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Foreword

Studies in Agricultural Economics has developed considerably over the last two years and now offers a very attractive package to authors, namely:

- Impact factor 0.1 (CitEc, 2012);
- Internationally respected Editorial Board;
- Papers are 'double-blind' peer reviewed;
- Accepted papers are proof read by a native English speaker;
- Papers are immediately published online, complete with Digital Object Identifier (DOI);
- Papers are also published in printed form;
- There are no publication fees of any kind;
- A 'content alert' is sent out by email to over 9,000 recipients;
- Full papers can be accessed via the AgEcon Search repository (http://ageconsearch.umn.edu/);
- Papers are abstracted in the CABI Agricultural Economics Database.

The increasing interest in publishing in the journal as a result of this package has enabled the publication of a third issue this year. In turn, this has allowed us to experiment with two innovations. Firstly, the appearance of an 'international section'. The main geographical focus of *Studies in Agricultural Economics* is Europe, especially eastern central and south eastern Europe. However, European agriculture operates in a global marketplace and European agricultural economists must maintain their awareness of topics of international significance. Secondly, the inclusion of a 'short communication'. *Studies in Agricultural Economics* welcomes such contributions that might deal with the economic aspects of policy, with the results of small research projects not justifying a full-length article, or comment on articles previously published.

Anticipating the start of the new European Union (EU) programming period in January 2014, Potori, Kovács and Vásáry model the impact in Hungary of the new system of direct payments under the Common Agricultural Policy (CAP). They conclude that, from an economic point of view, the redistributive payment would have no advantage over the capping of direct payments.

The study by Aleknevičienė, Stončiuvienė and Zinkevičienė reflects the increasing attention being paid in European agriculture to 'public goods'. It tests a model for the determination of the fair value of a multifunctional family farm that takes into account not just cash flows from financial support and earnings but also the value of created public goods and externalities.

Regional convergence is another topical issue in Europe and research by Monasterolo and Benni shows increasing divergence both within Hungarian NUTS 3 regions and between the eastern EU Member States NUTS 3 regions, especially after Hungary joined the EU. The role of the CAP in promoting cohesion in Hungary is found to be limited.

Goldschmidt and Bogner evaluate the perceptions of *Realschule* students in Bayern, Germany with regard to their hopes and fears in the context of plant genetic engineering. The majority of the students did not express strong views on the topic. The authors suggest that a perceived lack of relevance or a low interest in the topic may be the cause.

In their overview of the export growth trends in the Hungarian agri-food sector, Juhász and Wagner show that, almost without exception, the increasing market size accounted for most of the export growth to 14 countries. The grain sector is the success sector, although it is represented only by maize and wheat. The logistics of the Hungarian agricultural sector are still unsatisfactory.

The first paper in the international section, by Sengupta, Nag and Goswami, continues the theme of international trade. Using a macro model specially designed for economies in which the agricultural sector still plays a major role, they show that the short run and long run effects of shocks (e.g. monetary, changes in agricultural production and government expenditure) are different.

Another topic of international importance is land availability. Singh and Narayanan conclude that the economic development experienced by India in the post liberalisation period failed to reverse agricultural land expansion in the country. Net State Domestic Product per capita, cropping intensity and cereal yield are explanatory factors. Some conditions under which agricultural land expansion may start reversing are identified.

Finally, a short communication from Lančarič, Tóth and Savov reports that, from the point of view of return on equity, in the Slovak Republic the legal form 'company' is preferable over 'cooperative'.

I trust that all readers will find something of interest in thus issue of *Studies in Agricultural Economics*.

Andrew Fieldsend
Budapest, November 2013

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Book review

Francesco FELICI, Annalisa DE LUCA and Silvia GHIRIBELLI:

Tools and methods for sustainable development of the rural territories*

* Istituto Regionale Programmazione Economica Toscana, 72 pp.

This study was published within the European Union (EU) Interreg IIIC project *Rural Innova*, which developed an interregional rural development network. It was an output of Component 5, *Governance and sustainable development*, which sought to identify tools and methods that can be used for strategic analysis, territorial forward planning and the evaluation of rural development policy, programmes and projects, by means of a renewed governance and in the context of sustainable development.

The purpose of the study was to identify and test a set of non-agricultural rural development indicators that would be of particular value in quantitatively and qualitatively evaluating the impact of the (then) Leader+ programme. Hence the research is divided into two parts.

Following a brief introductory chapter that summarises the overall project methodology, chapter 2 describes how keyword analysis of local rural development planning documents from several EU regions was used to compare the degrees of importance attached to the economic, environmental, social and participation components of sustainable development. Although clear differences were evident between regions, only the latter (participation) would appear to be under-represented in many documents. However, when project partners were asked which of the components received greater attention, economic and environmental predominated. From this the report concludes that there is a lack of evaluation tools and indicators for the social and participation dimensions.

Chapter 3 begins by reviewing some of the more widely-used definitions of 'rural' and wisely concludes that 'there is not one single concept of rural area'. Then, using the OECD classification of predominantly rural, significantly rural and predominantly urban, it briefly describes the economic (GDP, employment structure, and per cent economically active population), social (age structure) and environmental (landscape structure) situations in each *Rural Innova* region.

Using the above evidence, in Chapter 4 a set of 39 non-agricultural indicators of sustainable development in rural areas is compiled, covering economic (13), social (8), environmental (14) and participation (4) themes. These are drawn from well established indicator sets such as OECD, Eurostat and the EU Common Monitoring and Evaluation Framework (CMEF).

The authors observe that an analysis of individual indicators can lead to a distorted view of reality and Chapter 5 introduces the second part of the study by using principal component analysis to reduce 18 (mainly economic) CMEF indicators to five composite indicators (attraction of the territory; low degree of tertiarisation; entrepreneurship; social component; and environmental component). It is, however, only an exercise for illustration that is not followed up later in the report.

Chapter 6 describes how, by means of a questionnaire, the usability, utility and 'SMART' features of the proposed indicators were assessed by eight Local Action Groups and eight provinces in Regione Toscana. The authors note that that the interviewees expressed a 'degree of surprise' as to some indicators, possibly because they were non-agricultural or alternatively because they were not related to the normal work of the interviewees. The indicators were arranged into eight groups and interviewees were asked to (a) remove one or more indicators, (b) assess the suitability of the remaining indicators as regards sustainable development in rural areas and (c) then propose one or more additional indicators. The evaluations were very positive, ranging (on a 0-10 scale) from 6.8 for 'transport' to 8.3 for 'structure of the economy'.

The process for selecting the final list of indicators of sustainable development is described in chapter 7. The reasoning for including each indicator, the comments of the project partners, the opinions of the interviewees and the sustainable development objectives of the EU were used as criteria for selecting the final indicator list. The result is a set of 35 indicators covering economic (structure of the economy; labour market), social (demography; health and public services), environmental (biodiversity and landscape; soil, waste, water and energy; transport) and participation (Leader, Agenda 21 and e-government) themes. Each indicator is accompanied by its units of measurement.

It is always possible to question the validity of some of the results of such a study. For example, this reviewer would not include 'number of museums and cinemas per head of population' in his personal top-35 list of rural development indicators. There are also a number of avoidable typos (for example, East Wales is not in the East of England). However, the authors deserve credit for producing a piece of work that is thought-provoking in a number of respects. Firstly it goes beyond the mindset of equating rural development with agricultural development. Secondly, its emphasis on the importance of indicators of participation anticipated a trend that is now well-established. Thirdly, the research is evidence based, using well established indicators that are validated by rural development practitioners.

The study is therefore a useful source of ideas for those with an interest in the important topic of how to assess the impacts of non-agricultural rural development policies.

Copies of Tools and methods for sustainable development of the rural territories *can be obtained free of charge by emailing studies@aki.gov.hu.*

Reviewed by Andrew Fieldsend, Budapest. andrew.fieldsend@aki.gov.hu

POTORI Norbert*, KOVÁCS Máté*‡ and VÁSÁRY Viktória*

The Common Agricultural Policy 2014-2020: an impact assessment of the new system of direct payments in Hungary

In Hungary, the rates of direct payments to farmers under the Common Agricultural Policy for the period 2014-2020, the distribution of these payments, and ultimately their impacts on farming decisions, will depend on the combination of mandatory and optional Pillar I support schemes to be introduced in 2015. This paper presents estimations of the structural impact of six new support policy option mixes (scenarios) compared to 2013 (baseline), and discusses the policy implications in terms of the degressivity of direct payments versus the possible introduction of the Redistributive Payment in particular. The calculations of direct payment rates and the distribution of these payments were based on the database of the Hungarian Agricultural and Rural Development Agency for 2011, and the moving averages of the descriptive parameters of farms were obtained from the Farm Accountancy Data Network. To assess the structural impacts an agent-based simulation model was developed. Decisions were modelled at the micro-level and macro-outcomes were modelled as the consequences of these micro-level decisions. From an economic point of view, the Redistributive Payment would have no real advantage over the reduction of direct payments in Hungary as the Redistributive Payment would benefit only farms of relatively small size and would shift funding away from even mid-sized family farms. Furthermore a top-up on the first 30 hectares would neither cause any significant structural changes in arable production, nor in livestock farming. In terms of employment and rural livelihoods, however, the picture might be more nuanced.

Keywords: CAP reform, scenarios, allocation of payments, farming structures, Hungary

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Introduction

On 26 June 2013, the European Commission (EC), the European Parliament (EP) and the Council of the European Union (EU) reached agreement on reforming the Common Agricultural Policy (CAP) for the period 2014-2020. This paper contributes to assessing the structural impacts of the new system of CAP direct payments on farmers in Hungary. Since no consolidated legal text has subsequently been published by the EC, our assumptions have had to be based on the information gathered from several other sources, such as the working documents on the proposal for a Regulation establishing rules for direct payments to farmers under support schemes within the framework of the CAP and related issues, published by the Council of the EU (Council of the EU, 2013a-f), and the frequent AGRA FACTS news bulletins about the CAP published by Agra-Europe, Bonn.

In Hungary, the rates of future direct payments and the distribution of these payments, and ultimately their impacts on farming decisions, will depend on the combination of mandatory and optional Pillar I support schemes to be introduced in 2015. There are several important decision options for national agricultural policy makers to be evaluated *ex ante*. The aim of this study is to assist in this process by simulating the adaptation of farmers to some of the possible changes in their support environment, *ceteris paribus*.

For Hungary, the decision on whether to cap the direct payments for individual farms (reducing the amounts higher than EUR 150,000 by at least 5 per cent), or rather opting for a Redistributive Payment (a top-up on the first 30 hectares, amounting to at least 5 per cent of the direct payment envelope of Hungary and not exceeding 65 per cent of the national average payment per hectare) as from 2015 onwards, is considered by policy decision makers and representatives of farming groups to be of key importance from both political and economic aspects. Determining the exact amount of the subsidy for small farmers within the range of EUR 500-1,250, and defining who can apply for it and how, is of equally high importance. This paper presents estimations of the structural impact of six new support policy option mixes (scenarios) versus 2013 (baseline) in Hungary, and discusses the policy implications in terms of the degressivity of direct payments versus the possible introduction of the Redistributive Payment in particular.

Agricultural production sectors in Hungary

According to Hungarian Central Statistical Office data, in 2011 the utilised agricultural area (UAA) in Hungary was 5.34 million hectares, while 1.92 million hectares were covered by forests, 65 thousand hectares by reeds and 35 thousand hectares by fish ponds. The arable area totalled 4.32 million hectares, and fruit orchards, vineyards and kitchen gardens occupied around 92, 82, and 82 thousand hectares of the UAA, respectively. The remaining 759 thousand hectares were grassland.

The principal arable crops in Hungary have traditionally been maize, wheat, barley, sunflower and oilseed rape. Normally, the production of each of these would exceed domestic needs by about twofold, thus they represent the bulk of exportable agricultural goods. While in the past maize and wheat had relatively stable sowing areas of 1.2 million and 1.1 million hectares respectively, the area devoted to oilseeds has increased significantly at the expense of other field crops such as barley. In the years following Hungary's accession to the EU on 1 May 2004, the area under oilseed rape has more than doubled to 240-260 thousand hectares, paralleling the boom in biodiesel production within the EU, an industry heavily dependent on rapeseed oil. Thanks to the increase in vegetable oil prices, sunflower has also considerably gained in popularity, lifting the sowing area by around 20 per cent to 600 thousand hectares.

Fruits and vegetables account for over 20 per cent of the value of agricultural production in Hungary. The fruits sector is dominated by apple production with sour cherries, plums, peaches, apricots and pears being next in importance. In the vegetables sector, sweet corn, green pepper, tomatoes and water melons are the major products, with sweet corn, either frozen or canned, being an exportable good of outstanding economic importance.

Livestock numbers in Hungary have been falling for decades. This process was accelerated firstly by the splitting of large cooperatives during privatisation after transition, accompanied by the collapse of the COMECON market where most of the livestock products were sold, and later by EU accession (i.e. the elimination of trade barriers and the termination of direct support to non-ruminants) as well as the dramatic increases in feed grain and oilseed meal prices. According to official statistics, by the end of 2011 the number of pigs had fallen to almost 3 million, this being the lowest figure since 1949, while the number of sows hit an all-time negative record with just around 210 thousand. The declines in cattle raising and milk production appear to have recently been reversed. The number of cattle increased significantly in 2011, reaching 694 thousand in December, the highest level until then since EU accession. The number of dairy cows bottomed out in 2010 and also increased, by 2.1 per cent to 197 thousand, in 2011, while milk production gained 3 per cent in the same year. Nevertheless, only around 82 per cent of the national milk quota was used in the 2011/12 marketing year. The number of suckler cows (including dual-purpose breeds) reached 130 thousand, showing a remarkable 12.1 per cent increase over 2010 as a response to the intense demand for beef cattle from Turkey. The number of ewes declined to 821 thousand in 2011, the lowest since EU accession, representing just over 70 per cent of the national quota. Broiler chickens and laying hens represent 80 per cent of the Hungarian poultry flock. In 2011, the number of broiler chickens was around 33 million (12 per cent less than in 2003), while the number of laying hens fell by 30 per cent to 11.4 million during the same period. In 2011, turkeys and waterfowl (i.e. geese and ducks) numbered around 3 million and 5.6 million, or 30 per cent less and 1 per cent more than in 2003, respectively.

