most economic activities and most land were privatised, a more relaxed policy towards foreign direct investments, a relative stabilisation of the national currency, and subsequently a more attractive financial market yielded the expected results and economic growth was more than a statistical figure. Since then, the Romanian economy has progressed quickly, but nevertheless in 2006 it reached only 38% of EU-27 GDP/capita (own calculation with data from WDI 2008). Romanian agriculture followed this positive development trend and produced US$ 10,917 million value added in 2006 (WDI 2008).

The importance of the agricultural sector declined the more the overall economy grew (Figure 4). Even keeping in mind that the share of agriculture in employment decreases slower than the share of agriculture in GDP when an economy starts to grow (Anriquez and Stamoulis 2007), the ratio between the shares of agriculture in total employment and in GDP was, with 3.2, in 2005, still very high. This high percentage of labour force that remains in agriculture indicates that agriculture has served and continues to serve as a social buffer.

Figure 4 Share of agriculture in total employment and GDP (%) in Romania



Source: WDI (2008).
Note: GDP = gross domestic product

Data show that economic development and poverty reduction are strongly correlated in Romania. However, agriculture and the overall economy show the same development pattern and it seems difficult to attribute success in poverty reduction to only one of them. Here, a deeper insight into the Romanian agricultural sector may help answer the question of whether it could be a driving force for poverty reduction and development.

3 Structure of Romanian agriculture and its position in rural economy

At the beginning of transition, Romanian agriculture was dominated by large-scale corporate farms. The land reform that was carried out after World War II restricted the amount of privately used land to 5 ha per family (DG Agri 2002)[6] thereby destroying the social group of private farmers. After the breakdown of the socialist regime, land restitution took place but was characterised by a number of political shortcomings. The legislative framework of land restitution over a fifteen year period comprises a number of laws. The first, Law 18/1991, stipulated that each former owner can reclaim their land up to a limit of 10 ha. This was the first step of fragmentation, especially for former properties which were hardly consolidated over the first half of the 20th century. Land restitution took place on an archaic model, splitting the property between the legally entitled successors. The same law stipulated that the co-owners, the neighbours, and the state have to be consulted prior to any sale of land. A State Domain Agency should have administrated the processes but it was founded years later, thus delaying the emergence of a liberalised, functioning land market. Law 169/1997 completed and amended the land restitution process and Law 1/2000 increased the upper limit, allowing restitutions up to 50 ha. This caused further problems in the restitution process, as the local administration faced severe legal, technical, and administrative difficulties. In fact, the new law practically restarted the land restitution process. However, Law 247/2005 re-established full owner rights over the land property, including agricultural land and forestry properties.

This half-hearted and still incomplete process led the agricultural sector in 2005 to be characterised by a dual structure with numerous smallest-scale farms that own only a small share of land on the one hand, and few large-scale farms that

[6] In fact, only 0.15 ha were left for private use.

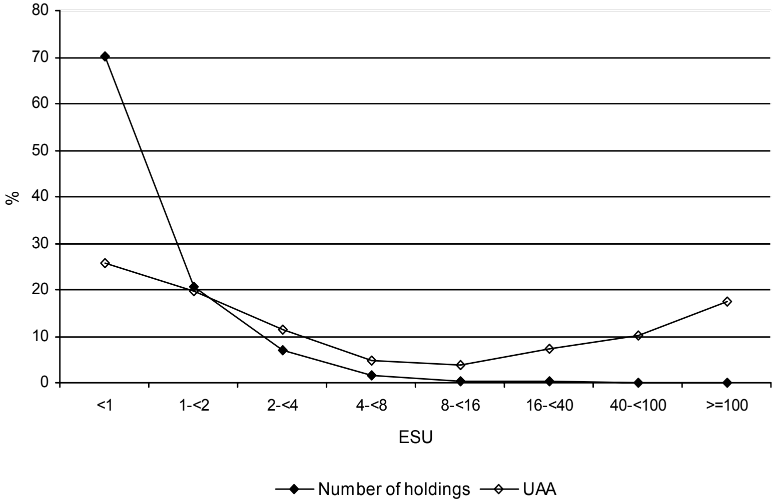
have nearly one-fifth of the utilised agricultural area (UAA[7]) available (Figure 4) on the other.

In absolute figures, 3 million farms are smaller than 1 ha and 1,940 farms are larger than 100 ha (Eurostat, 2008c).[8] These figures provide a vivid picture of an agriculture that is dominated by subsistence and semi-subsistence farm households. These households are not considered to be drivers of economic development but as safety nets in times of economic hardship and in retirement. This is also underpinned from migration statistics that show that younger people leave rural areas, whereas older people go back.

[7] Utilised agricultural area (UAA) is the area utilised for farming, and is made up of the following categories: arable land, permanent pasture, permanent crops and kitchen gardens (Eurostat 2008b, p. 524).

[8] Statistically, any person owning land is considered a farmer in Romania. Thus, over 4 million people are counted as farmers, while it can be estimated that less than half were doing agricultural work and the others possessing the land only, being too old or living too far away to cultivate it.

Figure 4 Percentages of number of agricultural holdings and utilised agricultural area (UAA) in farm size categories (ESU) in Romania in 2005



Source: Own calculations with data from Eurostat (2008c).
Note: UAA = utilized agricultural area; ESU = European size unit
European size unit (ESU): ESU is a measure for the economic size of farms in the EU. One ESU equals 1,200 Euro standard gross margins (FADN, 2008, p. 5).

Most of the agricultural work is done by family labour (Figure 5). In 2005, only 9% of the labour force measured in AWU[9] was not family labour. The small-scale farms up to 5 ha accounted in the same year for four-fifths of total agricultural labour force and three-quarters of family labour force. Considering the number of employed persons, the picture becomes even more pronounced. From 8.5 million people employed in Romanian agriculture in 2005, 7.6 million worked in farms smaller than 5 ha, from which only 16,000 people were non-family labour force. The high ratio of employed persons in relation to AWU of

[9] Annual work unit (AWU): "One annual work unit corresponds to the work performed by one person who is occupied on an agricultural holding on a full-time basis. Full-time means the minimum hours required by the national provisions governing contracts of employment. If these do not indicate the number of hours, then 1,800 hours are taken to be the minimum (225 working days of eight hours each)." (Eurostat 2008b, p. 524). In Romania, 1 AWU equals 1,960 hours (245 working days of eight hours each; NIS, 2009).

3.3 for the whole Romanian agriculture and of 3.6 for farms smaller than 5 ha indicates that agriculture employs many people for social and not for economic reasons, thus absorbing the labour that became abundant in the industrial and service sectors during transition. Nevertheless, time series show that labour input has been declining since 2000. In total, 3.6 million AWU were employed in agriculture in 2000, of which 3.4 million were non-salaried. Within seven years, these figures were reduced to 2.2 million AWU in total, of which 2 million were non-salaried (NIS 2009). When this is more than a statistical effect, it would show that with economic growth, people leave the agricultural sector. Whether this indicates a consolidation of the agricultural sector remains questionable.

For landless or underemployed people seeking an additional income, large-scale holdings are important. Nearly 49,000 persons of non-family labour force were employed in farms larger than 100 ha in 2005. The ratio of employed persons in relation to AWU was 0.9, indicating that large-scale farms do not employ labour for social reasons (own calculations with data from Eurostat, 2008d).

The age structure of Romanian agriculture points to two issues. First, it shows that most of UAA (54.6%) is operated by farm holders older than 54 years and 31% by persons older than 65 years old, while only 17.2% of UAA is managed by persons up to 44 years old (Eurostat, 2008d). Thus, innovation in promising technologies and farm enlargements are hardly to be expected and a change of generations seems overdue. Second, it also indicates that elderly people, after retiring or losing employment, start agricultural work. Since it can be assumed that they do not embark upon such difficult work without necessity, it can be concluded that there are social reasons for this phenomenon. Most pensioners have small pensions or even no pensions at all, but they do have a small agricultural property which could provide significantly for their subsistence needs. The property over that land seems to work as insurance for them. The employment structure supports this conclusion. While for non-agricultural occupations the share of employed persons decrease sharply for people older than 54, it remains high for agricultural activities (Table 3).

More than 90% of farms are managed by people without any formal agricultural training (Figure 5). Even relatively large farms, i.e., farms of size 8 to 16 ESU (9,600 to 19,200 Euro standard gross margin) are 80% headed by managers with only practical experience in farming but no formal agricultural training. Only one percent of farm managers, i.e., 44,500 persons, attended full agricultural training[10].

Figure 5 Annual work units (AWU) by size of farms (UAA) in Romania in 2005

Source: Own calculations with data from Eurostat (2008d).
Note: AWU = annual work unit; UAA = utilizes agricultural area

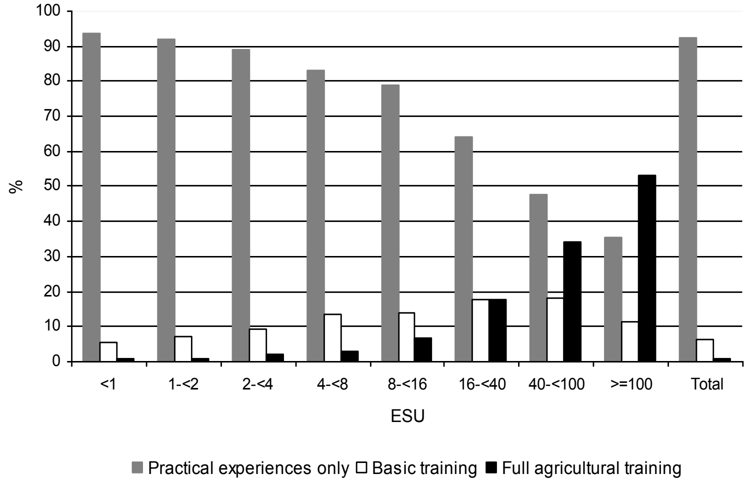
[10] Full agricultural training is any training course continuing for the equivalent of at least two years of full-time training. A completed agricultural apprenticeship is regarded as basic training (Council Regulation (EC) 1444/2002).

Table 3 Employment structure (% of employed persons) by selected occupation and age group in 2006

	15-24 years	25-34 years	35-44 years	45-54 years	55-64 years	Older than 64 years
Romania						
Total	8.6	27.3	26.0	23.1	10.2	4.9
of which:						
Agriculture, hunting, and forestry	3.1	6.1	5.5	5.6	5.6	4.7
Industry	2.0	6.6	7.9	6.8	1.2	0.0
Other	3.6	14.6	12.6	10.7	3.3	0.2

Source: NIS (2007, p. 188-195).

Figure 5 Agricultural training of farm managers (% of holdings) in farm size categories (ESU) in Romania in 2005



Source: Own calculation with data from Eurostat (2009).
Note: ESU = European size unit

4 Agriculture's role in fighting rural poverty and in driving economic development

Agriculture remains important for poverty reduction for both the rural and urban population. The poorer a household is, the more important the income from agriculture becomes. Since the majority of farms are subsistent or semi-subsistent, it is not primarily the agricultural income that contributes most to household income but the in-kind income, i.e., the opportunity to cover a family's food demand from own production. Thus, more than half of the household income for the poorest families is in-kind income from agriculture, while it is less than 5% for the richest households (Table 4).

Table 5 shows that in-kind agricultural income is important for pensioners and unemployed people and that the importance of agricultural income increases when the region is less developed. However, trends show that the importance of agricultural income is declining for non-farmers households (NIS, 2007).

Table 4 Composition of household income (%) by deciles in Romania in 2006

	Decile 1	Decile 2	…	Decile 9	Decile 10
Money income of which:	44.5	58.9	…	88.8	92.1
Salaries	3.8	14.3	…	67.1	71.1
Agricultural income	9.2	7.9	…	1.6	3.2
Income from social provisions	25.0	27.6	…	14.0	6.9
Equivalent value of consumption of agricultural products from own resources	54.3	39.6	…	7.1	4.1

Source: NIS (2007, p. 238-239).

Table 5 Composition of household income (%) by main household categories in Romania and selected regions in 2006

	Employees	Farmers	Unemployed	Pensioners
Romania				
Money income of which:	88.0	56.0	79.3	74.5
Gross salaries & other salary rights	78.4	7.2	28.8	20.6
Agricultural income	0.6	27.3	2.6	3.4
Equivalent value of consumption of agricultural products from own resources	8.3	42.8	17.4	21.9

Source: NIS (2007, p. 266-271).

Both tables show a vivid picture of the safety net function that Romanian agriculture plays for many millions of people. This supports the analysis done in the Romanian National Rural Development Programme (NRDP, 2008, p. 10), which concludes that "Many […] rural communities make a small contribution to economic growth but preserve the social fabric and the traditional way of life".

Whereas agriculture is important for poverty reduction, no evidence could be found that agriculture was a driving force for Romania's economic development in recent years. This is not necessarily a bad thing, because according to the World Bank (2007), Romania belongs to the group of countries for which agriculture is no longer expected to be a driving force for economic development (p. 4) and, "addressing income disparities … requires a comprehensive approach that pursues multiple pathways out of poverty-shifting to highvalue agriculture, decentralizing nonfarm economic activity to rural areas, and providing assistance to help move people out of agriculture," (p. 2). Currently, the unfavourable farm and age structure in Romanian agriculture prevents innovation and farm enlargements for most households. Few alternative income sources in rural areas and pensions that do not cover daily living expenditures prevent that people exit agriculture. Nevertheless, it is expected by NRDP (2008) that important structural changes will occur in the rural economy given that "Major development opportunities can arise from restructuring the agriculture and from revitalizing the rural economy […] The restructuring of agriculture will have a tremendous impact on the wider rural economy, as farming continues to be the most important activity in rural areas, and an essential source of income for rural households," (p. 10). Despite this optimistic statement, it should be kept in mind that as long as the majority of farms are safety nets, they cannot be the drivers of this development and the question remains: Who could do it?

Commercial private farmers[11] and large-scale corporate farms are the two other groups of agricultural producers. Two thousand holdings are larger than

[11] The distinction of subsistent and semi-subsistent farms, commercial private farms, and corporate farms is arbitrary and country specific. In this report farms up to 8 ESU are considered to be subsistent and semi-subsistent following the definition in NRDP (2008). Holdings larger than 100 ESU are called corporate farms. Farms between 8 and 100 ESU are termed commercial private farms.

100 ESU and operate nearly one-fifth of UAA (Eurostat, 2008c; Figure 3.1). These holdings could play an important role in the agricultural sector as suppliers of high value inputs for a competitive agri-food industry. They are already integrated in internationalised food-chains and are able to undertake large-scale modernisations. Since they do not employ more labour force than necessary for running the business, they do not contribute remarkably to employment in rural areas, but rather increase competitive pressure for up and coming commercial private farmers in the same region. As in most Central and Eastern European transition countries, this latter group is undersized, with only 28,000 holdings operating one-fifth of UAA (Eurostat, 2008c; Figure 4). Nevertheless, this group could be the backbone of the rural economy if given the opportunity to grow and modernise. Indeed, they produce a wide range of varieties supplying local and regional markets as well as niche markets for specialities. It can be expected that competition from the corporate farms will less affect them as a group due to the small number of corporate farms, but competition within the group of up and coming private farmers will be hard for credit, land, and product markets. Whether under these conditions a prospering group of private farmers can be brought back to life remains an open question.

5 Conclusions

During recent years, Romania has progressed successfully in reducing poverty. On the one hand, this can be attributed to the positive overall economic development. On the other hand, agriculture served as a social safety net for many millions of people. Now, the agricultural sector is dominated by subsistent and semi-subsistent farm households headed by persons of retirement age without formal agricultural training. This calls for structural changes since no innovation or initiatives for farm enlargements can be expected from these farm households. Thus, it would foster the necessary restructuring in the agricultural sector were small-scale farmers to abandon farming activities and offer their land to those farmers that are willing to modernise and to grow. Unfortunately, this is only a theoretically realistic option. The pensions' level is so low that agricultural activity on any scale is not an option but a must for most pensioners, which keeps them trapped in the sector. This situation is not expected to change rapidly. Thus, small-scale farming is likely to persist as an instrument for poverty reduction in rural areas.

The few large-scale corporate farms are integrated in food-chains but do not contribute remarkably to employment in rural areas and will not be the backbone of the rural economy due to their small number. The upcoming group of commercial private farmers is still undersized in Romania. They will face tough competition for credit, land, and market access. By producing a wide range of varieties supplying local and regional markets, as well as niche markets for specialities, they could support economic development in rural areas. But large-scale corporate farms and commercial private farmers comprise only 40% of Romanian UAA. Thus, although agriculture has been contributing to poverty reduction, there are good reasons to believe that future economic development will rather come from outside the agricultural sector, while agriculture will continue to play the role of a social safety net.

Strengthening the Romanian agricultural sector calls for concerted policy actions that are finely targeted for different groups. Fostering the restitution of land to former owners, developing a functioning land sales and rental market, and providing access to agricultural product markets could promote the resurgence of a highly productive group of commercial private farmers. Non-farm job creation in rural areas could provide income opportunities for abundant agricultural labour force. Both new farmers and potential non-farm employees seem to require profession-specific advice and training to become competitive in their transition environment. The large group of pensioners could be convinced to exit the agricultural sector if they could rely on an income from social provisions that covers their daily needs.

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Comparative analysis of the contribution of subsistence production to household incomes in five EU New Member States: Lessons learnt

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Abstract

Drawing on primary survey data, this paper assesses the importance of subsistence agriculture in five new Member States of the European Union (EU). The value of subsistence production to agricultural households is evaluated, particularly regarding its impact on assessments of poverty and vulnerability. The analysis indicates that the contribution of subsistence farming to household incomes is of utmost importance for the rural poor, particularly in Bulgaria and Romania. In Romania for poor households, the value of subsistence production accounts for more than 50% of per capita real incomes. The application of factor and cluster analysis reveals four types of agricultural households which differ significantly in terms of the importance of subsistence production. Older, dependent households characterise the largest cluster (46% of the sample). This cluster is predominately subsistence oriented and, on average, subsistence production accounts for approximately 19% of their real household incomes. Significant subsistence production is likely to persist in the short to medium term.

Keywords: agricultural households, subsistence, commercialization, incomes

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1 Introduction[1]

Twenty years after the downfall of socialist regimes in Central and Eastern Europe (CEE), small scale subsistence and semi-subsistence farms remain widespread. The resilience of small subsistence and semi-subsistence farms has generated substantial debate concerning their role and future, particularly in relation to the EU membership, as the New Member States (NMS) have to compete in the single EU market.

A lack of agreement regarding the role and prospects of subsistence farming characterizes the academic literature. One school of thought treats subsistence and semi-subsistence farms in Europe as an unwanted phenomenon that impedes economic growth in rural areas. It has been traditionally associated with backwards technology and low efficiency, using scarce resources which could have been allocated to more efficient uses (Kostov and Lingard, 2004). Usually, subsistence production is linked to poverty (Mathijs and Noev, 2004).

However, subsistence farming may act as an important survival strategy not only in low but also in middle income countries during periods of drastic economic reforms and/or economic recession. Brüntrup and Heidhues (2002) argue that subsistence farming is a mechanism for survival under difficult and risky conditions in fragile economies. Kostov and Lingard (2004) emphasize its potentially positive impact for the welfare of agricultural households in situations where there is no demand for their resources from the commercial sector.

The arguments above treat subsistence farming not as a voluntary choice but as a necessity; households are forced into subsistence by economic shocks and/or imperfect markets. However, subsistence farming could be a strategy selected by choice. Households with non-farm incomes or retired households may prefer to grow and consume their own food. This aspect of subsistence farming has received little attention in the literature on developing countries or CEE, but in

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The following SCARLED partners oversaw the process of data collection: University of National and World Economy (Bulgaria), Research Institute for Agricultural Economics (Hungary), Department of Economic Sciences, Warsaw University (Poland), Banat's University of Agricultural Sciences and Veterinary Medicine, Timisoara (Romania), and University of Ljubljana (Slovenia). The authors are also grateful to C. Suta for her assistance.

Western Europe and North America several studies address 'hobby farming' (Daniels, 1986; Holloway, 2002).

The paper consists of two main components. First, it evaluates the role of subsistence farming for the real incomes of agricultural households in selected EU NMS. Particular attention is paid to the contribution of subsistence farming to assessments of poverty and vulnerability. Second, the paper employs multivariate statistics (factor and cluster analysis) to produce a typology of agricultural households, according to their socio-economic characteristics, farm endowments and location. The reliance of each cluster of agricultural households on subsistence production is assessed. This provides the basis for more differentiated policy recommendations. The two aspects of the research are linked: the share of the imputed monetary value of subsistence production in total household incomes is used as one of the cluster profiling variables.

The study area covers five NMS where households with small farms are widespread: Bulgaria, Hungary, Poland, Romania and Slovenia. Data were collected through primary surveys of agricultural households within the EU FP6 SCARLED project. Data collection occurred in autumn 2007 to spring 2008. As far as we are aware, this is the first post-EU accession, cross national study of subsistence/semi-subsistence production in CEE.

The paper consists of six sections. The next section includes a working definition of subsistence farming and a brief description of what is currently known about subsistence/semi-subsistence farms in the NMS. Section three focuses on the methodology, and section four describes procedures for data collection and the sample of farm households analyzed. Section five presents the factor and cluster analysis results and section six concludes.

2 Defining subsistence farming

There is no universally agreed definition of subsistence farming. Most definitions stress the objective of satisfying household food needs. Barnett et al. (1996) define the following characteristics of subsistence farming: (i) the farming activities form a livelihood strategy; (ii) the output is consumed directly; (iii) only a few purchased inputs enter the production process; (iv) the proportion of output sold is low.[2] Mathijs and Noev (2004) argue that one problem for defining subsistence farming lies in the possibility of considering it from either a consumption or production point of view. This paper adopts the production approach. The consumption method is not preferred as any commercial operation, fully integrated in input and output markets, can still cover a great deal of food consumption of a household.

In relation to agricultural output markets, farms can be placed on a continuum from zero to 100% depending on the proportion of their output sold. At the two extremes are purely subsistence and purely commercial operations with different mixes in-between. In the NMS, farm households normally produce for their own needs but also sell to the market (Mathijs and Noev, 2004). It is assumed therefore that farms in NMS are not purely subsistence but *semi-subsistence*. This is not only a case in NMS, for instance Thorbecke (1993) argues that an important characteristic of many small-scale farms is that households produce both for sales and for own consumption. Another characteristic of such households is that they purchase some of their inputs (for example, fertilizers) and provide others themselves, e.g. family labour (Singh et al., 1986).

In this paper, 50% of output sold is used as a threshold for classifying farm households as mainly subsistence/semi-subsistence or mainly commercial. This threshold is arbitrary but has been used widely since Mosher (1970) defined subsistence farmers as those selling less than 50% of their output.[3]

The analysis of subsistence/semi-subsistence farming in the NMS is hindered by the lack of adequate data. One source of comparable cross-national data, albeit not focused on subsistence farming *per se,* is the EU Farm Structure Survey (FSS). To comply with EU requirements, the five countries analyzed conducted a FSS in 2005 and 2007. So far EUROSTAT has published data for 2007 for Hungary, Poland and Slovenia. For the two countries that joined the EU in the most recent enlargement, Romania and Bulgaria, data are from 2005.

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[2] See Kostov and Lingard (2004) for a more extensive review of definitions of subsistence farming.

[3] Another approach, based on household modeling, splits households into subsistence and commercial operators and uses the concept of non-separability of production and consumption (Singh *et al*., 1986). The latter authors show that under market failure household production and consumption decisions become non-separable.

The FSS surveys focus on commercial farms including all farms of an economic size of at least one European Size Unit (ESU).[4] However, EUROSTAT also publishes the number of holdings that produce mainly for own consumption and splits these holdings by economic size, i.e. smaller or larger than one ESU (Table 1). Table 1 indicates that for the five countries studied, there are approximately 5.3 million farm holdings which produce mainly for household consumption. In general, they are very small farms, with less than one ESU. One notable exception is Slovenia where most of the subsistence/semi-subsistence farms are larger than one ESU.

3 Methodology

The study comprises of two methodological stages. The first step focuses on the valuation of unsold output and the estimation of its contribution to the total household income. This step helps answer the following questions: (i) does subsistence farming make an important contribution to real household incomes? (ii) is this contribution more important in those NMS that are towards the poorest end of the EU Member States, e.g. Bulgaria and Romania, than it is in the Central European countries? (iii) what role does subsistence farming play for poor and vulnerable households?

The second step identifies homogeneous groups of farm households, using factor and cluster analysis, based on the head of the household and household members' characteristics; their farm endowments, location and the contribution of subsistence farming to their incomes. The purpose of this step is to see whether there are systematic characteristics of households that are more dependent on subsistence production. It also allows for, if heterogeneity of agricultural households is uncovered, the formulation of more focused policy recommendations. The two steps are explained in more detail below.

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[4] According to FSS methodology, an ESU is a measure of the economic size of a farm business. For each farm enterprise a standard gross margin is estimated, based on the area or heads of livestock, and a regional coefficient. The sum of these standard gross margins in a farm is its economic size expressed in ESU. One ESU is equal to 1,200 Euros. For example, in England, one ESU roughly corresponds to either 1.3 hectares of cereals, or 1 dairy cow, or 25 ewes, or equivalent combinations of these (DEFRA, 2004). https://statistics.defra.gov.uk/esg/asd/fbs/sub/europe_size.htm (2008-10-05)

3.1 Valuation of unsold output

Unsold output, product by product, was valued at market prices as a proxy for opportunity costs. If a household sold a portion of their output in the market, the same price was imputed to the unsold quantity as it was assumed that the price the household received was the best indication of the quality of the output. In cases where the household consumed all output produced, crops were valued using a weighted average price for the village. In cases where in a particular village there were only a few observations of output sold and there were large differences in reported prices, either regional averages or country averages were taken from national statistics.

