DISCUSSION PAPER

Leibniz Institute of Agricultural Development in Central and Eastern Europe

STRUCTURAL CHANGE AND FARM LABOUR ADJUSTMENTS IN A DUALISTIC FARM STRUCTURE: A SIMULATION STUDY FOR THE REGION NITRA IN SOUTHWEST SLOVAKIA

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ABSTRACT

This *Discussion Paper* explores interactions between structural impediments to labour adjustment, specific labour adjustment patterns and the impacts of differing economical and political frames. Based on the agent-based simulation framework AgriPoliS adjusted to the agricultural structure of the region Nitra in southwest Slovakia, we carry out a range of simulation experiments on the possible interplay between off-farm job opportunities for farm operators, growth in other sectors of the economy, and policy impacts. Results show that free movement of labour between sectors leads to strong adjustments in the agricultural labour force and benefits farms with a growth potential. EU Accession and a subsequent decoupling of payments lead farms to stay in business that would have otherwise left the sector. These farms, however, have a different mix of family and hired labour.

JEL: Q 12, Q 18

Keywords: Labour input, structural change, agent-based modelling, agricultural policy analysis.

ZUSAMMENFASSUNG

LANDWIRTSCHAFTLICHE BESCHÄFTIGUNG UND STRUKTURWANDEL IN DUALEN BETRIEBSSTRUKTUREN: SIMULATIONSERGEBNISSE DER REGION 'NITRA' IM SÜDWESTEN DER SLOWAKEI

Im vorliegenden *Discussion Paper* werden die Wirkungszusammenhänge auf landwirtschaftlichen Arbeitsmärkten, die auf ihnen auftretenden Hemmnisse hinsichtlich einer optimalen Allokation des Faktors Arbeit und die spezifischen Anpassungsprozesse unter sich wandelnden politischen und ökonomischen Rahmenbedingungen analysiert. Untersuchungsgegenstand ist die Region Nitra im Südwesten der Slovakei. Die dortige Agrarstruktur wurde zum Zweck der dynamischen Abbildung von Strukturveränderungsprozessen im agentenbasierten Model AgriPoliS rekonstruiert. Mit diesem wurden anschließend einerseits Simulationen zur Abschätzung des Einflusses von variierenden Opportunitätskosten des Faktors Arbeit durchgeführt, des Weiteren wurden die agrarstrukturellen Auswirkungen im Wechselspiel von volkswirtschaftlichem Wachstum und unterschiedlich gestalteten politischen Rahmenbedingungen untersucht. Die Ergebnisse zeigen, dass sich unter der Annnahme eines flexiblen, idealisierten Arbeitsmarktes starke Veränderungen in der Agrarstruktur und hinsichtlich des Einsatzes von Arbeitskräften im Landwirtschaftssektor ergeben würden. Derartige Bedingungen würden insbesondere überdurchschnittlich erfolgreichen Betrieben mit vorhandenem Wachstumspotential zum Vorteil gereichen. Sofern diese Wachstumsbetriebe aus der Gruppe der Einzelunternehmen stammen, zeigt sich, dass diese den steigenden Bedarf an Arbeitskräften durch Fremdarbeitskräfte decken würden. Der Beitritt zur EU und die damit einhergehende Implementierung eines Direktzahlungsregimes bewirkt, dass Betriebe, die ohne die neu geschaffenen Anreize aus dem Sektor ausgeschieden wären, kurz- bis mittelfristig in diesem verbleiben und den Strukturwandel hemmen beziehungsweise verlangsamen.

JEL: Q 12, Q 18

Schlüsselwörter: Landwirtschaftliche Beschäftigung, Strukturwandel, Agentenbasierte Modellierung, Politikanalyse.

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LIST OF ABBREVIATIONS

AgriPoliS	Agricultural Policy Simulator
AWU	Annual Working Unit
CF	Corporate Farms
CNDP	Complementary National Direct Payments
FADN	Farm Accountancy Data Network
IDEMA	Impact of Decoupling and Modulation in the Enlarged Union: A sectoral and farm level assessment (Research project supported by the European Commission)
IF	Individual Farms
SAPS	Single Area Payment Scheme
VUEPP	National Institute of Agricultural Economics, Bratislava, Slovak Republic

1 INTRODUCTION

Today's farm structure in Slovakia is the result of adjustment reactions to deep institutional reforms and policy changes during the first years of the transition process. Reforms have had landslide effects on the outflow of agricultural labour particularly in countries such as Hungary, the Czech Republic or Slovakia, where large-scale corporate farms have remained more important and labour use and intensity were already very low (MACOURS and SWINNEN, 2005). SWINNEN et al. (2005) explain that the strong adjustments in the first decade after transition with changes in the terms of trade, the higher share of private land use, the shift towards individual farming and change in the costs of labour relative to other inputs have significantly influenced employment in agriculture. Interestingly, during that time period, growth in other sectors of the economy has had little influence on the mobility of labour between sectors (SWINNEN et al., 2005). Although the strong adjustments due to transition have long settled, recent data for Slovakia show that more than a decade after transition started, agricultural employment in rural areas is still comparatively high and wages comparatively low. In poorer rural areas, agriculture accounts for more than 10 % of the total employment (Sample survey on Labour Force including seasonal labour – STATISTICAL OFFICE OF THE SLOVAK REPUBLIC, 2006), with a decreasing tendency. Wages in rural regions have for a long time been more than 30 % below wages in urban areas (STATISTICAL OFFICE OF THE SLOVAK REPUBLIC, 2006). More recently, real wages have been increasing. But this is likely to benefit urban and non-agricultural employees.

The relatively high percentage of agricultural employment in rural areas may be indicative of structural impediments preventing a flexible adjustment of farms with regard to employment. In this respect, one may differentiate between the adjustment paths taken by large-scale (corporate) farms and individual farms. Although large-scale farms employ many workers, they are flexible in adjusting their labour force. The increasing share of seasonal labour may be an indication for this. The labour adjustment patterns of individual farms seem to be more influenced by existing structural impediments, and in particular by the low skill level and education of older farm operators (DRIES and SWINNEN, 2002; MACOURS and SWINNEN, 2005). For such operators, off-farm work opportunities are rare, hence, the opportunity costs of labour are close to be zero. However, continuing growth in other sectors of the economy, technological change increasing the technological and cost gap between farms, as well as retirement create a new situation in the decision to take over a farm. The potential successor is usually younger and has better off-farm employment opportunities, particularly if wages are rising. The same situation emerges if production assets need to be replaced. As long as an old building can be used, agricultural production should continue even if the returns do not cover the ex ante calculated costs; thus, profitability on a full-cost basis is low. This specific adjustment pattern can be explained using the concept of sunk costs (BALMANN et al., 1996) or quasi-fixed factors (JOHNSON, 1956; JOHNSON and QUANCE, 1972) and applied to explain slow structural change (BALMANN, 1999; BALMANN et al., 2006; HAPPE, 2004). In terms of factors affecting agricultural employment, the following factors seem to play a major role (BAUM et al., 2006): Labour saving technical progress, macroeconomic environment, farm structure, socio-economic characteristics of the farmer, and agricultural support policies.