Application of the Single Area Payment Scheme

Hungary introduced the CAP on becoming an EU Member State. The country opted for the Single Area Payment Scheme (SAPS) as a substitute for all direct payment schemes financed from the Guarantee Section of the European Agricultural Guidance and Guarantee Fund (EAGGF) between 2004 and 2006, and from the European Agricultural Guarantee Fund (EAGF) from 2007 onwards with a decoupled flat rate payment per hectare of agricultural land. The Single Area Payment (SAP) was complemented by a complex system of national direct payments (Complementary National Direct Payments; CNDPs) that favoured arable, ruminant and tobacco farmers the most (Potori and Nyárs, 2007). The amount of the SAP increased from EUR 70.2 in 2004 to EUR 233.0 per hectare in 2013.

Following the mid-term review, or ‘Health Check’, of the CAP, pursuant to Article 68 of EC (2009), 3.5 per cent of the Pillar I funds in Hungary were granted to dairy farmers in the form of a re-coupled support, and a further 6.5 per cent were made available specifically for ruminant farmers, as well as for tobacco, rice, and fruits and vegetables producers.

In 2011, the area eligible for the SAP totalled 4,957 thousand hectares, a decrease of over 120 thousand hectares since 2007, when it peaked at 5,081 thousand hectares, and around 40 thousand hectares less than in 2004, the first year of application. In the same period, the number of farms eligible for the SAP declined from 208.5 thousand in 2004 to 176.3 thousand in 2011. The vast majority of farmers giving up agricultural activity were smallholders with an agricultural area less than 10 hectares.

The average size of farms eligible for the SAP was 28.1 hectares in 2011, 4.1 hectares more than in 2004. In Hungary the structure of farming is strongly dualistic (Davidova *et al*., 2013). Of the 176.3 thousand SAP beneficiaries, only 1.9 thousand had an agricultural area greater than 300 hectares in 2011, but these farms used 39.0 per cent of the 4,957 thousand eligible hectares. At the other end of the scale, 116.5 thousand farms of less than 10 hectares used less than 8.7 per cent of the SAP area.

Within the next multiannual financial framework (European Council, 2013), Hungary could spend around EUR 7.9 billion on direct payments from the EAGF between 2014 and 2020, 25 per cent more than between 2007 and 2013, at 2011 constant prices.[1] This figure represents a 3.0 per cent share of the financial commitments of the EU for direct payments in agriculture.

According to the agreement of 26 June 2013, EU Member States applying the SAPS in 2013, such as Hungary, may continue to do so until 2020 (EC, 2013). Favouring the SAPS, however, does not impede the introduction already in 2015 of any mandatory and optional Pillar I support schemes other than the Basic Payment Scheme (BPS), including the Redistributive Payment and the subsidy for small farmers, as well as the reduction of direct payments. Clearly, the SAPS can be regarded as a temporary alternative exclusively to the BPS. (It should be noted that if Hungary would choose to replace the SAPS with the BPS as from 1 January 2018 at the latest, it could use up to 20 per cent of its annual Pillar I financial envelope to differentiate the per hectare payments until transition. But studying this option was beyond the scope of this paper.)

Methodology

The calculations of direct payment rates and the distribution of these payments were based on the database provided by the Hungarian Agricultural and Rural Development Agency (ARDA) for 2011, and the moving averages of the descriptive parameters of farms were obtained from the Farm Accountancy Data Network (FADN) which in Hungary is operated by the Research Institute of Agricultural Economics (AKI) in Budapest. The ARDA database comprises data of the 176.3 thousand direct payment applicants while the Hungarian FADN includes around 1,900 farms. The theoreti-

[1] This increase is to be explained by the phasing in of direct payments during the period 2007-2013.

cal base year was chosen to be 2013, and it was equated to 2011. Six new policy option mixes were selected in which payment rates represent the extremes set in the agreement (EC, 2013) on reforming the CAP (Table 1).

Table 1: Policy option mixes used to estimate the structural impact of the new system of the Common Agricultural Policy direct support payments on agriculture in Hungary, 2014-2020.

Scenario	Parameters of direct support payments
A	5 per cent reduction above EUR 150,000, and a EUR 1,250 subsidy for all small farmers (mandatory up to a total of EUR 1,250 in direct payments)
B	5 per cent reduction above EUR 150,000, and a EUR 500 subsidy for small farmers (mandatory up to a total of EUR 500 in direct payments)
C	A top-up on the first 30 hectares, amounting to at least 5 per cent of the direct payment envelope of Hungary, and a EUR 1,250 subsidy for small farmers (mandatory up to a total of EUR 1,250 in direct payments)
D	A top-up on the first 30 hectares, amounting to at least 5 per cent of the direct payment envelope of Hungary, and a EUR 500 subsidy for small farmers (mandatory up to a total of EUR 500 in direct payments)
E	A top-up on the first 30 hectares, amounting to 65 per cent of the national average payment per hectare, and a EUR 1,250 subsidy for small farmers (mandatory up to a total of EUR 1,250 in direct payments)
F	A top-up on the first 30 hectares, amounting to 65 per cent of the national average payment per hectare, and a EUR 500 subsidy for small farmers (mandatory up to a total of EUR 500 in direct payments)

We assumed that Hungary will not introduce the optional Pillar I support scheme for areas with natural constraints. As from 2015, voluntarily coupled support may be granted up to 13 per cent of the direct payment envelope of Hungary with a further 2 per cent paid specifically to protein crop producers. We accounted for these amounts but did not allocate coupled support to any of the production sectors because that was beyond the scope of this paper. Based on the results of earlier research (Potori *et al*., 2013) we transferred 0.5 per cent of the Pillar I funds for an additional payment to young farmers.

To assess the structural impacts of the six new support policy option mixes on agriculture in Hungary, an agent-based simulation model was developed which, in the broad sense, belongs to the family of general equilibrium models (see e.g. Arrow and Debreu, 1954) since prices, supply and demand factors are determined endogenously. This model cannot be classified into the family of applied or computed general equilibrium (AGE/CGE) models (Mitra-Kahn, 2008) because our modelling approach was substantially different: agents aiming at maximising revenue were allowed to be heterogeneous, their objective functions, initial states, or even their choice paradigms could vary. Decisions were modelled at the micro-level and macro-outcomes were modelled as the consequences of these micro-level decisions. As an epilogue to the modelling process, several economic variables were estimated based on the simulation results.

For the modelling process, data were retrieved from the FADN database (Keszthelyi and Pesti, 2012). Each data provider was regarded as an individual decision maker representing a group of similar decision makers in the real economy. The properties of these agents were derived directly from FADN data. Only the principal agricultural sectors, namely wheat, barley, maize, sunflower and rapeseed production, as well as broiler, turkey, duck, goose, slaughter pig, sow, sheep and beef cattle keeping, and milk production were covered. Multiannual crops and vegetables production were omitted from this modelling exercise either due to their less flexible response, or to being under-represented in the FADN, or to the heterogeneity of production technologies and costs.

The operation of our model can briefly be described in the following steps:

- Loading and construction of data and agents (i.e. producers, consumers, sectors);
- Equilibrium search:
  - based on the initial prices, every agent determines its supply and demand of every produce;
  - the ‘auctioneer’ function calculates the excess supply vector;
  - prices are modified so that the Euclidean norm of the excess supply vector decreases.
- Equilibrium-state conditions (prices and production) are saved, and the effects of the equilibrium state are calculated.

The optimum problems were solved by using the COBYLA algorithm (Powell, 1994). We sought to replicate the CAP regulations precisely in the model which led to ‘badly behaving’ objective functions and boundary condition forms. There are several commonly used methods for equilibrium search (see e.g. Scarf, 1967). Because of these problems, the equilibrium search was transformed into an optimum problem which was then solved using the COBLYA algorithm again. The Euclidean norm of the excess supply vector was minimised.

We assumed that all producer agents optimised their objective functions. For simplification we assumed that all cost functions are linear, none of the agents have applied or will apply for financial credit and the agricultural area managed by every agent remains constant. The demand side was assumed to be represented by demand functions. To help interpret the results, the model outputs are given as annual moving indices.

Results

In Hungary, the reduction of direct payments above EUR 150,000 by 5 per cent would affect only 225 of the 176.3 thousand farms which received direct payments in 2011. The total of direct payments that could thus be transferred to Pillar II would amount to around EUR 2 million, or EUR 8.8 thousand per farm, without deducting the wages paid to employees with taxes and social contributions. Consequently, the reduction of direct payments by the minimum amount would have no significant impact on large farms.

As regards the financing, the number of potential claimants and the per hectare amount of the Redistributive Payment, scenarios C, D, E and F show clear differences (Table 2). In scenarios E and F, this payment scheme would require around 20 per cent of the direct payment envelope of Hungary in contrast to the 5 per cent in scenarios C and

Table 2: The size of the Redistributive Payment to farmers under the six different direct payment scenarios in Hungary (claimants of the subsidy for small farmers excluded).

Scenario	Financial envelope of the payment scheme		Potential claimants		Area eligible for the Redistributive Payment used by the potential claimants		Unit amount of payment	
	000 EUR	%	Number	%	ha	%	EUR/ha	%*
A	-	-	-	-	-	-	-	-
B	-	-	-	-	-	-	-	-
C	65,400	5.1	80,249	45.5	1,499,001	30.3	43.6	39.8
D	74,072	5.8	127,536	72.4	1,698,450	34.3	43.6	36.6
E	238,577	18.8	70,909	40.2	1,430,745	28.9	166.8	227.3
F	277,624	21.8	115,839	65.7	1,664,905	33.6	166.8	212.0

* Expressed in percentages of the Basic Payment per hectare
Source: Department of Agricultural Policy Research, AKI

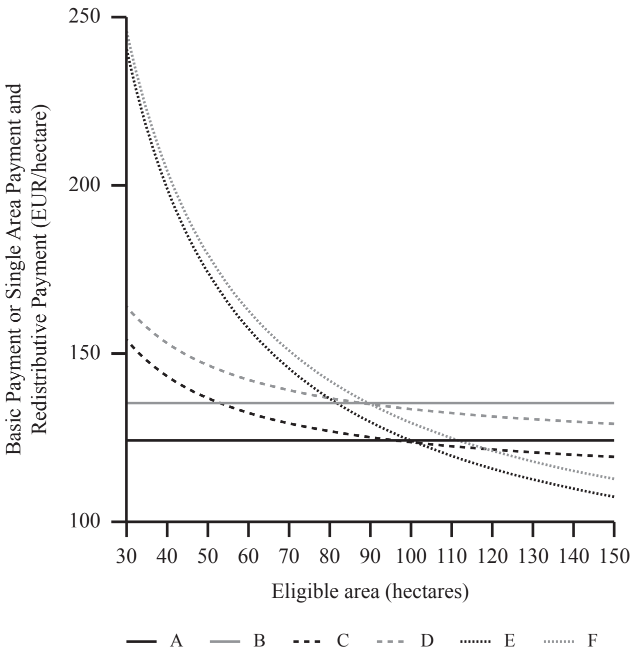

Figure 1: The break-even point for benefitting from the Redistributive Payment under the six different direct payment scenarios in Hungary.

Note: The break even points for scenarios C and E are where the curves C and E cross line A, while for scenarios D and F the break even points are those where the curves D and F cross line B
Source: Department of Agricultural Policy Research, AKI

Table 3: The size of the subsidy for small farmers under the six different direct payment scenarios in Hungary.

Scenario	Financial envelope of the payment scheme		Potential claimants		Eligible area used by the potential claimants	
	000 EUR	%	Number	%	ha	%
A	65,064	5.1	92,882	52.7	252,777	5.1
B	8,934	0.7	45,171	25.6	64, 635	1.3
C	68,596	5.4	95,985	54.5	272,138	5.5
D	9,946	0.8	48,698	27.6	73,290	1.5
E	79,561	6.3	105,325	59.8	340,995	6.9
F	13,528	1.1	60,395	34.3	106,835	2.2

Source: Department of Agricultural Policy Research, AKI

D. The number of its potential claimants may range from around 40 per cent (scenario E) to over 70 per cent (scenario D) of the 176.3 thousand beneficiaries of the SAP in 2011. The relationship between the number of the potential claimants in scenarios C and D, and scenarios E and F is explained by the amount of the subsidy for small farms (i.e. EUR 500 versus EUR 1,250). The amount of the Redistributive Payment would be at least around EUR 43 per hectare (scenario D) and it could increase up to EUR 167 per hectare (scenarios E and F). That is, it would be in the range of around 37 to 227 per cent of the Basic Payment.

The break-even point for benefitting from the Redistributive Payment would be around 100 hectares in scenarios C and E, and around 90 hectares in scenarios D and F (Figure 1).

The subsidy for small farms would absorb between 1 and 6 per cent of the direct payment envelope of Hungary (Table 3). Although the share of the potential claimants in the total area eligible for EU direct payments may range from 1 to 7 per cent in the case of this payment scheme, their number could vary between 25 per cent (scenario B) and 60 per cent (scenario E) of the beneficiaries of the SAP in 2011, representing a relatively large proportion which may eventually turn into a majority.

Table 4 shows the extent to which labour intensive vegetable production as well as cattle and sheep keeping would benefit from the Redistributive Payment under the different

Table 4: The share of the potential beneficiaries of the Redistributive Payment of the area under vegetables, in dairy production and in the number of other ruminants under the six different direct payment scenarios in Hungary (claimants of the subsidy for small farmers excluded).

Scenario	Vegetables area		Milk production		Suckler cows		Feeder cattle		Ewes	
	ha	%*	.000 l	%	No.	%**	No.	%**	No.	%**
A	-	-	-	-	-	-	-	-	-	-
B	-	-	-	-	-	-	-	-	-	-
C	28,409	44.4	130,715	7.8	48,001	37.2	53,823	53.2	442,700	55.8
D	27,811	43.5	117,841	7.1	46,332	35.9	53,149	52.5	424,323	53.5
E	28,762	45.0	132,617	8.0	48,524	37.6	54,118	53.5	449,845	56.7
F	27,934	43.7	122,478	7.3	46,968	36.4	53,350	52.7	428,506	54.0

* Percentage of the area eligible for the SAP
** Percentage of the total number of the respective ruminant eligible for any direct payment
Source: Department of Agricultural Policy Research, AKI

Table 5: The share of the potential claimants of the subsidy for small farmers in the area under vegetables, in dairy production and in the number of other ruminants under the six different direct payment scenarios in Hungary.