The data did not allow for computing a weighted average for livestock products, as only the average weight and the average price per head were reported, and not the quantities sold. For this reason, when a village/regional average price was calculated it was a simple arithmetic average.

An important objective of this part of the study is to investigate whether the monetary value of unsold output is of greater importance for poor and vulnerable households (see also Petrovici and Gorton, 2005). For identification of poor households, the EUROSTAT definition of at-the-risk-of-poverty is used. It refers to individuals living in households where the equivalised income is below the threshold of 60% of the national equivalised median income.[5] Equivalised income is defined as the household total income divided by the equivalent size of the household. The household equivalent size was calculated using the modified OECD equivalence scale, giving a weight of 1.0 to the first adult, 0.5 to any other household member aged 14 years and over, and 0.3 to each child.

Vulnerability is a more elusive concept. The World Bank addresses vulnerability from a social risk management perspective and defines vulnerable households as those that are more exposed to uninsured risk and shocks, and are less able to manage these effectively (Kozel et al., 2008). For the purpose of this research, vulnerability refers to households who depend on unearned income (social transfers) and subsistence production, i.e. pensioners, long-term unemployed. Vulnerable households may also be poor. We utilise as a proxy for vulnerability

[5] The at-the-risk-of-poverty thresholds per capita were in 2006: €1022 (Bulgaria); €2308 (Hungary); €1867 (Poland); €828 (Romania) and €5589 (Slovenia).

the dependency ratio, which is a ratio between consumers (dependent members outside working age) and workers (the economic active members) and is notated as *c/w* ratio. In calculating the dependency ratio, EUROSTAT and European Commission age brackets were used as they are appropriate for the countries studied. The dependency ratio is defined as the ratio of the household members aged 0-19 and 65 and over, divided by the members 20-64.

As a *c/w* ratio cannot be calculated for households without any economically active members, e.g. pensioner households, these households were assigned a *c/w* ratio of 8 (the highest *c/w* ratio within the sample for households that had economically active members was 7). Vulnerable households were defined as pensioner households without any economically active member and other households with a *c/w* ratio of 3 or higher.

As data from the five countries were pooled together, all income indicators have been converted into Euro using EUROSTAT purchasing power parities (PPP) for 2006, the reference year for the collected data.

3.2 Factor and cluster analysis

To better profile agricultural households, cluster analysis was conducted to define groups with the maximum homogeneity within the groups and maximum heterogeneity between the groups (Hair et al., 1998). The cluster analysis was preceded by a factor analysis since multicollinearity between the variables selected for clustering would bias the results. Factors were obtained through principal components analysis with varimax rotation. Factors presenting an eigenvalue greater than one were chosen. The cut-off applied was factor loadings greater or equal to 0.5 on at least one factor. Two tests assess the appropriateness of the factor solution. The Kaiser-Meyer-Olkin measure of sampling adequacy was used to judge whether the data matrix had sufficient correlation to justify the application of factor analysis. Bartlett's test of sphericity assesses the significance of the correlation matrix in order to reject the null hypothesis that the correlation matrix is the identity matrix.

The factors formed the basis of the cluster analysis. The latter followed a two-stage approach. First, a hierarchical technique was used to establish the number of clusters and to profile the cluster centers. Then, the observations were clustered by a non-hierarchical method with the cluster centers from the hierarchical results used as the initial seed points. This combined procedure allows one to take maximum benefit of the advantages associated with hierarchical and non-hierarchical methods, while at the same time minimizing the drawbacks (Punj and Stewart, 1983; Milligan, 1996).

Table 2 details the variables included in the factor and cluster analysis. As the objective is to produce a typology of agricultural households, we draw on Munton's (1990) analysis of the strategies of family farms to identify suitable variables. Munton (1990) argues that farm households have seven main inter-related elements that can be adjusted. The seven elements are: labor, business type/location, business structure, farm size, production mix, economic centrality (e.g. presence of off-farm income) and diversification elements. Using this as a framework, the cluster analysis draws on the following variables: age of the head of the household (HH), time spent on-farm by HH, time spent by HH in non-farm wage employment, total number of household members, total cultivated area, size of biggest plot, distance to largest plot, distance to most distant plot, total household income, distance to nearest urban centre and the real value of subsistence production as a share of total income.

The validation of the clusters depends on an array of additional variables. This includes variables characterizing the head of the household (e.g. education); household characteristics (*c/w* ratio; equivalised income per capita (PPP) with and without the valuation of subsistence production; share of own produced food in food consumption); farm characteristics and location (share of sales in agricultural output, value of agricultural equipment identified by respondent assessment of the sale value). Some binary variables were also used in the validation process, e.g. the incidence of poverty and vulnerability per cluster; labor allocation – namely the number of household members engaged in wage employment; the number of household members that are self-employed outside agriculture; capital and technology – farming with own agricultural machinery; with others' agricultural machinery; with own machinery and draft animals; with others' machinery and draft animals, and farming mainly with manual labor. The capital/technology variables provide an insight into whether the households that are most dependent on subsistence agriculture rely almost exclusively on manual technology.

4 Data collection and sample description

4.1 Sampling and data collection

A questionnaire to survey agricultural households was designed, collecting both quantitative and qualitative information. The questionnaire solicited data, amongst other items, regarding four relevant topics: (i) household head and household members characteristics; (ii) household income, employment and time allocation; (iii) agricultural land and non-land assets, production, and sales; (iv) household attitudes to their farming activities, and their perceptions of drivers for and impediments to commercial agricultural activity.

The survey employed geographical cluster sampling. Regions and villages were selected through a two-stage clustered sampling process. In the first stage, three regions in each of the five surveyed countries were selected according to their degree of economic development: (i) lagging behind (ii) average and (iii) prosperous, corresponding to a GDP per capita below, similar to and higher than the national average. The survey targeted rural areas, and for this reason the regions of the capital city and other large cities were excluded from the selection. EUROSTAT data at the NUTS3 level were used as a basis for this selection. In the second stage, three villages per NUTS3 region were selected (again with a view to cover the variations within the NUTS3 regions, namely a prosperous, average and lagging behind village in comparison to the regional mean). Only households that were engaged in agricultural production in two time points, 2006 and/or 2003, including production from gardens or yards belonging to the house, were included in the sample.

The survey was implemented via face-to-face interviews using local enumerators. Altogether, in the five countries 1,361 agricultural households were surveyed. After cleaning data for outliers and checking for valid entries for incomes and agricultural production, 1,124 usable records were available (Bulgaria 224, Hungary 219, Poland 229, Romania 257 and Slovenia 195).

4.2 Descriptive statistics of the sample

Table 3 presents the descriptive statistics of variables of interest for the sample pooled for the five countries. It indicates that the mean cultivated area is fairly small, 10 ha, but that agriculture accounts for the majority of the head of the household's working time (mean of 73.2%). Some households reported livestock production only, i.e. they did not also cultivate land. For this reason the minimum referring to variables e.g. total cultivated area, area of the biggest plot, distances to the biggest and farthest plot is zero. The standard deviation of the value of agricultural machinery is large. Some households are capital poor and do not own agricultural machinery.

The mean c/w ratio does not suggest vulnerability but a high standard deviation is apparent. For the vulnerable households in the sample, the dependency ratio is 5.8. At first glance, the location characteristics, represented by the distance to the nearest urban centre, do not suggest remoteness. Most farm within the local area (less than 4 km away from home) and are, on average, 23 km away from the nearest urban centers. These distances do not suggest isolation. However, in the presence of inadequate transport infrastructure and a lack of access to a private vehicle, some households might find their location impedes their ability to reach buyers and wholesale markets.

On average, the sample households sell less than one-half of their agricultural output, which, following Mosher (1970), classifies them as subsistence orientated. Home produced food covers a substantial part of their food consumption. Following the procedures outlined in section 3.1, subsistence production accounts for 18.1% of real household incomes. However, the above observations refer to the sample means. The minimum and maximum values indicate extreme cases of full dependence on subsistence farming, or conversely, a completely commercial focus. Table 3 indicates a large standard deviation of incomes per capita which increases with the valuation of unsold output.

5 Results

5.1 Importance of subsistence farming for real agricultural household incomes

The valuation of unsold output, sometimes also referred to as valuation of income in kind, provides an indication of the contribution of subsistence farming to household welfare. Table 4 provides a general picture of the contribution of subsistence farming to real household income.

Subsistence production valued at market prices contributes significantly to household incomes, particularly in Romania, Bulgaria and Poland. Although in Hungary there are more than half a million farms producing mainly for self-consumption (see Table 1), its contribution to household incomes is nonetheless modest. Most of these households generate the majority of their income from non-farm activities.

As expected, the contribution of subsistence farming is higher for households that are below poverty line (the poverty line is calculated before the valuation of the unsold output). Notably, subsistence farming appears to be crucial for the survival of poor agricultural households in Romania (Table 4). This is an important finding given the number of holdings engaged in small-scale production in Romania (Table 1). For poor households, income in kind from subsistence production accounts for more than 50% of real income per capita.

Subsistence production relives poverty but it is not enough to eradicate it. Figure 1 indicates that after the valuation of unsold output the number of poor households, and those who are simultaneously poor and vulnerable decreases. The number of vulnerable households who are not poor increases slightly.

Despite the critical importance of subsistence production for the real incomes of the Romanian poor, it is in Bulgaria where the effect of the valuation of income in kind has the largest effect, measured by the switch of households from below to above the poverty line (Table 5). In Bulgaria approximately 11% of sampled households are reclassified as non-poor as a result of valuing subsistence production. For the whole sample, 65 households (5.8%) switch from being classified as poor to non-poor due to the valuation of subsistence production.

The valuation of the contribution of subsistence farming also affects the distribution of incomes. Figures 2 and 3 plot the distribution of equivalised income per capita for Bulgaria, where the effect of subsistence seems to be the most pronounced, pulling households above the poverty line, excluding and including the value of unsold output respectively. As expected, the density of income distribution is right skewed. The valuation of unsold production does not affect the right tail but on the left the frequency of the lowest income households decreases.

5.2 Cluster analysis

As explained in the methodology section, cluster analysis was preceded by factor analysis. A five-factor solution was adopted, choosing the factors that present an eigenvalue greater than one. This solution explains 73% of the total variance in the data set, which is satisfactory. The cut-off for interpretation purposes is factor loadings greater or equal to 0.5 on at least one factor. Two tests confirmed the appropriateness of the factor analysis. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.62, indicating that the data matrix had sufficient correlation to justify the factor analysis. Bartlett's test of sphericity was statistically significant at the 1% level, implying that the hypothesis that the correlation matrix is the identity matrix could be rejected.

The first factor is associated with the head of the household's characteristics and their labor allocation (age, time spent on-farm and time spent on wage employment). The second factor is farm size, captured in terms of the total cultivated area and the size of the biggest plot. Factor three can be labeled 'farm fragmentation' and it is related to the distances to the biggest and to the most distant plot. The next factor represents household size – the number of household members and the total household income. The fifth factor, labeled market access, is associated with the distance to the nearest town and the contribution of subsistence production to the real household incomes. Table 6 presents the rotated component matrix.

These five factors formed the basis for cluster analysis. Applying the clustering method explained in the methodology section, a four cluster solution was obtained (Table 7). Tables 8 and 9 present the cluster validation variables and detail the distribution of cluster membership by country respectively.

Cluster 1 – Relatively large, commercially oriented households

The smallest cluster in the sample, this group stands out from others with respect to most of the profiling and validation variables. This cluster has significantly larger assets (land, agricultural equipment), higher shares of sales, and higher incomes than others. This identifies the cluster as comprised of relatively large, commercially oriented holdings. The mean farm size is 63 ha. Hired labor, credit and technical assistance are used to a greater extent in comparison with other clusters. Farming is more mechanized and ownership of agricultural machinery is significantly higher. Regarding vulnerable and poor households, these are noticeably underrepresented in this group. Counting the value of subsistence production, no household in this group falls below the threshold for being at the risk of poverty. Subsistence production as a share of total income is low for this group, even when bearing in mind that the value of subsistence production also includes possible inputs in production. In addition, this cluster has the lowest share of food consumption from own production.

With reference to their objectives regarding farming within the next five years (Table 10), 40% of the cluster's households intend to maintain business as usual. However, over one-third seek to intensify farming (increasing labor/resource inputs) or increase share of sales. In the case of those that intend to leave agriculture in the next five years, the main objective is to transfer to the next generation, which does not necessarily translate into decreasing farming activity for the holding as a whole. None are seeking to cease farming altogether.

Concerning the distribution of countries within this cluster, Hungary is the largest contributor, accounting for close to half of the cases (45.8%) followed by Slovenia (25.0%), Bulgaria (16.7%) and Romania (10.4%). Only one Polish household is included in this cluster.

Cluster 2 – Medium-sized commercially oriented households

This cluster accounts for approximately 22% of the sample and like the first cluster can also be profiled as commercially oriented based on the average share of sales (Table 8). However, the cultivated land area for this cluster is significantly lower (mean of 8 ha, which is close to the average for the sample). Similar to Cluster 1, the head of the household is primarily engaged in agriculture. However, differences between the clusters are striking. Firstly, subsistence production is very important for Cluster 2 both in terms of income and food consumption. Excluding the value of subsistence production, this cluster has the lowest equivalised income per capita and over one fourth of the group falls below the poverty line. Including subsistence production shifts nearly half of the poor households above the poverty line, yet the cluster still has the largest share of poor households. One possible explanation for the low incomes and the high importance of subsistence production for this cluster may be its remote location. With an average of 45.7 km to the nearest urban centre, it is likely that off-farm employment opportunities are limited (reflected by the low share of time spent in non-farm wage employment and the high share of households with no members in wage employment). As a consequence, farming becomes the main income source and also a necessity to satisfy the household's consumption needs.

Regarding farming technology, this cluster has the lowest share of mechanization (66.1%) and about one third of the sample farms either manually (21.9%) or with a combination of draft animals and machinery (10.7%). The value of owned agricultural machinery is consequently low. Within a time-frame of five years, most households intend to maintain their current level of activities but more than one-fifth plan to intensify farming. This cluster is dominated by Bulgarian households (60.7%), followed by Poland (21.0%). Hungarian, Romanian and Slovenian households are poorly represented.

Cluster 3 – Part-time farmers

This cluster accounts for 28% of the sample. Non-farm waged employment is the main income activity and the contribution of subsistence production to real incomes is relatively modest (14%). Only 28.9% of households in this cluster do not have at least one member engaged in wage employment. However, it would be incorrect to label these households "hobby farmers" as they cultivate, on average, areas far larger than what would typically be considered as a hobby activity (5.6 ha). Moreover, households sell quite a large share of their output (45.5%) and farm their land using agricultural machinery (78.0%). Bearing this in mind, "part-time farmers" is a more suitable descriptor. The shares of poor and vulnerable households within this cluster are fairly low, and income-wise this cluster is relatively well-off compared to medium-sized commercial households (Cluster 2) and older, dependent households (Cluster 4). The cluster is unlikely to disappear in the short to medium term – the majority plan to continue their operations with no change in the next five years. Only approximately one-tenth intend to retire or cease farming in the same time period. This cluster is reasonably well spread over the five countries, with Romanian households being the single largest nationality (26.8% of cluster members).

Cluster 4 – Older, dependent households

By far the largest cluster in the sample (46%), this group is dominated by significantly older heads of households than the other clusters (61.2 years) who spend close to all of their time on-farm (96.8%). The cluster holds the largest share of vulnerable households (19.7%) and the dependency ratio is significantly higher compared to the other clusters, indicating that the cluster is skewed towards the elderly. However, the average household size is just above three members and a majority of the households have at least one household member engaged in wage employment, implying that the households in this cluster are not purely pensioner households. For this reason, this cluster can be classified as older, dependent households rather than pensioners.

Households within this category are mainly subsistence oriented (52%), with a quite high average share of sales (44.6%). They farm mainly with household labor only and cultivate on average 6.1 ha. Only a small fraction of this cluster takes out credit for production and marketing, and technical assistance is not widely used (14.9%). Subsistence production is important for this group both in terms of topping up income (17.1%) and for food consumption (44.0%). When including the value of subsistence production, the share of poor households decreases from 14.7 to 9.6%. Still, counting the value of subsistence production, this group has the lowest equivalised income per capita in the sample.

With regards to their objectives in the next five years, 58% envisage no changes. Less than 2% plan to retire and 7% envisage ceasing farming. It is likely that their engagement in farming will only end when they can no longer continue physically, rather than a voluntary choice to retire. All countries are represented in this cluster with one third of the group comprised of Romanian households, with Hungarian, Polish and Slovenian households constituting about one fifth each.

6 Conclusions

The paper contributes to research on subsistence and semi-subsistence farming in the NMS by drawing on a recent and relatively large dataset (n=1124 useable responses). The latter provides detailed information on agricultural households in contrasting rural regions of five countries (Bulgaria, Hungary, Poland, Romania and Slovenia). The research generates four key conclusions.

First, *subsistence production remains pervasive in the NMS*. Using Mosher's (1970) definition of subsistence farmers as those selling less than 50% of their output, the majority of those sampled can be classified as subsistence oriented.

The prevalence of subsistence production is unlikely to change in the short to medium term – the majority of those sampled envisaged no change in their farming operations in the next five years. Subsistence production should not be seen as merely a transitional phenomenon in CEE – twenty years after the downfall of socialist regimes it remains a critical characteristic of agriculture in the NMS.

Second, *the contribution of subsistence production to real incomes is uneven but significant*. Using the procedures outlined in Section 3.1, the equivalent value of subsistence food production is €1854.1 per capita, accounting for, on average, 18.1% of the real incomes of sampled households. The contribution of subsistence production to real incomes is greatest in Romania and Bulgaria (28.1 and 22.4% of equivalent incomes per capita) and least important in Hungary and Slovenia (7.1 and 9.1% respectively). There is therefore a divide between Romania and Bulgaria and the 2004 NMS. For the sample as a whole the valuation of subsistence production pushes 5.8% of the sample above the poverty line (equivalent to roughly one third of those classified as poor prior to the valuation of such production). Given the large number of small-scale farms outlined in the EU FSS, this is an important finding. The level of subsistence production in NMS results in estimations of poverty being sensitive to its valuation.

Third, *cluster analysis reveals the distinctiveness of farming in CEE*. Only 48 agricultural households (4.6% of the sample) fall into Cluster 1. Relatively large, commercially oriented households characterise Cluster 1, which have a mean farm size of 62.9 ha, similar to what would be considered a medium sized family farm in Western Europe (Shucksmith and Herrmann, 2002). It is the latter group, which are central to the 'European model of farming' and the traditional focus of the Common Agricultural Policy (CAP) (Brookfield and Parsons, 2007). The vast majority of agricultural households in the NMS do not fit with notions of what constitutes a family farm in Western Europe. Clusters 2, 3 and 4 operate on a much smaller level (mean farm sizes of 8, 5.6 and 6.1 ha respectively) but the contribution of farming to total incomes makes them far more than merely 'hobby farms'. These 3 clusters are however not the main beneficiaries of CAP direct payments (Davidova, 2008), which for the NMS are currently paid on a simple per hectare basis.

Finally, highest in Clusters 2 and 4, *poverty is associated with remote locations, relatively small farm sizes and the lack of off-farm work*. Lower incomes and a higher incidence of poverty (26.8% of group) characterize Cluster 2 compared to Cluster 3, despite the former operating slightly larger, on average, farms. This is because households in Cluster 3 boost their incomes from off-farm work. Households in Cluster 2 appear less able to follow this strategy because of their location; they are distant from the nearest urban centre. A relatively low level of wage employment also characterizes Cluster 4, linked in the latter case to a higher proportion of elderly household members. Cluster 4 comprises households from all countries and its problems are not state specific. Both Clusters 2 and 4 are thus fairly reliant on agriculture for their livelihood but do not possess sufficiently large farms (such as in Cluster 1) to generate high incomes. As evidenced in Table 10, the majority are unlikely to alter their farming operations in the short to medium term. This suggests that their fortunes will be closely linked to social security systems, particular pensions for Cluster 4, and whether the non-farm rural economy expands to provide alternative occupations in remote rural locations. Cluster 3 would be vulnerable to a decline in off-farm work as their farms are also insufficient alone to generate reasonable incomes.

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Table 1 Farm subsistence orientation in the studied NMS*

	Bulgaria	Hungary	Poland	Romania	Slovenia
Number of holdings producing mainly for own consumption (in thousand)	367.9	522.6	908.2	3444.8	45.6
Share of holdings producing mainly for own consumption of size less than 1 ESU (%)	88.4	85.3	75.5	75.2	26.9

Source: EUROSTAT (2007a, 2007b, 2008a, 2008b, 2009)
Notes: * Hungary, Poland and Slovenia data for 2007; Bulgaria and Romania data for 2005.

Table 2 Variables used in factor and cluster analysis

Variable
Age of household head
Time spent on-farm by household head (%)
Time spent on non-farm wage employment by the household head (%)
Total number of household members
Total cultivated area (ha)
Size of biggest plot (ha)
Distance to most distant plot (km)
Distance to biggest plot (km)
Total household income (PPP€)
Distance to nearest urban centre (km)
Subsistence production as share of total income (%)

Table 3 Descriptive statistics for the sample households (2006)

n=1124	Min	Max	Mean	Std. D.
Age of household head (HH)	18	91	54.0	13.0
Share of time spent time on-farm by HH	0	100	73.2	36.6
Time spent on wage employment by HH	0	100	19.3	32.6
Education level of HH	1	7	3.4	1.3
Total number of household members	1	9	3.5	1.6
c/w ratio	0	8	1.3	2.3
Total cultivated land area 2006 (ha)	0	460	10.0	25.2
Size of biggest plot (ha)	0	72	3.2	6.6
Distance to most distant plot (km)	0	80	3.9	5.7
Distance to biggest plot (km)	0	45	2.5	3.6
Total household income (PPP€)	235	269229	17288.7	16849.6
Distance to nearest urban centre (km)	4	78	23.1	18.5
Share of sales of agricultural output (%)	0	100	48.2	35.5
Food consumption from own production (%)	0	100	41.5	27.8
Equivalised income per capita (PPP€)	78	86848	8023.7	7351.8
Equivalised income per capita incl. unsold quantities (PPP€)	183	191753	9877.8	10087.7
Subsistence production as share of total income	0	98.5	18.1	17.5
Value of agricultural equipment (PPP€)	0	680343	11166.9	34290.1

Table 4 Contribution of subsistence farming to households' income per capita by country

	Bulgaria	Hungary	Poland	Romania	Slovenia
Value of unsold output/capita (PPP€)	2,225	807	2,294	1,868	2,069
Unsold output in income per capita (%)*	22.4	7.1	20.6	28.1	9.1
Unsold output in income per capita of poor households (%)*	25.1	19.1	27.7	52.7	17.3

Note: * Calculated as equivalised value of unsold output per capita ⁄ equivalised income per capita including the value of unsold quantities.

Table 5 Sensitivity of assessments of poverty to the valuation of subsistence production by country, 2006 (in brackets %)

	Below poverty line excl. unsold output		Below poverty line incl. unsold output		Pushed above poverty line when incl. unsold output	
	Number	Share	Number	Share	Number	Share
Bulgaria	59	26.3%	35	15.6%	24	10.7%
Hungary	32	14.6%	24	11.0%	8	3.7%
Poland	21	9.2%	8	3.5%	13	5.7%
Romania	13	5.1%	5	1.9%	8	3.1%
Slovenia	50	25.6%	38	19.5%	12	6.1%
Sample total	175	15.6%	110	9.8%	65	5.8%

Table 6 Rotated component matrix

	HH characteristics	Farm size	Land fragmentation	Household size	Market access
Age of Head of the Household (HH)	**0.602**	-0.138	0.035	-0.312	-0.240
Time spent on-farm by HH (%)	**0.905**	0.016	0.015	0.034	0.146
Time spent on non-farm wage employment by HH (%)	**-0.903**	-0.035	-0.023	-0.062	-0.122
Number of household members	-0.021	-0.014	0.013	**0.818**	0.094
Total cultivated area (ha)	0.010	**0.875**	0.190	0.132	0.058
Size of biggest plot (ha)	-0.042	**0.907**	0.069	0.003	-0.012
Distance to most distant plot (km)	0.056	0.146	**0.872**	0.072	0.052
Distance to biggest plot (km)	0.000	0.101	**0.890**	0.004	-0.028
Total household income (PPP€)	-0.022	0.441	0.122	**0.641**	-0.249
Distance to nearest urban centre (km)	0.042	0.002	0.037	0.139	**0.773**
Subsistence production as share of total income (%)	0.087	0.010	-0.023	-0.445	**0.631**

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

Rotation converged in 5 iterations.