With accession to the EU, the latter aspect has received particular attention since the introduction of direct payments has created significantly different conditions for farming. Since 2004, direct payments have had landslide impacts on farm profits.[1] It may hence be asked, whether

[1] One should notice that this is most likely not a persistent phenomenon as payments are bid into factor prices. This issue, however, will not be dealt with in this paper.

the introduction of (decoupled) direct payments also slowed down structural change and in particular labour allocation by creating incentives for inefficient farms to remain in farming or for successors to take over the farm. Given this setting, the objective of this paper is to study interactions between structural impediments to labour mobility, specific labour adjustment patterns and policy. Using the agent-based simulation framework AgriPoliS (see section 2) adjusted to the agricultural structure of the region Nitra in southwest Slovakia (section 3), we carry out a range of simulation experiments on the possible interplay between off-farm job opportunities for farm operators, growth in other sectors of the economy, and policy impact (section 4). Following this, we summarise our findings and draw conclusions.

2 THE MODELLING FRAMEWORK

This section sets out the general components and main features of the simulation framework AgriPoliS which provides the basis for our exploration. The reader interested in details about the general model and assumptions is referred to HAPPE et al. (2006a) and HAPPE (2004) as well as to KELLERMANN et al. (2007). Here, we describe the model focusing on the point of view of labour allocation and labour mobility between sectors to facilitate the understanding of the later findings.

AgriPoliS is an agent-based model. That is, the core idea of AgriPoliS is the understanding and modelling of the agricultural system as an agent-based system, i.e. an evolving complex adaptive system, in which farms are interpreted as individual agents. What can be observed at a higher level of scale (region, sector) is the result of actions and interactions at the individual farm level. In this way, it is possible to develop a stylised picture of the development of aggregate characteristics of the system. AgriPoliS provides the functionality for mapping key components of regional agricultural structures: Heterogeneous farm enterprises and households, space, markets for products and production factors. Accordingly, AgriPoliS can be adapted and used for understanding the development of different farm structures over time and issues related to structural change. KELLERMANN et al. (2006), e.g. apply AgriPoliS to study the impact of transaction costs on land mobility. HAPPE et al. (2006b) use AgriPoliS together with a detailed linear programming model MODAM to study the impact of policies on a set of non-commodity outputs.

In this paper we particularly focus on labour market participation. We consequently model characteristics that we assume to determine time allocation of farm family members and employment decisions of corporate farms in a differentiated way. So, let's assume a region in which there is a dual farm structure consisting of a number of farm agents.[2] Of these, a certain share is operating as individual farms, whereas the remaining farms are corporate farms. Let's assume that farms are not in the position of changing their legal form. A corporate farm differ from an individual farm in that the farm is owned by some imaginary owner (or a group of shareholders), which exerts no influence on production decisions. On corporate farms all labour including the management is hired on a year to year basis at a single wage rate. Furthermore we assume workers laid off by a corporate farm due to downsizing or closing do not take up farming themselves but work elsewhere in the economy or benefit from social benefits.

Individual farms, on the other hand, are run by a farm family consisting of one or more active farm family members. In addition, individual farms can hire additional labour on a year to year basis. Likewise, farm family labour not used on the farm can be offered on the labour market. The (in)ability of farm labour to take up off-farm work (e.g. due to a lack of skills,

[2] For simplicity we'll further on only talk about farms instead of farm agents.

poor education, or age) is reflected in it's opportunity costs of labour. For simplicity we assume that all farm family labour faces the same level of opportunity costs. After a given number of years, an individual farm is handed over to the next generation. Depending on the successor's opportunity to work off-farm, handing over the farm is associated with a higher level of opportunity costs of the successor. This reflects a situation that a farm is only handed over if the expected future profit of the farming activity is at least as high as the expected off-farm wage of the successor.

We assume all farms, i.e. corporate and individual farms, to maximise household income or profit (in the case of corporate farms). To do so, in any one simulation period, farms produce an optimal combination of products using available production factors of different types, technological standards, and capacities. Production activities are valued at exogenously given gross margins. Economies of size arise because we assume lower fixed costs per unit for larger operations. In addition these require less labour input. Investment costs are assumed to be fully sunk. Differences in variable production costs between farms are assumed to reflect the different managerial abilities of farm operators. In the model, managerial ability is assumed to be independent of any other farm characteristics such as age or farm size.

Similar to the European Union's Farm Accountancy Data Network (FADN)[3] classification, a farm agent is classified as a certain farm type, depending on its main production line. To derive the farm's actions in any one simulation period, i.e. to select the profit or income maximising combination of production possibilities, we employ a mathematical programming approach. In addition to choosing the optimal combination of production activities, based on available endowments, farm agents decide on

1. Investments in new machinery, equipment, and technology,
2. The on-farm or off-farm allocation of farm family labour (family farms only),
3. Hiring labour or laying off labour (corporate farms and individual farms),
4. Land allocation and leasing additional land,
5. Continuation of farming or exiting the sector.

A farm's internal state is represented by a balance sheet which keeps track of factor endowments, the operator's age, and price expectations, along with a number of financial indicators. The exit decision is determined by the level of equity capital and opportunity costs of farm-owned production factors. Accordingly, a farm agent leaves the sector if equity capital is zero or if the opportunity costs of farm-owned production factors are not covered.

Farms are situated in a dynamically changing environment which we assume to consist of other farms, space, other sectors, and the relevant policy framework. Within this environment, farms interact with each other and other parts of the environment in several ways. In the AgriPoliS framework we assume farm agents to interact on markets for the production factors land, labour and capital, and on product markets. Markets for products, capital and labour are coordinated via a simple price function with a given price elasticity and a price trend for each product. These markets are exogenous as farms in a modelled region are assumed to exert no major influence on markets. The land market, as a regional market is endogenous to the model. Consequently, individual actions of farm agents directly influence land prices. For simplicity, the land market is implemented as an iterative sequential auction in which a market agent

[3] The Farm Accountancy Data Network (FADN) is an instrument for evaluating the income of agricultural holdings and the impacts of the Common Agricultural Policy. It consists of an annual survey of farms in EU member states.

allocates free plots of farmland to farm agents wishing to rent these plots. Bids are produced based on the shadow prices for one or more additional plots less transport costs and an additional surcharge reflecting other costs of renting land (e.g. fees, taxes).