Scenario	Vegetable area		Milk production		Suckler cows		Feeder cattle		Ewes	
	ha	%*	.000 l	%	No.	%**	No.	%**	No.	%**
A	5,549	8.7	989	0.1	238	0.2	3,483	3.4	3,968	0.5
B	1,357	2.1	48	0.0	0	0.0	167	0.2	51	0.0
C	6,023	9.4	1,060	0.1	264	0.2	3,722	3.7	4,389	0.6
D	1,537	2.4	64	0.0	0	0.0	193	0.2	51	0.0
E	7,653	12.0	1,374	0.1	369	0.3	4,485	4.4	5,754	0.7
F	2,290	3.6	109	0.0	0	0.0	304	0.3	124	0.0

* Percentage of the area eligible for the SAP
** Percentage of the total number of the respective ruminant eligible for any direct payment
Source: Department of Agricultural Policy Research, AKI

scenarios. The differences may be considered negligible except for vegetable production (see e.g. scenarios D and E). While the potential claimants of the Redistributive Payment with an eligible area not exceeding the break-even point (Figure 1) would represent only 7 to 8 per cent of total milk production, these farms would possess a considerable 36-38 per cent of the total number of suckler cows, around 53 per cent of the feeder cattle herd, and 54-57 per cent of the ewe flock eligible for any direct payment. They would also cultivate 44-45 per cent of the area under vegetables.

Table 5 shows the extent to which the above mentioned agricultural production sectors would benefit from the subsidy for small farmers under the different scenarios. Here, scenario E could be the preferred choice for small farmers: the smallholders of 12 per cent of the vegetable growing area and more than 4 per cent of the feeder cattle herd would receive some additional funding.

The results of the structural impact assessment of the six scenarios are summarised in Table 6. No significant changes would occur either in arable production or in livestock farming. The area under wheat, rapeseed and sunflower may increase by around 1-2 per cent, and maize may become even more popular with an expansion in area of 4-5 per cent, while the area sown to barley may decrease by 2-2.5 per cent, *ceteris paribus*. Although changes in livestock numbers may differ by the sectors and the scenarios, the estimated values are in almost all cases around or below 1 per cent and thus the impacts of these scenarios on livestock farming could practically be negligible.

Overall, all of the scenarios would favour arable production. The ruminants sectors may be preferred by payments voluntarily coupled to production which, in the case of Hungary, may take up to 13 per cent of the Pillar I resources.

Table 6: Estimated annual percentage changes in the area of the major arable crops and in the number of livestock under the six different direct payment scenarios versus 2013 (baseline) in Hungary.

Scenario	A	B	C	D	E	F
Area						
Wheat	0.4	1.1	0.9	0.8	1.4	1.2
Maize	4.2	5.1	4.7	4.4	5.0	4.6
Barley	-1.7	-2.2	-2.4	-2.0	-2.1	-2.0
Rapeseed	1.8	2.1	2.0	1.9	2.2	2.3
Sunflower	2.1	2.1	2.2	2.0	1.8	2.4
Livestock numbers						
Broilers	-0.1	0.1	0.4	0.7	1.1	-0.1
Turkey	-0.8	-0.4	-0.6	-0.2	-0.4	0.1
Ducks	-0.3	0.1	0.4	0.7	-0.3	0.3
Geese	0.4	0.1	-0.1	0.2	-0.1	-0.2
Slaughter pigs	-0.9	-0.6	-0.4	-0.7	0.1	-0.5
Sows	-1.2	-0.9	-0.7	-0.4	-0.6	-0.7
Feeder cattle	-1.0	-0.8	-0.5	-0.7	-0.4	0.1
Dairy cows	-1.2	-1.0	-1.1	-1.6	-1.3	-0.8
Ewes	-0.8	0.1	0.3	0.1	0.1	-0.6

Source: Department of Agricultural Policy Research, AKI

Discussion

The new design of the CAP for the period 2014-2020 will provide options for the EU Member States to further increase the complexity of their existing direct support schemes. In this respect the question arises as to whether national governments would rather prefer greater flexibility, i.e. the application of all the possible financial tools, to additional simplification and transparency, i.e. a strict selection of optional direct support schemes. Flexibility at the supranational level does not necessarily translate to flexibility at the national level. A rational economic approach at the national or the regional level may justify the implementation of a smaller number of optional support schemes, and favouring the reduction of direct payments against a top-up on the first 30 hectares of eligible farm land along with the introduction of the subsidy for small farmers.

One of the policy implications of our modelling results is that, in the case of Hungary, the reduction of direct payments as an alternative to the Redistributive Payment may be worth considering. The Redistributive Payment would benefit only farms of relatively small size and would shift EU funding even from farms that fall into the 100 to 500 hectares category, i.e. the mid-sized family farms in Hungary, which are explicitly preferred by the government as it is highlighted in the new Land Transaction Law (Act CXXII of 2013 on the transfer of agricultural lands and lands of forestry) recently passed by the Parliament.

The decision to refrain from the introduction of the Redistributive Payment is also supported by the results of our impact assessment which show that a top-up on the first 30 hectares would neither cause any significant structural changes in arable production nor in livestock farming. (Vegetable production may be encouraged the most in scenario E). It may, however, impose an extra burden on the administration.

From an economic point of view, the Redistributive Payment would have no real benefit over the reduction of direct payments in Hungary. However, from a social point of view, in terms of employment and rural livelihoods, the picture might be more nuanced. The analysis of the social aspects of the new direct payment schemes was, however, beyond the scope of this paper.

As regards the subsidy for small farmers, the determination of the amount of payment within the range from EUR 500 to 1,250 deserves careful consideration. In Hungary in 2011, farms with less than 30 hectares eligible area represented around 85 per cent of all farms eligible for direct payments. A subsidy level set too high may distort the risk awareness of smallholders, may change their behaviour under uncertainty and may reduce the efficiency of farming. As opposed to the implementation of the Redistributive Payment, the subsidy for small farmers clearly points towards lower administrative costs.

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Determination of the fair value of a multifunctional family farm: a case study

The article analyses the problems of the determination of the fair value of a multifunctional family farm using the method of discounted cash flow, presents a model of determination of the fair value of a multifunctional family farm and tests it for a selected family farm. The specificity of the cash flows in a multifunctional family farm is related to the cash flows from financial support, different value drivers of the earnings before interests and tax and their calculation methodology, and the value of created public goods and externalities. Two types of discount rates are used to determine the value of a family farm: market-based and social discount rate (SDR). It is appropriate to use the SDR to discount the cash flow of investment, the economic and social benefits whereof are distributed among present and future generations. The stages of the determination of the fair value of a farmer's farm include: value drivers' decomposition; differentiation of cash flow and discount rates and measuring value drivers; forecasting cash flow and discount rate value drivers; value drivers' composition; determination of the terminal value; and cash flow discounting.

Keywords: fair value, multifunctional family farm, free cash flows, discounting

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Introduction

Market efficiency means that an existing business organisation is sold, transferred or exchanged at a price that is equal to its fair value. The discounted cash flow (DCF) method is used to determine the fair value of an existing business organisation where only a few transactions are made in the market. The use of this method for the purpose of determining the fair value of a business was studied amongst others by Eccles *et al*. (2001), Damodaran (2002), Kazlauskienė (2005), Mass (2005), Greene (2007), Hill and Zeller (2008) and Lütolf-Carroll and Pirnes (2009). The fair value of a family farm is created not only by the profit earned from the commercial production and provided services but also by the benefits arising from the multifunctionality of agriculture in supplying public goods and ensuring the sustainable development of a family farm. Owing to the above, specific cash flows are created at family farms, the impact whereof on the fair value comes through different discount rates: market-based and social discount rates. The problems encountered in determining the value of such a farm include differentiation and calculation of different nature cash flows as well as fixing market-based and social discount rates.

Family farms are private entities and hence some methods cannot be used to calculate the cost of equity. The selection of a method and its justification remains a scientific problem. The methods of the cost of equity calculation in a private organisation and their application possibilities were studied by Koeplin *et al*. (2000), Bajaj *et al*. (2001), Pratt, (2001), Das *et al*. (2003), Adams *et al*. (2004), McConaughy (2009) and many others. The problems they addressed included not only those of method applicability and measurement of variables but also the possibilities of method modification and adaptation for private organisations.

Another scientific problem that is still unsolved is the social discount rate (SDR), when an organisation incurs expenses related to the creation of public goods and ensuring sustainability but the economic and social benefits are transferred to future generations. Researchers who analyse public goods highlight their diversity, different intended purposes and benefits and emphasise the necessity of a public goods classification or typology and valuation from the macroeconomic perspective (Bateman and Willis, 2002; Randall, 2007; Sydorovych and Wossink, 2008; McVittie *et al*., 2009; Vaznonis, 2009; Hasund *et al*., 2011). As a rule, public goods and their typology are studied from the macroeconomic point of view, however the research related to the supplier's benefit, incurred expenses and their impact on the value of the supplier providing public goods – family farm – is insufficient.

The research problem is how to determine the fair value of a multifunctional family farm, being a private business organisation with specific cash flows, the impact whereof on the fair value comes through different discount rates: market-based and social discount rates. In this paper we conduct a synthesis and analysis of scientific research into the fair value of business organisations and its drivers in order to develop a model of the determination of the fair value of a multifunctional family farm and to test it for a family farm. This work is divided into three tasks: (a) to justify the specificity of the multifunctional family farm cash flows, discount rates and their value drivers; (b) to develop a model of the determination of the fair value of a multifunctional family farm and to justify the methodology; and (c) to test the model of the determination of the fair value for a family farm.

Value drivers of a multifunctional family farm

The key value drivers in each organisation are free cash flows (FCF) and the discount rate (Eccles *et al*., 2001; Damodaran, 2002; Kazlauskienė, 2005; Mass, 2005; Hill and Zeller, 2008). The FCF of an organisation engaged in traditional agricultural activities depends on such value drivers as the earnings before interests and tax (EBIT), fixed asset depreciation and amortisation expenses, capital investment and additional working capital (Aleknevičienė *et al*., 2012). The marginal profit from the sale of products and provision of services, being the key EBIT driver, is decomposed into three value drivers: the sales volume, the sales price and the unit cost. Using the method of decomposition, all the other EBIT value drivers are reflected in the cash flows according to the statement form prescribed in Business Accounting Standard 3 'Income Statement' for entities, whose typical activities are cultivation of biological assets, production and treatment of agricultural produce, processing of agricultural produce of own and treatment production.

The cash flow statement prescribed for a family farm of the Republic of Lithuania (ŽŪM, 2006) provides that grants related to income shall be reflected in cash flows from operating activities, while grants related to assets shall be included in cash flows from financing activities. In general, the cash flows from financing activity are not included in FCF determining the fair value. An exception is grants related to assets, which are non-repayable and increase the cash flows for the owners. When the FCF are increased by the amount of the received grants for assets, the EBIT is not adjusted by the depreciation expenses of the subsidised fixed assets.

With respect to the typology of public goods provided by family farms, the European Union (EU) Common Agricultural Policy (CAP) subsidy measures are classified into three groups: (a) for promoting commercial production development or discontinuation; (b) for indirect promotion of the creation of public goods through the support for the development of commercial production infrastructure; and (c) for the provision of public goods (Vaznonis and Vaznonis, 2011). Some of the subsidies are lump sum or periodic payments, intended to compensate for the income foregone or costs incurred in a family farm. Other subsidies are support to investments the economic benefits whereof can be purely individual or intended for a defined group of individuals. And there are also subsidies that support investments the economic benefits whereof future generations will enjoy. In the valuation of projects with significant environmental impact, the discount rate and the time horizon are the key factors determining the return on social and environmental investment projects (Almansa and Martinez-Paz, 2011). The SDR must reflect the public attitude towards the valuation of the future benefit and costs in comparison with the present benefit and costs (EC, 2008).

To determine the fair value of a multifunctional family farm it is necessary to separate cash flows discounted at a market-based rate and cash flows that are discounted at the SDR. Owing to their nature, cash flows from the sale of farm products and services as well as grants and subsidies for the purpose of efficiency improvement and business diversification in rural areas must be discounted at the weighted average cost of capital (WACC). Cash flows related to investments the economic benefits whereof will enjoy future generations must be discounted at the SDR. Currently under the EU Rural Development policy 2007-2013 such investments include investments into first afforestation of agricultural land, first afforestation of non-agricultural land, actions to restore forestry potential and prevention actions, and non-productive investments linked to forest-investment payments. Both the economic benefits of such investments (income from prepared and sold timber and other income) and public goods (recreation, landscape, biological, historical, cultural and environmental diversity) are fully or partially transferred from the present generation to the future generations since a forest, depending on the trees growing in it, can live 60-120 years or even longer.

The key value drivers of the WACC include the capital structure, the cost of equity and the cost of debt. Plenborg (2002) argues that the WACC should be calculated relying on the target capital structure rather than the actual one based on the information in the balance sheet. The other two drivers of the WACC value are the cost of debt and equity. The drivers of the cost of debt are widely recognised and a single all-purpose methodology is used to determine the cost of capital. On the other hand, there are many different methods for determining the cost of equity. Some of them link the return sought by the owners with the risk, while others do not. Some of them require market information and others do not. Family farms are private organisations and therefore some methods cannot be used to calculate the cost of equity. A farmer does not have a portfolio of financial investment, i.e. his/her investments are not diversified. Therefore the systematic risk is not the only risk assumed by the farmer. The systematic risk arises from macroeconomic factors and therefore it is not diversified. This is the approach followed by Kerins *et al*. (2004), McConaughy (2009) and Pattitoni *et al*. (2012). In their opinion, the cost of equity depends on the following value drivers: risk-free return, return and standard deviation of return on market portfolio, and the standard deviation of return of a private organisation. The cost of equity in a family farm is calculated according to the following formula:

$$r_y = r_f + (\sigma_j / \sigma_m)(r_m - r_f) \quad (1)$$

where r_y is the cost of equity; r_f is the risk-free return; σ_j is the standard deviation of return in a family farm; σ_m is the standard deviation of return on a market portfolio; and r_m represents the return on a market portfolio.