Table 7 Cluster analysis

	1 n = 48	2 n = 224	3 n = 287	4 n= 477	Mean	4 –cluster *F*-test	
Age of household head	50.0	49.3	46.9	61.2	54.2	116.3	***
Time spent on-farm by household head (%)	75.1	86.7	25.7	96.8	73.9	809.7	***
Time spent on non-farm wage employment by the household head (%)	14.4	5.9	61.0	0.2	18.9	675.3	***
Total number of household members	4.08	4.17	3.40	3.13	3.47	26.7	***
Total cultivated area (ha)	62.9	8.0	5.6	6.1	9.0	328.3	***
Size of biggest plot (ha)	20.3	2.5	2.1	2.2	3.1	211.2	***
Distance to most distant plot (km)	14.8	4.0	3.1	3.2	3.9	82.0	***
Distance to biggest plot (km)	8.9	2.2	2.3	2.1	2.5	67.8	***
Total household income (PPP€)	45223	15694	16683	15468	17232	63.9	***
Distance to nearest urban centre (km)	21.6	45.7	18.0	16.6	23.5	225.8	***
Subsistence production as share of total income (%)	14.3	29.0	13.7	17.1	18.6	39.5	***

Notes: *** −1%-level of significance

Table 8 Variables for validation of the clusters

	1 N = 48	2 n = 224	3 n = 287	4 n = 477	Mean	4 –cluster *F*-test	
Continuous variables							
Education level of household head	3.2	3.9	3.9	3.0	3.5	43.83	***
c/w ratio	0.84	1.11	0.96	1.69	1.32	7.60	***
Share of sales in agricultural output 2006	73.3%	54.3%	45.5%	44.6%	48.3%	12.65	***
Share of food consumption from own production	33.8%	46.4%	38.4%	44.0%	42.5%	5.70	***
Equivalised income per capita (PPP€)	19370	6551	8130	7499	8019	53.88	***
Equivalised income per capita including unsold quantities (PPP€)	22326	9167	9257	8908	9683	50.19	***
Value of agricultural equipment (PPP€)	85027	11321	10985	14400	16453	44.99	***
Binary variables							
Vulnerable households (%)	4.2	8.0	11.5	19.7	14.2		
Below poverty line (%)	4.2	26.8	8.4	14.7	15.1		
Below poverty line incl subsistence production (%)	0.0	14.7	5.9	9.6	9.3		
No household members who are self-employed (%)	85.4	91.5	92.7	93.5	92.5		
No household members in wage employment (%)	33.3	48.2	28.9	41.1	38.9		
Farming with household labour only (%)	62.5	75.9	90.9	86.2	84.2		
% owning agricultural machinery	72.9	43.8	41.8	40.3	43.0		
% using others' agricultural machinery	20.8	22.3	36.2	40.3	34.4		
% using own draft animals and agricultural machinery	2.1	8.5	4.5	3.6	4.8		
% using others' draft animals and agricultural machinery	0.0	2.2	2.4	4.0	3.0		
Farm only manually (%)	4.2	21.9	13.6	10.7	13.6		

Note: *** −1%-level of significance

Table 9 Cluster membership by country

	1	2	3	4
Bulgaria				
Number of households	8	136	34	35
% of cluster membership	16.7	60.7	11.8	7.3
Hungary				
Number of households	22	8	64	87
% of cluster membership	45.8	3.6	22.3	18.2
Poland				
Number of households	1	48	54	97
% of cluster membership	2.1	21.4	18.8	20.3
Romania				
Number of households	5	18	77	156
% of cluster membership	10.4	8.0	26.8	32.7
Slovenia				
Number of households	12	14	58	102
% of cluster membership	25.0	6.3	20.2	21.4
Sample total	48	224	287	477

Table 10 Main objective for the household in relation to agriculture within the next five years (%) by cluster

	Cluster			
	1	2	3	4
▪ No change	39.6	44.3	54.5	57.6
▪ *Objectives committing to farming*				
– Intensify farming (increase labor/resource input)	20.8	21.7	8.6	5.5
– Increase the share of sales	16.7	6.3	6.1	4.9
– Specialize farming	2.1	4.5	3.9	2.0
Sub-total:	*39.6*	*32.6*	*18.6*	*12.4*
▪ *Objectives to phase out farming*				
– Transfer to the next generation	14.6	6.3	7.5	10.0
– Scale down farming	2.1	6.3	8.6	9.5
– Retire	2.1	2.3	2.2	1.8
– Decrease farming intensity (decrease labor/resource input)	2.1	1.4	1.4	1.3
– Cease farming	0.0	6.8	7.2	7.3
Sub-Total:	*20.8*	*23.1*	*26.9*	*29.9*

Figure 1 Effect of subsistence production on poor and vulnerable households

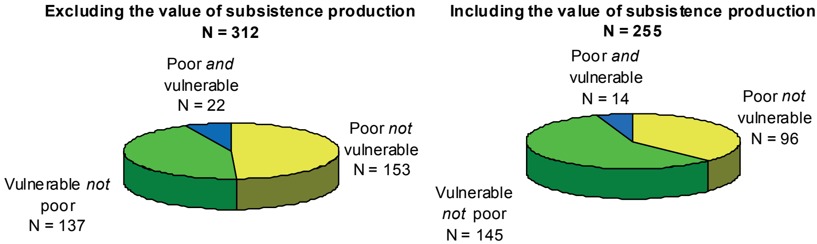


Figure 2 Density distribution of household incomes in Bulgaria prior to the valuation of unsold output

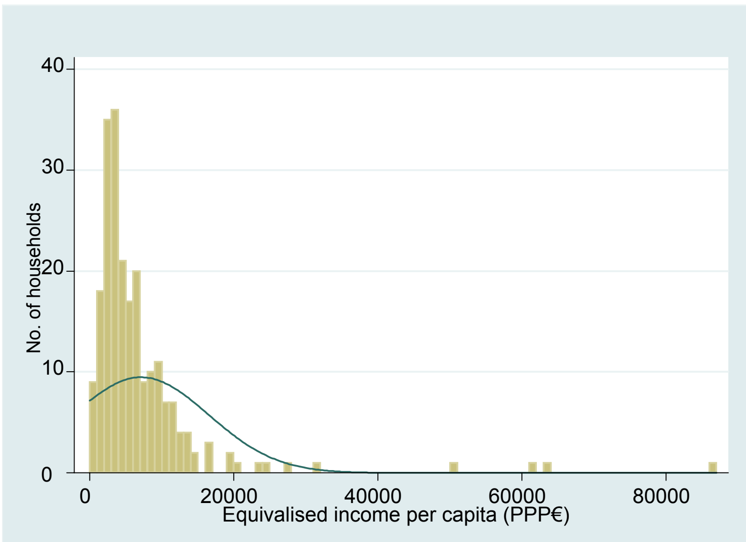
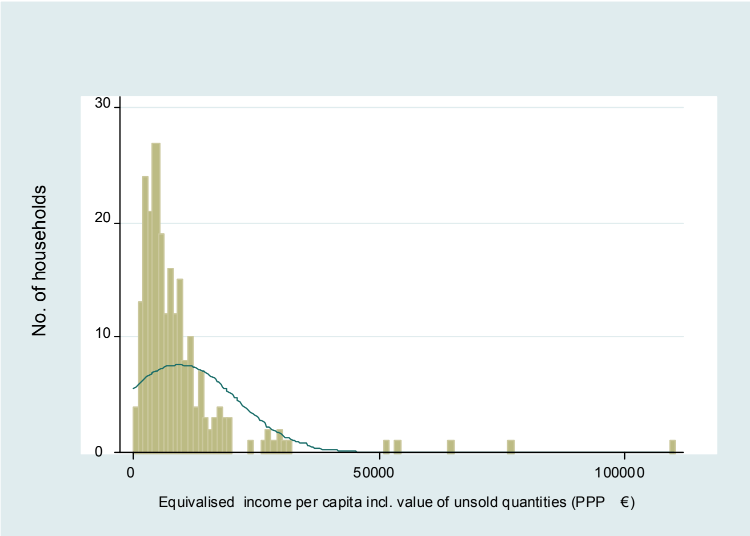


Figure 3 Density distribution of household incomes in Bulgaria following the valuation of unsold output



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The flexibility of family farms in Poland

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Abstract

This paper investigates the flexibility of the Polish farming sector during transition, where flexibility is considered to be a farm's ability to change output by sustaining average costs. We argue that flexibility is a crucial factor in a farmer's competitive advantage, especially under dynamic environmental conditions. We propose a flexibility measure that accounts for both input and output flexibility. This measure is used to empirically investigate the magnitude and sources of flexibility in Polish family farming. We also identify the main factors that explain the proposed flexibility indices. The empirical findings reveal that Polish farms use different technologies regarding their input and output flexibility. While small and specialized farms can easily adapt their input structure, the larger and highly diversified producers adjust their output levels according to price changes. Farmers who use more capital-intensive production technologies, i.e., milk producers, are less flexible with regard to input and overall adjustments. Furthermore, access to bank credit increases a farm's ability to adjust.

Keywords: Flexibility, family farm, Poland

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1 Introduction

Agricultural enterprises in transition countries are faced with dynamic economic, legal, and political conditions. Output adjustment in response to these changes is often associated with an increase in the average costs of production at the farm level. Thus, flexible production technology is required to meet this challenge. In our study we define flexibility as farmers' ability to modify output by sustaining its average costs. In this context, flexibility can be considered a crucial factor of competitive advantage. The agricultural sector in the EU's New Member States is often dominated by small family farms. Despite their relatively low productivity, family farms did not disappear during transition nor after EU accession. One possible explanation could be that small farms use more flexible technologies as their source of competitive strength. The main question of this study, then, is whether small farms in Poland are more flexible and thus better able to respond effectively to changes in demand than large farms.

Researchers have been interested in firms' flexibility since the topic was introduced by Stigler (1939), who defined flexibility as those attributes of cost curves that determine how responsive output decisions are to demand fluctuations. Stigler discussed flexibility in terms of the relative convexity (the second derivative) of the average cost curve. Thus, the flatter the average curve, the greater the flexibility. Therefore, in line with Stigler, we consider flexibility as an extent of average cost changes in response to output variations. Using duality of production technology, we present two alternative indices in terms of elasticities of the cost and production functions. While the existing flexibility literature focuses on either input or output flexibility, the proposed measure allows us to distinguish between both dimensions and analyze their interdependence and contributions to the overall flexibility of the firm. Thus far, little work has been done to investigate the determinants of flexibility in the agricultural sector. With the exception of Weiss (2001), there are no empirical studies that consider the impact of family and individual characteristics of farmers on flexibility.

The goal of this paper is to empirically investigate the magnitude and distribution of flexibility across Polish farm households, as well as the relationship between farms' flexibility and several farm characteristics. In the first step, we calculate flexibility indicators using estimated parameters of the production function. We apply an approach developed by Alvarez et al. (2003,

2004) that is able to account for farm-specific technologies. In the second step, we use a two-stage regression procedure proposed by Hsiao (2005) to explain flexibility by determining various factors. Polish agriculture is dominated by family farms. Thus, we consider various economic factors as well as socio-demographic variables in the empirical model.

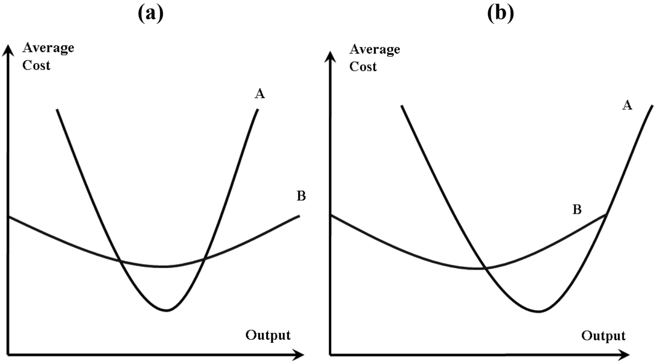
The structure of this paper is as follows. Section 2 introduces and discusses the proposed flexibility measure. Section 3 provides empirical analysis. We first discuss the approach used for the estimation of flexibility and present obtained parameters of the production function. Afterward, we present our hypothesis and empirical results regarding the explanation of flexibility. The fourth section concludes the paper.

2 Definition and measure of flexiblity

Following Stigler (1939), we consider flexibility as an attribute of the production technology to accommodate output variations at the lower costs. According to Stigler's definition, flexibility varies inversely with the curvature of the average cost curve. To illustrate this concept we consider two single-product firms with U-shaped average cost curves, as shown in Figure 1a. In this example, firm B, with a flatter average cost curve, uses more flexible technology than firm A, which has a steeper curve, because the average costs of firm B change less than the average costs of firm A in response to a change in output levels. Because the curvature of a function is measured by the second derivative, the firm is considered to be more flexible the smaller is the second derivative of its average cost curve.

Although Stigler's example, illustrated in Figure 1a, considers two firms with the same optimal output level, the argument can also be applied when firms have their optimum at different production levels. Such a situation arises when the average cost curve of the inflexible firm A is shifted to the right, as illustrated in Figure 1b. In this case, the smaller firm B, with a higher minimum average cost, uses a more flexible technology than the relatively larger firm A. Such a situation, in which there is a trade-off between the static efficiency of large firms and the flexibility (dynamic efficiency) of small firms, is widely analyzed in theoretical and empirical studies (see e.g. Mills and Schumann, 1985; Das et al., 1993; Weiss, 2001). The opposite case, when larger firms are more flexible, is also conceivable. Thus, the relationship between the production scale (firm size) and flexibility can only be assessed with an empirical analysis.

Figure 1 Average cost and flexibility



Based on the definition provided above, we use the second derivative of the average cost function with respect to output as a flexibility measure for single-output firms:

$$Flex = \frac{\partial^2 AC}{\partial y^2} = \frac{C_{yy}}{y} - \frac{2C}{y^3}(\varepsilon_{cy} - 1), \qquad (1)$$

where AC is the average cost, C_{yy} is the second order derivative of the cost function $C(y)$ with respect to the output y, and ε_{cy} is the cost elasticity with respect to the output, $\varepsilon_{Cy} = \frac{\partial C}{\partial y} \cdot \frac{y}{C}$.

The cost elasticity is reciprocal to the scale elasticity ε_{sc}, defined as the sum of the output elasticities given the production function $f(x)$: $\varepsilon_{sc} = \sum_i \frac{\partial f(x)}{\partial x_i} \cdot \frac{x_i}{y}$.

Under perfect competition, marginal cost is equal to the output price. Differentiating this equality with respect to output price yields the following relationship between the second derivative of the cost function and supply elasticity:

$C_{yy} = \varepsilon_{yp}^{-1} \cdot \frac{p}{y}$ with $\varepsilon_{yp} = \frac{\partial y}{\partial p} \cdot \frac{p}{y}$ - own price supply elasticity.

After some transformations, the flexibility measure (1) can be expressed in terms of the supply and scale elasticities:

$$Flex = \frac{p}{y^2}\varepsilon_{yp}^{-1} - \frac{2C}{y^3}(\varepsilon_{sc}^{-1} - 1)\,. \qquad (2)$$

The measure of flexibility can be decomposed into two terms: output and input flexibility. Output flexibility measures the ability of the firm to adjust production in response to output price changes:

$$OutputFlex = \frac{C_{yy}}{y} = \frac{p}{y^2}\varepsilon_{yp}^{-1}\,. \qquad (3)$$

This term encloses the second derivative of the cost function from (1) or, alternatively, the reciprocal of the supply elasticity from (2), weighted by the output price and the output level. An increase in the supply elasticity will generate flatter average cost curves, implying more flexible production technologies. Thus, the higher the *OutputFlex*, the lower the flexibility.

The notion of flexibility expressed in terms of supply elasticity is widely used in the existing literature (e.g. Mills/Schumann, 1985; Das et al., 1993). On the other hand, some authors suggest using the second derivative of the cost function, i.e., the slope of the marginal cost function, as a measure for flexibility (e.g. Tisdell, 1968; Zimmermann, 1995).

Input flexibility considers input adjustments in response to output changes. This measure encloses the cost elasticity (or scale elasticity) weighted by the cost and the output level. Firms with higher economies of scale will cause steeper average cost curves, which is associated with inflexible production technology. Thus, the higher the *InputFlex,* the lower the flexibility. Chambers (1997) uses the cost elasticity as an indicator for flexibility:

$$InputFlex = -\frac{2C}{y^3}(\varepsilon_{cy} - 1) = -\frac{2C}{y^3}(\varepsilon_{sc}^{-1} - 1)\,. \qquad (4)$$

Thus, the proposed flexibility measure takes into account the alternative flexibility measures used in the existing literature. The advantage of the decomposed flexibility measure is that it allows us to analyze the flexibility as a whole, as well as its components separately, to distinguish some sources of flexible technologies by different firms.

3 Data and empirical analysis

We used a data set consisting of eight years of observations, from 1994 to 2001, from 580 Polish farms; the total number of observations was 4,455. The data set was provided by the Polish Institute of Agricultural and Food Economics - National Research Institute (IERiGZ-PIB). Variables contain both farm-specific accountancy information and socio-demographic characteristics. More detailed information on several variables used for the particular empirical estimation will be presented in the following corresponding sections.

The empirical analysis proceeds as follows. In Section 3.1 we present the procedure and the empirical results of the flexibility estimation. Because flexibility indices can be calculated using alternative specifications of the cost and the production function, we first discuss the choice of approach. Parameters of the production function, estimated using the empirical approach developed by Alvarez (2003), are presented and discussed. Section 3.2 deals with an explanation of flexibility. Based on the estimated parameters of the production function, we calculate flexibility indices and discuss their distribution over Polish family farms. We then formulate a hypothesis regarding the factors affecting farms' flexibility and discuss empirical results.

4 Estimation of flexibility

The indicator of flexibility could be directly derived from a cost function. However, estimating a cost function requires information on input prices, and the data set contains only information on quantities (labor, land) and expenditures (variable inputs, capital). For some farms the cost of land and labor can be taken from the expenditures and quantity of hired labor and rented land. However, the majority of farms employ only family-owned resources. Using the information available would either decrease the number of observations dramatically or would induce, if average prices were used, an unacceptable bias in the exogenous variables.

An alternative would be to estimate a restricted cost function with labor, land, and capital as fixed inputs. Variable inputs could be captured by their price indices. Official statistical publications provide detailed information about input price indices for various categories of variable inputs. With this information, firm-specific input price indices could be constructed using the shares of the categories in the variable input aggregate. This approach, even if firm-specific price developments could be considered, has one major drawback: It must be assumed that in the base year all farms face the same price relations. Moreover, because the base year can be chosen arbitrarily, the estimation results cannot be interpreted consistently. Moreover, they differ according to the base year.

In addition, our experiments indicate that the restricted cost function is not theoretically satisfactory: cost increased in fixed factors, even at the sample mean. Moreover, the concavity in input prices was not satisfied for the majority of observations. Given these empirical and conceptual problems, we refrained from using a cost function and applied a production function instead. The required information for calculating the flexibility indicator can be taken from the production function as well, because both approaches characterize the technology.

A consistent interpretation of the technology indicator requires it to be differentiated between various technologies. Several methods are available for dealing with this problem. First we experimented with a latent class approach. Within this framework the technologies are differentiated endogenously. Because of parameter restriction in econometric packages, this approach can only identify a rather limited number of different technologies. In addition, the estimation results showed that the classification does not provide a homogeneous, but rather a heterogeneous group with regard to farm size or specialization in production. We proceed by conducting a cluster analysis to provide an exogenous classification of farms according to various technologies. We considered variables for farm size (hectare), specialization (number of cows and hogs), and technology (land productivity, man-to-land ratio). However, the estimation of the group-specific production functions led to theoretically inconsistent technologies. Because of these problems we chose an approach that assumes each firm has a specific technology. This approach is explained as follows:

We specify technology as a translog production function ($y_{it} = f(\mathbf{x}_{it})$):

$$\ln f(\mathbf{x}_{it}) = \alpha_0 + \alpha_m m_i + \frac{1}{2}\alpha_{mm} m_i^2 + \alpha_t t + \frac{1}{2}\alpha_{tt} t^2 + \alpha_{tm} m_i t + \boldsymbol{\alpha}_{\mathbf{x}}' \ln \mathbf{x}_{it} + \boldsymbol{\alpha}_{\mathbf{x}t}' \ln \mathbf{x}_{it} t + m_i \boldsymbol{\alpha}_{\mathbf{x}m}' \ln \mathbf{x}_{it} + \frac{1}{2} \ln \mathbf{x}_{it}' \mathbf{A}_{\mathbf{xx}} \ln \mathbf{x}_{it} . \quad (5)$$

Here, $\mathbf{x}_{it}$ represents observable inputs and outputs, t accounts for productivity change over time, and m_i represents a non-observable firm-specific factor. Subscripts $i = 1,...,N$ and $t = 1,..,T$ denote firm and time, respectively.

It is assumed that output increases in m_i. In addition, we assume that an optimal level of the firm-specific factor exists, m_i*, with $m_i \leq m_i$*. When $m_i = m_i$*, these presumptions imply that (5) can be considered as a metaproduction function, i.e., the envelope of firm-specific technologies (Hayami and Ruttan, 1970). In order to identify firm-specific technologies, we assume that m_i is not necessarily on its optimal level. In this case production occurs not on, but below the metaproduction function. However, since both m_i* and m_i are not observable, a direct estimation of the functions is not possible.

The assumption can be reformulated in an efficiency context in which an estimation is possible. The difference between the metaproduction and the actual technologies is:

$$\ln f\left(\mathbf{x}^e{}_{it}\right) - \ln f\left(\mathbf{x}^e{}_{it}\right)_{|m_i = m_i*} = -u_{it} = \ln TE_{it} =\leq 0 . \qquad (6)$$

Correspondingly, the observed output and the metaproduction function are linked through the following relationship:

$$\ln y_{it} = \ln f\left(\mathbf{x}^e{}_{it}\right)_{|m_i = m_i*} - u_{it} + v_{it} . \qquad (7)$$

Equation (7) represents a traditional efficiency model. Because m_i* cannot be observed, conventional estimation techniques cannot be applied. However, based on a random parameter setting, Alvarez et al. (2003, 2004) showed that (7) can be estimated by the maximum simulated likelihood technique. They apply the following distributional assumptions: $\ln TE_{it} \sim N^+(0, \sigma_u)$, $m_i * \sim \bullet(0,1)$. The symbol $\bullet$ indicates that m_i* might possess any distribution with zero mean and unit variance. In addition, random effects are considered in a variable $v_{it} \sim N(0, \sigma_v)$.

Moreover, with (6), TE_{it} is defined by:

$$\ln TE_{it} = \gamma_0 + \gamma_t t + \boldsymbol{\gamma}_{\mathbf{x}}' \ln \mathbf{x}_{it}, \text{ with } \begin{aligned} \gamma_0 &= \alpha_m (m_i - m_i*) + \frac{1}{2}\alpha_{mm}\left(m_i^2 - m_i*^2\right) \\ \gamma_t &= \alpha_{tm}(m_i - m_i*) \\ \boldsymbol{\gamma}_{\mathbf{x}} &= \boldsymbol{\alpha}_{\mathbf{x}m}'(m_i - m_i*) \end{aligned} . \qquad (8)$$

According to (8), within this setting technical efficiency is totally defined by the difference between m_i and m_i* and the intensity of input use. Moreover, (8) can be used to indentify the actual level of the specific factor because m_i is the only unknown.

The production function was estimated using the following variables. We consider one output and four inputs (land, labor, capital, and intermediate inputs). Output is the sum of crop and animal gross productions. This indicator is a more comprehensive measure of output than sales, because they include sales, home consumption, and stock changes. Because the individual figures for crop and animal production were in current values, the variables were deflated by the output price index provided by the Statistical Office in Poland (GUS var. issues, a, b).

Table 1 Variable definitions and descriptive statistics

Variable	Description	Symbol	Mean	Std. dev.	Minimum	Maximum
Production	gross production, deflated	Y	352.7	344.2	13.7	4565.8
Labor	hours of work (family and hired labor)	A	3903.9	1799.1	82.0	17648.0
Land	arable land and grassland in use	L	14.9	14.8	1.1	185.8
Capital	depreciation of farm assets plus expenditures on services, deflated	K	41.3	29.5	4.7	330.2
Intermediate inputs, crops	variable costs of crop production, deflated	V1	30.9	51.8	0.5	1204.0
Intermediate inputs, animals	variable costs of animal production, deflated	V2	90.4	122.2	0.1	2650.6
Intermediate inputs, general	other costs minus depreciation and expenditure on services, defl.	V3	27.3	24.4	0.3	228.55

Source: IERiGZ-PIB, own estimates.
Note: No. of observations: 3,434.

Land input was approximated by the sum of arable land and grassland in use. Unused land was excluded to provide a more accurate indicator of land used in production. Labor was considered as agricultural working units for both family and hired labor. Capital input was approximated by the sum of the expenditures on capital services and depreciation on buildings, machinery, and equipment. We deflated the data by the price index of agricultural investment because the information was delivered in current values. Intermediate inputs were separated into three groups: variable cost of crop production, animal production, and general inputs. Again, because the data set contains only current cost values, we deflated the series by the corresponding price indices of purchased goods and services in agriculture. The definition of variables including some descriptive statistics is provided in Table 1. For the estimation, all variables were divided by their geometric mean. Moreover, the homogeneity restriction was imposed with regard to crop production.

Table 2 provides the coefficients estimated by model (7). The estimated first order coefficients (A, L, K, V1, V2, V3) represent the elasticities at the sample mean since all variables were normalized. Most of the coefficients are significant; moreover, the parameters for monotonicity and (quasi-)concavity have the expected sign, so that at least at the approximation point the estimates are theoretically consistent (H > 0, and H*H + H^2 – H <0, for H = A, L, K, V1,V2,V3). The scale elasticity at the sample mean can be computed by adding the parameter estimates for the first order effects. With a value of approximately 1.1, the calculation provides that substantial economies of scale are present in Polish agriculture. This finding is consistent with the small farm sizes, i.e., Polish farmers operate in general at a suboptimal scale. Moreover, technical progress (T > 0) affected agricultural production in Poland positively.

In Section 2 we mentioned two requirements that the estimates should fulfill for them to be consistent with a metaproduction function: production must be increasing in mi* and the actual firm-specific effects must be smaller than the optimal effect (mi ≤ mi*). In Figures 2a and 2b, both requirements are fulfilled for all observations; therefore, the further computations can use existing and not virtual production technologies.