AgriPoliS models spatial characteristics in a stylistic way. Space is represented by a kind of cellular automaton consisting of a grid of equally sized cells/plots. Each cell represents a plot of land of a certain size. Cells can either be farm land, i.e., arable land or grassland, or non-agricultural land (e.g. forests or roads). Farm land is either owned by farm agents or non-farm land-owners. In the latter case, land is rented out to be used by farm agents.

Overall economic change is reflected in interest rate levels, wages, and the technology. Regarding the latter, we assume that technological progress is created in the up-stream sector. Farms can benefit from better technology by adopting new technology at the time of re-investment. New technology reduces unit production costs.

The way to adapt AgriPoliS to a real farm structure is to create an input data set to initialise the simulations with a virtual farm structure that provides a close approximation to the observed real farm structure of the study region in a base year. The adaptation of the starting conditions is done in two steps.[4] The first step is to represent the region's key structural indicators such as the number of farms, farm size distribution, farm specialisation etc. based on a number of so called typical farms.[5] A weighting factor is assigned to each typical farm representing number of times this typical farm has to be located in the region such that the agricultural structure of the region is best represented. The second step is to model the internal organisation of these farms by reflecting their specialisation, main production activities, assets and capital endowments. Suitable data sources for the second step are standard farm management norms and specific technical data.[6]

3 MODELLING THE NITRA REGION IN SOUTHWEST SLOVAKIA

The region Nitra is located in the soutwestern part of the Slovak Republic.[7] The study region is one of the country's eight districts with an extension of approximately 100 km x 100 km. The region's climate is continental with favourable production conditions and above average yields on flat plains of mostly Chernozem soil types. Therefore, land is used quite intensively as arable land (86.6 %), grassland (6.6. %), gardens (3.0 %), vineyards (2.6 %) and hop gardens (0.1 %) (STATISTICAL OFFICE OF THE SLOVAK REPUBLIC, Cenzus 2001).

In 2001, there were 16,973 farms greater 1 ha in the region (Table 1).[8] Although large farms dominate in terms of production, there is a large number of small individual farms, many of which can be classified as subsistence or semi-subsistence farms. Around 56 % of farms are smaller than 0.5 ha. Excluding all farms below 5 ha (as done by the FADN), the number of farms declines to 1,342, which is 8.9 % of all officially registered farms.

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4 For details, see KELLERMANN et al. (2007).

5 The term "typical farm" refers to single farms which are closely related to empirically observed farms in the region.

6 These data were collected and verified by experts from the National Institute of Agricultural Economics (VUEPP), Bratislava, Slovakia. They can be found in SAHRBACHER et al. (2005).

7 For an explanation of the dataset see SAHRBACHER et al. (2007).

8 The definition of a "farm" in the Census is the following: The UAA is more than 0.5 ha *or* the acreage of intensive crops (orchards or vegetable or flowers) is more than 1,500 sqm *or* the acreage of vineyard is more than 500 sqm *or* 300 pieces of vine-stocks *or* at least 1 head of cattle *or* 2 pigs *or* 4 sheep *or* 4 goats *or* 50 poultries *or* at least 100 fur-bearing animals *or* 100 rabbits *or* 5 colonies of bees.

Table 1: Organisational form of farms (total number and share of total)

Organisational form	Total number	in %	Total ha	in %
Individual farms	16,654	98.1	76,426	18.5
Corporate farms	319	1.9	336,922	81.5
Total	*16,973*	*100.0*	*413,348*	*100.0*

Source: STRUCTURAL CENSUS OF FARMS 2001 (CENZUS 2001).

There are a few large scale farms that are orientated towards market production and organised as co-operatives, limited liability companies or joint stock companies.[9] Corporate farms manage about 81.5 % of the land, but they account for only 1.9 % of all farms (STATISTICAL OFFICE OF THE SLOVAK REPUBLIC, Census 2001). Around 30 % of all farms specialise in field crop production, mixed production (livestock and crop production) or permanent crop production.

The initialised farm structure is derived from the EU's farm accountancy data (FADN). Although FADN represents a reliable data source, it does not consider the whole range of farms in the region. As farms below 5 ha are excluded and no other information on small-scale farms was available, the initial farm structure only considers farms greater 5 ha. The FADN-sample of Nitra contained 81 farms in the year 2001 out of which were finally selected a number of 20 typical farms; 7 individual farms and 13 corporate farms. Individual farms range between 5 ha and 780 ha in size. The average farm size is 165 ha. Corporate farms have between 80 and 4,963 ha of land; the average size amounts to 1,592 ha. Of the individual farms, five are field crop farms (FC) and two are mixed farms (M). Of the corporate farms, four are field crop farms and 11 are mixed farms. Table 2 shows a selection of typical farms. Each farm has a specific weight. The sum of farms weighted with their respective weighting factor constitutes the virtual region as it is illustrated in Table 3, column "upscaling results". The last column shows the deviation between the "considered and adjusted data"[10] and the "upscaling results". Regarding the number of farms in different size classes it is obvious that the farm classes between 5-10 ha and 10-50 ha are underrepresented in the final sample as shown by a deviation of -9 % and -10 %, respectively. In contrast, the size class "100-500 ha" is over-represented as indicated by a deviation of +14 %.

[9] Within the group of legal entities is an ongoing trend of transforming cooperatives to legal bodies which are characterised by a remuneration and decision making according to the capital share put into the company by their shareholders, e.g. Ltd's and joint stock companies. This trend is accompanied by splitting farms into several legal entities ('downsizing') motivated by reasons like `achieving more flexibility on the production and market side' as well as for taxing purposes and requirements. Hence, the number of registered farms (individual farms and legal entities) has been continuously increasing in the past.

[10] "Considered and adjusted data" means that there are on the one hand characteristics that were not considered for the upscaling procedure (e.g. all farms < 5 ha). On the other hand there are "adjusted" data that had to be changed as the objective function of the upscaling procedure has to match with the FADN-sample basis (e.g. the total number of farms).

Table 2: Representation of typical farms (Extract; 9 of 20 typical farms)

Organisational form	**Individual farms**				**Corporations**				
Farm type	Field crop	Field crop	Field crop	Field crop	Field crop	Mixed	Field crop	Mixed	Mixded
Weighting factor	341	206	198	38	14	32	214	18	4
Land (ha)									
Arable land	5	20	40	90	780	78	130	1,765	2,568
Grassland	–	–	–	–	–	–	13	58	20
Share of rented land	100%	68%	95%	87%	95%	98%	100%	95%	100%
Livestock (head)									
Beef cattle older than one year	–	–	–	–	–	–	20	110	–
Dairy cows	–	–	–	–	–	21	–	395	633
Fattened pigs of 20 kg or more	–	19	–	–	–	–	–	2024	842
Unpaid labour (AWU*)	0.5	1.2	1.0	1.6	2.0	1.8	2.3	–	–
Net worth (€/ha)	700	480	900	1,000	1,320	4,380	2,000	1,000	1,330

Source: SAHRBACHER et al., 2005.