Pilot studies (Aleknevičienė, 2012) revealed that an equivalent of a market portfolio is the benchmark OMXBB index (www.nasdaqomxbaltic.com). Following the analysis of earlier research (Ismail and Kim, 1989; Nekrasov and Shroff, 2009; Cohen *et al*., 2009), the return on equity (ROE) was used to measure the return in a family farm and companies included in the index. Following the approaches of Ward (1999), Moon and LeBlanc (2008) and Collins and Huang (2011), in the pilot research Aleknevičienė (2012) calculated risk-free return with respect to the investment horizon where the selected bonds of the Government of the Republic of Lithuania were those with the longest maturity in 2003 through 2010.

The value drivers of the social discount rate were analysed by Brukas *et al*. (2001), Groom *et al*. (2005), Hepburn and Koundouri (2007), Voinov and Farley (2007), Price (2010) and Almansa and Martinez-Paz (2011). The conclusion is that the SDR depends on the economic growth rates in the long term, the elasticity of the marginal utility of income, the time horizon of social investment projects and the econometric model of calculation of discount rate declining over time. According to Moore *et al*. (2003) the SDR ranges from 1.5 to 4.5 per cent, where investments are related to one generation only, and from 0 to 3.5 per cent if investments are attributable to several (current and future) generations.

Almansa and Martinez-Paz (2011) argued that in determining the value of high nature value projects with a long-term impact on the future generations, the key factors are the choice of the discount rate and the time horizon. They conducted a *Delphi* survey and found that the discount rates of projects embracing several generations must be declining in time. Brukas *et al*. (2001) argue that the owners of private forests should discount the cash flows from the implementation of forestry investment projects in Lithuania at 2 per cent SDR, with regard to the fact that forests create such non-commercial products as recreation, landscape, biological, historical, cultural and environmental value. Hepburn and Koundouri (2007) maintain that the period of growth of some trees before they become suitable for timber can be about 120 years and therefore the SDR should also be applied for economic benefits derived from timber.

From these insights we conclude that the weighted average of the SDR over time suggested by Moore *et al*. (2003) and Almansa and Martinez-Paz (2011) corresponds to the 2 per cent SDR suggested by Brukas *et al*. (2001). With respect to the results of these earlier studies, the following SDR were chosen: 0-40 years: 3.5 per cent; 41-130 years: 2.75 per cent; 131-165 years: 1.75 per cent; 166-250 years: 1.0 per cent; and over 250 years: 0.5 per cent.

In determining the fair value of a family farm using methods based on DCF, the FCF, discount rates and their value drivers must be forecasted. The choice of the forecasting technique depends on the nature of the information. There are two broad categories of forecasting techniques (Naumenkova and Glazun, 2002; Budrevičius, 2007). Quantitative forecasting techniques are applied in a stable economic situation when there is sufficient quantitative information about the phenomena to be forecasted; however, from time to time it is important to check if the conditions are satisfied. When information is limited, qualitative techniques are more practicable (Budrevičius, 2007).

Quantitative techniques are used to analyse actual data from previous periods. Forecasting focuses on the trends of economic activity that are identified through performance analysis (Fedotova, 2009). The choice of a forecasting technique depends on the nature of the time series, i.e. their stationarity. The techniques of moving average, exponential smoothing and simple forecasting are used to forecast stationary indicators while the linear trend is used to predict non-stationary indicators. If historical data are available, the trend projection or regression models are useful, particularly in the case of long-term forecasts. Stutely (2005) noted that analysis and forecasts usually use data for the last 3-5 years. The weakness of the extrapolation method is that it is based on the assumption that all the present conditions will remain relatively constant and the present patterns will continue into the future. If the conditions change, the forecasts must be calibrated on account of internal and external changes. According to Kasnauskienė (2010), the extrapolation horizon should not exceed the number equal to one third of the analysed time series values. The extrapolation method is usually used to forecast the production and stock level (Armstrong, 2000).

In forecasting the FCF, it is essential to build the general forecast structure. Integrated forecasting of the profit and loss statement and the balance sheet followed by FCF calculations is the best way to develop the structure. If there are little historical data available, it is recommended to make the FCF forecasts for five or three years.

When forecasting product sales volumes and sales prices it is feasible to use the trend or averages (depending on the stationarity of the time series). The reliability of the trend function shall be verified by the Mean Absolute Percentage Error (MAPE) and the Root Mean Standard Deviation (RMSE). Forecasting of the production volumes of agricultural products and biological assets shall take into account the agricultural crop areas and the yields of crops. When making forecasts of agricultural crop areas it is appropriate to use averages, particularly if there is no intention to change the land areas, and to take into consideration changes in rotation. The use of agricultural products and biological assets should be forecasted with respect of the planned production volumes and the agricultural product and biological asset consumption for the internal needs of the farm.

The forecasts of variable and fixed costs are attributable to the production and sales volumes. After the structure of variable and fixed costs and the past trends of change were analysed based on the available historical data, forecasts were made for the amounts of each major cost type and all costs of production per hectare of agricultural crop.

Depreciation of fixed assets accounts for a major part of fixed costs. The depreciation was forecasted with respect of the cost of acquisition of the farm assets, their remaining useful life and the depreciation rates. The family farm has grants to assets and therefore the forecasting of the depreciation costs took into consideration the used part of grants related to assets and the depreciation costs were reduced thereby. The used part of grants related to assets was calculated on the basis of the used grant amount in the last analysed year and with regard to the unspent balance of grants at the end of the last analysed period.

Grants related to income were forecasted in the light of the CAP. It is assumed that during the forecast period the CAP that was in force during the last financial year would remain in operation and thus the grants were forecasted by calculating an average grant amount per hectare of crop area with respect of the forecasted crop areas.

The forecasting of the additional working capital relies on changes in stock, crops and amounts payable and receivable excluding loans. It is assumed that the current asset and non-interest bearing liability management policy will remain unchanged. Then those amounts are forecasted in proportion to sales revenue changes (Aleknevičienė, 2009).

Having taken into account the factors generating cash flows and having chosen their forecasting methods, it is necessary to develop the methodology of forecasting the cost of equity. The expected return on market portfolio and risk-free return are forecasted using the trend function or a simple forecasting method. The calculation of the cost of equity is based on historical standard deviations of the market portfolio and the family farm profitability assuming that the risk will remain at the same level.

Usually the *WACC* represents an algebraic manipulation, where the cost of equity (r_e) and debt (r_d) are mixed so that the components of equity (w_e) and debt (w_d) represent the capital structure. With respect to the tax (T) effect, the WACC is calculated as:

$$WACC = w_e r_e + w_d r_d (1 - T) \tag{2}$$

This formula is used under the assumption that the debt-to-equity ratio in a family farm is constant over time. In fact the debt levels in the capital structure change as the farm value changes and therefore in determining the fair value of a farm it is assumed that the capital structure is rebalanced in infinite term. Then the *WACC* is calculated as (Emery *et al.*, 2004):

$$WACC = r - L r_d T[(1 + r)/(1 + r_d)] \tag{3}$$

here r is the unleveraged cost of equity; L is the target capital structure (debt/equity ratio); r_d is the interest rate; and T is the profit or income tax.

The relationship between the standard deviation of return on equity of unleveraged farm (σ_{uj}) and standard deviation of return on equity of leveraged farm (σ_j) can be expressed as:

$$\sigma_{uj}/\sigma_m = [(\sigma_j/\sigma_m)(1 - L]/(1 - TL) \tag{4}$$

Then the unleveraged cost of equity is calculated according to the following formula:

$$r = r_f + \left[\frac{(\sigma_j/\sigma_m)(1 - L)}{(1 - TL)}\right](r_m - r_f) \tag{5}$$

The forecasting of unleveraged cost of equity relies on the forecasted risk-free return and return on market portfolio, historical standard deviations of the returns on market portfolio and family farm, and the projected effective income or profit tax rate. The target capital structure is the arithmetic mean of the capital structure. In the *WACC* calculations, the interest rate is forecasted with respect of the average interest rate on loans. If both long-term and short-term loans are to be used to finance the business, it is advisable to use the weighted average interest rate.

In reliance of all the value drivers of the multifunctional family farm, its terminal value is determined by taking into account only the FCF from the sale of farm products and services. Cash flows from the implementation of forestry investment projects are planned for the whole period with respect of the prevailing types of trees and the functional purpose of the forests and therefore the calculations of the terminal value are not made.

Lütolf-Carroll and Pirnes (2009) argued that if the *FCF* growth in infinite term is not estimated, the terminal value is calculated as follows:

$$TV_T = FCF_{T+1}/WACC\infty \tag{6}$$

Then the fair value is:

$$PV = \sum_{t=1}^{T} \frac{FCF_t}{(1 + WACC)^t} + \frac{FCF_{T+1}}{(1 + WACC)^T (WACC\infty)} \tag{7}$$

The zero growth or constant growth rate in infinite term can be used in determining the terminal value. According to Lütolf-Carroll and Pirnes (2009), the fact that the growth rate is increased in determining the terminal value does not create value by itself. They suggested an alternative for determining the terminal value, which corresponds to the growth rate and the assumptions related to the return on long-term investment, which raises the question about the need of capital investments and additional working capital:

$$TV_T = \frac{EBIT(1 - T)\left(1 - \frac{g\infty}{ROCE}\right)}{WACC\infty - g\infty} \tag{8}$$

here *ROCE* is the return on capital employed; and g is the growth rate.

The growth rate g depends on the return on equity (*ROE*) and the weight of reinvested capital (w):

$$g = ROE \times w \tag{9}$$

It can also be determined in reliance of the GDP growth rates in the long term considering the correlation between GDP and sales revenues of the farm.

The fair value of a multifunctional family farm is the sum of three values: present value of *FCF* at a definite period, present value of terminal value and present value of cash flows from investment into forests:

$$PV = \sum_{t=1}^{T} \frac{FCF_t}{(1 + WACC)^t} + \frac{TV_{T+1}}{(1 + WACC)^T (WACC\infty)} + \frac{FCF_{ft}}{(1 + SDR)^t} \tag{10}$$

here FCF_t is the free cash flows from forestry investment projects; and *SDR* is the social discount rate.

Multifunctional family farm valuation model

The logical scheme of the multifunctional family farm valuation model (Figure 1) allows the determination of the fair value of a multifunctional family farm using the DCF method, in accordance with the principles of scientific validity, consistency of valuation, accuracy and objectivity.

In accordance with the principle of *scientific validity*, the value drivers of the multifunctional family farm value are decomposed and composed; the cash flows are differentiated by their impact on the value of the family farm and their value drivers are measured; the discount rates are differentiated and their value drivers are measured; and the terminal value and the fair value of the family farm are determined. The principle of *consistency of valuation* underlies the stages of the determination of the fair value. The principle of *accuracy* requires using scientifically sound methodologies and correct information. The principle of *objectivity* means that there are at least two parties that are interested in the correct fair value and therefore in a transaction one party cannot benefit at the expense of the other. Assumptions used as the basis in forecasting the value drivers and determining the terminal value must satisfy both parties of the transaction.

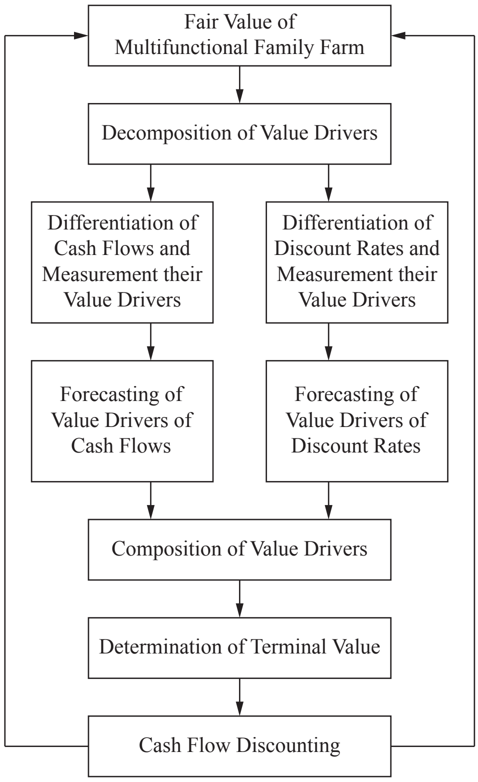

Figure 1: The logical scheme of the multifunctional family farm valuation model.

Testing of the model for a family farm

Here the model of the determination of the fair value is tested for a family farm in Jonava district in the central part of Lithuania,. It is composed of 460 hectares in total; 87 per cent of the arable area is devoted to cereals and oilseed rape, and 16 hectares are covered by woodland. There are no hired employees in this family farm, only the farmer and his wife are engaged in agriculture and forestry.

The determination of the fair value starts with forecasts of the FCF from commercial production and provided services. The FCF calculation is based on certain forecasting assumptions. When the FCF of the family farm are calculated for a period of three years, a stability assumption is made that the weather conditions will be typical and the industrial land plots will not change. The FCF forecasting was made subject to the analysis of the actual data of production (areas, crop, yield), sales (sales prices, sales volumes), costs and expenses (production variable and fixed costs, depreciation costs, operating expenses), grants related to revenue and grants related to assets, and current and fixed assets in 2009-2011. The forecast of the third year was made on the assumption that the forecasted indicators will remain the same as in the second year of forecasting. Insufficient availability of data about the family farm lowers the accuracy of forecasting.

The forecasting of the sales revenue (Table 1) is based on the planned sales volumes and the average sales prices. The sales volumes depend on the agricultural crop areas and the yields. Having taken into account the data of the time series in the analysed period and having identified the trends of changes, the areas of individual agricultural crop were forecasted based on averages, while the agricultural crop yield and the sales prices of agricultural products were forecasted using the trend function. The variable and fixed costs per hectare of agricultural crop were also forecasted using the trend function.