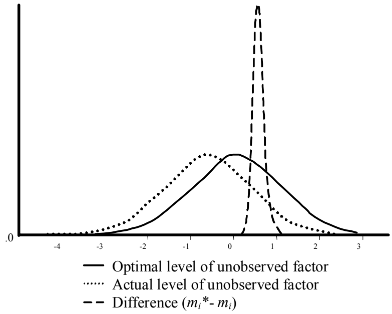
Table 2 Estimation results for the random coefficient model with unobserved input

means of the random process	C	0.00105	Second order effects	
	T	0.02869***		
	A	0.19918***	A*A	0.18810***
	L	0.17614***	L*L	0.03121
	K	0.10323***	K*K	0.05482**
	V1	0.14257***	V1*V1	0.08978***
	V2	0.38470***	V2*V2	0.12719***
	V3	0.09617***	V3*V3	0.02179*
coefficients on firm-specific effect	C*M	0.14408***	A*L	-0.07531***
	T*M	0.00613***	A*K	0.00477
	A*M	0.01246**	A*V1	0.01141
	L*M	-0.01140**	A*V2	-0.05147***
	K*M	0.02945***	A*V3	-0.00569
	V1*M	-0.00800*	L*K	0.03761**
	V2*M	-0.04722***	L*V1	-0.02414**
	V3*M	0.01734***	L*V2	-0.03784***
	M*M	-0.00489	L*V3	0.01581
further coefficients capturing technical change	T*T	-0.00100	K*V1	-0.04017***
	A*T	0.00463**	K*V2	0.00483
	L*T	0.01178***	K*V3	-0.04154**
	K*T	-0.00341	V1*V2	-0.04041***
	V1*T	-0.00792***	V1*V3	0.01741*
	V2*T	0.00197*	V2*V3	-0.00503
	V3*T	0.00141		

Source: Own estimates.

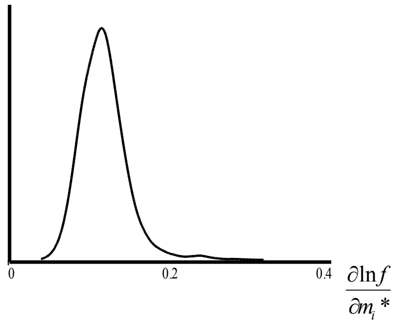
Notes: C denotes a constant. *, **, *** denote significance at a=0.1, 0.5, and 0.01 levels, respectively. No. of observations: 4,434, No. of farms: 580.

Figure 2a Distribution of the firm-specific factor, kernel density estimate



Source: Own estimates.

Figure 2b Marginal effect of m_i* on log output, kernel density estimate



Source: own estimates.

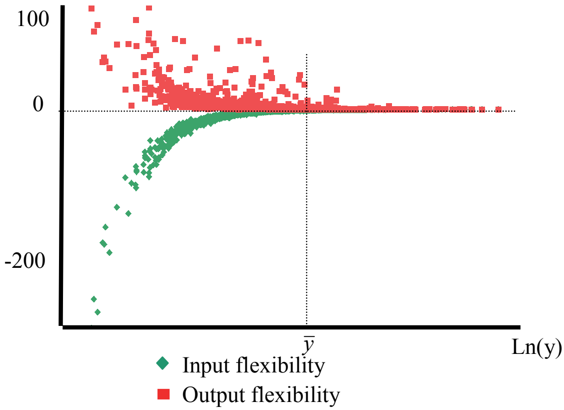
4.1 Determinants of Flexibility

We start by presenting information about the estimated flexibility indicator, which we use as an endogenous variable in the following regression model. Corresponding to the theoretical consideration, we differentiate between output and input flexibility. While input flexibility can be estimated using a first order effect, the calculation of output flexibility requires comparative statics. Meaningful results require that both the monotonicity requirements (first order effects) and the curvature conditions are satisfied (second order effects). Only if both conditions hold will supply elasticities have correct signs.

Checking the curvature conditions revealed that the estimated function was not (quasi-) concave for all observations. This holds especially when we considered all inputs to be variable. However, the results changed significantly when we considered land, capital, and labor input as fixed inputs. We skipped all observations which violate theoretical consistency. This resulted in a reduction of the firms' number from 580 to 523 and to a decline in the number of observations from 4,455 to 2,708.

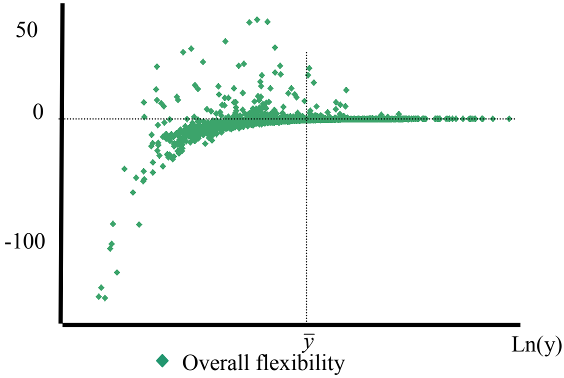
Figure 3 presents the results regarding output and input flexibility. Interestingly, the two indicators have opposite levels for small farm sizes. Input flexibility is high but output flexibility is low. Moreover, there is a larger variation in output than in input flexibility. For larger firms, the difference in the flexibility indicators vanishes. Indeed, both types of flexibility tend to be positive, though on a relatively low scale. The results for overall flexibility provide that large farms are medium flexible (Figure 4). The highest flexibility is observed for small farms. On average, medium-sized farms have the lowest flexibility; however, the group of farms is not homogeneous because the flexibility indicator varies significantly among the farms.

Figure 3 Input and output flexibility by output



Source: Own estimates.

Figure 4 Overall flexibility by output



Source: Own estimates.

4.1.1 Determinants of flexibility

We distinguish between two groups of factors that influence a farm's flexibility. These are economic and socio-demographic farm-specific factors. Factors in the first group are based on accounting data and vary over time. Variables from the second group vary across the farms but not over the time. We first discuss our hypothesis, followed by the regression analysis in the next section.

One of the most important research questions of this paper concerns the relation between farm size and flexibility. Based on Stigler's definition, Mills and Schumann (1985) hypothesize an inverse relationship between flexibility and firm size. They argue that large firms have greater economies of scale and are less flexible than small firms. Although large firms are statically more efficient than small firms due to lower average costs, the comparative advantage of small firms is their flexibility. Large and small firms are likely to have different cost structures. While small firms use more variable inputs, large firms rely more on capital-intensive fixed production factors. Based on this argument, we expect that input flexibility decreases with farm size. On the other hand, large farms might be better integrated into the market, have better access to the relevant information, and thus cope easier and quicker with changing market conditions. Therefore, we argue that large farms have greater output flexibility. Because these two flexibility measures affect overall flexibility in opposite directions, the relationship between farm size and overall flexibility is ambiguous. For the empirical analysis of this relationship, farm size is measured by gross agricultural output, deflated by the corresponding investment price index provided by the Central Statistical Office in Poland.

In addition, we controlled for the role of diversification, measured by the Berry index.[1] Product diversification is one of the most important strategies that firms use to adjust to fluctuating demand. Although we use a single-product flexibility measure, we can assume a positive effect of diversification on flexibility, especially output flexibility.

Besides output specialization, we also include an indicator that is supposed to capture the effects of farm specialization on capital-intensive production technologies. Milk production requires high specific investments and ongoing monitoring, so we assume the high share of this product in total agricultural production to be negatively correlated with the farms' flexibility.

Access to external sources of production factors might help agricultural enterprises meet the changing demand (Gasson and Errington, 1993). We expect additional capital flows to have a positive influence on the farms' flexibility. We consider two variables to capture for these effects: off-farm incomes and access to bank credit.

Further, we assume that commercialization, defined as a share of sales in the gross output value, has a positive influence on all measures of flexibility. Farmers who sell a large portion of their product on the market will be more flexible, irrespective of farm size. Such farmers are more involved in market relationships and must consider changes in demand and other market conditions.

Polish agriculture is dominated by family farms, so we investigate the influence of family and individual socio-demographic characteristics on farms' adjustment abilities. Pollak (1985) argues that some roots of farm heterogeneity may lie in differences in the internal organization and structure of families and households, as well as in the attitudes of farm holders toward risk-taking. We assume that flexibility decreases with the age of the farm holder. Older farmers are more risk-averse decision-makers than their younger counterparts, and hence prefer organizational forms with lower flexibility (Weiss, 2001; Zeller and Robinson, 1992). On the other hand, older farmers might be more experienced.

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[1] The index has the form of $BI = 1 - \Sigma(s_{ij})^2$, where s_{ij} is the share of the j-th agricultural product in the total sales of the i-th farm.

Nevertheless, given the drastic changes in the economic and institutional environment during transition, it can still be expected that formal education has become more relevant to the ability to adjust than longer practical experience. Thus, we expect that agricultural education has a positive influence on farms' flexibility. Additionally, we include the variables 'gender' and 'family size' (defined as the total number of family members living in the farm household) in the model to control their influence on flexibility. Table 3 provides a summary of the explanatory variables, as well as some descriptive statistics.

Table 3: Definition and descriptive statistics of variables used to explain farm-specific flexibility

Variable	Description	Mean	Standard deviation	Mini-mum	Maxi-mum
Farm size	Agricultural gross output, deflated	0.27	0.23	0.01	3.23
Prod. diversification	Berry-Index, based on 28 typical agricultural products	0.78	0.12	0.33	0.98
Specialization on milk production	Share of milk production in gross agricultural production	0.20	0.16	0.00	0.90
Off-farm income	Share of non-agricultural labor hours in total family labor	0.18	0.31	0.00	3.85
Access to credit markets	Share of bank credit in total debts	0.39	0.47	0.00	1.00
Commercialization	Share of sales in gross agricultural production	0.56	0.17	0.00	1.73
Age	Average age of the head of household	46.35	9.88	19	79
Agr. education	Agricultural education of farm head	2.38	1.34	0	6
Gen. education	General education of farm head	3.41	0.92	0	9
Gender	Dummy variable: 1 if the farmer is male, 0 otherwise	0.83	0.37	0	1
Family size	Number of family members	4.45	1.58	1	14

Source: Own estimates.
Note: No. of observations: 2,708.

4.1.2 Empirical results

We used the two-step procedure proposed by Hsiao (2005) to take into account the data's panel structure, which contains both time-variant and time-invariant variables. In the first stage we estimate the panel fixed-effects model including only the first group of time-variant variables on the right-hand side. These regressions provide the vector of mean effects of all neglected variables, including the effect of time-invariant variables. In the second stage we regress the vector of the fixed effects on variables included in the second group to obtain estimates for the socio-demographic and other time-invariant variables. The estimation results are reported in Table 4. The high significance of the F-test in all regressions indicates joint significance and confirms the relevance of the variable used in the models.

Before providing an interpretation of results, the following should be mentioned: Smaller values of estimated flexibility indicators imply a flatter average cost curve and thus, more flexibility. Therefore, we must turn over the sign of the estimated parameters, i.e., the negative sign would mean that the investigated variable positively influences flexibility. The parameters indicate that the impact of the various determinants on output and input flexibility goes in opposite directions. The overall effect on the overall flexibility is dominated by the influence on input flexibility.

According to our theoretical considerations, our findings reveal a significant negative influence of the farm size on the input flexibility and a positive effect on the output flexibility. Hence, it is easier for smaller farms to adjust their inputs, but larger farms are more flexible with respect to their output adjustment ability. Because these two effects compensate for each other, the overall flexibility is not affected by the farm size, as indicated by the non-statistically significant estimated coefficient.

The estimates show that only output flexibility is positively affected by the diversification of agricultural production. Thus, highly diversified farms can adjust their output more easily to changing demand. One possible interpretation of this finding is that diversified (multi-product) firms have more possibilities to reduce the adjustment costs via allocation of resources (labor, capital) to the more profitable production line in a given year, and hence to stabilize or even increase total farm output. On the contrary, more specialized farms are characterized by greater input flexibility.

Table 4 Estimated parameters of the two-step procedure for time-variant and time-invariant factors determining flexibility

Determinants	Output Flexibility	Input Flexibility	Overall Flexibility
Economic factors, time-variant (Fixed-effects regression)			
Farm size	-4.60***	6.93***	2.32
Prod. diversification	-9.31***	14.04***	4.73***
Specialization in milk production	-6.98	15.99***	9.00***
Off-farm income	0.57	-0.63	-0.06
Access to credit markets	0.29	-0.90**	-0.60***
Commercialization	1.02	0.72	1.73*
R^2	0.53	0.72	0.57
F-statistic	4.62*** [528, 2179]	10.59*** [528, 2179]	5.41*** [528, 2179]
Socio-demographic factors, time-invariant (OLS)			
Constant	16.480***	-22.217***	-5.737**
Age	0.029	-0.058	-0.029
Agr. education	-0.651***	0.757**	0.106
Gen. education	-0.194	-0.115	-0.310
Gender	-1.659**	2.320**	0.662
Family size	-0.559***	0.468*	-0.091
R^2	0.074	0.044	0.01
F-statistic	8.27*** [5,517]	4.71*** [5,517]	0.86 [5,517]

Source: Own estimates.

Note: No. of observations in the first model: 2,708, in the second model: 523. ***, **, * indicate that the variable is significant at the 1, 5, or 10 percent levels, respectively.

Further, they are likely to be better integrated into input markets and vertical supply chains, and thus can adjust their input structure more easily by sustaining average costs than highly diversified farms. However, the significant positive estimates for the variable ‘Specialization in milk production’ indicate that in the case of specialization in capital-intensive technology, which requires high investments in fixed capital, the adjustment ability might be affected negatively. Moreover, access to bank credit, measured by the share of bank credits in debts, increases input and the overall flexibility of the farm. However, the estimated parameters for off-farm income and commercialization were not significant.

A less clear picture emerges for the role of socio-demographic factors. Our findings reveal that agricultural education, family size, and gender have a significant influence on flexibility. However, the estimates sometimes contradict our expectations. The results support only our expectations regarding the positive relationship between output flexibility and the level of agricultural education. On the contrary, farms operated by better-educated managers are less flexible with respect to input adjustments. A possible explanation could be that well-educated farmers have better access to know-how and capital. Thus, they are more likely to operate large farms, which usually specialize in capital-intensive technologies, which in our case influence input flexibility negatively. Furthermore, the impact of family size and gender on flexibility indicators is ambiguous. Parameter estimates of farmer's age and general education were not statistically significant. Thus, further research is needed to assess the impact of interaction effects of some variables and to explain the influence of socio-demographic factors on flexibility.

5 Conclusions

This paper empirically investigates the magnitude and the determinants of flexibility across Polish family farms. The production technologies of Polish farms differ in their ability to accommodate output variations. Moreover, farmers use different strategies to avoid significant cost increases associated with production adjustments. Using the proposed flexibility measure, we examined two sources of farmers' abilities to adjust their output to changing conditions: input and output flexibility. While smaller farms could easily adapt their input structure, the larger ones have the advantage of being able to adjust their output levels according to price changes. Thus, the trade-off between flexibility and static efficiency is characterized only by considering input flexibility. More diversified farms can more easily alter their production mix to changing market conditions, and thus have higher output flexibility. On the contrary, more specialized farms exhibit greater input flexibility unless they specialize in capital-intensive milk production. Moreover, flexibility is positively affected by additional capital flows from the credit market. The effects of family and individual characteristics of the farmer are ambiguous and require further investigation.

The results show that the adjustment of agricultural production is driven by changes on the input and output markets. Thus, farms have the chance to react flexibly, either by adapting to input or output markets, or both. Some of the effects may compensate for others. Thus, both input and output flexibility should be analyzed separately to correctly assess farm flexibility.

The flexibility analysis presented in this paper is based on a single-output case. Thus, the results might be biased, especially when investigating highly diversified production sectors (e.g. Polish agriculture). Therefore, the flexibility measure must be extended for the multi-product case. However, the estimation and derivation of such a measure will be more complex and requires further research.

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Agriculture and rural structural change: An analysis of the experience of past accessions in selected EU15 regions

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Abstract

In the light of four competing models for rural development (agrarian, exogenous, endogenous and neo-endogenous), this paper evaluates the relationships between agriculture, agricultural policy and rural development in five regions in European Union (EU) member states. Regions were selected based on their ability to offer 'successful' experiences of rural transition following their country's accession to the EU. Evidence suggests that both the agrarian and exogenous models are anachronistic. Though the Common Agricultural Policy (CAP) remains closest to the agrarian model of rural development, it is currently unsuited to promoting wider rural and territorial development. The LEADER programme, which is often perceived as a viable alternative approach to rural development, fits most closely with the neo-endogenous rather than endogenous model. However, for European policy to fully embody the neo-endogenous approach, a far more fundamental reform of the CAP would be required than that agreed upon in the wake of the recent Health Check.

Keywords: rural development, rural policy, EU.

Table of contents

1 Introduction[1]

The Common Agricultural Policy (CAP) continues to account for approximately half of the European Union (EU) budget, making agricultural and rural affairs an important and politically sensitive policy domain, particularly after the recent EU enlargements. Agricultural policy is an example of 'deep integration', with the CAP being an example of the EU as a regulatory (Majone, 1996) and redistributive (Pahre, 1995) state. Since the introduction of the Rural Development Regulation (RDR) as a so-called Second Pillar, the CAP has evolved from a purely sectoral policy to partially embrace a wider, rural and territorial agenda. Yet support for agricultural production and producers (First Pillar) continues to account for approximately 80% of CAP expenditure. This raises the question: what roles do agriculture and agricultural policy play in European rural development?

We address this issue by analysing the relationships between agriculture, agricultural policy and rural development in five selected EU15 case study regions. All five regions exhibit some elements of successful rural development, post-accession to the EU. The analysis draws on four competing models of rural development (agrarian, exogenous, endogenous and neo-endogenous), evaluating the degree to which the trajectories of regions fit with particular models. This provides a basis for reflecting on whether the CAP, as currently constituted, acts as a useful mechanism for stimulating rural development. Thereby, the paper seeks to contribute to debates concerning the extent to which rural policy should be 'far-centric' or embrace a wider set of actors and activities. This is central to deliberations about the future of the CAP and the balance between the First and Second Pillars (Lowe et al., 2002). For instance, in response to the so-called Health Check of the CAP, EU agriculture ministers in 2008 agreed to a modest increase in modulation, whereby direct payments to farmers are reduced and the funds transferred to the Second Pillar.

This paper draws on case study and synthesis reports prepared by various authors within the SCARLED project, i.e., Hubbard and Gorton (2008a and 2008b); Hubbard and Kaufmann (2008); Hubbard and Ward (2007); Iraizoz

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(2007); Copus and Knobblock (2007) and Wolz and Reinsberg (2007). The five selected EU15 regions are Border, Midlands and Western (BMW), Ireland; the Autonomous Community of Navarra, Spain; the County of Skåne, Sweden, the Tyrol Region, Austria; and the Altmark Region, Germany.

The paper is organised as follows. Section 2 reviews models of rural development against which the case study experiences are evaluated. Section 3 presents the rationale for the selection of case study regions and briefly profiles each in turn. The role of agriculture within the regional economy as a whole is assessed in Section 4. Section 5 evaluates the role of CAP in rural development and Section 6 draws conclusions in light of the competing models of rural development.

2 Models of rural development

A substantial debate exists in rural studies regarding the appropriateness of competing 'theories' or 'models' of rural economic development and the role of rural development policy in stimulating economic growth in rural regions (Lowe et al., 1993; Cloke, 1997; Ray, 2000; Terluin, 2003). This section reviews four models that seek to provide both a theoretical framework and specific policy recommendations for guiding rural development. A distinction is made between agrarian and wider rural development models, with the latter separated into exogenous, endogenous and neo-endogenous approaches. Table 1 summarises the main features of each model.

(A) Agrarian. The agrarian model is based on the belief that the essence of rural is agriculture. This has taken two forms. The first is a *productivist* stance whereby the primary function of the rural economy is to produce food and fibre. Success under this model is measured in terms of the marketable surplus of farms and improvements in productivity. According to *productivist* perspectives the prosperity of farms stems from improvements in agricultural productivity and public support, which should shelter farmers from the short-term vagaries of the market. The task of policy, it follows, is to support research and development that improves agricultural productivity and to put in place domestic market and trade measures that ensure the continuation of farming. Such a 'farm-centric approach' to rural development continues to pervade many EU Ministries of Agriculture. Surveys of EU farmers indicate that most see that their primary role is the production of food and fibre (Gorton et al., 2008).

However, when examining agriculture's importance to the local economy, employment structure and social environment, a focus on the farming sector may exclude much of what is inherently understood and classified as rural.

Table 1 Approaches to rural development

	Agrarian	Wider rural development		
		Exogenous development	*Endogenous development*	*Neo-endogenous development*
Premise	Viable rural areas dependent on farming activity, both economically and culturally	A competitive farming sector is not a prerequisite for viable rural areas		
Key determinants	Agricultural productivity and policy	Economies of scale and concentration	Employing local resources (natural, human and cultural capital)	Interaction between local and global forces
Drivers of growth	Agricultural R&D	Urban growth poles (external driver)	Local initiative and enterprise	Globalisation, knowledge economy
Function of rural areas	Food production or multi-functionality	Aid urban economies (e.g. food, land and labour)	Diverse 'enclosed' economies	Participation of local actors in local and external networks and development processes
Major rural development issues	Agricultural policy	Peripherality and relative costs of capital, land and labour	Limited capacity of areas/groups to participate in economic activity	Resource allocation and competitiveness in a global environment
Focus for rural policy	Agricultural policy and increasing productivity; multifunctionality	Agricultural productivity, encourage labour and capital mobility	Local capacity building (skills, institutions, etc.)	Enhance local capacity and actors participation to direct local and external forces to their benefit

Source: adapted from Ward et al. (2005) and Hubbard and Gorton (2008a).

The second agrarian model stresses the *multifunctionality* of agriculture: that farming produces a wide range of non-commodity goods and services, shapes the environment and affects social and cultural systems in ways that contribute to the vitality of rural areas beyond the mere production of food and fibre (Van Huylenbroeck et al., 2007). Agriculture is thus multifunctional when it has one or several other functions in addition to its primary role in food production. The multifunctional approach has become an increasingly influential policy framework and is closely related to a so-called 'European model of agriculture':

The fundamental difference between the European model and that of our main competitors lies in the multifunctional nature of agriculture in Europe and in the role it plays in the economy and the environment, in society, and in the conservation of the countryside; hence the need for maintaining agriculture all over Europe and protecting farmers' incomes" (Commission of the European Communities, 1998, p.5).

This remains a farm-centric model of rural policy, but farmers are perceived as being rural entrepreneurs who should combine food production with other activities (Potter and Burney, 2002).

(B) Exogenous. The exogenous development model rests on the assumption that growth is driven from outside of rural areas. Rural development emerges out of the relocation of capital and labour from urban centres, which are the main growth poles for the economic development of regions and countries (Lowe, 2008). Policy should thus be geared towards attracting capital, principally branch plants to relocate in the countryside. This approach was widely adopted in several European countries in the 1970s, including the UK and Ireland, where tax relief and subsidies were used to entice multinational and national companies to relocate part of their operations (Dobson, 1987; Grimes, 1993). In addition to policy support, rural areas were seen as offering 'natural benefits' such as lower land and labour costs. Without such cost advantages, rural areas were perceived as offering scant grounds for development due to their being technically, economically and culturally distant from (and inferior to) the main (urban) centres of activity (Lowe, 2008). Under this approach, variations in rural development are explained by differences in the extent to which they can attract external capital and offer resources that are useful to urban-led development, particularly land and labour. However, as the post-war economic boom collapsed in the 1970s, policies solely based on the attraction of branch plants became discredited as they seemed to offer the host region little in the way of skill formation, technology transfer, the fostering of entrepreneurial spin-offs or reinvestment of profits (Amin and Thrift, 1994).

(C) Endogenous. In contrast to the exogenous approach, endogenous development is based on local resources (Picchi, 1994) and the assumption that the 'specific resources of an area – natural, human and cultural – hold the key to its sustainable development' (Lowe et al., 1995, p.91). Bryden and Dawe (1998) argue that an endogenous approach is preferable, because by utilising local

resources, multiplier effects will be greater. Moreover, they advocate that rural development strategies should be focused on immobile resources that ‘hold down the global’. Bryden and Dawe (1998) define immobile resources as those which are not open for competition – social capital, cultural capital, environmental capital and local knowledge capital. By being immobile, they conceptualise these resources as immune from a ‘race to the bottom’: the lowest cost point of production. As such, they offer opportunities for sustainable, value added development. However, the endogenous approach has been criticised on two counts (Lowe et al., 1995). First, the focus on local resources ignores questions of control, for instance the activities of international mining companies would be classified as a form of endogenous development on Picchi’s (1994) definition, but may offer no local autonomy (Lowe et al. 1995). Second, the emphasis on local self-sufficiency is unrealistic in contemporary markets. For example, indigenous Small and Medium Sized Enterprises (SMEs) are widely perceived as an important building block for endogenous development. However, the success of rural SMEs in sparsely populated, low valued added local markets often hinges on successfully accessing larger, urban markets (Gorton, 1999). The question thus becomes how ‘local circuits of production, consumption and meaning articulate with extra-local circuits’ (Lowe et al., 1995, p.93).

(D) Neo-endogenous. Neo-endogenous development rejects the polarisation of exogenous and endogenous development models (Terluin, 2003), recognising that development will emerge out of the interplay between local and external forces (Lowe et al., 1995). The critical issue is, however, developing local institutional capacity to be able to ‘both mobilise internal resources and cope with the external forces acting on a region,’ (Ward et al., 2005, p.5). Ray (2000) argues that local institutional capacity is critical to human and social capital. Given the importance of human and social capital, ‘soft connections’ and informal networks are important mechanisms for local development activity. He believes that community initiatives such as LEADER[2] are particularly suited to fostering neo-endogenous development. This is because, Ray (2000) argues, development should be defined by local needs, problems and capacities based on an integrating ‘network’ approach recognising the inter-relationships between economic, socio-cultural and physical resources.

[2] LEADER = Liaison entre actions de développement de l´économie rurale.