Note: * An annual working unit (AWU) is defined to 1,800 working hours per year according to the Slovakian FADN classification.

Table 3: Upscaling results for Nitra (Extract)

General characteristics	**Regional data**	**Adjusted data (excluding farms < 5 ha)**	**Upscaling results**	**Deviation**
Number of farms	16,973	**1,342**	1,292	-4 %
Utilized agricultural area (UAA; ha)	413,348	**387,909**	372,408	-4 %
Number of beef cattle older than 1 year	15,336	**8,576**	8,508	-1 %
Number of dairy cows	36,847	**35,400**	36,551	3 %
Fattening pigs with more than 20 kg	203,085	**168,318**	174,200	3 %
Structural characteristics (Extract)				
Organisational form				
Number of individual farms	16,654	**1,090**	1,043	-4 %
Number of holdings	319	**252**	249	-1 %
Total	16,973	**1,342**	1,292	
Number of farms in different size classes				
Less than 5 ha	15,486	**–**	–	–
5-10 ha	419	**373**	341	-9 %
10-50 ha	519	**447**	404	-10 %
50-100 ha	157	**143**	138	-3 %
100-500 ha	198	**188**	214	14 %
500-1000 ha	68	**66**	65	-2 %
Above 1000 ha	126	**125**	130	4 %
Total	*16,973*	***1,342***	*1,292*	

Source: SAHRBACHER et al., 2005.

4 SCENARIOS

The goal of the following scenarios is to improve the understanding of different factors affecting the outflow of labour from agriculture. The scenarios implement different assumptions on four factors influencing labour allocation and economic framework conditions: Wage increases in non-agricultural sectors, the opportunity of farm family members to work off-farm, handing over the farm to the next generation, and technological progress (Table 4). A growing economy is – among other factors – characterised by an increase of wages in non-agricultural sectors and technology advancing over time. Moreover, technological progress is assumed to affect active farms by way of investments. New investments reduce production costs compared to old technology, whereby reduction is higher with larger investments. Wage increases affect the off-farm work opportunities to work off-farm. Yet, not all farm-family labour has equal opportunities to participate in the off-farm labour markets. The participation particularly of older farm operators or farm family members in the labour market is often very restricted. Likewise, a lack of skills or education restrict off-farm work opportunities. This is reflected in the degree of sunk costs of labour. Hence, if costs of labour are fully sunk, farm family labours have no possibility to work off-farm.

Scenario BASE is a hypothetical baseline scenario. In this scenario, we puposely reduce all of the mentioned factors affeting labour allocation to their minimum. Hence, labour mobility between sectors is limited. We do so to provide a reference point for comparison to the other scenarios. In this way, the impact of factors directly affecting labour allocation can be singled out. In this scenario, we assume an economic environment in which there is literally no change. There are no incentives for farm family labour to work off-farm as costs of labour are fully sunk and wages in other sectors are constant relative to the agricultural sectors. This is equivalent to zero opportunity costs of labour. Accordingly, labour is not pulled out of the sector. In this scenario, farms exit because of equity erosion, or impediments to reinvest. Scenario FLEX is at the other end of the spectrum because it assumes strong growth in the economy, for which an annual increase of labour costs (and thus the opportunity costs of labour) by 2.5 % and the presence of technological progress. Moreover, all farm-family labour has the possibility of working off-farm, as given by the assumption of 0% sunk costs of labour. Contrary to scenarios BASE and FLEX, scenario AGE-DEP introduces a step-wise decline in the opportunity costs of labour depending on the age of the farmer. This is in line with BAUM et al. (2006), RIZOV and SWINNEN (2004), and BOJNEC et al. (2003) who find that middle-aged and old farmers have little or no off-farm working possibilities. Hence, in scenario AGE-DEP we consider that it is mostly the younger better educated farm family members who are able to work off-farm. Assuming that one farming generation is 25 years, opportunity costs of older farm-family members are lower (10-20 years after taking over the farm) or zero (20-25 years after taking over the farm), respectively, reflecting their (in)ability to find off-farm jobs.

Table 4: Scenarios

Scenario	Annual wage increase[11]	Sunk costs of labour	Opportunity cost increase at generation change[c)]	Technological progress[a]	Policy
BASE	0 %	100 %	0 %	(0 %, 0 %, 0 %)	Pre-accession
FLEX	2.5 %[12]	0 %	25 %	(1.5 %, 1.25 %, 1 %)	Pre-accession
AGE-DEP	2.5 %	0-10[b]: 0 % 10-20: 50 % 20-25: 100 %	25 %	(1.5 %, 1.25 %, 1 %)	Pre-accession
ACCESSION	2.5 %	0-10: 0 % 10-20: 50 % 20-25: 100 %	25 %	(1.5 %, 1.25 %, 1 %)	Accession

Note: [a]) Depending on the size of the investment there come 3 different degrees of technical progress into effect: For large investments it is 1.5 %, for medium 1.25 %, and 1.0 % for small ones. The BASE scenario is characterised by no technical progress at all.

[b]) According to the mentioned reasons, the degree of opportunity costs for labour decreases depending on the farmers age. Vice versa, the degree of sunk costs for labour increases with the time period a farmer manages his farm. This assumption is implemented step-wise, e.g. sunk costs are 0 % in the range from 0-10 years.

[c)] Generation change every 25 years.

To single out the strong impact of an accession policy, which is analysed in a fourth scenario (ACCESSION), all the above scenarios assume a pre-accession situation. Table 5 shows the level and allocation of pre-accession support payments. Compared to post-accession conditions, the pre-accession is characterised by comparatively low premiums for crop production. Contrary, in the livestock sector the pre-accession payments are higher because of almost no support of livestock lines of production in the accession policy (except for suckler cows which are not part of the modelling).

Table 5: Pre-accession payments (mean coupled premiums 2001-2004)

Crops:	Ø – premium (€/ha)
Wheat	22.6
Barley	21.0
Grain Maize	24.5
Rape Seed	37.7
Maize Silage	14.0
Meadows	1.4
Pasture	13.4
Livestock:	**Ø – premium (€/head/year)**
Dairy cows	108.2
Beef cattle	28.5
Sows	1.9
Fattening pigs	3.4

Source: VUEPP: Farm data 2001-2004 and own calculations.

[11] The initial level of labour costs is set at 1.60 €/h for hired labour and 1.55 €/h for off-farm labour activities of farmers, respectively.

[12] This parameter refers to the development of the real value of labour net-costs. After a period of real purchasing power losses (until 2000) came up a trend of increasing real wages on a level of about 2 % on average since 2000 (STATISTICAL OFFICE OF THE SLOVAK REPUBLIC).