The forecasting of agricultural crop and autumn ploughing balances was made by calculating the averages and taking into account the balances at the beginning of the period, the forecasted production volume, the sales volumes and the consumption in the family farm, while a moving average was used to forecast the agricultural crop and purchased stock balances (Table 2).

Forecasting of the additional working capital is based on the family farm not having trade debtors in the last analysed year and therefore the trade debtors were calculated on the basis of the forecasted sales prices and the average trade debtors in the analysed period. The non-interest bearing liabilities included debts to suppliers and other amounts payable and those debts were forecasted with respect of changes in the sales volumes. Table 3 shows the FCF calculation in the family farm based on forecasted data of the profit and loss statement and the balance sheet.

Once the forecasted FCF from commercial products and provided services is calculated, the cost of equity of the family farm is estimated. The analysed period covers periods of both economic growth and recession and therefore it is assumed that the forecasted values subject to extrapolation of statistical data will correspond to either the trend or the average. In 2011, in comparison to 2003, the ROE of the

Table 1: Forecast of the crop production sales revenue, variable and fixed costs in the family farm used in the case study (LTL).

Indicator	Year the forecast is made for		
	1	2	3
Sales revenue	879,710	830,128	830,128
Variable costs	653,156	644,569	644,569
Fixed costs	173,702	181,144	181,144
including depreciation costs	134,326	134,326	134,326

Source: the forecast is made using family farm financial reports for 2009-2011

Table 2: Forecast of the family farm work in progress (autumn ploughing and crops), agricultural output and purchased stock (LTL).

Indicator	Year the forecast is made for		
	1	2	3
Work in progress (autumn ploughing and crops)	166,534	166,834	166,834
Agricultural output	230,561	216,465	216,465
Purchased stock	152,350	124,504	124,504

Source: the forecast is made using family farm financial reports for 2009-2011

Table 3: Calculation of the free cash flows of the family farm used in the case study (LTL).

Indicator	Year the forecast is made for		
	1	2	3
EBIT less accrued income tax	378,993	453,815	453,815
Depreciation of fixed assets	134,326	134,326	134,326
Additional working capital	-226,302	-43,690	0
FCF	739,621	631,831	588,141

Source: the forecast is made using family farm financial reports for 2009-2011

Table 4: Average return on equity (ROE)*, OMXBB and family farm ROE and standard deviations, 2003-2011.

Indicator	ROE (%)									Average ROE (%)	Standard deviation of ROE (%)
	2003	2004	2005	2006	2007	2008	2009	2010	2011		
OMXBB index	14.4	14.3	13.1	12.7	14.5	2.9	-8.0	11.1	11.7	9.6	7.5
Family farm	19.5	26.6	27.2	25.8	38.6	33.3	7.4	19.4	19.1	24.1	9.1

*Lithuanian FADN 2003-2008 and family farm financial reports for 2009-2011
Sources: NASDAQ OMX Baltic

Table 5: Average return on the Government bonds of the Republic of Lithuania with maturity of 3-11 years, 2003-2011.

Indicator	Year									Average
	2003	2004	2005	2006	2007	2008	2009	2010	2011	
Return (%)	4.8	4.0	3.3	3.8	4.6	5.5	7.6	4.7	4.9	4.8

Source: Bank of Lithuania

OMXBB index decreased by 2.7 percentage points whereas in 2011, as compared to 2009, the ROE of the family farm under investigation increased by 11.7 percentage points. The accuracy of forecasting suffers from insufficient availability of the family farm data as the only available information is the family farm ROE in 2009-2011 and the average ROE of farms engaged in cereal and oilseed rape growing in 2003-2008 (Table 4).

In order to calculate the cost of equity, it is necessary to determine the expected ROE of the OMXBB index. The SPSS software is used to forecast the ROE of the OMXBB index and the reliability of the trend function is verified. The value of the forecasted indicator is 10.7 per cent. As regards the main reliability measures, MAPE = 71 and RMSE = 7.7 per cent mean that the forecasted indicator value is not reliable. In such situation a simple forecasting method is used:

$$\bar{\Delta} = \frac{11.7 - 14.4}{8} = -0.34$$

$$r_t = 14.4 + (-0.34) \times 9 = 11.3$$

The calculations show that the forecasted ROE of the OMXBB index is 11.3 per cent.

Table 5 shows the return on the Government bonds of the Republic of Lithuania with maturity of 3-11 years in 2003-2011. The average of maturity of risk-free asset during the analysed period was 6.4 years. The returns on the government bonds of the Republic of Lithuania changed depending on the macroeconomic situation: they increased during the period of economic growth and decreased during the period of economic recession.

The forecasted risk-free return based on the trend function is 4.9 per cent. MAPE = 18 and RMSE = 1.3 per cent mean that the forecasted indicator value is correct.

The cost of farmer's equity is 12.7 per cent.

$$r_{yu} = 4.9 + (9.1/7.5)(11.3 - 4.9) = 12.7$$

To calculate the WACC it is necessary to know the cost of equity of unleveraged family farm, the target capital structure, the effective rate of personal income tax and the forecasted interest rate on loans. The target capital structure is estimated as the arithmetic mean of the historical capital structures. Table 6 shows historical capital structures of the family farm, expressed as the ratio of financial debts to financial debts plus equity.

Table 6: Capital structure of the family farm used in the case study.

Indicator	Year			Average
	2009	2010	2011	
Capital structure (interest bearing debts/equity)	0.142	0.053	0.108	0.101

Source: family farm financial reports for 2009-2011

Table 7: Interest rate on loans in LTL to non-financial corporations and households in Lithuania, 2004-2011.

Indicator	Year							
	2004	2005	2006	2007	2008	2009	2010	2011
Short-term loan interest rate (%)	5.7	5.6	5.5	6.5	7.8	8.8	6.3	5.4
Long-term loan interest rate (%)	4.9	4.6	4.6	6.0	7.2	8.4	5.1	4.2

Source: Bank of Lithuania.

During the last two years the family farm was paying income tax. The effective personal income tax rate was 1 per cent. The cost of equity of unleveraged family farm is 11.9 per cent:

$$r = 4.9 + \left[\frac{(9.1/7.5)(1 - 0.101)}{(1 - 0.01 \times 0.101)}\right](11.3 - 4.9) = 11.9$$

On the assumption that over the projection period of three years the family farm will be subsidised just like it was during the period of analysis, the taxable result is profit. The tax advantage derived by the farmer from the non-taxable interest is very small and therefore it does not affect the fair value of the farm. Both long-term and short-term loans are used to finance the business of the family farm (Table 7).

Based on the trend function, the forecasted interest rate on short-term loans is 3.3 per cent. MAPE = 0.19 and RMSE = 1.9 per cent mean that the forecasted indicator value is very accurate although the probable value error is 1.9 per cent. Similarly, the forecasted interest rate on long-term loans is 4.2 per cent. MAPE = 18 and RMSE = 1.5 per cent mean that the forecasted indicator value is accurate and the probable value error is 1.5 per cent. On average, the weight of the family farm short-term loans in the total loans in the analysed period accounted for 0.691 and consequently the weighted average of interest rates is 3.6 per cent $(0.691 \times 3.3) + (1 - 0.691) \times 4.2)$).

The WACC amounts to 11.9 per cent:

$$WACC = 0.119 - 0.101(0.036)(0.01)\left[\frac{(1 + 0.119)}{(1 + 0.036)}\right] = 0.119$$

Table 8: Afforestation and maintenance expenses incurred by the family farm in the case study.

Year	Type of expenses	Amount (LTL)	Year	Type of expenses	Amount (LTL)
1	Afforestation and maintenance per year	47,016	15	Pre-commercial thinning	2,828
2	Maintenance	3,703	25	Commercial thinning	7,708
3	Maintenance	4,254	35	Commercial thinning	9,635
4	Maintenance	4,254	45	Routine commercial thinning	12,526
5	Maintenance	3,276	60	Routine commercial thinning	15,417
6	Maintenance	3,276	80	Non-intensive routine/sanitary thinning	7,708
7	Maintenance	3,276	100	Main thinning	69,375
8	Pre-commercial thinning	2,626			

Source: 'Medstata' project data

Table 9: Revenue from the commercial forest production of the family farm in the case study.

Revenue year	Revenue type	Total (LTL)
25	Revenue from the sales of fuel wood	13,574
35	Revenue from the sales of timber and fuel wood	24,644
45	Revenue from the sales of timber and fuel wood	33,875
60	Revenue from the sales of timber and fuel wood	41,693
80	Revenue from the sales of timber and fuel wood	24,563
100	Revenue from the sales of timber and fuel wood	221,069

Source: 'Medstata' project data

The WACC equals the cost of equity of unleveraged family farm as the tax advantage from the non-taxable interest is very small and does not affect the fair value of the farm.

The analysed family farm is implementing an investment project of afforestation, therefore when determining the fair value of the family farm it is necessary to take into account the FCF of the investment project and to discount them at the SDR. The FCF of the forest investment project were predicted on the basis of the forecasting assumptions given below. The afforestation project was prepared for an area of 4.04 ha. Given the dominating type of trees (European larch, *Larix decidua*) and the functional purpose of the forest (forest group 4, commercial forests), the planned turnover of the forest is 100 years, and thus the project cash flows, the social and environmental benefits were estimated for this period.

The project prepared by the firm 'Medstata' includes afforestation and plant maintenance works over a period of five years. Pursuant to the Forest Regeneration and Afforestation Regulations, the plant maintenance works will also have to continue in years 6 and 7 after afforestation.

The new forest thinning was designed pursuant to the *Rules of Forest Felling* that provide for pre-commercial thinning in trees under 20 years old, thinning in coniferous stands from 21 to 40 years old, and routine thinning from 40 years old. With respect of the yields of the growth location and the composition of the planted forest species, two pre-commercial thinning sessions are provided in 8 year old and 15 year old trees along with intensive commercial thinning and routine thinning. The *Rules of Forest Felling* provide for non-intensive routine thinning or, as the case may be, sanitary felling at the age of 80. The costs of pre-commercial and commercial thinning were forecasted on the basis of the average forest work costs in the state forest sector over the last three years while the timber prices were based on the average wood sortiments prices (www.gmu.lt).

The dynamics of the planted forest volume was forecasted based on the normal forest stand growth tables for II bonitet pine stands (Repšys *et al*., 1983) as the European larch growth course in Lithuanian conditions has not yet been researched. It was assumed that at maturity the stand stocking level will amount to 0.8. The afforestation and maintenance expenses of the family farm are incurred in different years during the period from 1 to 100 years (Table 8) and are estimated at LTL 196,878 in total.

Forest thinning and felling produces fuel wood and timber, the sales whereof generate income for the family farm (Table 9). The family farm plans that the sales revenue will amount to LTL 359,418. On the assumption that the buyers will pay for the sold products the same year, the cash inflows equal to the sales revenue.

The analysed non-timber forest functions included CO_2 accumulation; landscape/recreation, water protection; biodiversity and hunted animals. The CO_2 accumulation function was appraised with regard to the change in timber volume, the CO_2 emissions from the wood pulp, and the average market carbon price in 2012 (LTL 24.47 per tonne). The CO_2 accumulation function of the planted forest is greater than that of the existing forests due to a relatively lower change in volume. The values of these functions were calculated on the basis of average values for Lithuanian forests per year (LTL 6.95 and LTL 7.05 per ha respectively) established by Mizaras *et al*. (2012). The value of the CO_2 accumulation function in the planned period falls from LTL 595 in the first year to LTL 264 in the last year.

The recreation/landscape and biodiversity conservation functions were appraised with regard to the net losses in using the timber that are calculated using the opportunity costs approach. The water protection function was appraised with regard to the formation of clean water flow, water protection against pollution, increase of water flow and surface flow infiltration into groundwater. The value of hunted animals was determined with regard to the costs related to hunted animal care and hunting arrangements and the net revenue from hunting. According to Mizaras *et al*. (2012), the values of recreation and environment, water protection functions, biodiversity conservation and hunted animals are LTL 28.08, 28.48, 43.91 and 13.82 respectively. Those values remain the same throughout the planned period, except the recreation and landscape value which is not created before year 20.

Since the species composition of the planned stand is uncharacteristic of Lithuanian forests, it is not possible to assess the potential yield of mushrooms, berries and medicinal plants and therefore the value of those forest products was not calculated.

When the FCF of forest investment projects is calculated, the cash flows from financing activities should be taken into account as the government grant is non-repayable and increases the FCF in the family farm. The support for afforestation and forest maintenance to be given to the family farm is LTL 47,016 in year 1, LTL 3,703 in year 2, LTL 4,254 in year 3, LTL 4,254 in year 4 and LTL 3,276 in year 5.

The FCF of the forest investment project were calculated by deducting the expenses of afforestation and maintenance from the revenue from the commercial forest production and by adding the government grant and the value of non-timber resources that includes the value of recreation and environment, water protection functions, biodiversity conservation and hunted animals. The FCF are discounted at the SDR, which is justified in part two of the paper: 0-40 years: 3.5 per cent; 41-130 years: 2.75 per cent. The discounted FCF amount to LTL 40.2 thousand:

$$PV = \sum_{t=1}^{n=40} \frac{FCF_{ft}}{(1+0.035)} + \sum_{t=1}^{n=41,42\ldots100} \frac{FCF_{ft}}{(1+0.0275)^t} = 40159$$

Each year the forecasted FCF are different and therefore they are excluded from the formula and only the overall calculated result is presented.