3 Regional case studies: Choice and profile

Case study regions were selected in terms of their ability to offer 'successful' experiences of rural transition following accession to the EU. Multiple factors influenced the choice of the five regions: BMW, Ireland; the Autonomous Community of Navarra, Spain; the County of Skåne, Sweden, the Tyrol Region, Austria; and the Altmark Region, Germany. It is, however, important to note that 'success' is a relative term. The success of a local rural area may be measured against the norms for urban areas in its region, or against the regional average. The success of a region might also be measured against the national average or against the average of the EU as a whole. We considered a series of socio-economic and demographic indicators such as the contribution of the region to the economy as a whole, regional GDP/person, employment and unemployment rates, population change and life expectancy, to assess the success of regions. With one exception (Skåne) all the regions are classified as predominately or intermediate rural.[3]

Against this background, it is crucial that 'success' in local rural development be understood in the particular context of the performance of the Member State. The development of the BMW region in Ireland is remarkable in this respect. Although economic growth in the BMW region has been lower than that of Ireland's other NUTS2 (Southern and Eastern) region and lower than the Irish national average, economic growth in BMW has been significantly higher than the norm for the EU as a whole. GDP per capita (Euro/inhabitant) increased from 60% of the EU15 average in 1995 to 106% in 2005 (Table 2). During the 1980s the region suffered substantial out-migration and high unemployment rates. Recently, employment rates were comparable with national averages and unemployment is amongst the lowest within the regions of the EU member states (Table 3). Until 2006, the BMW region was eligible for EU Objective 1 funds. Regarding agriculture, although most of the BMW area is classified as severely and less severely handicapped, almost half of the total Irish farmed area and more than half of the total farms are located in this region. The region also accounts for 40% of total Irish agricultural output.

[3] Using the OECD (1996) and national definitions for rural areas.

Table 2 GDP and GDP per person in selected regions, 1995 and 2005

	Tyrol		BMW		Navarra		Skåne		Saxony-Anhalt*	
	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005
GDP(€million)	15,491	21,383	10,243	31,346	7,772	15,354	22,509	33,630	38,103	40,300
- as % of country	8.5	8.7	20.3	19.4	1.7	1.7	11.6	11.4	2.1	2.2
- as % of EU15	0.23	0.21	0.15	0.23	0.12	0.15	0.33	0.32	0.60	0.47
- as % of EU27	0.22	0.19	0.15	0.28	0.11	0.14	0.32	0.31	0.58	0.44
€/inhabitant	23,772	30,794	10,857	28,253	14,597	26,271	20,271	28,861	14,662	19,458
- as % of country	103.1	103.3	76.2	72.6	125.9	125.5	92.3	88.4	62.1	71.5
- as % of EU15	131.7	115.5	60.1	106.0	80.8	98.6	112.3	108.3	81.2	73.0
- as % of EU27	162.5	137.5	74.2	126.1	99.8	117.3	138.6	128.8	100.2	86.9

Source: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=0 &language=en&pcode=fab10000

Note: * data presented for Saxony-Anhalt, as no data are available for the Altmark Region.

The region of Navarra, by contrast, was prosperous economically prior to Spain's entry to the EU. The country's accession brought even more favourable conditions for further economic development. Although it is a relatively small regional economy (less than 2% of the national economy), Navarra's economic performance is remarkable. As detailed in Table 2, standards of living (expressed in GDP per capita) significantly exceed the national average (126%) and EU25 average (118%). With a regional GDP per capita consistently above 75% of the EU15 average since EU accession, Navarra was never classified as an EU Objective 1 region. A higher rate of labour activity than the national average and lower rates of unemployment than the Spanish average also characterise Navarra (Table 3). Particularly remarkable has been the process of convergence between Navarra and the EU15 average, which accelerated after the mid-1990s, leading to a reduction of the gap between regional and EU levels for most indicators. The largest proportion of the region's GDP is accounted for by services. Compared to the national average, Navarra's agriculture is better mechanised and less fragmented. Agricultural labour productivity in the region continues to be superior to the national level. Additionally, the region benefits from a high degree of integration between agriculture and the food industry. The agro-food industry contributes significantly to the regional economy. Moreover, some 8% of the country's agricultural and food exports are provided by Navarra. Rural tourism is also an important economic activity.

Table 3 Employment and unemployment rates, 2005

	Employment rate* (%)	Unemployment rate (%)
Tyrol	71	3.5
Austria		5.2
BMW	66.1	4.4
Ireland		4.3
Navarra	69.1	5.6
Spain		9.2
Skåne	69.7**	8.4
Sweden		7.5
Altmark	60.7**	16.5***
Germany		11.1
EU15	…	8.2
EU27	…	9.0

Source: Eurostat database http://epp.eurostat.ec.europa.eu/extraction/evalight/EVAlight.jsp?A=1&language=en&root=/theme1/reg/reg_lfu3rt;

Note: * Employment rate of the age group 15-64 as % of the population of the same age group; ** This refers to Saxony-Anhalt and Svdsverige Regions (NUTS 2 level); *** At the end of December 2007 (www.marko-muehlstein.de/english/altmark-stat.htm).

Tyrol, Austria's most mountainous Federal Province, is a relatively wealthy region accounting for 9% of the country's GDP. Like Navarra, its economy performed well even prior to the country's EU accession. Regional GDP/person is above the national and EU15 averages (Table 2). The region also has the third-highest birth rate in Austria and the highest life expectancy amongst the nine Federal Provinces. Moreover, its gross income is mainly generated from services, with tourism and the associated retail market being extremely important. Tyrol's agriculture contributes very little to the regional economy directly, but it contributes much more indirectly by preserving the natural and cultural landscape and by being integral to agri-tourism. For large parts of rural Tyrol, farming remains the core of the rural community.

Skåne is the most internationally competitive agricultural region in Sweden. It has both physical advantages (in terms of climate, topography, soils) and location advantages (close to a major urban market, export gateways, and a very dynamic labour market offering many opportunities for off-farm employment).

Additionally, infrastructure improvements have allowed it to exploit opportunities to compete on a wider market since EU accession. Farm structures are also more commercially-orientated compared to other Swedish regions. It should therefore be viewed as a region likely to benefit from the wider market access provided by EU membership, rather than from just (national and EU) policy aspects of addressing structural or regional handicaps.

The Altmark region consists of the Districts of Salzwedel and Stendal, located in the Federal State of Saxony-Anhalt. It has its own particularities as it is the only region amongst the five selected case studies that belongs to a former socialist country. Altmark possesses a strong agricultural and forestry sector. It was selected as a post-socialist region that successfully transformed its agricultural base, under EU accession, to be competitive on the European market (Wolz and Reinsberg, 2007). However, its robust primary base has not shielded the region from high unemployment, which affected East Germany after unification. Indeed, rural areas within the region suffered a sharp decline of (particularly young) people, who left in search of better employment opportunities.

4 Agriculture and the rural economy

In the context of developing countries, Bryceson (1996) introduced the term de-agrarianization to describe three interconnected processes: economic activity reorientation (livelihood), occupational adjustment (work activity), and spatial realignment of settlements. According to Bryceson's first two processes, all the selected regions witnessed de-agrarianization following EU accession. Despite these countries joining the EU at different times and the social, economic and political conditions they faced differing to a greater or lesser extent at the time of accession, their agricultural sectors have followed a similar pattern in terms of agriculture's declining share of Gross Value Added (GVA) and regional labour force activity (Table 4). For instance, between 1984 and 2004 agriculture's share of GVA and labour force activity in Navarra declined from 7.5 and 14% to 4.9 and 5.3%, respectively. BMW also recorded a substantial fall. Both these regions possess substantial manufacturing and service industries, which typically have little direct connection with agriculture. Similarly, by 2005 in Skåne, the tertiary sector accounted for 81 and 82% of regional GDP and labour force, respectively. For this region, between 1995 and 2005, the contribution of the service sector to GDP increased by one-third while agriculture's share of regional GDP dropped by 17%. Many rural areas in the EU15, in contrast to the exogenous model, cannot be seen as merely serving urban economies by providing food, land and labour.

Table 4 The role of agriculture and services within regional economies

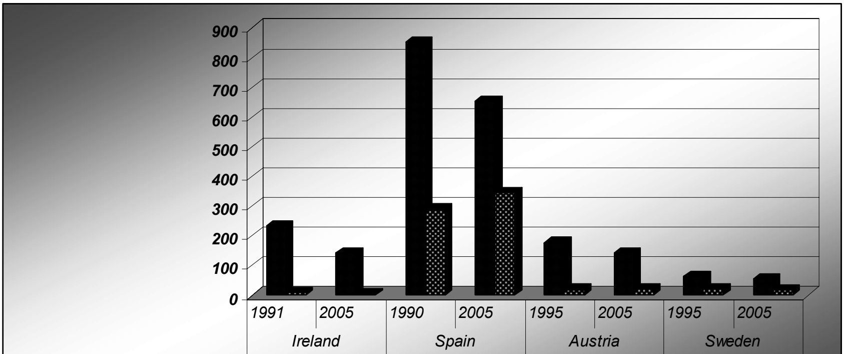
	BMW		Navarra		Skåne		Tyrol		Altmark
	1995	2004	1984	2004	1999	2005	1995	2005	2005
Agriculture									
% of GVA	13.4	4.7	7.5	4.9	1.6	1.3	1.8	1.2	…
% of Labour	17.0*	12.4	14.0	5.3	2.4	2.0	…	1.2	5.2
Services									
% of GVA	50.4	63	55.0	56.0	60.9	80.8	69.2	70.1	
% of Labour	35.0*	59.2**	47.9	55.7	…	82.0	…	70.0	69.0***

Sources: Compiled from Hubbard and Kaufmann (2008); Hubbard and Ward (2007); Iraizoz (2007); Copus and Knobblock (2007) and Wolz and Reinsberg (2007);

Notes: * Authors' estimation; ** 2003 data; *** An average figure for rural areas.

Figure 1 presents evidence of occupational adjustment in agriculture. All cases witnessed a clear reduction in family labour input (expressed in Annual Work Units) although, with the exception of the Altmark region, farming is still very much a family business. In Navarra the decline in family labour has been partially offset by an increase in regular non-family workers. Between 1995 and 2005, Altmark experienced a switch from full-time, permanent workers to part-time and seasonal employment. Part-time farming has become an important feature of all regions and continues to increase, particularly in Tyrol and Altmark. The increasing share of part-time farming is also linked to the rise in off-farm employment and the number of farms reporting other gainful activities outside of agricultural production.

Figure 1 Agricultural labour input ('000 AWUs) by countries



	Ireland		Spain		Austria		Sweden	
	1991	2005	1990	2005	1995	2005	1995	2005
■ Family labour	234.2	141.7	852.7	652.4	178.1	141.3	65.05	54.3
▩ Regular non-family workers	11	7	290	345.4	20.1	23.7	22.62	17.86

Source: Compiled from Hubbard and Kaufmann (2008); Hubbard and Ward (2007); Iraizoz (2007); Copus and Knobblock (2007).

Most regions have not experienced Bryceson's (1996) third process of de-agrarianization – spatial realignment of settlement, by which she implies that agriculture's declining economic role is accompanied by rural depopulation. In contrast, as the regional economy developed, four out of the five regions have actually experienced counter-urbanisation. For instance, Navarra's population rose from approximately 508,000 in 1981 to 580,000 in 2005, a rate of growth similar to the national average. Skåne's rural population increased between 1995 and 2004, particularly in locations that permit commuting to Malmö. All but one of the nine political districts that comprise the Tyrol region experienced a net growth in population between 1996 and 2006. The rural population of BMW grew by 17% from 965,190 in 1996 to 1.1 million in 2006. The exception to this pattern is Altmark - where the total population fell from 261,175 in 1990 to 227,307 in 2005. In general the changes in population have little connection with the fortunes of agriculture; demographical change is linked more closely with the growth, or in the case of Altmark contraction, of the far larger non-farm rural economy. De-agraranisation in terms of agriculture's declining use of labour and contribution to livelihoods has not triggered significant demographic change.

Navarra, BMW and Altmark, post-accession to the EU, have largely followed a productivist model of agricultural development (Wilson, 2001). Robinson

(2004) argues that according to this model, agriculture is subject to increasing intensification, concentration and specialisation. Table 5 presents data regarding concentration. With the exception of the Altmark region, a severe drop in the number of farms and an increase in the average size occurred in all regions following EU accession. Overall, the most affected were small-scale farms (e.g. less than 5 ha) which either exited the industry or were amalgamated into larger and more viable units. However, although gradual, the process of farm expansion differs from region to region and follows the development of various CAP changes. For example, the reduction of the number of farms was very slow in Ireland (and BMW) as farm structure hardly changed for almost two decades following accession. This was mainly due to the specific characteristics of the Irish farming and landownership system, with land transferred from one generation to another and a limited land market (Lafferty et al., 1999). This contrasts with Navarra, where farm expansion was more intensive and a flexible land tenancy system led to a significant increase in the area of rented land after EU accession. Nevertheless, the Spanish agricultural sector is still characterised by a dualistic farm structure, with a large number of very small scale (e.g. 49% of farms have less than 5 ha but account for 4% of total agricultural land) and a small number of large units (e.g. 10% of farms have more than 50 ha and account for almost 70% of total agricultural land).

Regarding concentration, in BMW, Navarra and Altmark there is little evidence that agriculture acts as a lever for other economic activities, as the overwhelming majority of farmers depend on agriculture for their livelihood. For instance, the share of farms with Other Gainful Activities (OGA) in BMW (3.7% of the total number of farms) and Ireland as a whole (4.5% of total farms) remains modest. The number of farms which were engaged in OGA is also modest in Spain, where only 3.3% of total farms[4] were recorded as having OGA in 2005 (Benoist and Marquer, 2007).

[4] Total farms refer to agricultural holdings with an economic size of at least 1ESU.

Table 5 Agricultural land, number of farms and average farm size

Country/Region	UAA (1000 ha)	No of farms	Average size (ha/farm)
Ireland (2005)	4,307	133,000	31.8
BMW			
- 2005	1,936	70,000	27.6
- 1991	…	88,816	20.6
Spain (2005)	24,855.1	1,069,700	23.2
Navarra			
- 2005	588.6	17,790	33.0
- 1990	657.4	30,810	20.0
Austria* (2005)	7,569.3	189,591	39.9
Tyrol*			
- 2005	1,222.6	16,846	72.6
- 1995	1,189.9	20,721	57.4
Sweden (2005)	3,216.8	75,808	42.4
Skåne			
- 2005	517.7	9,783	53.0
Germany (2005)	17,035	390,000	46.0
Altmark			
- 2006	275	1,600	211.0
EU15 (2005)	130,331	6,284,000	20.7

Source: Compiled from Hubbard and Kaufmann (2008); Hubbard and Ward (2007); Iraizoz (2007); Copus and Knobblock (2007) and Wolz and Reinsberg (2007);

Notes: 1 ESU = €1,200; * Includes agricultural and forestry area and holdings.

As farm structure changed so did land use and the structure of agricultural output. Fewer, larger farms led to the specialisation and intensification of agricultural production. For example, there was a clear shift from dairy to specialist beef farms in the Irish BMW region. Currently, BMW has the largest number of specialised beef, sheep and mixed grazing livestock farms in Ireland. The share of crop production, particularly cereals and horticultural products, has increased in Spain's overall agricultural output whereas the contribution of livestock (particularly milk and eggs) has decreased drastically. Cereals production became increasingly dominant in Skåne after 1995.

Tyrol, and to a lesser extent Skåne, have followed a more multifunctional path in that farming is more closely interwoven into non-commodity and non-agricultural production and consumption. In Austria, particularly in Tyrol, agricultural diversification and other related activities such as food processing, direct sales or farm cooperation (contractual work) are very important. Almost a quarter of farmers have at least one OGA outside of agricultural production (or 'secondary agricultural activities'). Processing agricultural (e.g. cheese) and forestry products is the most important secondary activity, with 48% of holdings with OGA engaged in it. Rural tourism also represents one of the major off-farm sources of income. At least one in three holdings (34%) with secondary activities was engaged in tourism in 2005. A farm holiday initiative has proved to be very successful, attracting a substantial number of tourists every year. Some 10% of Austria's total accommodation capacity is directly on farms and other non-farm activity holdings in rural areas. Contractual work is undertaken by approximately 30% of farms with OGA, and most of the farms which practice this activity have over 50 hectares. Interestingly, there has been a gradual increase in the number of holdings involved in the generation of renewable energy (2% of farms with secondary activities in 2005). In recent years, biomass (e.g. wood and arable crops) has become a source for energy production. The share of farms with other OGA is also high in Sweden, where almost 30% of total farm holdings have other gainful activities directly or not linked to agriculture. In Skåne, in 2005, 21% of holdings were recorded as having OGA directly linked to agriculture and some 16% with OGA not directly linked to farming. It is important to note, however, that both Sweden and Austria embraced, and were characterised by, this feature of multifunctional agriculture prior to EU accession. Both countries have a long tradition of farming being combined with other occupations and policy support for OGA such as farm tourism emerged long before EU accession (Embacher, 1994).

The presence of OGAs, however, did not prevent an accelerating downward trend in the number of farms in Sweden and Austria, post-EU accession. While the average farm size has increased, countertrends are apparent at the extreme. The case of Sweden is notable in this respect: between 2003 and 2005 the number of farms with less than 5 ha increased by 4%, whereas the number of farms with 100 ha or above declined by 8%. Additionally, in Skåne the decline of farms with 50-100 ha was even more rapid. This seems to be due to the effects of the implementation of the Single Farm Payment Scheme (SFPS) in Sweden rather than an increase in those engaged in farming activity (Copus and Knobblock, 2007).

5 The CAP and rural development

In all selected regions, the current importance of direct payments for farmers' livelihoods is unquestionable, though there are significant differences in their distribution by farm types and size across countries and regions and thus not all farms benefit to the same extent. Irish farmers, particularly those engaged in cattle rearing and sheep production in the BMW region, would not survive without direct payments, which account for more than 100% of their total farm income. Yet beef farmers in Sweden, and cereals and olive oil producers in Spain also rely on these payments. With the exception of Austria and to a lesser extent Sweden, the distribution of direct payments has proved to be uneven, with the large commercially-oriented farms being the main beneficiaries. This is particularly the case for Spain, where 78% of farmers received only 17% of total direct aid (allocated for the country) in 2005.

Despite the importance of direct payments, farm incomes have not, in general, kept pace with growth elsewhere in the rural economy. For instance, in Ireland, family farm income, when measured in real terms, declined between 1995 and 2006 (Hubbard and Ward, 2007). Similarly, when measured in real terms, both total agricultural income and agricultural incomes per worker were broadly static in Navarra between 1985 and 2005. Between 1991 and 2005 in Saxony Anhalt, the growth in average annual gross income per employed person in agriculture lagged significantly behind rises in the industrial and service sectors. These data indicate that even in successful rural regions, the CAP's welfarist aims are not being met. Much of this reflects worsening terms of trade. This gives credence to Marsden and Sonnino's (2008) argument that multifunctionality should not be limited to a notion that farm diversification can act as a palliative to the productivist 'cost-price' squeeze, but also consider how farming and the food industry can reconnect with markets and consumers in ways that improve value added.

Second Pillar measures, particularly agri-environmental measures and less favoured areas' (LFAs) compensatory allowances are particularly important for Austria and Sweden. Both countries took full advantage of the opportunities of EU membership by considering agri-environmental schemes as ideal mechanisms for supporting their farming community. The survival of most Austrian mountainous farms depends on receiving these payments. This is also reflected in the distribution of funds between First and Second Pillars, with

Austria devoting one of the largest shares of all EU member states to the latter. In Sweden, agri-environmental payments and support for organic farming increased the survival chances of smaller, less competitive holdings as providers of public goods rather than of conventional output (Copus and Knobblock, 2007).

The focus on agri-environmental policy in Sweden and Austria, however, predates EU membership. In Austria in particular, there is a high degree of continuity between measures currently funded under the RDR and pre-accession instruments. In the two countries widely perceived as amongst the most ‘environmentally-oriented’ EU Member States, it was not the adoption of the CAP which led to a ‘greening’ of agricultural policy. In contrast, in Ireland and Spain, European initiatives and policy reforms, rather than domestically-generated concerns, have largely driven the emergence of agri-environmental policy.

Amongst Second Pillar measures, the role of the Community Initiative LEADER is noteworthy. Although very limited funds were initially allocated for this measure, LEADER has become popular and well received by local communities. Its popularity led to countries such as Spain and Germany creating similar national programmes (named PRODER and Active Regions, respectively). Across countries, funds were mainly allocated for rural tourism, the creation and support of small businesses/services, training and local management and the promotion of natural and cultural heritage (Table 6).

The LEADER programme is often classified as an instrument for endogenous rural development (Shucksmith, 2002), in that it seeks to mobilise and harness local actors, knowledge and other resources. Yet the successful cases all drew on external capital and actors as well. For example in Navarra, the programmes attracted a significant contribution from the private sector, much of it from outside of the region. The experiences of Ireland, Spain and Austria indicate that significant growth in rural tourism depends on attracting visitors from outside of the local economy, so that the main market lies outside of the region. Similarly, the growth of small businesses in isolated, sparsely populated and poor regions depends on accessing more prosperous markets. LEADER, rather than embodying endogenous rural development, illustrates a key tenet of neo-endogenous models – that successful rural development should link local conditions with external opportunities.

Table 6 LEADER programmes across countries, 1991-2006

	LEADER I (1991-1994)	LEADER II (1995-1999)	LEADER + (2000-2006)	Principal areas of support & achievements
Ireland	16 areas covering 30% of population €34 million*	34 LAGs covering 9,600 projects €100 million*	22 areas (10 in BMW) 35 LAGs €75 million*	Rural tourism, small business, agriculture, forestry & fisheries and natural resources LEADER+: 3,100 new jobs; it sustained 3,900 existing jobs; trained over 30,000 people
Spain	52 LAGs covering 16% of territory & 5% of population €387 million*	132 LAGs covering 45% of territory & 12% of population €605 million* (plus €759 million from private sector)	145 LAGs 50% of area & 19% of population €794 million	Promotion of rural tourism & rural crafts, local services, natural & cultural heritage & marketing of local agricultural products LEADER I generated >10,000 jobs LEADER II: > 2,500 new small businesses & ~ 20,000 new jobs
Sweden		12 LAGs	27 LAGs	Training, raising value of local products & gained improved market access, improving the quality of life & exploitation of natural & cultural resources
Austria		31 LAGs €82 million	8 areas, 56 LAGs 54% of area & 27% of population €182 million*	Rural tourism, local management, training, introduction of ICT & training, improving quality of life in rural areas
East Germany			148 LAGs & 4,800 projects €250 million*	Promotion of rural tourism, renewable resources, cultural activities, marketing of local products; social work & communication

Source: Compiled from Hubbard and Kaufmann (2008); Hubbard and Ward (2007); Iraizoz (2007); Copus and Knobblock (2007) and Wolz and Reinsberg (2007);

Notes: *Allocated national and EU funds; LAG =local action group.

6 Conclusions

This paper considers the relationships between agriculture, agricultural policy and rural development in five regions in established EU Member States: BMW, Ireland; Navarra, Spain; Tyrol, Austria; Skåne, Sweden; and Altmark, Germany. The regions were selected because of their ability to offer ‘successful’ experiences of rural transition following their country’s accession to the EU. Evidence for the regions is evaluated in the light of four competing models for rural development (agrarian, exogenous, endogenous and neo-endogenous).

All selected regions experienced a substantial decline of agriculture's contribution to employment and economic activity. In all regions, both services and manufacturing far exceed agriculture's contribution to GVA and employment. In this context, agrarian based models of rural development appear anachronistic. Apart from Altmark, all of the regions have experienced net population growth since EU accession, despite agriculture's declining economic role. A competitive farming sector does not appear to be a prerequisite for viable rural areas. Moreover, in conflict with the exogenous model, the function of rural areas goes far beyond supplying urban economies with food, labour and other resources. Rural areas can be important spaces of non-agricultural economic activity in their own right.

While the agrarian model is anachronistic, the CAP remains closest to such a model of rural development. Support for agricultural production and producers predominates, and even under the Second Pillar many instruments focus on the farm. The shift from a sectoral to a territorial approach has been extremely limited. Moreover, while the CAP seeks to support a 'European model of agriculture', the contrasts between the productivist logic that has underpinned developments in Navarra, Altmark and BMW and the more multifunctional character of Skåne and Tyrol are actually most evident. In the latter two cases, multifunctionality predates EU accession, rather than being induced by the CAP.

The importance of the CAP to agricultural livelihoods should, however, not be downplayed. Direct payments make a significant contribution to farm income in all regions, especially in Ireland and Spain. However, despite substantial policy support, farm incomes have not kept pace with rises in real incomes for non-agricultural occupations. Strategies for maintaining the viability of farming cannot solely rest on public support, but must also embrace, as recommended by Marsden and Sonnino (2008), mechanisms for reconnecting with consumers in ways that add value.

All of the case studies note the popularity of LEADER as an instrument for stimulating rural development. While often characterised as a mechanism for endogenous rural development, the evidence here notes that success depends on combining both local and external resources and capacities in meaningful ways. This fits with neo-endogenous development. Yet the CAP does not embrace the spirit of neo-endogenous theory, which requires policies to enhance local capacity and actors' participation so as to steer development to best meet local needs. This could only be accomplished if farmers were to lose their current privileged position in EU rural policy. The implementation of European policies consistent with the neo-endogenous model of rural development would require far more fundamental reform of the CAP than envisaged in the recent 'Health Check'.

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Expanding biogas production in Germany and Hungary: Good prospects for small scale farms?