Finally, we investigate the specific impact of phasing in EU-direct payments for Slovakia starting in 2004 (ACCESSION). Except for the "policy parameter", all other parameters are the same as in the AGE-DEP scenario. For this scenario we assume the same settings as for the pre-accession scenario with age-dependent opportunity costs. As in reality, there is a single area payment scheme (SAPS) with increasing payments year by year until 2013 which is augmented by coupled Complementary National Direct Payments (CNDP), or "top-ups". The schedule of payments is shown in Table 6. The policy corresponds to what is actually implemented by the Slovak government until 2008. After 2008 the level of payments is assumed in the way that if the sum of SAPS and top-ups is equal or higher than the 2013 target level, top-ups are successively cut. This leads automatically to a decoupled single area payment in 2013, but there is no explicit introduction of a decoupling policy in 2009. The values are calculated based on national ceilings and according to the further disposition of funds.

Table 6: Definition of policy scenario ACCESSION

	Unit	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
SAPS	€/ha	47	58	71	87	107	132	149	207	207	207
CNDPs*											
Eligible crops on arable land	€/ha	74	72	64	68	64	60	50	0	0	0
Total	€/ha	121	130	135	155	171	192	199	207	207	207

Source: Own calculations based on data from VUEPP, Bratislava, 2006.

Note: * Suckler cows, ewes and goats are eligible for coupled payments, but they are not considered in the modelling. Beef production does not entail any premium receiving after 2004 (in contrast to other New Eastern Member States).

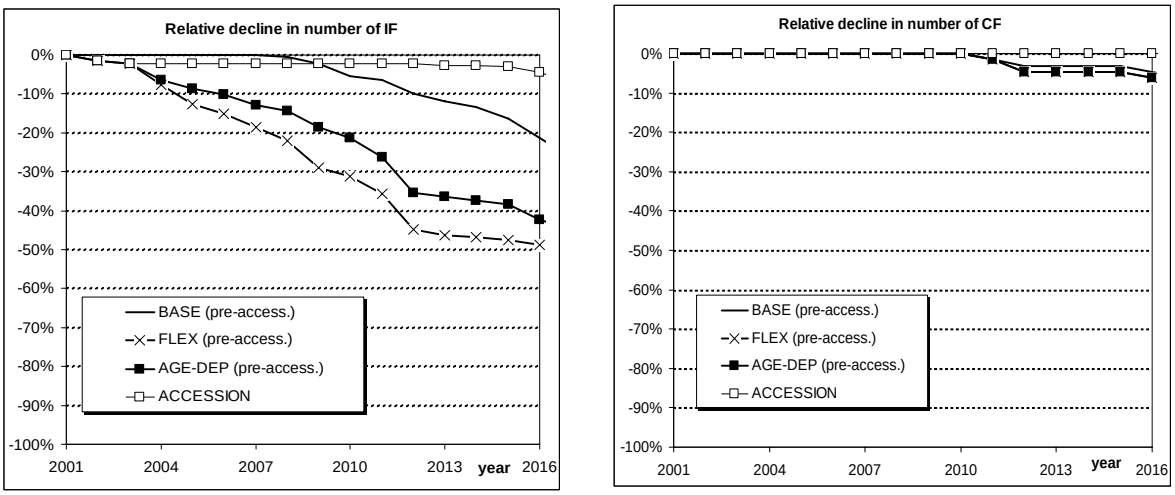
All simulations start in 2001, whereby in the ACCESSION scenario the policy change starts in 2004. In addition, the following assumptions apply:

- We simulate each scenario for 15 time periods.
- Farms are handed over to the next generation every 25 periods. At simulation start-up, we assign a random age between 0 and 25 to each farm agent, irrespective of any characteristics.
- Farms base decisions on the expected total household income in each period taking account of government support payments.
- Agricultural machinery and buildings are assumed to be specific to agricultural production. Accordingly, investment costs are sunk and cannot be recovered by farms. Farms use machinery, equipment and buildings during their entire useful life.
- Each working farm family member withdraws at least 2,000 € per year to sustain her living.
- Access to capital is not restricted by institutional factors, but by the available equity capital on the farms.
- Land rental contracts run between 9 and 18 years. The duration of land rental contracts is randomly distributed in this range. Whenever a rental contract terminates, the land is released to the land market and open for rent by other farms.
- Farms purely optimise their individual situation and do not act strategically. That is, they do not take account of intended or realised actions of their neighbours.

5 RESULTS

We start by analysing how the relaxation of assumptions influencing labour mobility as implemented in the BASE scenario affects the number of farms in the region. According to Figure 1, a relaxation of assumptions particularly affects the persistence of individual farms in the region. If we assume no labour mobility between sectors (BASE), roughly 20 % of the farms leave the sector after 15 years. As labour is inflexible, farm exit in this case can be attributed to liquidity shortages, equity erosion, and higher opportunity costs of physical capital. If, on the opposite, we assume full mobility of all labour in an economic growth environment (FLEX), the number of farms is about 50 % less compared to 2001. Considering that particularly elderly farm operators have no opportunities to work off-farm (AGE-DEP) the share of individual farms dropping out of the sector is lower (Figure 1, a). Yet, there is still a considerable amount of farms which are being pulled out of the sector due to off-farm work opportunities. As corporate farms exclusively operate with hired labour, their numbers are less affected by a change in opportunity costs, wage increases and technological change (Figure 1, b). Higher payments granted with accession to the EU (scenario ACCESSION) in any case slow down structural change. Hence, the incentive provided by the SAPS payments and top-ups outweighs the impact of better off-farm work-opportunities.

Figure 1: Change in the number of farms relative to base year for individual farms (a) and corporate farms (b)

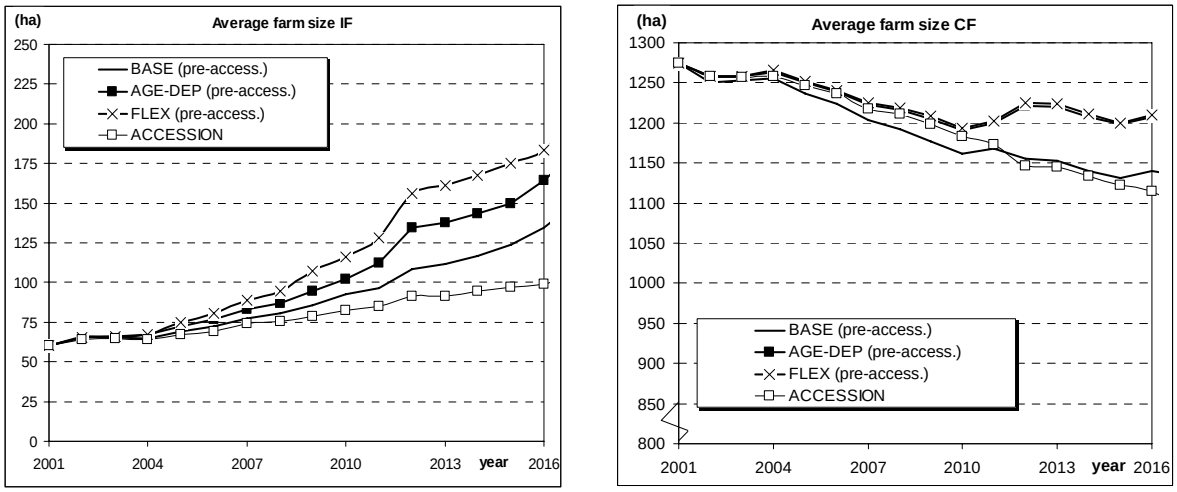


(a) (b)

Source: Own calculations.