The terminal value of the family farm is determined on the assumption that the FCF growth rate in infinite term will equal zero since in the analysed period from 2009 through 2011 the farmer used more profit for personal needs than earned the net profit. The use of net profit for personal needs over the forecasted period of three years is planned to be 100 per cent. The terminal value of the family farm is LTL 4942.4 thousand:

$$TV_T = \frac{588141}{0.119} = 4942361$$

With respect of the CFC of the investment project, the fair value of the family farm is calculated to be LTL 5154.3 thousand.

$$PV = \frac{739621}{1.119^1} + \frac{631831}{1.119^2} + \frac{588141}{1.119^3} + \frac{4942361}{1.119^3} + 40159 = 5152783$$

The fair value is calculated for the capital employed. To determine the total fair value of the family farm, non-interest bearing liabilities (debts to suppliers and other accounts payable) shall be added to the fair value of the capital employed. In the last financial year, 2011, it amounted to LTL 142,133 and consequently the fair value of the family farm is LTL 5294.9 thousand. The fair value of the family farm is significantly higher than its book value (LTL 3088.6 thousand). To determine the value at which the family farm can be sold, the debt in the last financial year, i.e. 2011, shall be deducted from the fair value of the capital employed.

Discussion

The DCF method is the only way to determine the fair value of an existing business organisation where only a few transactions are made in the market. When using the DCF method for determining the fair value of any business organisation, two key value drivers must be estimated: free cash flows and the discount rate. The research novelty of this paper lies on the logical scheme of the multifunctional family farm valuation model in which the differentiation of cash flows and discount rates is the main stage.

The specificity of the cash flows in a multifunctional family farm is related to the cash flows from financial support, different value drivers of the EBIT and their calculation methodology, and the value of public goods and externalities.

In general, the cash flows from financing activity are not included in FCF determining the fair value. An exception is grants related to assets, which are non-repayable and increase the cash flows for the owners. When the FCF are increased by the amount of the received grants for assets, the EBIT is not adjusted by the depreciation expenses of the subsidised fixed assets.

The marginal profit from the sale of products and provision of services, being the key EBIT driver, is decomposed into three value drivers: the sales volume, the sales price and the unit cost. Using the method of decomposition, all the other EBIT value drivers are reflected in the cash flows according to the statement form prescribed in Business Accounting Standard 3 ‘Income Statement’ for entities, whose typical activities are cultivation of biological assets, production and treatment of agricultural produce, processing of agricultural produce of own and treatment production.

Cash flows related to investments the economic benefits whereof that future generations will enjoy must be discounted at the SDR. Currently under the EU’s Rural Development policy 2007-2013 such investments include investments into first afforestation of agricultural land, first afforestation of non-agricultural land, actions to restore forestry potential and prevention actions, an non-productive investments linked to forest-investment payments.

Family farms are private organisations and therefore some methods cannot be used to calculate the cost of equity. The investments of the farmers are not diversified, so they assume total, not only systematic risk, and this is the approach followed by Kerins *et al*. (2004), McConaughy (2009) and Pattitoni *et al*. (2012). That is why the cost of equity is calculated using a modified capital asset pricing model (CAPM) and includes total, not only systematic, risk. However, previous researchers do not answer the question: what accounting information shall be used in CAPM? The WACC is calculated under the assumption that capital structure is rebalanced to target capital structure and the SDRs used decline over time.

Being a key method, DCF has some limitations considering both techniques of value drivers’ measurement and forecasting. Firstly, several difficulties arise in the measurement of public goods and externalities in monetary terms, because some of them are non-measurable. Secondly, all value drivers are uncertain, so the assumptions related to the techniques of value drivers’ measurement and forecasting depend not only on the reliability of methods, but also on the expectations of purchaser and seller of family farm. Thirdly, the fair value is a dynamic concept, and it changes over time in response to macroeconomic and microeconomic factors.

The question “Can the ‘fairer’ value for the farm be determined?” remains open. It can be ‘fairer’ only in the light of consensus of two interested parties: purchaser and seller. The purpose of this paper was to present the possible techniques for determining the fair value of a multifunctional family farm, and thus to help to solve problems that arise when calculating and forecasting free cash flows, and determining market based and social discount rates.

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Non parametric methods to assess the role of the CAP in regional convergence in Hungary

Using the stochastic kernel, we analysed the Hungarian convergence path before and after accession to the European Union (EU), within its NUTS 3 regions (counties), and between those of the eastern EU Member States. Then, we develop a convergence analysis of GDP per capita PPS (Purchasing Power Parity) conditioned to Common Agricultural Policy (CAP) funds, in order to understand the role of the introduction of the CAP in the convergence of Hungarian rural areas. We find increasing divergence both within Hungarian NUTS 3 regions and between the eastern EU MS NUTS 3 regions, especially after Hungary joined the EU; a limited contribution of the CAP to the catching up of rural areas; and persisting difficulties of working with lacking rural disaggregated statistics.

Keywords: Non-parametric; sub-regional convergence; CAP; enlargement

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Introduction

In the last decade, the eastern enlargement of the European Union (EU) focused attention on the EU policy objectives and instruments for cohesion. In fact, the eastern EU Member States (MS) showed a much lower level of GDP per capita (p.c.) than the EU-15 average, and their agricultural sector was still playing an important role in their economic structure. The EU pre-accession instruments (SAPARD, PHARE, ISPA), followed after the EU accession by the Cohesion and Structural funds, and by the Common Agricultural Policy (CAP), were meant to enhance the catching up of these countries with the established EU Member States[1].

Since 2004, and more than a decade after the important reforms which interested the Cohesion policy and CAP, the initial convergence between the eastern EU MS and the best performing EU MS turned into divergence (Matkowski and Próchniak, 2004; Brasili and Costantini, 2005; Ezcurra *et al*., 2007). Regional and sub-regional inequality spread (Monasterolo, 2011), affecting the living conditions of the agricultural population, especially those living in remote rural areas (Bertolini and Montanari, 2008; Csáki, 2008) and the new urban poor. The assessment of the convergence path of the eastern EU MS, with particular attention to the role played by the agricultural sector in that, could help policy makers understand the development bottlenecks and introduce better targeted policies that account for the regional and sub-regional disparities. The further application of this methodology to the current EU candidate countries would highlight income evolution at the disaggregated geographical level and the effect of the policy measures on that, helping to overcome the problems experienced in the last enlargement. This point is very topical: in fact, the EU is still affected by the consequences of the recent global financial and economic crisis, which also influence (negatively) the speed of the EU enlargement path towards the Western Balkans. In this regard Croatia, which became the 28th EU MS in 2013, already shows evidence of regional divergence (that increased during the pre-EU accession period) and experiences the same pre-accession funds absorption problems already evidenced by other eastern EU MS.

Thus, this paper provides (a) an analysis of the convergence path of GDP p.c. PPS (Purchasing Power Parity) between the Hungarian NUTS 3 regions from 1997 to 2009, which is compared to (b) the convergence path of GDP p.c. PPS among the eastern EU MS (EU-10) (NUTS 3) from 1999 to 2009, and (c) an assessment of the role of CAP support (decoupled and Single Area Payment Scheme (SAPS) payments) on convergence in GDP p.c. PPS between Hungarian NUTS 3 regions, applying Quah's conditional convergence model (Quah, 1997a)[2].

Advances beyond the state of the art

The quest for growth has been pursued by development economists since the search for the determinants of the wealth of nations was initiated by Adam Smith in 1776. Then, it passed through Lewis's 'surplus labour' model, Rostow's stylised facts (Rostow, 1960) and Kutznet's critiques (Kutznet, 1955), the neoclassic visions by Gerschenkron (1962) and Gomulka (1971), until the opposition coming from the endogenous and new economic geography growth theories (Krugman, 1991).

Cohesion was also a central issue in the foundation and enlargement of the EU[3]. In 1989, the introduction of a set of policies and instruments under the Structural and Cohesion Policy framework was aimed at decreasing development inequalities between the former Objective 1 (now Convergence) regions, and the bulk of faster growing ones (the so called *blue banana*) through economic convergence. Since

[1] The cohesion objective is clearly stated in the Treaty of Rome (Art. 158, 1958) which states the creation of the EU. Since 1962, the CAP introduction (art. 39-43) was aimed at reducing income disparities between the agricultural and the other economic sectors, by promoting investments in agricultural and rural areas, and introducing support policies.

[2] Decoupled payments per farm weighted for the SAPS payments per county was chosen as conditioning variable, in order to include just payments directly affecting farm income (as a difference from the other investments or programme related payments, which impact on farm income just in the medium to long term).

[3] The objective of the European cohesion policy is defined in Articles 2 and 4, and Title XVII of the Treaty establishing the European Community. Cohesion policy should contribute to *promote economic and social progress as well as a high level of employment, and to achieve balanced and sustainable development*, and Article 158: *in particular, the Community aims to reduce the disparities between the levels of development of the different regions and the backwardness of the least favoured regions or islands, including rural areas*.

the second half of the 1980s, early results for the EU-15 showed (a) slow convergence and (b) the persistence of a core-periphery pattern at the regional level (Petrakos *et al*., 2005). In fact, at the disaggregated level inequality spread (+10 per cent), despite the EU budget and measures for cohesion (Rodriguez-Pose, 2002). The enlargement path seems to have contributed to reducing disparities across countries but not across regions within countries (Overman and Puga, 2002). This is the case in Convergence regions, where most of the funds were allocated (Quah, 1996), highlighting the case of an equity/efficiency trade off, and a debate on the role of Cohesion Funds in the beneficiary countries (Sapir *et al*., 2003). This is also the case in the eastern EU MS: in fact, almost a decade after the EU accession, inequality between the EU-27 is gradually diminishing while regional inequality increases. The capital towns are able to attract Foreign Direct Investment and develop, while agricultural and rural areas, especially at the eastern and southern borders, lag behind (Monasterolo, 2008).

Monitoring and evaluating the efficiency of policies for cohesion and convergence became a priority during the EU eastern enlargement of 2004. In fact, the EU population increased up to about 500 million, and a redistribution of the EU budget from the former beneficiaries to the newcomers, especially under the CAP because the eastern EU MS were characterised by very different structural features and problems unsolved in transition. In fact, at the time of accession the countries presented a lower economic performance: Hungary could reach 60 per cent of the average EU-25 GDP p.c., the level of the poorest regions in the EU-15 such as Iperios (Greece), while Latvia stopped at 30 per cent. The figures were even lower for Bulgaria and Romania, which joined the EU in 2007 (25 per cent of the EU GDP p.c.).

The case of Hungary caught our attention because it was considered the 'best performing' transition country (WB, 1997) and it was also among the first block of Central and Eastern European Countries negotiating the EU accession, but since 2008 the country has been undergoing severe economic (and political) troubles which hinder its EU membership. Moreover, Hungary is a good example of how the lack of institutional and implementing abilities, together with weak EC control of community funds, could vanish the *value added* of the EU policy, especially in the most peripheral and rural areas, finally increasing the internal development gap.

Previous analyses investigated income-level convergence in the enlarged EU following different methodologies: Matkowski and Próchniak (2004) and Paas *et al*. (2007) use parametric methodologies; Ertur and Koch (2006) use exploratory spatial analysis; Ezcurra *et al*. (2007) adopt a non-parametric approach, highlighting the role played by neighbouring regions for explaining the dispersion in the distribution of GDP per worker; Chapman and Meliciani (2012) use non-parametric and spatial regimes analyses. They mainly find evidence of catch-up during the integration process, but also a new north-west/east polarisation pattern which replaces the previous north-south one for the EU-15. In particular, Matkowski and Próchniak (2004) show that there is a clear β-convergence in income levels among eight EU accession countries in the period 1993-2005, and income differences between individual countries tend to diminish. Åslund and Dabrowski (2007) find that economic growth in the last decade has, on average, been higher in the eastern EU MS than in the EU-15, and they use this as evidence of catch-up and convergence between the two blocks of countries, but they forget to highlight that most of the growth in the eastern EU MS was concentrated in and around capital cities (Gorton *et al*., 2009). Chapman and Meliciani (2012), following the approach developed by Rodriguez-Pose (1998), analyse the relevance of socio-economic and specialisation groups in affecting the *within countries* convergence in the EU-27, using the sigma convergence and a spatial approach. They find that socio-economic clusters explain the divergence in regional GDP p.c. within eastern EU MS, where regions specialised in knowledge intensive services, and urban regions, are better off from the integration process while regions specialised in agriculture and in low tech industries have been falling behind.

We argue that an analysis of the growth path at a disaggregated territorial level (NUTS 3) is needed because this is the level at which most of the inequality emerged in eastern EU MS (Monasterolo, 2008). Looking at how sub-regions perform together in the eastern EU MS, would help better understand the bottleneck of EU funds allocation and absorption, thus improving the effectiveness of the EU funds and policy targeting. In this regard, it is important to study the path followed by agricultural and rural areas in eastern EU MS at the sub-regional level during the EU integration process because (a) is still widely unknown, and (b) it can help to understand the role of CAP support to convergence and the productivity convergence in agriculture[4] (Stilianos and Stilianos, 2010), issues which attract considerable attention in the EU policy agenda.

Methodology

Non-parametric approach and its application

The convergence hypothesis under the parametric approach (β- and σ-convergence) is based on the idea that given the same exogenous technology, countries with low per capita income and low capital per worker would provide higher returns to capital (Baumol, 1986). This, in turn, would attract more foreign capital assuring a higher accumulation rate and faster growth, the condition being that the economies are open to international markets. In fact, according to Solow's (1956) results, (a) an economy starting from a low GDP p.c. level (and low capital per worker) tends towards a steady state and grows faster than the economy starting from a higher income and capital level; and (b) economies approaching different steady states need not converge.

We recognise that the use of the synthetic parameters β and σ to assess convergence presents several limitations[5];

[4] Agricultural labour productivity in NUTS 2 regions in the enlarged EU has been studied testing for β and club convergence (Stilianos and Stilianos, 2010), which do not allow us to understand the internal distribution dynamic between the initial and final year of analysis.

[5] β-convergence and σ-convergence differ from a conceptual point of view: in fact, the presence of the latter implies the presence of the former, but the opposite is not true: income differences between countries can rise and at the same time less developed countries may develop faster (Barro and Sala-i-Martin, 1992).

- They rely on neoclassic assumptions of stable economic growth (Quah, 1993);
- They are not able to catch the dynamics of the internal distribution (Quah, 1996) or to underline the existence of a subgroup of regions presenting different dynamics of growth from that of the average of the sample (Bernard and Durlauf, 1995; Quah, 1997b);
- They return different and often opposite results according to the data and the number of regions analysed;
- The estimation of β is characterised by a systematic tendency towards 2 per cent (Canova and Marcet, 1995), while σ-convergence is highly influenced by the presence of outliers, which leads to an underestimation of convergence;
- It was demonstrated that an initial evidence of catching up can subsist together with an increase in sub-regional divergence, as a trade-off between national and sub-regional convergence evidenced by the inverted U curve (Williamson, 1994), due to the concentration of economic activities in specific areas, or growth poles (agglomeration economies, Viesti and Prota, 2004).