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Abstract

Biogas production in Germany and Hungary has experienced a significant economic upturn in recent years. Although the countries' respective national legislations target the promotion of biogas plants and regulate the minimum amount of feed-in tariffs in a similar way, large industrial biogas plants ranging into the megawatt-scale dominate in Hungary, while in Germany, farm-scale biogas units continue to prevail. Based on the evaluation of national support systems and statistical data on agricultural structures, this paper explores the reasons for these apparently opposite trends and examines whether small farms will benefit from participating in biogas production. The paper concludes that despite the stronger focus of both tariff systems on small biogas plants since 2007, investments in small scale biogas agricultural units are no longer economically attractive for farms smaller than 5 ha. This is mainly due to the high fixed investment costs and rising prices of biogas feedstock. The key explanatory factors for different production scales in Germany and Hungary are the farm size distribution and the motivation behind national support schemes.

Keywords: Biogas, feed-in tariff, farm size distribution, Hungary, Germany

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1 Introduction

In light of decreasing fossil energy resources and rising energy prices, pressure on alternative energy has been growing. Biogas is considered one of the promising alternatives. For countries with a high share of natural gas in their energy consumption mix and a high dependence on energy imports, expanding biogas production is of particular importance. Due to strong national support programs, biogas production in the EU experienced an economic boom in the last few years. However, participation in energy production brings along with it new challenges for both farmers and industrial biogas producers who have to adjust their production decisions to fluctuating volumes of policy support and to highly volatile price developments on the agricultural and energy market.

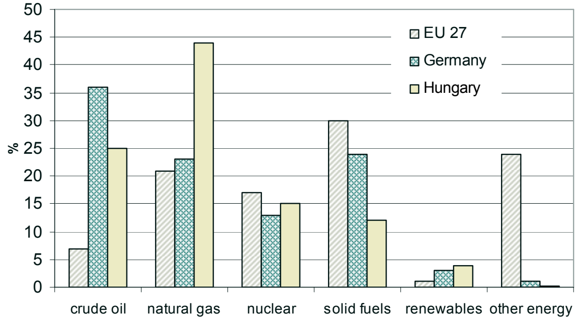
In the European context, two possible paths towards biogas development can be illustrated by German and Hungarian biogas production. These countries have distinctly unequal agricultural structures and are dependent on energy imports to varying degrees. Having started from different initial situations, Germany's and Hungary's path toward biogas show some similar tendencies, especially regarding production scale, use of feedstock and development of support systems. Although these countries' national legislations target the promotion of similar biogas plants and regulate the minimum amount of the feed-in tariffs in a similar way, large-scale biogas plants dominate in Hungary. In Germany, currently the biggest biogas producer in the EU, small farm biogas units have instead been prevailing. Against this background, this paper addresses the reasons for these apparently opposite trends. It also examines whether small farms will benefit from expanded biogas production when running farm-scale biogas units. The analysis is based on the evaluation of national support systems and statistical data.

2 General characteristics of German and Hungarian biogas production

2.1 Energy security and import dependence

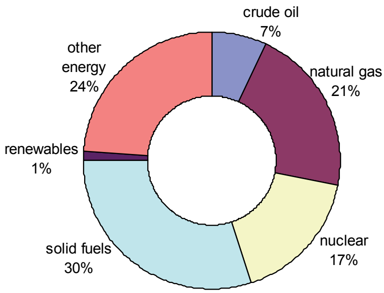
At present, the demand for biogas is mainly politically driven, e.g. by means of tax releases, guaranteed purchasing prices or blending targets. One of the main political concerns driving bioenergy production in general and biogas production in particular is ensuring energy security, which encompasses reducing dependence not only on fossil energy sources but also on energy imports (Figure 1 and 2).

Figure 1 Energy consumption mix in the EU 27, Germany and Hungary (2007)



Source: Own presentation based on Eurostat (2009) and Euracoal (2009)

Figure 2 Energy consumption mix in the EU 27 (2007)



Source: Own presentation based on Eurostat (2009)

Energy dependency of the EU has been growing. In 1994 to 2007 it increased steadily from 43% to 54% (in Germany it accounts for 62%, in Hungary for 63%). Natural gas imports amount to above 26% of the European net imports of primary energy (EU-27) in 2007 (Eurostat, 2009). Nearly 25% of the European natural gas imports originate from Russia, whereas 80% of them flow through Ukraine's pipeline grid. Hungary's dependence on Russian oil and natural gas is especially significant: 80% of its oil consumption must be imported, and over 80% of this originates from Russia, while the European average oil imports from

Russia are 30% (Energy Statistical Yearbook, 2005). Likewise, nearly 50% of Hungarian natural gas consumption must be imported from Russia, which is also far above the EU average (cp. Statista, 2009). Hungary is unique in the EU in that it consumes more natural gas than oil (see Figure 1 and 2). In 2007, the share of natural gas consumption in the total energy consumption amounted to 44%, while in Germany it was 23% and only 21% of the European average (Eurostat, 2009).

This overdependence on the dominant energy supplier, complicated by the disputes between Russia and the transit countries[1], can lead to more volatility on the energy market and put the energy supply at risk. Besides, both Russia and Turkmenistan – the biggest European gas supplier - will not be able to fulfil growing supply obligations even in the short and medium run due to a lack of sufficient investments and gas reserves (Riley, 2006). Given this dependency on energy imports on the one side and the growing energy demand on the other side, developing a substitute for fossil energy sources has been of particular importance in the European context.

2.2 National systems of biogas promotion

Among the existing renewable energy sources biogas is considered to be one of the most promising and feasible alternatives. Biogas gathered from one hectare of biomass is twice as effective as biodiesel (European Parliament, 2008). Besides, it can be used as a universal energy source. For Hungary, where natural gas has the biggest share in the energy consumption mix (44%) and is imported up to 80%, substitution of natural gas by domestically produced biogas has become a particularly pressing issue. The Hungarian National Renewable Energy Strategy (RES) therefore places special emphasis on promoting biogas production and use (ITD, 2008). However, biogas production's profitability is still negative (European Parliament, 2008), and currently available technologies still do not allow biogas to compete economically with natural gas. This fact called policy makers into action, which resulted in encouraging the use of currently available bioenergy by setting blending targets, guaranteeing feed-in prices and other support programs. The most important support mechanism aiming at bio-

[1] E.g. Russian-Ukrainian gas dispute in 2005, Russian-Belorussian gas dispute in 2004 and 2007, that resulted in turning off gas supplies to those countries.

gas promotion is the guaranteed purchase price for electricity from renewable energy sources (feed-in tariff).

The German Act on Granting Priority to Renewable Energy Sources (*Erneuerbare Energien Gesetz: EEG*) from 2000, last amended in 2009, regulates the guaranteed feed-in prices and premiums for electricity produced from renewable energy sources, including biogas[2]. The tariffs, as shown in Table 1, depend on the size (measured in kWel) and age of the biogas plant, on feedstock (e.g. energy crops, waste, and manure) and technology used, and on whether the electricity is produced in combined heat and power units (CHP). The period of payment is guaranteed for 20 years, whereby payments will be reduced by 1% for new plants and by 1.5% for old plants annually. This period of payment restarts if an existing plant is significantly renewed through additional construction or rebuilding.

Table 1 Feed-in prices and premiums according to the EEG 2009

<table>
<tr><th colspan="2">Tariff (€ct/kWh)</th><th><150 kWel</th><th>>150 kWel
<500 kWel</th><th>>500 kWel
<5 MWel</th></tr>
<tr><td colspan="2">Basic feed-in price (start-up in 2008)</td><td>11.67</td><td>9.18</td><td>8.25</td></tr>
<tr><td colspan="2">Premium for emission reduction</td><td>1.00</td><td>1.00</td><td>--</td></tr>
<tr><td colspan="2">Premium for purely renewable agricultural substrates</td><td>7.00</td><td>7.00</td><td>4.00</td></tr>
<tr><td colspan="2">Premium for use of manure</td><td>4.00</td><td>1.00</td><td>--</td></tr>
<tr><td colspan="2">Premium for landscape conservation</td><td>2.00</td><td>2.00</td><td>--</td></tr>
<tr><td rowspan="3">Premium for new technologies</td><td rowspan="2">Innovative processing (e.g. dry fermentation)</td><td colspan="3">2.00 (up to 350 Nm³/h)</td></tr>
<tr><td colspan="3">1.00 (up to 700 Nm³/h)</td></tr>
<tr><td>Innovative plants, machinery</td><td>2.00</td><td>2.00</td><td>2.00</td></tr>
<tr><td colspan="2">Premium for CHP* biogas plants</td><td>3.00</td><td>3.00</td><td>3.00</td></tr>
</table>

Source: Art. 27 of the Act on Granting Priority to Renewable Energy Sources (EEG).
Note: *CHP: Combined heat and power biogas plant.

The Hungarian legal framework for promoting biogas production consists mainly of the Act No CX (2001) on Electricity, its Amendment (Act No LXXIX, 2005) and associated Governmental Decrees of Execution (180/2002 [VIII.23] and 389/2007). The non-central-budget-based feed-in tariff scheme, introduced

[2] The *Erneuerbare Energien Gesetz* (EEG) replaced the Electricity Input Law (*Stromeinspeisegesetz*) of 1992.

in September 2005, is guaranteed until 2020 (Renewable Development Initiative, 2009)[3]. The system was modified in favour of smaller plants and those providing remote heating in 2008. There is no differentiation between the renewable sources. According to this Regulation, electricity suppliers are obliged to purchase electricity from energy producers that utilise renewable energy sources if their capacity is over 100 kW. Currently, i.e., in 2009, a biogas producer receives, on average, the average feed-in price for electricity from biogas, approx. 18.35 HUF (0.073 Euro) per kW. The following table provides an overview of the Hungarian feed-in tariff scheme.

Table 2 Feed-in tariffs in Hungary (2009)

Rate*(€/kWh)	Plants smaller than 20 MWel	Plants of 20 - 50 MWel	Plants larger than 50 MWel	Plants using waste
Peak rate	0.1	0.075	0.058	0.092
Valley rate	0.092	0.075	0.034	0.067
Deep valley rate	0.033	0.033	0.034	0.033

Source: ITD Hungary (2009) and Hungarian Energy Office (2009).
Note: *Converted by using the exchange rate 1 EUR = 300 HUF.

Unlike the German support scheme, the Hungarian scheme does not provide additional premiums or technology specific payments, but differentiates the payments depending on the season and daytime (i.e. peak rates)[4]. The classification of plant capacity according to Table 1 and Table 2 indicates that the definition of a small and large biogas plant differs significantly in Hungary in Germany: Where in Germany a biogas plant with capacity >500 kWel<5 MWel is grouped as a large biogas plant, the plants smaller than 20 MWel are arranged in the group of the relatively small plants in the Hungarian feed-in scheme (ITD Hungary, 2008)[5]. This classification reflects the fact that currently large biogas plants dominate in Hungary, and small scale biogas plants using agricultural

[3] The Electricity Act considers the feed-in tariffs to be an intermediate solution which should lead to a green certificate system.
[4] Cp. A-Table 1. The fact that this tariff system is based on the tariff calculation for conventional electric power plants (daily load in summer and winter, i.e. peak/valley rates) highlights the evidence that the most biogas plants operate on an industrial scale.
[5] Significant EU grants are available for establishment of small plants. However, the average size of new small biogas units is 500 kWel, i.e. they are still significantly bigger than a German small scale biogas plant).

crops as a substrate prevail in Germany. The last amendments of both Renewable Energy Laws can then be seen as adjustments to the current national biogas production patterns.

In addition to the feed-in-tariff system, other financial incentives like EU and national funds are earmarked for supporting investments in the renewable energy sector in Hungary (ITD Hungary, 2009 and BMUNR, 2008)[6]:

- EU funds for renewable energy sources in Hungary (Subsidy I). The operational program „Environment and Energy", which is a sub-program of the European Structural Funds, allocates grants (EUR 280 million) for investments in systems that generate electricity from renewable energy through calls for applications (ITD Hungary, 2009). These grants, covering 10-60% of eligible costs, can be provided for heat and electricity production from renewable sources and for local heat and cooling supply from renewable sources. Eligible costs encompass preparation, project management costs, services, and tangible and intangible assets.
- National Energy Saving Plan (NEP) (Subsidy II). This program promotes the use of renewable energy sources through subsidies for clean energy usage and energy efficiency for households with lesser amounts. The subsidies may be combined with soft loans allocated by the Energy Saving Credit Programme 2008.
- Loans (Energy Saving Credit Program 2008). Loans subsidise the use of renewable energy sources through low-interest loans and may be used jointly with subsidies awarded by the NEP or independently. Contracts on loans granted under the program may be concluded until 31st December 2010.

Taking into account feed-in tariffs *and* subsidies, Hungarian biogas producers receive a total 11.5-12.9 Ct per kWh (Neue Energie, 2009), which is comparable with payments for German biogas producers only if the basic tariff and the CHP bonus are paid[7].

After having compared the two support schemes, it can be concluded that the rationale behind both systems of tariffs and subsidies is not fully the same. In

[6] In Hungary, feed-in prices, subsidies and loans are guaranteed for the lifetime of the biogas plant.
[7] In both countries, biogas producers also have the possibility of generating additional income from the sale of Green Certificates.

Germany, an important expectation toward the supporting system, along with environmental reasoning and promoting development of a substitute for fossil energy sources, is providing additional income opportunities for small farms. The Hungarian remuneration strategy suggests, in contrast, that the reduction of the import dependency has the top priority in promoting biogas production. Although nearly 90% of Hungarian agricultural holdings have a size of less than 5 hectares, biogas production on a very small farm scale is economically not feasible and thus is not in focus of the tariff scheme. The high grants, covering up to 60% of eligible investment costs in Hungary, benefit investments in large scale biogas units. Thus, boosting primarily large scale biogas production on an industrial scale in order to increase the share of domestic energy supply is the main motivation behind the Hungarian support system.

The last amendments of statutory provisions in Germany and Hungary show that, although being different in motivation, structure and support amounts, both support systems aim at biogas promotion based on efficiency, technical development and environmental advantages. They also cover the same time span, issuing only an intermediate guarantee of the obligatory purchasing prices for electricity as the main biogas product. However, until cost efficient second generation biotechnologies have been developed, biogas producers will continue to rely on considerable support from both European and national financial resources.

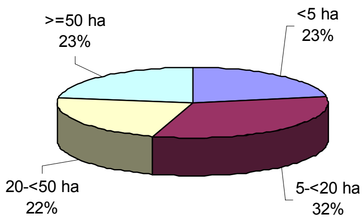
3 Biogas production in Germany and Hungary

3.1 Farm size implications for biogas production

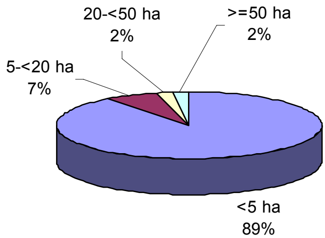
The number of agricultural holdings has been steadily decreasing, both in Germany and Hungary (cp. A-Figure 1). In 2007, there were 370,480 agricultural holdings in Germany which is a decrease of 5% compared to 2005. The average farm size increased also by 5% or 2.2 ha (from 43.6 ha to 45.8 ha). Hungary, with an agricultural area of about 6.1 Mio ha (nearly 2/3 of the total area), 4.5 Mio ha of which is cropland, is a distinct agricultural country. Being nearly 4 times smaller than Germany, Hungary has almost twice as many agricultural holdings. Within the size groups shown in Figure 3, agricultural holdings of 5-<20 ha are the dominant farm size in Germany; the share of small and large holdings is nearly the same (22.6% and 23% accordingly). In Hungary, the number of agricultural holdings is also declining. In 2007, it amounted to

626,320, representing a 12% decrease in 2005-2007. The average farm size rose in the same period by 14 % or 1.2 ha from 8.5 ha to 9.7 ha. Small holdings (<5 ha) represent 89.4% of agricultural holdings in Hungary, while large holdings (≥50 ha) amount to only 1.9%.

Figure 3 Share of agricultural holdings by size in Germany and Hungary (2007)



Germany



Hungary

Source: Own presentation based on Eurostat (2009).

However, this very amount of holdings plays the pivotal role in Hungarian biogas production. These large holdings farm 975,000 ha of cropland and have relatively large quantities of livestock (approx. 390 cattle per farm) (Eurostat, 2009). This explains the high availability of liquid manure in Hungary which currently amounts up to 15 Mio m^3 per year. The amount of slaughterhouse waste that can be used for methanisation is currently estimated at up to 300.000 m^3 per year (IDT Hungary, 2008). Despite its small absolute amount when compared to liquid manure, its role should not be underestimated, since its energy yield (ca. 200 m^3/t) - due to a high organic matter content - is up to 5 times higher compared to that of manure (ca. 40 m^3/t) and even higher than of corn silage (180 m^3/t)[8]. The large livestock holdings therefore serve as the main input suppliers of the biogas plants, which are deliberately situated close to such holdings. The use of energy crops as a substrate input, although expected to grow, still remains of minor importance for biogas production. The potential of energy crops produced for biogas purposes only (e.g. maize, sorghum, grass) is estimated to be up to 80 % of the total input capacity for biogas production (ITD Hungary (2008). However, it is doubtful that this potential can ever be used fully, since the areas under energy

[8] Cp. Waste Energy Solutions, available at: http://www.fromwastetoenergy.com/eye.php

crops are steadily decreasing and crop prices have been rising (cp. also Figure 6).

In Germany, the size groups of farms are nearly equally distributed, with a slight dominance of holdings with 5-<20 ha in size. Given that approx. 32 tonnes of energy crops are needed per year to produce 1 kW of electricity from biogas[9], and 3% of this amount must be stored locally, a 20 kW biogas unit (ENBEA, 2009)[10] needs 640 tonnes of raw material along with a storage capacity for19 tonnes of raw material. Translated into acreage and livestock needed to produce sufficient amount of input factor, it results in at least 6.4 ha (Fachverband Biogas, 2006, quoted by Wagner, 2007, p. 45)[11] or 100 livestock units (Staatsministerium für Ernährung, Landwirtschaft und Forsten, 2009). This simplified calculation shows that an agricultural holding of 5 ha in size and below is not capable of running a biogas plant on a commercial scale. Medium-scale holdings (5-<20 and 20-<50 ha), in contrast, are capable of running a biogas plant with substrates from own production due to the sufficient amount of arable land and/or livestock. The relatively high premium paid for the use of energy crops and manure and the additional premium for CHP plants (cp. Table 1.) also favour investments in small farm scale biogas units with a capacity up to 150 kWel.

With regard to the farm size distribution and development as well as to the national support schemes, it can be concluded that in Hungary investments in biogas plants will continue to be made primarily by large agricultural holdings[12], while in Germany investment in Biogas can be attractive even for agricultural holdings with less than 20 ha.

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[9] This calculation is based on estimation provided by BioVAG (2006).

[10] Biogas plants with installed capacity smaller than 20 kWel can be run primarily for captive electricity and heat consumption. The number of such biogas units is negligible in Germany. In addition, standard biogas plants are usually built with a capacity of at least 40 kWel, e.g., http://www.enbea.de/wirtschaftlichkeit.php or other biogas plants manufacturers (accessed in May 2009).

[11] This calculation is based on the data for 2006, where 350,000 ha of agricultural area under energy crops were needed for the production of biogas with 1,100 MW of electric capacity, http://www.na-hessen.de/downloads/dvl2007landwirtenergiewirt.pdf (accessed in April 2009).

[12] All currently existing small biogas units with an average capacity of ca. 9 kW are run only as communal biogas units for captive energy consumption (cp. Table 3).

3.2 Trends in biogas plants' development

3.2.1 Germany

According to the *Biogas Barometer 2008*[13], Germany is currently by far the leading European country in terms of biogas production (2.4 Mtoe in 2007) as well as per head of population. Over 71% of the total biogas was produced in small farm methanisation units[14]. It is estimated that at the begging of 2009 there were 4000 biogas units in service in Germany; most of them (about 1400) are located in Bavaria. Most of the currently existing biogas plants (98%) in Germany use energy crops as a basis for methanisation[15]. This preference is explained by a relatively high feed-in tariff for small biogas plants as well as by the high premium for use of purely renewable agricultural substrates (cp. Table 1) in methanisation units up to 500 kW. Figure 4 displays the development of biogas plants and installed electric power since 1992[16].

The number of biogas plants is still rising, but the growth rate of installation shows an initial downward tendency. This decrease owes mostly to two reasons. The primary one is an erratic increase in the prices for energy crops. The price for maize, which is the most used energy crop and thus, a decisive point for investments in agricultural biogas, rose by almost 100% in 2005-2007 and by 83% in 2006-2007 (Eurostat, 2009)[17] (cp. also Figure 6), resulting in lessened interest by farmers in operating biogas plants. The other reason is the increased price for biogas plants due to growing demand for them. The price for a methanisation unit of e.g. 500 kW of installed capacity doubled in 2003-2006 (EurObserv'ER, 2008; Biogas Barometer 2008, p. 48), adding to farmers' reluctance to invest in biogas. As a result, the cost-effectiveness of biogas plants using agricultural crops as substrate was considerably affected. In this regard, small biogas units are especially sensible, since an output needed to operate profitably under the current support conditions is about 600-700 kW (Klinski, 2006).

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[13] EurObserv'ER (2008): Biogas Barometer 2008, Table 1, p. 46 (2).

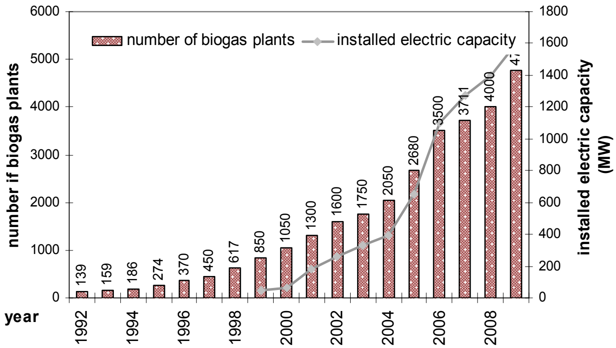
[14] Ibid, Table 1, p. 48 (4).

[15] EurObserv'ER (2008): Biogas Barometer 2008, Table 1, p. 48 (4)

[16] The initial trigger in the development of German biogas production was the Electricity Input Law (*Stromeinspeisegesetz*) of 1992. This Law regulated purchasing prices for each electrical kWh produced from renewable energy sources and delivered into the public electrical grid. In 2000, the Electricity Input Law (*Stromeinspeisegesetz*) was replaced by the Renewable Energy Law (*Erneuerbare Energien Gesetz*), which established even higher tariffs for each electrical kWh delivered into the public electrical grid.

[17] Data for selling prices of maize.

Figure 4 Number of biogas plants and installed electric power in Germany 1992-2009 (estimated values for 2008 and 2009)



Source: Fachverband Biogas (2009).
Notes: Cited after: Agentur für Erneuerbare Energien (2009): Biogas: Biogas in Deutschland 1992-2009.

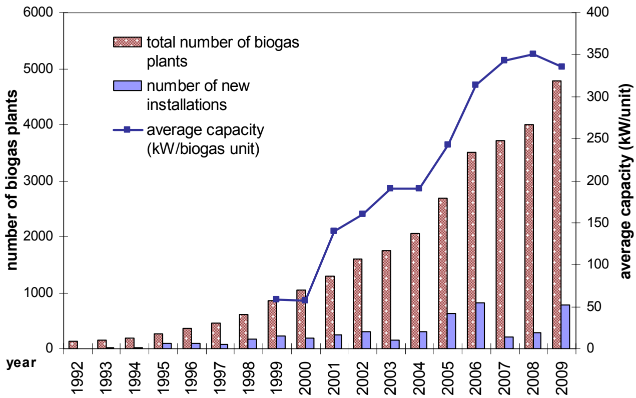
The run of the curve "average capacity" of biogas units in Figure 5 suggests that from 2003, the growth in absolute number of biogas plants is mainly due to the installation of bigger units[18]. The steep rise in the total (cp. Figure 4) and average productivity in 2005-2006 which goes along with the steep increase in new biogas plants backs up this assumption.

The rising productivity of biogas plants is not least due to the development of production technology. The technical improvement of biogas plants has been targeting not only at increased efficiency in use of input factors and optimisation of digestion processes, but also at the development of co-digestion units capable of treating different types of waste at the same time, mainly manure and organic waste. Until 2000 all biogas plants in Germany were designed for the digestion of organic waste or for the co-digestion of organic waste and manure; from 2000 to 2004 very few farmers tried energy crop digestion. The first pure energy crop digestion biogas plant was put into operation in 2003[19]. Two years later, 98% of all biogas plants were energy crop digestion plants with and without manure.

[18] This paper uses average numbers for Germany. However, due to the regional differences in prevailing farm size and structure, large centralized biogas plants dominate in the former East Germany, while farm-scale biogas plants still prevail in West Germany.
[19] Krieg & Fischer Ingenieure GmbH, http://www.kriegfischer.de (accessed in April 2009).

However, in order to improve gas output[20], an increasing number of newly installed biogas plants use mixed digestion, whereby substrates with organic matter content (primarily slaughterhouse by-products and waste) are added to energy crops. The development of co-digestion plants is also driven by the fact that because of the low energy yield of manure no biogas plant is economically feasible with manure as input substrate only[21].

Figure 5 Number of biogas plants and average installed electric power in Germany 1992-2009 (with estimated values for 2008 and 2009)



Source: Fachverband Biogas (2009).

Note: Cited after: Agentur für Erneuerbare Energien (2009): Biogas in Deutschland 1992-2009.

Due to the Act on Granting Priority to Renewable Energy Sources (EEG) of 2000, energy production from agricultural biogas experienced an economic boom in Germany, encouraging primarily medium scale farms (>5-<50 ha) to invest in biogas. The last amendment of the EEG in 2009 encompasses not only conversion of biogas to electricity, but also the feeding-in of biogas into the natural gas grid. This regulation provides new impetus for the construction of biogas plants producing biogas-based methane that should be fed in into natural gas pipelines. According to the German Energy Agency (2009), there are 14

[20] Average 60% of gas production originates from addition of organic matter, cp. Waste Energy Solutions, http://www.fromwastetoenergy.com/eye.php (accessed in April 2009).