As regards average farm size in hectares, the direction of change differs between individual farms and corporate farms (Figure 2). Average farm size of individual farms increases, whereas that of corporate farms declines. As for individual farms, there are clear differences between scenarios. Starting with an average size of 60 ha, farm size increases up to 100 ha over 15 years in the ACCESSION scenario, with hardly any farms leaving the sector. On the opposite, farm size triples in the FLEX scenario. Age-dependent opportunity costs of labour slightly reduce the dynamics of change but do not create a fundamentally different adjustment pattern than FLEX. Concerning corporate farms, the declining trend applies to all scenarios in the medium term view until 2010. After 2010, average farm size consolidates in scenarios FLEX and AGE-DEP, while it continues to decline in BASE and ACCESSION.

Figure 2: Development of the average farm size for individual farms (a) and corporate farms (b)



(a) (b)

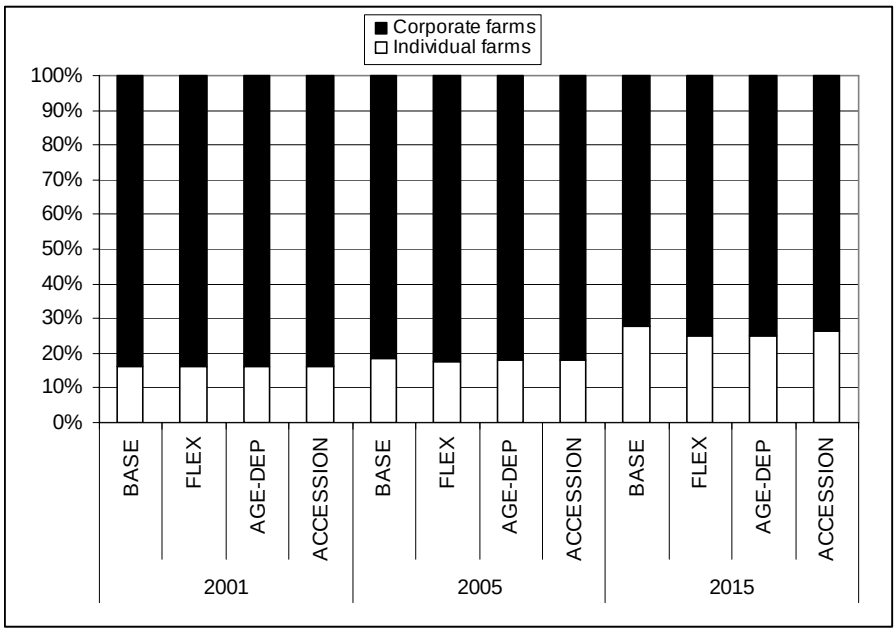
Source: Own calculations.

The different patterns of farm size growth and decline can be explained by different competitive environments. In the scenarios FLEX and AGE-DEP more individual farms leave the sector than in BASE and ACCESSION (Figure 1, a). Thus, there is more free land available for growing farms. In the BASE and ACCESSION scenario individual farms have to gain more land from corporate farms for their growth. The growth of individual farms is driven by two factors: The competitive position of individual farms as opposed to corporate farms on the land market, and opportunity costs of labour.[13] As regards the first, it is reflected in a movement of land from corporate farms to individual farms. Land redistribution is particularly evident in scenarios BASE and ACCESSION as shown in Figure 3 by comparing the shares of each legal type in 2001 and 2015.[14] The ACCESSION scenario is characterised by a policy induced incentive to remain in the sector which concerns all farms alike. Since opportunity costs of labour are zero in the BASE scenario, shadow prices for land are higher than in the scenarios with positive opportunity costs of labour. Hence, these farms can offer higher bids on the land markets relative to corporate farms. Unlike individual farms, the shadow price of corporate farms remains the same. Thus, whenever land is traded on the land market, individual farms are placed in a better position in the BASE scenario. Despite of greater economic dynamics, higher direct payments in the ACCESSION scenario also increase the shadow price for land, which in the end leads to a similar redistribution than in the baseline scenario.

[13] Within the model the movement of land is not restricted by institutional or natural barriers, i.e. transaction costs are not considered (cp. KELLERMANN et al., 2006; and CIAIAN and SWINNEN, 2005).

[14] There is hardly any redistribution effect in the short-term perspective from 2001 to 2005.

Figure 3: Percentage shares of land managed by corporate farms and individual farms



Source: Own calculations.

Note: The total area remains constant on a level of 97,373 ha over all simulation periods.

Figure 4 shows the development of total labour input and average farm size relative to the BASE scenario for individual farms (Figure 4, a) and corporate farms (Figure 4, b) over 15 simulation periods, i.e. 15 years. Accordingly, the adjustment patterns differ significantly between legal types.

Focussing on individual farms, the permission offered to all farm family labour (FLEX) or part of the farm family labour force (AGE-DEP/ACCESION) to work off-farm leads to an initial labour input which is half of the corresponding labour input in the BASE scenario, where farm family labour cannot relocate to other sectors in the economy. This gap of the initial labour input between the BASE scenario and all other scenarios is shown in Table 7 (in absolute terms). In fact, this assumption does not imply that all farm family labour is necessary to pursue the farm's production activities. The gap in labour input reveals some inconsistency in the initialised dataset which could not be seen beforehand. It shows that the initialised farm-family labour force (which was based on farm accountancy data) is higher than the labour input required by each production activity. Yet, data on labour input was based on expert judgements and standardised production data. Consequently, there is some evidence that actual labour input in farming is higher than was initially assumed. As in AgriPoliS all farms individually optimise their organisation, the surplus labour works off-farm to maximise income. Even if we assume off-farm labour to be a function of age (AGE-DEP), the gap remains large. Hence, the BASE scenario reveals the part of the surplus work force which is not necessary to run the farm operations. In this scenario, individual farms potentially use their labour inefficiently compared to the other scenarios.