Thus, in order to overcome such methodological and conceptual limits, we chose to apply a non-parametric approach. Since the beginning of the 1990s, the endogenous growth school has developed new, non-parametric approaches to the analysis of economic convergence[6]. Among them, Quah's (1993) econometric model based on the stochastic kernel presents several advantages because it provides a dynamic analysis of GDP p.c. density function, looking at the evolution of the cross-country distribution of GDP p.c. PPS. The stochastic kernel can be considered as a kind of transition probability matrix (or Markovian matrix) where classes are defined in a continuum because it estimates the whole marginal density function for the variable through the years. It also allows assessing the long term perspectives of the distribution of the chosen variable: in fact, the final output is an ergodic income distribution estimated on the observed variations in the analysed period.

As a difference from the parametric methods, this dynamic analysis is able to evidence the presence of two main characteristics: (a) *persistence*, when the classification of regions according to their GDP p.c. does not change (rich economies remain rich and the poor ones remain poor); and (b) *polarisation*, better known as the phenomenon of twin peaks or convergence clubs, where countries move toward different groups, diverging (the opposite of what is required for convergence)[7].

Let us define F_t as the distribution of incomes (GDP p.c.) at time t and F_{t+1} as the distribution of incomes at the following time. There is an operator M (the stochastic kernel), that maps the evolution of the distribution from time t to time $t+1$. The operator M can be defined by:

$$F_{t+1} = M + F_t \quad (1)$$

Repeated for the distribution of all the analysed years, it is possible to obtain an operator M which describes the transition of the distribution from time t to time $t+s$. Assuming M to be invariant in time, we obtain an estimator for the future distribution of density, that is:

$$F_{t+2s} = MF_{t+s} = M(MF_t) = M^2F_t \quad (2)$$

$$F_{t+rs} = M_r F_t \quad (3)$$

If $r \rightarrow \infty$, then we obtain an estimate of the limit distribution of incomes at the end period which allows us to explore the changes that have occurred in the observed period, the distributive characteristics of GDP p.c. (namely, if the evolution in the future shows a similar trend to the previous years), and to assess if convergence takes place.

Through a graphical representation it is possible to follow the movement of the distribution through the years:

- On axis *t1* the possible values of the GDP p.c. PPS for each statistical unit at the initial period are reported;
- Axis *t2* shows the possible values in the long term (a not specified period in the future);
- The axis 'kernel' reports the estimates of the kernel function.

The graph should be read starting from the main diagonal of level (*t1*, *t2*), whereas the points are determined from the same values at time *t1* and time *t2*. Two extreme cases can occur: (a) the straight line at 45 degrees, which defines a situation of persistence. In this case, if the kernel surface is entirely distributed along this diagonal, the observed countries do not change their position in time; and (b) the alignment of the kernel surface along the secondary diagonal, which indicates that the evolution of the distribution of GDP p.c. determines a reversal of the initial situation (in the long term, poor regions get rich and *vice versa*).

Perfect convergence occurs when the kernel surface is parallel to axis *t1* around a single modal value. All the units are distributed around the same income level at time *t2*, which means that in the long run poor regions would grow more than the richest ones until all the regions show similar income levels. The process of convergence is represented by an anti-clockwise rotation around the main diagonal line in two directions: in the case of income values below the average, rotation of the peaks disposed under the main diagonal; modal rotation above the main diagonal line in the case of wealthier regions.

The conditioned convergence

The concept of conditional convergence (Barro and Sala-i-Martin, 1991, 1992) considers the structural differences of the economies, looking for the variables which are able to influence the convergence path[8], in order to derive useful

[6] The introduction of non-parametric models able to observe the path followed by the statistical units in the time period considered was possible also thanks to the increase in statistical information.

[7] *Twin peaks* phenomenon, within persistence, are the most frequent features observed in Quah's analysis on economic convergence (1993).

[8] Assessing the presence of conditional convergence would mean that, if all the economies start from the same initial conditions, they would follow the same growth path, while if starting from different levels they would reach specific steady states to each economy.

insights for political economy. Thus, we move away from the hypothesis of a single steady state according to which every region converges, leaving the perspective for catching up of poorer regions.

It is possible to better specify the absolute β-convergence model conditioning the path followed by GDP p.c. to one or more influencing variables:

$$\frac{\left(\log \frac{y_{i,t}}{y_{i,0}}\right)}{t} = a - \beta l \log y_{i,0} + \gamma Z_{i,t} + u_{i,0,t}$$

where $Z_{i,t}$ represents the variables able to influence GDP p.c. growth.

This approach observes only the relationship between the statistical units analysed in their average values. In order to overcome this limit, Quah (1997b) provides a methodological framework for the analysis of the distribution of conditioned GDP p.c., assessing how the conditional variable influences the distribution function (GDP p.c. PPS)[9].

Moving from the β-convergence approach, it is possible to analyse if the conditioning variable Z explains the variable of interest Y[10], highlighting possible differences in the two expected values $E(Y|X,Z)$ and $E(Y|X)$, for the respective distributions $Y|X,Z$ and $Y|X$.

When the two distributions are linear:

$$E(Y|X,Z)=\beta X+\gamma Z \quad (4)$$

it is possible to test if the regression coefficient $\gamma=0$.

Quah (1997a) explores the possibility for equality of the conditioning distribution of $Y|X,Z$ and $Y|X$[11], and the transformation of Y in $Y|Z$, which can be represented mathematically by the stochastic kernel, the operator which models the changing distributions, and thus the effects of conditioning. In case of equality of the two distributions, Z does not explain Y[12].

Therefore, the stochastic kernel can perform the following operation:

$$F_{z,t}=M*F_t \quad (5)$$

where $F_{z,t}$ is the distribution of variable Y conditioned to variable Z at time t and F_t is the unconditioned distribution of Y at time t. The operator M provides information on the origin of the evolution of the distributions through the years. It observes how the distribution changes when passing from an unconditioned variable to a conditioned one; then, the stochastic kernel is applied to the residuals of the time series of the conditioned distribution, providing results for the convergence analysis.

The use of the stochastic kernel still leaves to the researcher the choice for the conditioning variable to include, according to the structural and development peculiarity of the areas analysed.

9 In fact, explaining the dynamics of the conditioned distribution corresponds conceptually to analyse the effects of the conditioning on the distribution of the study variable (Quah, 1997b).

10 It works also when X is included in the model.

11 In case X is a null variable, we would study the relationship between the conditional distribution $Y|Z$ and the unconditioned distribution of Y.

12 The variations in Z do not influence the distribution of Y.

Data and sample

The composition of the sample and the time period chosen depend on data availability at NUTS 3 level. A non-parametric convergence analysis was made on the twenty Hungarian NUTS 3 regions (counties), GDP p.c. PPS from 1997 (the year when the EC agreed on the enlargement negotiation procedures at the Luxembourg European Council and initiated the participation in Community programmes as a pre-accession strategy for the candidate countries) to 2009 (chosen as the final year due to data availability). This variable allows us to better compare the wealth levels of different statistical units, accounting also for the different level of prices (Leonardi, 1998).

For the non-parametric analysis on the eastern EU MS NUTS 3 regions, we use Eurostat data for GDP p.c. PPS available from 1999.

It was not straightforward to gather statistical information on the CAP payments to Hungarian beneficiaries at the sub-regional level. We also wanted to include the CAP payments which directly contribute to farm income, because support to investments and support provided under specific programmes (for example, Rural Development, Leader approach) would show effects on farm income only in the medium term. Thus, we weighted data on the decoupled payment support at the regional level in Hungary (data provided by the FADN/RICA database) from 2004 to 2009 for the number of successful applications for SAPS support, provided at the NUTS 3 regional level by the Hungarian Payment Agency (*Mezőgazdasági és Vidékfejlesztési Hivatal*, MVH). Then, the obtained value is used as conditioning variable in the conditional convergence analysis of GDP growth.

Results

Non-parametric convergence analysis of the Hungarian NUTS 3 regions

Analysing the marginal density functions of GDP p.c. PPS distribution between 1997 and 2009, we see that Hungarian NUTS 3 regions[13] tend to (a) increase their economic performance, probably as a result of the end of the transition period and the EU pre-accession funds, but (b) their performance is very different. In 1997 NUTS 3 regions gather into three groups which are characterised by high internal variability, while in the following years a stronger convergence take place which leads to NUTS 3 regions gathering into two groups, one characterised by high internal volatility in terms of GDP p.c. PPS, and a richer one which keeps increasing its economic performance and shows higher internal cohesion (Figure 1).

This interpretation is confirmed by the stochastic kernel (Figure 2)[14], which shows the evolution of GDP p.c. PPS: a small group of NUTS 3 regions headed by Budapest grew fast

13 The limited number of statistical units should be considered, when analysing the intensity of the peaks.

14 The analyses are provided using the algorithm in Gauss. The graphic outputs are obtained with the S-Plus software.

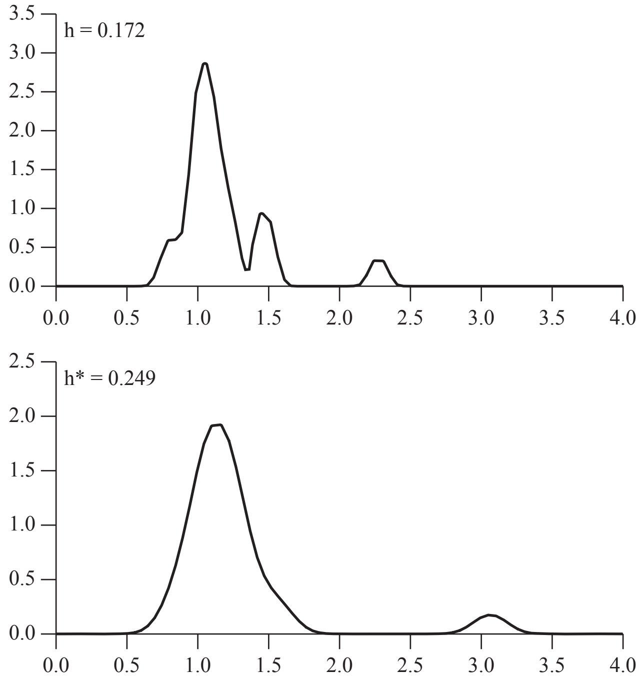

Figure 1: Marginal distribution of GDP p.c. PPP in the NUTS 3 regions of Hungary in (a) 1997 and (b) 2009.

* The *smoothing* parameter (or bandwidth) h has been computed as an average between the h proposed by Silverman (1986): $h = 0,9\ A(n)^{-1/5}$; where A is the minimum value obtained between the standard deviation and the first quartile divided for 1.34, and the h [$h = \left(\frac{4}{3n}\right)^{1/5} \sigma$] computed for a Gaussian estimate function.

Source: own elaborations on Eurostat data

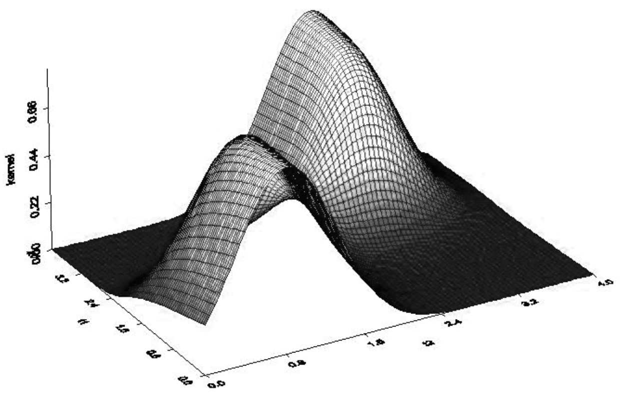

Figure 2: Stochastic kernel of GDP p.c. PPS in the NUTS 3 regions of Hungary.

Source: own elaborations on Eurostat data

while the other group, composed by the most of the mainly rural and less developed NUTS 3 regions tended to converge among themselves at lower income levels, confirming previous descriptive analysis (Csáki and Jambor, 2010).

As shown by the contour plot (Figure 3), these two groups of NUTS 3 regions evidence a tendency towards convergence within themselves in the long term (in fact, they dispose parallel to *t1*) at different GDP p.c. PPS levels (polarisation).

In order to see if the sub-regional convergence path followed by Hungarian NUTS 3 regions shares similarities with the rest of the eastern EU MS, we ran the same analysis on the other eastern EU MS, from 1999 to 2009. This is the first convergence analysis at such disaggregated level (NUTS 3) for all the eastern EU MS.

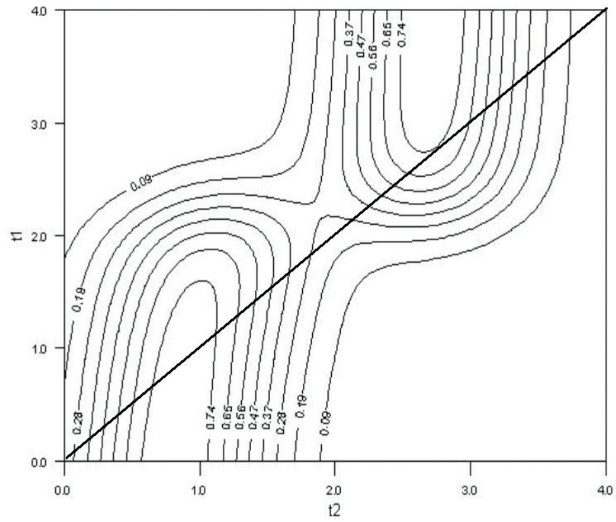

Figure 3: Contours of GDP p.c. PPS in the NUTS 3 regions of Hungary.