[21] Cp. comparison of energy yields of different input factors provided by Waste Energy Solutions, http://www.fromwastetoenergy.com/eye.php (accessed in April 2009).

biogas plants producing methane as a final good, and 26 new industrial scale biogas plants with output reaching far into the megawatt range are currently being planned or installed.

3.2.2 Hungary

Compared to Germany, Hungarian biogas production is still significantly lagging behind. With 20 kilotonne of oil equivalent (ktoe) to the total biogas production, it ranks 16 in the EU- 27[22]. In view of Hungary's power consumption and the high amount of energy imports, the role of biogas is expected to grow[23]. Presently, only ca. 10% of the feasible biogas potential is used[24]. As a distinct agricultural country with over 60% of arable land, Hungary still has possibilities for extending biogas production. The annually accrued amount of manure and slaughterhouse waste, which can be used as input for biogas production, amounts to 15 Mio m^3 and up to 300,000 tonnes, providing a feasible and affordable opportunity for the further extension of biogas production.

In 2008 there were 45 biogas plants in Hungary, whereby 44 of them used waste as substrate (ITD, 2008, p. 4)[25]. The first biogas plant that used agricultural crops and manure as input factors was put into operation in 2003 in Nyírbátor. With its production capacity of 2.5 MW (Neue Energie, 2008) it was the largest biogas plant in the world. Its biogas production is based on slaughterhouse waste drawn through the installed pipelines from the close-by slaughterhouse and on manure from animal husbandry (2700 milk cows and 1.2 Mio chicken)[26]. In 2007, there were 6 farm-scale biogas plants using agricultural feedstock as a substrate. In contrast to German agricultural biogas plants, Hungarian agricultural biogas is based mainly on agricultural waste, by-products and residues, and not on energy crops. Table 3 displays the number of biogas plants in 2007 and

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[22] EurObserv'ER (2008): Biogas Barometer 2008, Table 1, p. 46 (2).

[23] The Hungarian state-owned electricity wholesaler MVM estimates that only 50-60% of Hungary's current generating capacity would still be on-line by 2020, while energy consumption will increase nearly by 2% annually. It projects that in order to resolve the upcoming energy deficit about 6,300 MW of new capacity will be needed in the next 10 to15 years, whereat most of this amount should originate from renewable energy sources. (Cp. US Department of Commerce (2007): Renewable Energy in Hungary, p. 4.)

[24] AHK (2009): Erneuerbare Energien in Ungarn. See also IDT Hungary (2008), p. 4.

[25] However, there are very contradictory data regarding the number of biogas plants: according to Riepen et.al. (2003), there were 85 biogas plants already in 2000, *Neue Energie* (2008) counts only 20 biogas units (6 of 20 are farm-scale biogas plants) in 2008.

[26] This biogas plant is running by an agricultural holding with acreage of 4000 ha.

the planned extension of production capacity by plant type according to the ITD Hungary.

Table 3 Present and planned biogas capacities in Hungary

Plant type	Installed capacity (2007)			Enlargement to be expected by 2015		
	Unit (piece)	Capacity (MW)	Biomass demand (1000 t)	Unit (piece)	Capacity (MW)	Biomass demand (1000 t)
Agricultural	1	1.6	90	10–12	10.5	660
Communal	44	0.4	100	80	3.2	900
Total	45	2.0	190	90–92	13.7	1560

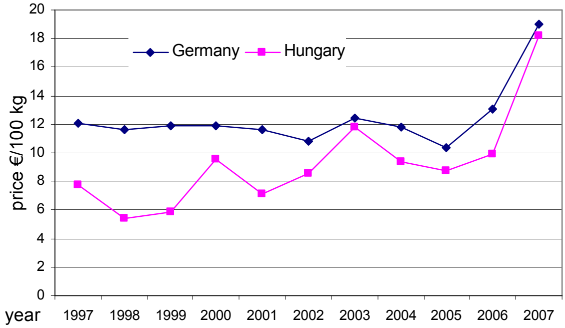
Source: ITD (2008, p. 4).

Taking into account the numbers provided by other sources, e.g. by Neue Energie (2008), and the already extended capacity of the biogas plant in Nyírbátor (2.5 MW in 2008), the planned production capacity of agricultural biogas units (over 10 MW) was likely already reached in 2008 (Neue Energie, 2008). This fast development in biogas production is also due to the last amendment of the Hungarian Act on Electricity in 2007, which puts more emphasis on the promotion of farm-scale biogas plants. According to the ITD Hungary, a further 38 biogas plants of agricultural type are currently planned or already under construction (ITD, 2008 p. 4 and Neue Energie, 2008). Therefore, significant EU grants, national subsidies and loans are available that support the establishment of small farm-scale plants with a capacity of 250-500 kW each (ITD Hungary, 2009 and BMUNR, 2009)[27]. However, biogas plants of this size are still significantly bigger than a German small scale plant (up to 150 kW).

Despite the targeted promotion of agricultural biogas plants since 2007 and the high potential of energy crop cultivation (ITD, 2008), energy crops (e.g. corn for silage, sorghum and grasses) play only a marginal role in Hungarian biogas production. Among energy crops, corn has the highest energy yield and hence is the most commonly used agricultural substrate for biogas production in the European Union. The following graph displays the development of corn prices from 1997 to 2007.

[27] EU funds for renewable energy sources: KEOP 2009/4.4.0 (Heat and/or electricity production from renewable sources) and KEOP 2009/4.2.0 (Local heat and cooling supply from renewable sources).

Figure 6 Selling prices of corn (€/100 kg)



Source: Eurostat (2009)

Figure 6 shows that as from 2005, i.e. as bioenergy production from agricultural crops was boosted by national support programs, prices for agricultural crops distinctly followed the price developments on the energy market[28] (cp. A-Figure 2). The doubling of corn prices in 2005-2007 was accompanied by the doubling of natural gas prices[29] in the same period of time; but unlike energy prices, pries for agricultural crops in Germany and Hungary have been clearly converging.

Besides, corn acreage is strongly trending downward in Hungary. In 2007, area under corn cultivation was 87,000 ha, which is about 11% of the German corn acreage. In Germany, though it is also decreasing (approximately 30 ha annually since 2003), its silage yield remains significantly higher than in Hungary (45-50 t/ha in Germany and 25 t/ha in Hungary) (Eurostat, 2009 and Destatis, 2009). Since no premiums are paid for the use of renewable crops (as is the case in Germany) according to the support scheme, costs of substrate inputs are more decisive in Hungary than in Germany. Under these conditions, profitable biogas production from energy crops is not feasible in Hungary. Due to stricter EU regulations for agricultural waste handling and high prices for corn and cereals, no shift to using agricultural crops can be expected in Hungary in the medium

[28] Since Hungary's accession to the EU in 2004 and the introduction of the same or similar conditions for agricultural sector through the reform of the Common Agricultural Policy in 2005, domestic prices for agricultural feedstock and energy in Hungary converge toward the world prices.

[29] After considering purchasing power parity, Hungary records the second highest price for natural gas (after Slovak Republic) and the fifth highest price for electricity in the OECD countries. Cp.: IEA/OECD: Natural Gas Information (2008), p. 31, and IEA: Key World Energy Statistics (2008), p. 43 (45).

term. Therefore, it can be assumed that Hungarian biogas production will continue to trend towards waste, sewage sludge and manure based biogas plants.

4 Summary and conclusions

Having begun from different initial situations, Germany's and Hungary's paths toward biogas illustrate some similar tendencies, especially regarding production scale and use of feedstock and the development of support systems. In both countries investment in biogas production is still considerably dependant on European and national support programs. Although both support schemes primarily promote CHP biogas plants, the rationale behind both systems of tariffs and subsidies is not completely the same. In Germany, an important expectation toward the supporting system is to provide additional income opportunities for small farms. In Hungary, by contrast, addressing overdependence on energy imports in general and on natural gas in particular is of top priority in promoting biogas production. The basic guaranteed price for biogas-based electricity is set at 0.09 EUR per kWh in Hungary. Taking into account the basic tariff and all possible subsidies and loans that can be claimed by Hungarian biogas producers, the total amount of payment can reach about 0.13 EUR per kWh, while in Germany all possible bonuses can amount to around 0.20 EUR per kWh.

In the last 2 years, both support schemes put a stronger focus on promoting small farm-scale biogas production. The impact of these efforts however, is being absorbed by rising feedstock prices, thereby increasing the reluctance of small farms (<5 ha) to invest or reinvest in biogas production. In Hungary, high investment subsidies for renewable energy production (up to 60% of eligible fixed costs) on the one hand, and its overdependence on energy imports on the other also favour large-scale biogas production. The current development in Germany reflects an initial trend towards larger biogas units operated by public utility companies, as well as a shift from the use of energy crops to communal waste and mixed digestion.

With regard to the farm size distribution, as well as national support schemes, it can be concluded that in Hungary investments in biogas plants will continue to be made primarily by large agricultural holdings, while in Germany investment in biogas can be attractive even for agricultural holdings with less than 20 ha. Although nearly 90% of Hungarian agricultural holdings have a size of less than 5 ha, biogas production on a very small farm scale is economically not feasible and thus is not a focus of the tariff scheme. Unlike German agricultural biogas plants, Hungarian biogas is based mainly on agricultural waste, by-products and residues, and not on energy crops. Since no premiums are paid for the use of renewable crops (as is the case in Germany), Hungarian biogas production is reliant on low cost and abundant feedstock like liquid manure, waste from slaughterhouses and sewage. Soaring prices for agricultural crops also hinder a shift towards the use of agricultural crops as biogas feedstock.

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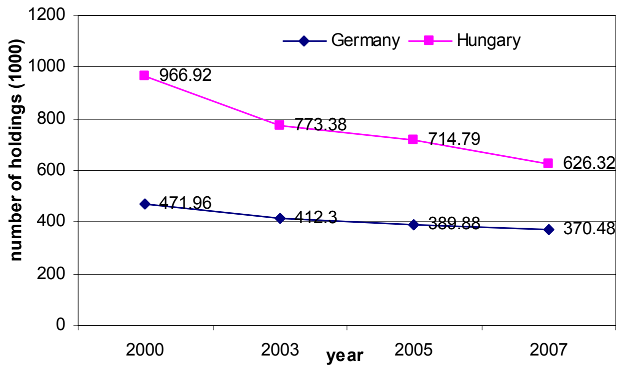
Appendix

A-Table 1 Differentiation of the feed-in tariffs depending on the peak period

Periods of day (time zones)		Summer time	Winter time
Peak period	daytime	between 08-14 h	between 07-13 h
	evening	between 18-21 h	between 17-20 h
Valley period	morning	between 06-08 h	between 05-07 h
	daytime	between 14-18 h	between 13-17 h
	night	between 21-03 h	between 20-02 h
Deep valley period		between 03-06 h	between 02-05 h

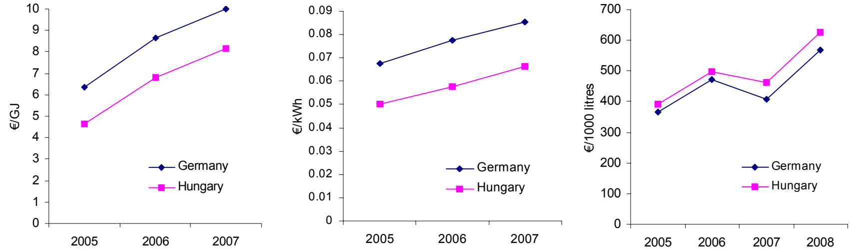
Source: Hungarian Energy Office (2009)

A-Figure 1 Number of agricultural holdings in Germany and Hungary (1000) in 2007



Source: Own presentation based on Eurostat (2009)

A-Figure 2 Energy product prices; (a) and (b) for large industrial stadard consumers.



(a) Natural gas prices (€/GJ) (b) Electricity prices (€/kWh) (c) Diesel oil prices (€/1000 L)

Source: Own presentation based on Eurostat (2009)

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Impact of topical policies on the future of small-scale farms in Poland – A multiobjective approach

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Abstract

Contrary to what was expected at the beginning of the transformation, semi-subsistence farm households (SFHs) have persevered. There is an ongoing debate about what could prompt SFHs to become more profitable or to exit farming. A number of policy measures within the Common Agricultural Policy address this issue. This contribution assesses the impact of selected EU rural development measures on SFHs in Poland. Under the heading of multiple criteria decision-making, different approaches have been discussed in the literature. In this contribution, a multiobjective linear programming household model using compromise programming is applied. Four household objectives are optimised simultaneously: net agricultural production, net non-farm income, and household cash balance are maximised, while agricultural labour input is minimised. All together, four representative SFH types were simulated. Simulation results show that fine-targeting of policy measures to specific household situations is a strong precondition for successful development. The differing results between the multiobjective approach as compared to programming with one objective are also discussed.

Keywords: Semi-subsistence agriculture, policy analysis, transition countries, multiobjective modelling

Table of contents

1 Introduction[1]

Semi-subsistence farming in Central and Eastern Europe (CEE) was not a short- or medium-term phenomenon in the transition from centrally-planned towards market economies. As the experiences of nearly two decades have shown, semi-subsistence farming's (SFHs) importance has even grown during transition. It seems that SFHs of less than five hectares have become a persistent and economically non-negligible phenomenon in CEE. Indeed, they make up the majority (82% of 9.2 million) of farms in the New Member States (NMS) of the European Union (EU) and, according to Pouliquen (2001), referring to the late 1990s, contribute at least 50% to total agricultural production. Nevertheless, the majority of SFHs cannot provide sufficient income to secure an adequate level of livelihood for the related farm households (EC, 2004).

The existence of these small-scale subsistence-based farms is to a certain extent a legacy of the socialist era when agricultural workers employed by the state and collective farms were allowed to manage small plots for their family's consumption. At the beginning of the 1990s, the number of semi-subsistence farms further increased due to the collapse of the non-farm sector in rural areas. In some countries like Romania, the loss of employment opportunities in urban areas, together with land privatisation, led to a migration into rural areas to secure a minimum livelihood from agriculture (Buchenrieder and Knüpfer, 2001; Petrick and Weingarten, 2004). Semi-subsistence farming in such settings has played an important role as a socio-economic buffer (Buchenrieder and Knüpfer, 2001; Kostov and Lingard, 2002). However, the dual farm structure,

[1] This article is based on the final report of the EU tender project "Sustainability of Semi-Subsistence Farming Systems in New Member States and Acceding Countries (S-FARM)", funded and coordinated by the Joint Research Centre, Institute for Prospective Technological Studies (JRC-IPTS) of the European Commission (Seville, Spain) and executed by the Leibniz Institute of Agricultural Development in Central and Eastern Europe (IAMO).
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with a few large commercial producers and a very large number of small-scale farms, is frequently perceived as inefficient and socio-economically non-sustainable (cf. Sarris et al., 1999; EC, 2004).

Given the history of farm restructuring in the established EU Member States, only a few semi-subsistence farms in the NMS can be expected to grow to commercially viable and socio-economically sustainable sizes (EC, 2004). Therefore, one of the key questions within the formulation process of the EU rural development policy is how can semi-subsistence farms be approached most effectively.

However, the high level of SFHs heterogeneity makes policy decisions difficult, particularly because research results indicate that semi-subsistence farmers are not very responsive to market and policy signals that would normally lead to farm exit or expansion (Mathijs and Noev, 2002; Kostov and Lingard, 2004). Historical evidence suggests that SFHs rather try to maintain the status quo when it comes to land and animals. On the other hand, SFHs strive to increase average household member income by diversifying their income sources through non-farm sector activities. There is growing evidence that in CEE, rural households commonly depend on non-farm sources for 30-60% of their income (Davis and Gaburici, 1999).

Having said this, it is clear that on-farm decisions, from choice of technology to choice of specialisation, are influenced not only by on-farm but also off-farm commitments and opportunities, as well as unearned income flows (such as social transfer payments and subsidies). This has further policy implications. For instance, policy support of agriculture and rural development in general may affect different types of SFHs differently, depending on the relative importance of on-farm income from subsistence and commercialisation versus off-farm income from non-farm activities and unearned income.

Concerning the impact of selected EU rural development measures on SFHs, three key questions arise:

1) How will the income situation of SFHs develop over time?
2) What impacts do existing policy measures have, e.g. which adaption strategy is the best for different types of SFHs?
3) What impacts do households' preferences have on the decision of SFHs to allocate their resources to farming or non-farming income activities?

This contribution assesses the impact of selected EU rural development measures on SFHs, focussing on these key questions using a multiobjective programming approach. SFHs are especially interesting for modellers because SFHs have to make a series of decisions to increase their livelihood, and maximising farm performance may not be the most important one. There are often other objectives like satisfying the family's daily food needs or saving farm labour for non-farm income activities that have to be equally taken into account. Moreover, according to Braun and Lohlein (2003), modelling the transition process from subsistence to market-oriented production not only has to take into account the use of resources, but also risk aversion, preferences for special activities, and motivations that may cause an SFH to maintain, e.g. a certain degree of self-sufficiency even at the cost of income losses.

These objectives are often contradictory and SFHs try to find a balance to satisfy their different needs. Commonly used mathematical programming approaches optimise only one objective function and do not catch these specifics of SFHs. This requires another methodology. In this contribution, a multiobjective linear programming household model using compromise programming is applied, thus explicitly considering additional objectives which may be relevant for SFHs.

Simulations are carried out for four exemplary Polish households representing major types of SFHs, namely rural diversifiers, rural pensioners, farmers, and rural newcomers, which have been identified and extensively described by Fritzsch et al. (2008). The main characteristics of the major types can be summarised as follows:

Rural diversifiers are characterised by the highest share of non-farm revenues in household net income and the highest level of formal schooling. The households of rural diversifiers use the highest share of their own agricultural production and produce the highest number of agricultural products to meet family demand. They also have a low share of social security benefits in net household income.

Rural pensioners receive high social security benefits, have a low non-farm income and operate small farms. Their main characteristic is a high average age.

Farmers cultivate the largest farms among SFHs, focus on crop production and are better integrated in markets than the other major types. Farmers also have the highest annual household cash balance.

Rural newcomers are the youngest and have very little experience as farm managers. They have the lowest annual household cash balance. Furthermore, their educational level is very low.

The paper is organised as follows: Section two discusses multiobjective programming, the applied compromise programming approach and the scenarios for policy analysis. Section three depicts the simulation results, and Section four concludes.

2 A multiobjective programming approach for policy analysis

When multiple objectives are considered in programming approaches, more than one optimal solution exists, as in general the objectives possess various, exclusive optimal solutions. Therefore, a choice has to be made out of the set of non-dominated[2] solutions by making assumptions about the preference structure of decision-makers or by eliciting preference information from decision-makers. Mathematical approaches for multiple criteria decision analyses have matured and there now exists a variety of methods and fields of applications. Figueira et al. (2005) provide an extensive overview to existing approaches.

Romero and Rehman (2003) discuss different methodological approaches for considering multiple objectives in agricultural decision models. One of these discussed approaches is compromise programming, which was used in this study and implemented with a multiobjective linear programming (MOLP) approach. In compromise programming, only subsets of the non-dominated set are considered based on the relative importance of the objectives for decision-makers, which is estimated by weights. In compromise programming, a utopian non-feasible ideal point is defined, which optimises all objective functions simultaneously. This point is calculated by simply combining the optimal solutions of the single objective functions within one vector. Assuming that non-dominated solutions that are closest to the ideal point would be preferred by decision-makers, the weighted distance to the ideal point is minimised. This results in non-dominated solutions with minimal weighted distances to the ideal point.

[2] A solution is called non-dominated if there is no other solution with a bigger value for at least one objective function, while the values for all other objective functions are bigger or equal when all objectives are to be maximised.

An advantage of compromise programming is that it results, under limited preference information, in solutions that better represent a possible choice of decision-makers due to the underlying idea of minimising the distance to the ideal point than, for instance, scalarising techniques like the weighted sum approach. Scalarising techniques are more appropriate for interactive decision-making support. Additionally, this model calculates – in contrast to goal programming – only non-dominated solutions. In contrast to the weighted sum approach, this model considers all solutions of the non-dominated set. However, it does require considerable modelling effort and in multiple criteria decision analysis it is not possible to state an absolute advantage of one approach over others for a certain problem (Romero and Rehman, 2003, p. 75 for further discussion). Teufel (2007) used compromise programming for simulating the effects of various technological interventions on small-scale milk producers in Punjab, and in this study the approach proved quite useful for simulating the behaviour of small-scale farms.

In order to consider the aims and certain possible strategies of households for policy scenarios, the constraint method is used. By setting lower or upper bounds, i.e., minimum or maximum levels, on certain model parameters, it is possible to consider aims in addition to the explicitly formulated objective functions. For the possible scenario, "diversify income sources", e.g. lower bounds (minimum levels) on agricultural and non-farm income could be set.

A MOLP model that represents a semi-subsistence farm household was implemented in GAMS[3] for the policy analysis. A farm household model consists of various income sources with their costs, labour use, and expenditure positions to assess the household's cash balance. In general, SFHs have limited resources in the form of land and physical assets. They usually have plentiful labour with low opportunity cost in the local economy, especially at certain times of the year. However, farming activities typically only partially contribute to household income. This is why for certain types of SFH, e.g. higher purchased input costs, the value of agriculture might increasingly erode in this form of enterprise. Moreover, keeping up with the standard of living with other parts of society greatly increases cash requirements. The option of no change strategies for such households seems increasingly untenable. Therefore, the structure of the model is adapted to explore and find the most acceptable

[3] GAMS: General Algebraic Modeling System.

household choices from a variety of options, such as non-farm employment, the adoption of agricultural technology, amalgamation of land into bigger holdings, and self-employment in non-farm businesses.

The following sections explain the model structure and SFHs objectives that are considered within the model. Also, the simulation assumptions are specified, as well as the analysed policy measures.

2.1 Implementation of MOLP for modelling major types of SFHs

The implemented farm household model considers three income activities as decision variables with their operational costs and labour inputs: (1) farming, (2) self-employment and (3) waged employment. Household labour is allocated to these three activities. In addition, the labour input to farming and self-employment can be complemented by hired labour, which is set as a parameter in policy scenarios, implying investments and the extension of a certain activity.

The following four objective functions are included in the programming approach:

1. Net agricultural production (max): This objective represents the household's possible preferences for agricultural production due to aims like food security or tradition.
2. Net non-farm income (max): This objective considers possible household preferences for the development of additional income sources or to reduce its dependency on farming.
3. Household cash balance (max): This objective shows directly whether (or not) the household will have a positive cash balance and will thus be able to cover all expenditures and save some money for future needs under the respective scenario. This objective is equivalent to the objective "maximise net household income", which is usually used in household models. The only difference is the subtraction of household expenditures, which includes expenditures for loan and credit repayments. Furthermore, interests, as well as investments in the farm and in self-employment, are included into household expenditures for calculating the annual household's cash balance in the model.

4. Agricultural labour use (min): This objective might be of relevance for households which seek to maintain agriculture on a certain scale due to tradition or for food security, but which are also considering additional income sources, or try to reduce agricultural labour input due to a high age.

In the following the equations of the programming approach are listed using GAMS notation. These consist of the four objective functions, the equations of the matrix (constraints), and the right-hand side (RHS) of the constraints, e.g. the bounds on resource use. Table 1 to Table 3 summarise the abbreviations that are used in Equation 1 to Equation 4.[4]

Equation 1:Objective functions of the programming model

$$\max \quad net\_agr\_prod = level(farm) * inc(farm) - level(farm) * o\_cost(farm) - ex\_labour(farm) + invest$$

$$\max \quad net\_off\_inc = \sum_{activity=2}^{3} [level(activity) * inc(activity) - level(activity) * o\_cost(activity) - ex\_labour(activity)]$$

$$\max \quad hh\_cash = \sum_{sub=1}^{1} subsidies(sub) + \sum_{oth=1}^{4} oth\_inc(oth) + net\_off\_inc + net\_agr\_prod - \sum_{ex=1}^{8} hh\_ex(ex) - own\_use - [level(farm) - own\_land] * land\_rent + level(farm) * SAPS$$

$$\min \quad labour(farm) = level(farm) * lab(farm)$$

Source: Fritzsch et al. (2008).

Equation 2:Calculation of labour input and its costs

$$labour(activity) = level(activity) * lab(activity)$$
$$own\_lab(activity) = labour(activity) - p\_lab(activity)$$
$$ex\_labour(activity) = p\_lab(activity) * lab\_cost(activity)$$

Source: Fritzsch et al. (2008).

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[4] The terms "level(activity)" and "level(farm)" represent the decision variables of the model. The terms "inc(activity)" and "inc(farm)" minus the terms "o_cost(activity)" and "o_cost(farm)" (minus "land_rent" plus "SAPS" for the objective hh_cash) represent the objective coefficients. The term "lab(activity)" represents the coefficients of the labour restriction with "hh_lab" being the total labour use and "hh_lab_cap" the RHS.The other terms are parameters representing fixed items, e.g. expenditures and income from subsidies, and are thus just subtracted or added to the total of the respective functions.

Equation 3:Calculation of household labour use

$$hh\_lab = \sum_{oth\_act=1}^{5} oth\_lab(oth\_act) + \sum_{activity=1}^{3} own\_lab(activity)$$

Source: Fritzsch et al. (2008).