Table 7: Initial labour input on individual farms

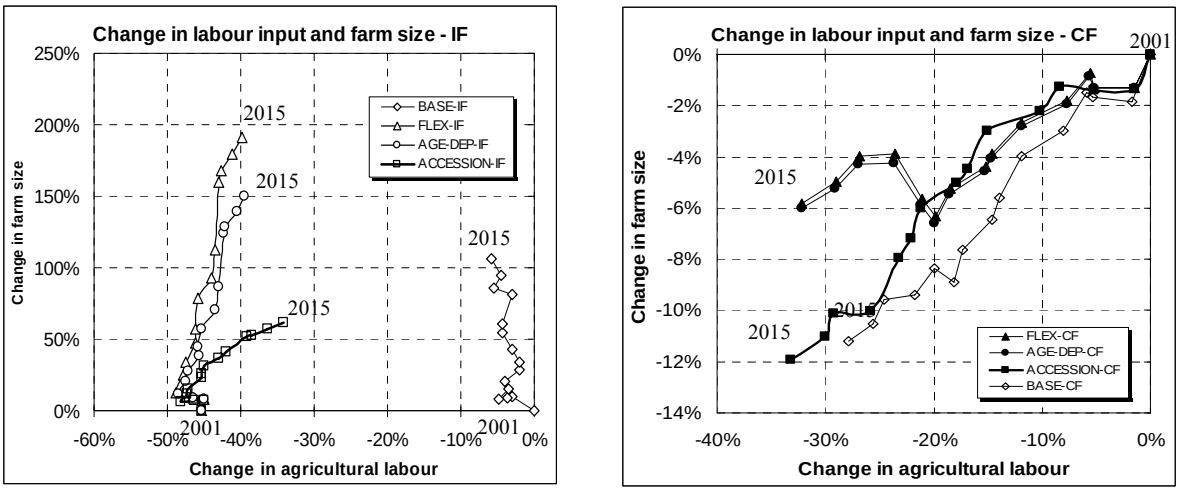
Scenario	BASE	FLEX	AGE-DEP	ACCESSION
Labour input in t=0 (year 2001) [AWU]	290	159	159	159

Source: Own calculations.

Over time, Figure 4a shows that total labour working in agriculture is slightly decreasing in the BASE scenario for individual farms, whereas it increases in all other scenarios[15], but at a different pace (The chronological starting point is the x-coordinate at the bottom (year 2001). Every data point represents a year. Hence, the final year simulated is 2015). The decrease in labour input in BASE can be explained by some farms becoming illiquid and leaving the sector. In the other scenarios, over time, total on-farm labour increases. Farms either gain land from other farms leaving or from a redistribution of land from corporate farms, such that they enlarge existing or engage in new lines of production. Differences between the scenarios can be explained by the difference in the share of land that the individual farms gain from corporate farms. In the ACCESSION scenario, redistribution of land from corporate to individual farms is about 8 % higher than in FLEX or AGE-DEP. Corresponding to this, the labour demand is 6 % higher than in FLEX or AGE-DEP.

As for corporate farms, the adjustment pattern looks quite differently (Figure 4, b). First of all, labour input and average farm size decrease over time, with a particularly strong decrease of around 30 % in scenarios BASE and ACCESSION. This mirrors the development of individual farms. Generally speaking, corporate farms loose land and thus employ less labour. In addition, there is a decline in labour-intensive livestock production, which is mainly concentrated in corporate farms.

Figure 4: Adjustment path of labour input and average farm size relative to the initial period for individual farms (a) and corporate farms (b)



(a) (b)

Source: Own calculations.

Figure 5 depicts the development of average profits per hectare for individual farms and corporate farms. To make values comparable between individual and corporate farms, individual farms' profits were adjusted by imputed costs for family farm members working on-farm.[16] Within the sample of initialised farms, average profits per ha of individual farms start from a

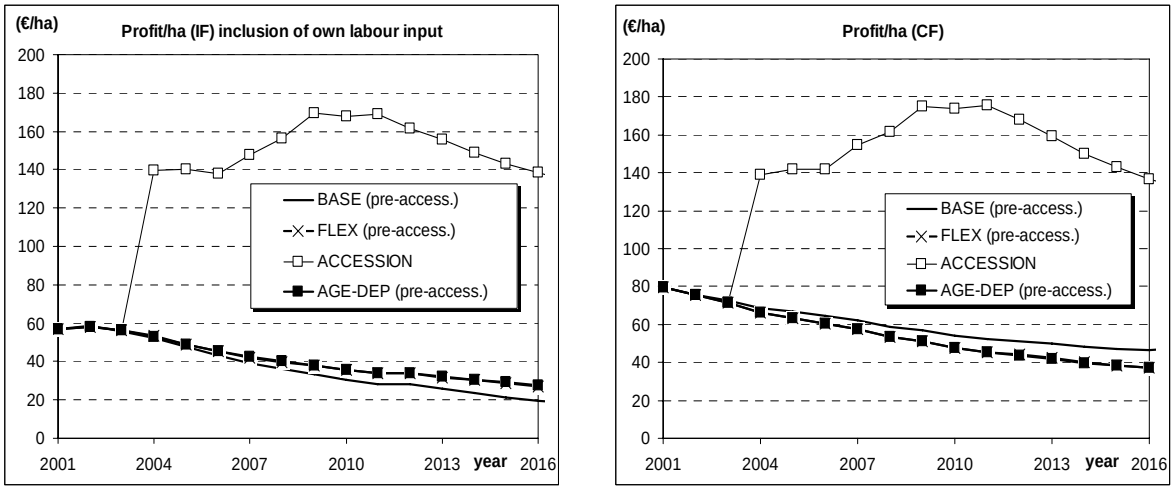
[15] Total on-farm labour increases after an abrupt decrease by initially setting up the simulations in t=0 which is represented by the starting data point on the x-coordinate.

[16] Imputed costs are calculated on the basis of the off-farm wage (1.6 €/h) multiplied by the family farm members working force. For scenarios FLEX, AGE-DEP and ACCESSION under consideration of an annual wage increase of 2.5%.

level of about 60 €/ha, whereas that of corporate farms start from about 80 €/ha.[17] The differing starting levels are mainly caused by the fact, that corporate farms in the sample keep more livestock which receive coupled premiums under pre-accession conditions (cp. Table 5). The slight decrease of profits for both groups of legal forms in the PRE-ACCESSION scenario is caused by increasing rental prices (cp. Figure 6).[18]

With accession to the EU, profits per hectare increase abruptly up to about 140 €/ha for both legal types. Differences between legal types are levelled. This is not a general effect, but it is due to the specific characteristics of the sample of farms in relation to the implemented accession policy. At initialisation, individual farms in the sample have a slightly higher share of arable land. Together with top-up payments for eligible crops on arable land, above average benefits are given to those farms with higher shares of arable land. In addition, livestock production is no longer eligible for premium payments. Hence, the relative increase in corporate farms' profits is lower. Profits of IF and CF increase until 2009 on a level of about 170 €/ha and remain on that level until 2011. After 2011 the distribution effect of the accession policy that favours arable land farms will be levelled with coupled CNDP's shifting towards a single area payment that is paid for grassland as well as for arable land (cp. Table 6). While after 2011 the amount of direct payments persists at a constant level, profits decrease. This is due to an increasing capitalisation of payments towards rental prices (Figure 6) in addition to continually increasing labour costs (except in the BASE scenario).