Table 1 Parameters in the programming model

Abbreviation	Description	Unit
Ex_labour(activity)	Household expenditures for paid labour	EUR
Hh_ex	Sum of household expenditures over expenditure positions	EUR
Hh_lab_cap	Household labour capacity	hours
inc(activity)	Turnover or gross income per unit of activity	EUR/hour and EUR/ha for farming
Invest	Lump-sum for return from investments (farm investment, invested TSSS payment)	EUR
lab(activity)	Labour input per unit of activity	hour/hour and hour/ha for farming
lab_cap(activity)	Labour capacity for activity	hour
lab_cost(activity)	Costs of paid labour per hour	EUR
land_cap	Capacity of land for farming	ha
Land_rent	Land rent per hectare rented land	EUR/ha
Minimum(activity)	Minimum level for each activity	ha for farming (land), hour for other activities
O_cost(activity)	Operational costs per unit of activity	EUR/hour and EUR/ha for farming
objwt(obj)	Weights for the objective functions	No unit
oth_inc(oth)	Other (non-earned) income	EUR
oth_lab(oth_act)	Household labour use for other activities	hour
Own_land	Own land in 2006 from survey data	ha
Own_use	Value of the own used agricultural production	EUR
P_lab(activity)	Paid labour input per activity	hour
SAPS	Payment from the single area payment scheme	EUR/ha
Subsidies(sub)	Received subsidies	EUR

Source: Fritzsch et al. (2008).

Note: Parameters are constants within the model that are determined by the modeller. Costs per unit of hired labour or per unit of income activity, as well as all model constraints, are typical parameters within a linear programming framework.

Equation 4: Bounds / RHS

$$land \leq level(farm) \leq land\_cap$$

$$0 \leq own\_lab(activity) \leq lab\_cap(activity) \quad \forall\, activities$$

$$0 \leq hh\_lab \leq hh\_lab\_cap$$

$$level(activity) \geq minimum(activity) \qquad \forall activities$$

Source: Fritzsch et al. (2008).

Table 2 Variables in the programming model

Abbreviation	Description	Unit
hh_cash_bal	Annual household cash balance	EUR
hh_lab	Used household labour	hour
labour(activity)	Labour use per activity	hour
level(activity)	Activity levels: farming, self-employment, and waged employment	hour and ha for farming
net_agr_prod	Net agricultural production	EUR
net_hh_inc	Net household income	EUR
net_off_inc	Net non-farm income	EUR
own_lab(activity)	Own labour input per activity	hour

Source: Fritzsch et al. (2008).

Note: Within a modelling framework, the word “variable” denotes what economists call an "endogenous variable" (Brooke et al., 1992). Variable values are chosen within the model so that an objective function is optimised. Simply put, variable values are what the model decides. Activity levels, labour use, and net household income are typical examples of variables.

Table 3 Sets in the programming model

Abbreviation	Description
Activity /farm, self, dep/	Three income activities: farming, self-employment, and waged work
Ex /energy, food, transp, farm_inv, self_inv, edu, support, o_ex/	Fourteen categories of household expenditures: energy, buildings, equipment, food, insurance policies, taxes, transport, farm investments, investments in agro tourism, investments in family business, interests and repayments of loans, education, support of other people, and other expenditures
Sub / retire/	One subsidy item: early retirement payment
Oth /pensions, benefits, remitt, other/	Four categories of other (non-earned) income: pensions, social benefits, remittances, and other income
oth_act /processing, household, education, childcare, leisure/	Five other household activities: processing, household keeping, education, taking care of children, sick, and older people, and leisure
Obj /net_agr_production, net_off_farm_inc, hh_cash_bal, agr_lab_input/	Four objectives: net agricultural production (max), net non-farm income (max), household's cash balance (max), and agricultural labour use (min)

Source: Fritzsch et al. (2008).
Note: In GAMS, sets define the indices for the parameters and variables.

2.2 Simulation parameters and scenarios for policy analyses

The simulation was carried out for one real household per major type of SFH using data from the household survey (Fritzsch et al., 2008) depicting the households' situation in 2006. The selected households had to represent their respective major types through their main characteristics i.e., the household's variables had to be comparable to the median value of the respective major type.

Since MOLP is used for simulating future policy impacts, assumptions on the future values of number of parameters entering the model had to be made. Costs and income parameters were increased by the growth forecasts of gross domestic product (GDP) (FAPRI, 2008) to calculate the parameters of the simulation year 2016 (51% for Poland). For agricultural income, the simulated increase of 150% was even higher considering the rapid increase of agricultural product prices from 2006 to 2007. Furthermore, based on expert assessments, costs for education, transport, and energy were increased by 80%, and costs for farming were increased by 110%, as it can be assumed that these costs will rise above the GDP growth level.

The necessary weights (Table 4) of the single objectives were assessed based on survey results according to answers that the respondents gave in the face-to-face interviews. For every simulation household, the median values of the objective weights for the respective major type of SFH were used.

Table 4 Weights of objective functions for selected households

Household	Net agricultural production (max)	Net non-farm income (max)	Household's cash balance (max)	Agricultural labour use (min)
Rural diversifiers	0.09	0.55	0.27	0.09
Rural pensioners	0.26	0.17	0.31	0.26
Farmers	0.32	0.26	0.32	0.11
Rural newcomers	0.24	0.47	0.24	0.06

Source: Fritzsch et al. (2008).

The impact of policy measures was assessed by calculating the policy scenarios given in Table 5. The following five policy measures were combined for the scenarios:

1. Single Area Payment Scheme (SAPS)
2. Transitional semi-subsistence support
3. Farm investment support for the modernisation of agricultural holdings
4. Support for diversification into non-farm activities
5. Early retirement support.

A **baseline scenario** is understood as the situation in 2016, when direct payments are fully implemented, i.e., to 100% of agreed payments, in all three surveyed countries. The policy scenarios reflect different strategies onto which a household of a certain major type of SFH could embark. The scenario **"farm development"** presumes that the household will invest in farming activities and receives respective support from policy measures. In the scenario **"start self-employment"** it is assumed that the household will start a self-employed activity other than farming while receiving the respective support from policy measures. The scenario **"farm development and start self-employment"** assumes that the household invests into farming and diversifies into self-employed activities. All assumptions of the single scenarios "farm development" and "start self-employment" are applied. The scenario **"stop agriculture"** presumes that the farm operator stops farming activities and receives respective payments from the early retirement scheme. In addition, all scenarios that did not imply giving up farming activities are calculated in two variants: (i) with transitional semi-subsistence support, and (ii) without.

By comparing the baseline scenario with the results of the seven policy scenarios, which impact the policy measures have on the development of SFHs of a certain major type can be assessed. Furthermore, it shows which adjustment strategy is the most beneficial option for the household in the future.

Table 5 Scenarios for policy analysis with regard to SFHs

	Policy measures				
Scenarios	SAPS	Semi-subsistence support	Farm investments	Diversification support	Early retirement
Baseline **(base)**	x				
Farm development with semi-subsistence support **(farm+sss)**	x	x	x		
Farm development without semi-subsistence support **(farm)**	x		x		
Start self-employment with semi-subsistence support **(self+sss)**	x	x		x	
Start self-employment without semi-subsistence support **(self)**	x			X	
Farm development and start self-employment with semi-subsistence support **(farm+self+sss)**	x	x	x	X	
Farm development and start self-employment without semi-subsistence support **(farm+self)**	x		x	X	
Stop agriculture **(retire)**					x

Source: Fritzsch et al. (2008).

The different strategies that the policy scenarios imply are implemented by setting respective bounds and parameters in these scenarios. Moreover, a household's specifics, e.g. its capacities and aims, are also implemented by setting respective bounds. In the following these specific parameters and bounds are outlined.

Households have to hire 900 hours of paid labour[5] in the scenarios farm development, starting self-employment and farm development plus starting self-employment, and the parameter for hired labour is set to this value in these scenarios.

Lump-sums for returns from investments are considered in the farm development scenarios and scenarios including the transitional semi-subsistence support measure. In the farm development scenario, a lump-sum return of 15% of an investment of 10,000 EUR was agreed upon by all project experts. Hence, 1,500 EUR are added as a lump-sum to net agricultural production. These 1,500 EUR stand for the higher turnover net of higher operational costs. For the scenarios implying farm development or starting self-employment, yearly capital costs of the investments are added. For scenarios including the transitional semi-subsistence measure, a net return from the invested semi-subsistence payment of 100 EUR was agreed on and added as a lump-sum to net agricultural production.

Moreover, it was assumed that farm investments will cause changes in the production structure in favour of crop production. As the model displays average values for production activities, the gross agricultural income per hectare of farming is multiplied by 0.8 in farm investment scenarios, as well as the costs and labour input per hectare of farming in order to implement this assumption. This multiplier implies that the gross income per hectare, the operational costs per hectare, and the labour input per hectare will decrease in the case of farm investments.

The minimum activity level (lower bounds) depends on household aims, which were evaluated in the survey, thus taking the households philosophy of life explicitly into account. If the households of a major type stated on a median level a high importance for the aims of "be rooted to the soil", "conserve the heritage", "keep up family's traditions", and "enjoy rural lifestyle", the minimum level for the farming activity is set to 50% of the cultivated area in 2006. If these aims did not receive a high rating on a median level, the minimum level is set to zero, which allows for giving up farming activity.

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[5] 900 hours equal 0.5 Annual Working Unit (AWU) as defined by Eurostat.

Likewise, a lower bound for waged employment was set to 30% of the activity level in 2006 if the household stated a high importance for the aim, "diversify income sources".

On the other hand, specific minimum levels were set in policy scenarios: In farm development scenarios and in scenarios with the transitional semi-subsistence support, the minimum level of the farming activity is set to the cultivated area of the base year 2006, assuming that the household will at least maintain the actual level for receiving support from this measure. Starting self-employment is modelled by allocating a minimum level of household labour to this activity. In these scenarios, the minimum activity level is set to 1,800 hours per year for the self-employment activity. As it is assumed that the household employs 900 hours of paid labour in these scenarios, a minimum level of 1,800 hours requires own labour input of at least 900 hours.

Upper bounds on labour capacities for the income activities are set according to the number of economically active household members, their age and education. The upper bound for farming depends on the strategy and their current allocation of time between domestic and agricultural work and non-farm activities, which was assessed in the survey. For farming, the labour capacity is set to the total labour capacity for income activities of the household.

Factors such as the educational level of the single household members determine whether they could do other activities than farming. In general, the following rules for setting the labour capacities are applied: The educational level of each single adult[6] household member is considered. For an educational level greater than or equal to "secondary school, grammar school", the total labour capacity of the household member is assumed as being available for all activities, including self-employment. If there are no household members with an educational level greater than or equal to "secondary school, grammar school", the labour capacity for self-employment is set to the level of labour input of one adult person of the household to either waged employment or farming in 2006. If the household did not have a family business in 2006, a labour capacity for self-employment is only assumed as being available in the respective diversification scenarios.

[6] A household member is considered an adult when older than 16 years.

In farm development scenarios it is assumed that the household becomes able to rent in more land up to a new land capacity, which corresponds to 200% of the capacity for the farming activity in 2006. In all other scenarios, the household cannot operate more land than it did in 2006, and in the early retirement scenario the capacity for farming is set to zero. For an in-depth description of all model parameters and simulation assumptions, see Fritzsch et al. (2008).

3 Simulation results

The different strategies implied by a policy scenario, such as developing and investing in the farm, affect households expenditures (e.g. credit costs, costs for rented in land, costs for own food consumption) and incomes (e.g. income per hectare farming, income from the different activities, subsidies) and thus affect the households' cash balance. Moreover, policy measures cause changes in household behaviour and its labour allocation between farm and non-farm income sources. The decision of the household about its labour allocation is driven by the changes in the net incomes from the different activities, but might also be influenced by its specific preferences for other objectives.

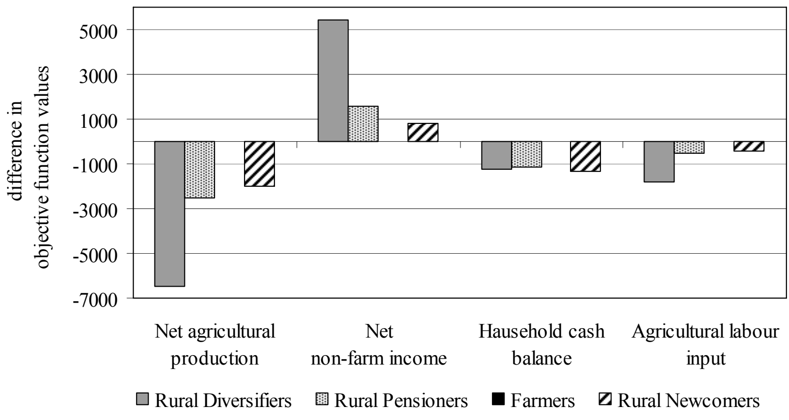
The following analysis begins by discussing the role of the households' preferences for the different objectives on their labour allocation. Second, the impact of the policy scenarios on the households' cash balances is considered. Finally, results from sensitivity analyses are depicted.

3.1 Impact of a household's preferences on its labour allocation

The weights of the household objectives derived from face to face interviews (Table 4) indicate the households' preferences for certain objectives. The rural diversifiers show a high preference for non-farm income, as the respective weight is most pronounced and the objective "maximise net agricultural production" receives only a low weight. For rural pensioners it appears that there are relatively small differences between the weights for the objectives. However, the weight for "minimise agricultural labour input" is most pronounced when compared to the other household groups. Farmers also show quite equal weights. Only the weight "minimise agricultural labour use" is at a lower level than the weights of the other objectives. On the other hand, the weights for maximise household cash balance and maximise net agricultural production are more pronounced. For rural newcomers, the weight for net non-farm income is most pronounced.

In commonly used household programming approaches, net household income or the household cash balance is maximised only. Which impact the specific preferences for the different objectives in the MOLP apprach have on the allocation of household labour will be assesed in the following. This can be done by comparing the values of the objective functions resulting from the compromise solution of the MOLP approach, with those objective function values resulting from maximising the household cash balance only. Figure 1 shows the differences between the compromise objective function values and maximising only the household cash balance in the base scenario.

Figure 1 Deviation of objective function values in compromise solution of base scenario from values resulting from maximising household cash balance alone



Source: Calculations with data from Fritzsch et al. (2008).

It appears that the compromise solution for the farmers' households does not deviate from maximising the household cash balance alone. For all other households, the values for net non-farm income are increased, whereas the values for the other objectives are decreased. The reason is that these households shift more labour to waged employment than they would when maximising only the household cash balance and in return accept a lower household cash balance.

For the rural diversifiers, the shift to non-farm activities is the largest that can be seen from the decrease in agricultural labour input. Also, the changes in net agricultural production and net non-farm income are the biggest. However, the loss in household cash balance is at a similar level to the other households, and the households can compensate for the loss of farming income quite well with non-farming income. In contrast, the rural newcomers have the lowest shift to waged employment but still have approximately the same losses in the household cash balance.

3.2 Impact of policy scenarios on the households cash balances

By comparing the household cash balances of the different policy scenarios, their impact on the livelihood of the households can be assessed, and hence which strategy (policy option) would be the best for the household determined.

Table 6 shows the development of the households' cash balances in 2016, when no rural development measures are applied (base scenario) as compared to its observed level in 2006. The results can be interpreted as the effect of the strategy "continue as it is" without policy induced changes. First, it appears that all households except the rural diversifiers had a negative household cash balance in 2006. This changes for the base scenario, and cash balances increase for all households but the rural pensioners. However, for the rural newcomers this increase is not large enough to result in a positive household cash balance.

Table 6 Comparison of household cash balance in 2006 with base scenario in 2016

	Rural diversifiers	Rural pensioners	Farmers	Rural newcomers
2006	+	-	-	-
2016 base	++	--	++	-+

Source: Fritzsch et al. (2008).

Notes: +: Household's cash balance is positive in 2006. -: Household's cash balance is negative in 2006. ++: Household's cash balance is positive in 2016 and increased in comparison to 2006. +-: Household's cash balance is positive in 2016 but decreased in comparison to 2006. -+: Household's cash balance is negative in 2016 but increased in comparison to 2006. --: Household's cash balance is negative in 2016 and decreased in comparison to 2006.

To analyse the households' cash balances under the different policy scenarios in more detail, Table 7 depicts the changes in the cash balances for each scenario and household compared to the base scenario. Additionally, Table 8 shows the ranks of the household cash balances for each scenario and household.

Table 7 Comparison of household cash balances in scenarios

	Rural diversifiers	Rural pensioners	Farmers	Rural newcomers
early retirement				
base	+	-	+	-
retire	++	--	+-	++
start self-employment without sss				
base	+	-	+	-
self	--	--	+-	--
farm investment without sss				
base	+	-	+	-
farm	++	++	++	++

Source: Fritzsch et al. (2008).

Notes: +: Household's cash balance is positive in base scenario. -: Household's cash balance is negative in base scenario. ++: Household's cash balance is positive in scenarios without transitional semi-subsistence payment and increased in comparison to base scenario. +-: Household's cash balance is positive in scenarios without transitional semi-subsistence payment but decreased in comparison to base scenario. -+: Household's cash balance is negative in scenarios without transitional semi-subsistence payment but increased in comparison to base scenario. --: Household's cash balance is negative in scenarios without transitional semi-subsistence payment and decreased in comparison to base scenario.

The desirability of the different strategies under the policy scenarios differs among the major types. For ***rural diversifiers***, farm development would result in higher cash balances compared to the base scenario. However, giving up the farming activity under the early retirement scenario would result in the highest cash balance. Those scenarios implying the start of self-employment result in the lowest cash balances. ***Rural pensioners*** seem to rely on the farming activity, as giving up farming would result in a decrease of the household cash balance compared to the already negative level of the base scenario. The best option would be farm development, and the second-best option to maintain the status quo as in the base scenario. The scenarios including the start of self-employment seem to be rather unlikely for the less educated and pensioner households, and also show lower household cash balances. Also, the early retirement scenario is not an option. The ***farmers*** show the highest household cash balances under the farm development scenario. The second-best option would be to combine farm development with the start of self-employment, whereas only self-employment without farm development would result in lower cash balances compared to the base scenario. The lowest cash balance is achieved with early retirement. ***Rural newcomers*** would be best off in the farm development scenario and second-best in the early retirement scenario. The base scenario ranks third, with a negative household cash balance. Self-employment would result in the lowest cash balances.

Table 8 Ranks of household cash balances

Scenario	Rural diversifiers	Rural pensioners	Farmers	Rural newcomers
Baseline	4	3	5	4
Farm development with sss	2	1	1	1
Farm development	3	2	2	2
Start self-employment with sss	5	6	6	5
Start self-employment	8	8	7	8
Farm development and start self-employment with sss	6	4	3	6
Farm development and start self-employment	7	5	4	7
Stop agriculture	1	7	8	3

Source: Calculations with data from Fritzsch et al. (2008).

Besides maintaining the current situation, early retirement, and non-farm diversification of income activities, farm investment seems to be a sound strategy. Indeed, all of the simulated Polish households could profit from a farm development strategy compared to the base scenario. However, rural pensioners and newcomers would still remain on a relatively low level. Undertaking a self-employed activity other than farming is only an option for the farmers' household. Still, it has to be mentioned that setting up a family business is a challanging task that only few households will be able to manage. Early retirement is only an option for the rural diversifier household. Rural newcomers would also achieve an increased cash balance under this scenario as compared to the base scenario. However, given their young average age they are mostly not eligible for this policy measure.

Table 9 Differences in the household's cash balances in diversification scenarios with and without the transitional semi-subsistence payment (self+sss net self, EUR)

	Rural diversifiers	Rural pensioners	Farmers	Rural newcomers
Poland	740	504	100	972

Source: Fritzsch et al. (2008).

As the policy scenarios were calculated with and without the transitional semi-subsistence support measure, the impact of this measure on the household cash balance can be assessed. In the scenarios that imply farm development, the effect of the transitional semi-subsistence measure on the households' cash balance was exactly the 100 EUR that were presumed in the model as the net return of investing the received money into the farm. Differing results were only obtained in the diversification scenarios. Table 9 depicts the difference in the household cash balance of the self-employment scenario with transitional semi-subsistence support as compared to the same scenario without the semi-subsistence support.

For the farmers, the effect also amounts only to the assumed 100 EUR net return from investment. However, for Polish rural diversifiers, rural pensioners, and rural newcomers, the effect was larger than the assumed net return of 100 EUR. The reason for these differing results is a shift of labour in these households to non-farm activities in diversification scenarios without the semi-subsistence measure, as in these scenarios there is no condition to maintain the current level of farming[7]. Households with an increase in the cash balance larger than 100 EUR in diversification scenarios with the semi-subsistence measure have a high preference for non-farm activities despite a lower income than from the farming activity. In those cases, the households are distracted from non-farm

[7] In scenarios including transitional semi-subsistence support and farm investment support, the minimum level of farming activity was set to the level of 2006.

activities when participating in the measure and are thus kept in farming, which on the other hand results in higher cash balances. However, these households have rational reasons for the specific preferences for non-farm income, and looking at the cash balance alone would not consider these reasons.

3.3 Sensitivity analysis

Sensitivity analyses have been carried out for the Polish rural newcomers' household. The model is triggered by three key assumptions: (i) turnover or gross income per unit of an activity, (ii) operational costs, and (iii) labour capacity. Especially for the farming activity there are some uncertainties, as the assumed growth rates for agricultural turnover and operational costs are based on experts' assessments. Therefore, the focus of the sensitivity analyses was laid on the parameter operational costs per unit activity and the following six sensitivity analyses were carried out:

1. 15% increase in operational costs per unit of farming
2. 30% increase in operational costs per unit of farming
3. 10% increase in operational costs per unit of self-employment
4. 10% decrease in operational costs per unit of self-employment
5. 10% increase in operational costs per unit of waged employment
6. 10% decrease in operational costs per unit of waged employment.

There were no alterations in the activity levels in all six analyses. However, there were impacts on net agricultural production and net non-farm income. This results in lower cash balances but does not change the quality of the strategies with one exception: when the operational costs per unit of farming are increased by 30%, early retirement results in a higher cash balance than farm development, which was not the case before. Moreover, the increased costs of farming result in a decrease of the value of net agricultural production by no more than 12%.

The effect of decreased or increased operational costs of non-farm income activities is straightforward. When the operational costs are increased, the net income from non-farm income activities decreases by no more than 5%, and vice versa. The following could be specifically observed:

1. Results for a 15% increase in operational costs per unit of farming: There was no impact on activity levels. Due to higher operational costs the value of the net agricultural production decreases by about 4% to 6% in the scenarios with farming.
2. Results for a 30% increase in operational costs per unit of farming: There was no impact on activity levels. The value of net agricultural production decreases by 7% to 12% in the scenarios including farming. Considering the decreased cash balances, the early retirement option becomes preferable to the farm development option for the simulated Polish rural newcomers' household.
3. Results for a 10% increase in operational costs per unit of self-employment: There was no impact on the activity levels. Non-farm income decreases by 3% in scenarios including the self-employment activity.
4. Results for a 10% decrease in operational costs per unit of self-employment: There was no impact on activity levels. Non-farm income increases by 3% to 4% in scenarios including the self-employment activity.
5. Results for a 10% increase in operational costs per unit of waged employment: There was no impact on activity levels. Non-farm income decreases by 0% to 4% in scenarios including the waged employment activity.
6. Results for a 10% decrease in operational costs per unit of waged employment: There was no impact on activity levels. Non-farm income increases by less than 1% to 5% in scenarios including the waged employment activity.

The sensitivity analyses revealed that the simulation results are stable for variations in the activities' operational costs.

4 Conclusions

Considering the impact of the single policy scenarios, it appears that all households but the rural diversifiers had a negative household cash balance in 2006. This situation changes for the base scenario and cash balances increase for all households but the rural pensioners. However, for the rural newcomers this increase is not big enough to result in a positive household cash balance. Early retirement is the only option for the rural diversifiers that results in an increased household cash balance. Farm investment and development could improve the situation of all households, whereas starting a self-employed activity only seems advantageous for farmers.

The results show that targeting the various types of semi-subsistence is a strong precondition for success. Polish rural diversifiers earn sufficient income from waged employment and farming to maintain their standard of living. Given that they are, on average, relatively well educated, it is reasonable to assume that they will continue to do so until retirement, particularly since retirement is near for the majority of them. The recommendation here would be to prepare the ground for them to enjoy a poverty-free retirement. Rural pensioners were found to be non-viable under most policy scenarios. Given their high average ages, a well-functioning and generous social security system seems to be most beneficial for them. As they display mostly a negative cash balance, the pensions would not only have to be adapted to economic growth in terms of average percentage growth, but more generously to catch up for their grave situation. SFHs classified as farmers possess the greatest development potential. Even without additional policy measures these households are mostly in a comparatively good situation. Nevertheless, the farm investment measure could help them grow and prosper further. Yet the average age of farm owners is quite high. Thus, for this type of farm, the question of how to make the farm attractive to a potential successor or pension program are also important issues to be addressed. Overall, sectoral policy measures can greatly benefit this type of SFHs. Rural newcomers should be the focus of specific policy measures because they are relatively young, lack professional training in both farming activities and non-farm sectors, and in general their employability is rather limited. If they continue on as at present, their socio-economic situation is likely to further degrade. It would be in their best interest, on the one hand, to improve their employability in the non-farm labour market. On the other hand, to become capable of operating a farm economically successfully, they require advice on investment and production strategies as well as marketing ideas.

Using MOLP, the impact of various policy scenarios on SFHs has been assessed. It appears that considering several objectives in the programming approach can lead to additional insights. For example, the strong preference of Polish rural diversifiers for non-farm income sources was shown by using the approach and led to different results. Mishra and Goodwin (1997) show that farms which receive significant income support through government farm programmes are less likely to work off-farm. Using the MOLP approach, this possible effect could be shown for the transitional semi-subsistence measure.

Moreover, results show that Polish farmers have a clear preference for agriculture while also having the best prospects in this activity. All other major simulated Polish household types seek income from non-farming sources. Indeed, they do so under most policy scenarios, even under the farm development scenario. Possible rational reasons for this behaviour might be better anticipated prospectives in the labour market and a more stable and secure income than from farming. The results underscore that to improve the situation of SFHs, it is crucial not to focus policy measures on the farming sector alone.

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