Figure 5: Development of profit/ha in IF (a) and CF (b). Consideration of unpaid labour input in IF (a)



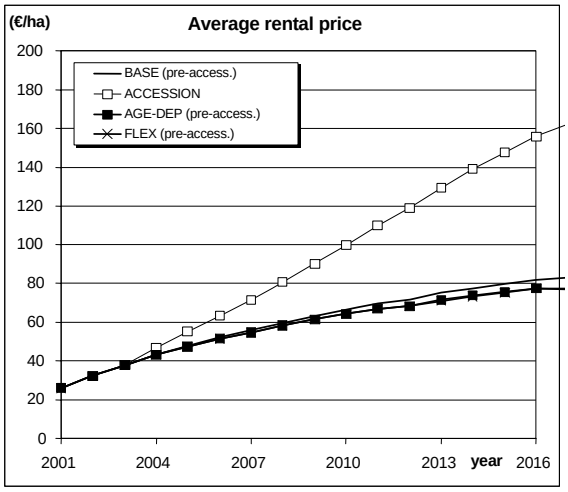
(a) (b)

Source: Own calculations.

[17] As farms are derived from FADN data, which are generally farms performing better than the average of all farms, average profits in reality may be below the values indicated here.

[18] The increase of rental prices itself is a model-endogenous outcome connected with the internal shadow prices of farms offered for on additional plots of land. In the long term run, the rental price approximates the farms' internal shadow prices minus an adjustment term (surcharge).

Figure 6: Development of average rental prices

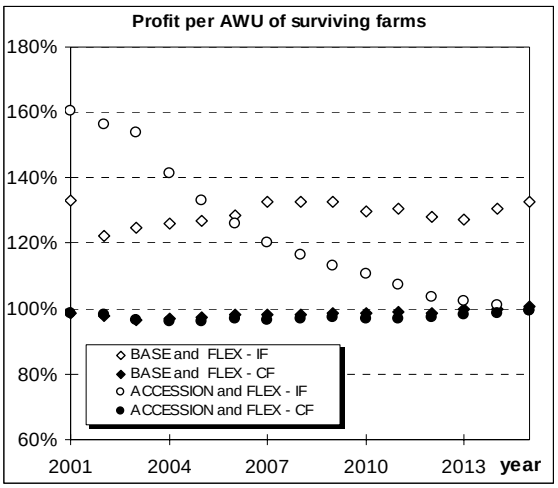


Source: Own calculations.

Finally, we analyse which farms are more likely to survive under different policy scenarios. For this, Figure 7 shows the level of profits per annual work unit (AWU) of surviving farms relative to all farms in a particular year. We analyse farms surviving in scenarios BASE and FLEX, and those surviving in scenarios ACCESSION and FLEX. It shows that farms surviving in both BASE and FLEX on average have about 30 % higher profits per AWU in all periods than the average of all farms in the baseline. While these farms can keep their advantage during the whole simulation, individual farms surviving in scenarios ACCESSION and FLEX have initially about 60 % higher profits than the average of all farms in the ACCESSION scenario.[19] However, the advantage is diminishing over time. The reason is related to the fact that most of the surviving farms are specialised in field crops. Thus, they receive high payments at the beginning. Due to the phasing-in of SAPS payments the top-ups for arable land are transferred to the SAPS payments, which are also paid for grassland. Non-field crop farms gain subsidies and the gap between the profit of the surviving field crop farms and the whole sample of farms shrinks.. However, with accession, the same farms turn out to have an average profit per AWU which decreases over time down to the level of the sample mean. Consequently, the accession policy favours farms to stay in business and to derive higher profits that would have left the sector without direct payments. The profit of those farms which survive in the FLEX scenario decreases to the average level of all farms (100 % level). For corporate farms we cannot identify any differences in the profits per AWU between the surviving farms and the whole sample, because only few corporate farms quit agriculture (cp. Figure 1, b).

[19] This is surprising because it would imply that the surviving – and more labour efficient farms – would be even above average beneficiaries from the possibility to have off-farm working options by having a profitable use for their surplus workforce. A priori, one can expect that additional income sources should favour less successful farms instead of those farms that already possess a high survivability.

Figure 7: Profits per annual work unit (AWU) of individual farms and corporate farms surviving in scenarios BASE and FLEX and ACCESSION and FLEX and all periods relative to the sample mean



Source: Own calculations.

6 SUMMARY AND CONCLUSION

This paper presents results of simulation experiments on the interplay between impediments to labour mobility, overall economic dynamics, and policy with regard to structural change. We use the simulation environment AgriPoliS to initialise an agricultural structure similar to that of the region Nitra in southwest Slovakia. We start by analysing the impact of different assumptions on factors influencing the mobility of labour. In this light, we analyse the impact of the actually introduced accession policy on labour allocation and structural change.

Results underline the importance of opportunity costs of labour for structural change and the mix of farm-family and hired labour on farms. The analysis identified different adjustment paths for individual and corporate farms. Simulation results show that the accession (and subsequent decoupling) policy affects structural change in a similar way than a (hypothetical) situation in which we assume limited mobility of farm family labour. Even though we assume a growing economy in the accession scenario, the level of direct payments offsets the effect of economic growth on structural change and result in a persistence of previously existing farms. Current developments of an increasing demand for agricultural products – caused by various reasons – can supposed to act as well as a push factor by promoting a continuation – and even intensifying – of farming activities. Overall, results show that the impact of direct payments overlays the impact of sunk costs and economic growth. Therefore it can be assumed a continuity of comparatively large farms (> 5 ha) at least if they are not immediately faced to a generation change situation. Furthermore, these farms are likely to persist by potentially "downsizing" with regard to their labour input (not with regard to their hectare size) by applying innovative modes of cooperation. This might be an appropriate adjustment option to persist and to benefit even in a strong growing economy with increasing opportunity costs. The results, however, have to be understood in the light of the assumptions made. The underlying assumptions on farm family labour and opportunity costs are of a preliminary nature. The role of these factors, as well as processes of succession in structural change would need to be studied in greater depth.

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