Source: own elaborations on Eurostat data

A very different situation appears: in 1999, the most of eastern EU regions show a similar economic performance characterised by a general increase in GDP p.c. PPS, and dispose mostly around the average level of GDP p.c. PPS (in fact, the marginal density function is clearly multi-modal). Instead, richer NUTS 3 regions (set on the right end of the distribution) gather in two very small sub-groups and show GDP p.c. PPS levels two times higher than the first group (Figure 4). This clear polarisation between regions showing average GDP p.c. PPS level and two much richer (and smaller) groups of regions persists through time (Figures 5 and 6). The poorer group experience different speed growth rates towards the average GDP p.c. PPS value, while the better off ones mainly remain at their average level.

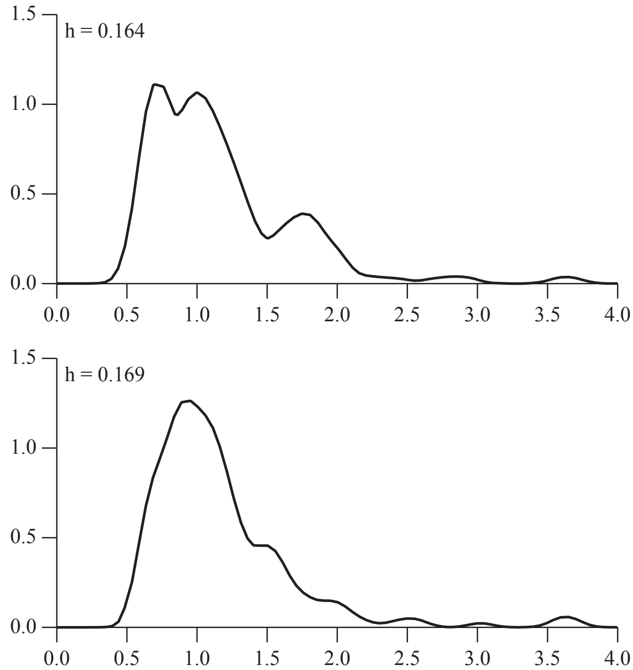

Figure 4: Marginal distribution of GDP p.c. PPP in the NUTS 3 regions of the eastern EU MS in (a) 1999 and (b) 2009.

Source: own elaborations on Eurostat data

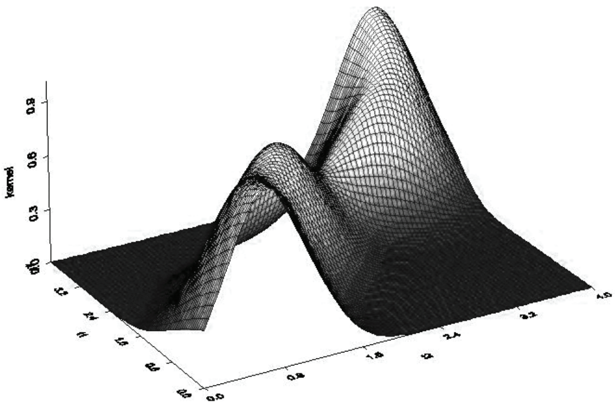

Figure 5: Stochastic kernel of GDP p.c. PPS in the NUTS 3 regions of the eastern EU MS.

Source: own elaborations on Eurostat data

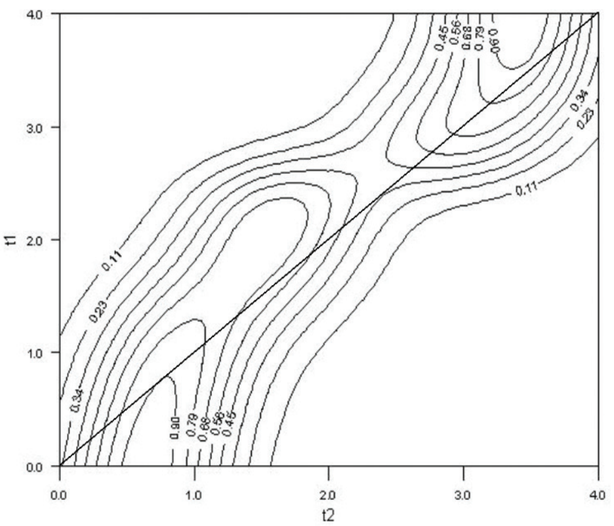

Figure 6: Contours of GDP p.c. PPS in the NUTS 3 regions of the eastern EU MS.

Source: own elaborations on Eurostat data

Has the CAP introduction influenced the economic performance of poorer, mostly agricultural based and rural areas in Hungary?

This question is important because the introduction of the CAP in the eastern EU MS was a debated issue. At the time of the EU enlargement, the eastern EU MS were more agricultural (in terms of agricultural land and percentage of the sector in the GDP), and their agricultural and rural areas were interested by important development delays. Thus, the CAP support was expected to play a relevant role for convergence.

In order to test it, we ran a non-parametric analysis of GDP p.c. PPS of Hungarian NUTS 3 regions conditioned to the CAP support (direct payments, CNDP) from 2004 (the year of the introduction of the CAP in the eastern EU MS) to 2008 (the last year for which data are available). We found that that the introduction of CAP payments did not affect considerably the convergence path at the NUTS 3 level: in fact, the conditioned marginal distributions (Figure 7) and the stochastic kernel (Figure 8) are very similar in the shape

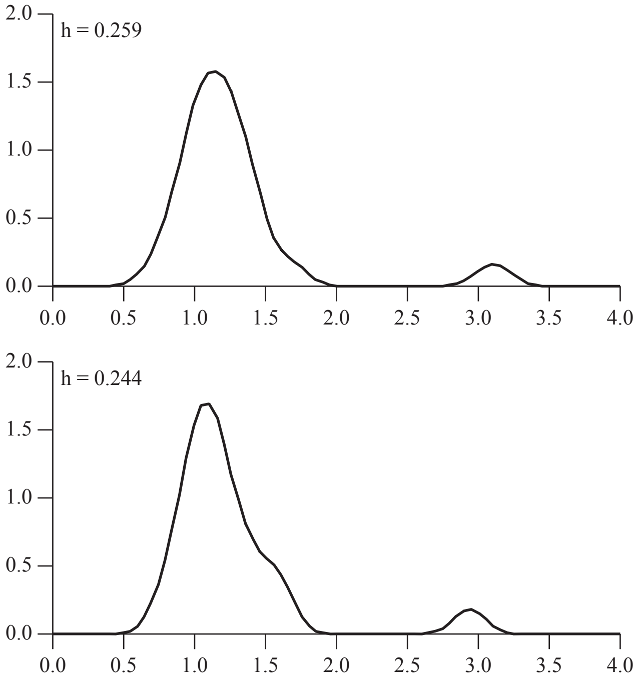

Figure 7: Marginal distribution of conditioned GDP p.c. PPS in the NUTS 3 regions of Hungary in (a) 2004 and (b) 2008.

Source: own elaborations on Eurostat data

of the distributions and in the values to the unconditioned ones. The contour plots (Figure 9) still show polarisation in two groups of NUTS 3 regions on different GDP p.c. levels, with the poorer group (on the left) converging internally around the average value, while the richer one converges around values three times higher than the average.

In order to shed light on such a limited role played by the CAP introduction on agricultural rural areas, we looked at the allocation of CAP funds, namely the socio-economic, geographic and demographic characteristics of applicants and beneficiaries. We found that between 2004 and 2008 decoupled payment levels increased in every NUTS 3 region: they more than doubled in absolute levels, ranging between +74.2 per cent in Dél-Alföld and +155 per cent in Közép-Dunántúl (Table 1), and their share in total subsidies (Table 2) increased everywhere, between 17 per cent (Közép-Dunántúl) and 45 per cent (Nyugat-Dunántúl). By the way, the low nominal level of decoupled payments in comparison with the EU-15 average and the lower share directed to

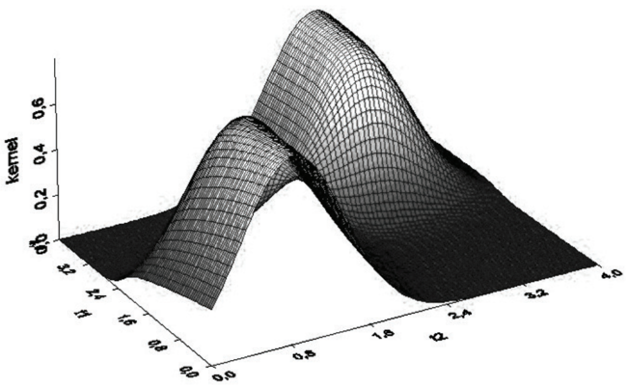

Figure 8: Stochastic kernel of conditioned GDP p.c. PPS in NUTS 3 regions of Hungary.

Source: own elaborations on Eurostat data

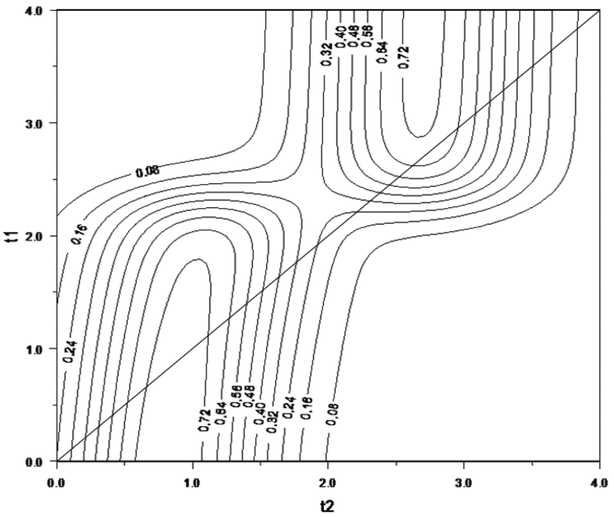

Figure 9: Contours of conditioned GDP p.c. PPS in Hungarian NUTS 3 regions.

Source: own elaborations on Eurostat, FADN and MVH data.

poorer performing NUTS 3 regions (Észak-Magyarország, Dél-Alföld) could have contributed to the limited role played by CAP on convergence.

The lack of targeting emerges from the correlation analysis of the distribution of the SAPS funds to successful applications. The applications for public (SAPS and top-up) payments within the Agricultural and Rural Development Operational Programme (AVOP) in 2005[15] show that land size and the area of provenance affect both the quality and quantity of demands. In fact, farmers with 0.3[16]-1 hectare presented the lowest number of applications and the majority were refused by managing authorities. The number of applications increases with the increase in average land size, and peaked for the land size class 1-5 ha. Farm size also influences the result of applications: the bigger the farm, the more successful the applications.

Table 1: Evolution of decoupled payments per farm in Hungary by NUTS 3 region (EUR), 2004-2008.

Region	2004	2005	2006	2007	2008	Var 08/04 %
Közép-Magyarország	3,781	4,203	5,438	5,149	7,321	93.6
Közép-Dunántúl	5,227	6,711	7,701	11,276	13,342	155.3
Nyugat-Dunántúl	4,881	5,435	6,904	7,983	9,600	96.7
Dél-Dunántúl	5,184	5,766	6,702	7,14	10,625	105.0
Észak-Magyarország	3,179	4,197	5,910	6,726	7,004	120.3
Észak-Alföld	2,788	3,397	4,362	4,582	5,553	99.2
Dél-Alföld	2,525	2,439	3,145	3,624	4,398	74.2

Source: own elaborations on FADN data

Table 2: Rate of decoupled payments on total support to farms in Hungary by NUTS 3 region (EUR), 2004-2008.

Region	2004	2005	2006	2007	2008	Var 08/04 %
Közép-Magyarország	36.5	39.0	45.7	44.7	47.7	30.7
Közép-Dunántúl	32.8	35.8	41.3	35.7	38.4	17.1
Nyugat-Dunántúl	32.5	32.6	42.3	43.7	47.2	45.2
Dél-Dunántúl	30.4	28.1	36.2	39.3	41.3	35.9
Észak-Magyarország	43.1	37.1	46.4	45.7	53.0	23.0
Észak-Alföld	35.9	37.5	44.0	40.5	49.7	38.4
Dél-Alföld	36.7	37.5	43.7	43.6	49.4	34.6

Source: own elaborations on FADN data

Following previous findings (Elek *et al.*, 2008; Katona Kovács, 2008) we performed a correlation analysis between the number of applications received, the payments (top-up + SAPS), farmers' age, and average farm size and farm location in less favoured areas (LFA) at the county level. We found no significant correlation between applications (or payments) and farm size and farm location in LFA, while we recorded significant – but negative – correlations between applications received, payments and farmers' age (over 55 years old). Therefore, the younger is the farmer, the higher the successful applications and payments for the county.

Discussion

The non-parametric convergence analysis conducted on the 20 Hungarian NUTS 3 regions between 1997 and 2009 (GDP p.c. PPS) shows polarisation between the region with the capital town Budapest, which grew fast, and the rest of the regions. In particular, rural NUTS 3 regions tend to converge among themselves at low income levels. Between 1999 and 2009 even greater polarisation takes place among the eastern EU MS NUTS 3 regions, where few areas (the capital towns) show higher income levels, comparable with the EU-27 average. These findings show that a main stated objective of the enlargement, i.e. the integration through convergence of GDP p.c. of eastern EU MS in the EU to be supported by the EU Cohesion Policy, did not take place.

The comparison between the conditioned and unconditioned analysis shows that, despite weak improvements of poorer NUTS 3 regions, the CAP payments were not able to influence the convergence of lagging behind areas, which are mostly mainly agricultural and rural (7.4 per cent of employment in the primary sector), playing a limited role for the cohesion. This result confirms the issues which were raised, at the time of EU accession, by academics and policy makers from the eastern EU MS about the lack of targeting and efficiency of CAP funds for the newcomers. As Gorton *et al.* (2009) and Csáki and Jámbor (2010) showed, the eastern EU MS had to adapt to a CAP structure and function designed to fit the needs of the EU-15 while agricultural and rural areas in the eastern EU MS had to face serious structural and productivity challenges.

The short time series available and the low number of statistical units analysed represent a serious limit for the conditional convergence analysis. Also, the FADN data on CAP support that we used for the analysis are not fully representative of the farm reality in the EU-27. In fact, the FADN sample is only composed of farms which exceed the minimum economic size of 1 ESU (EUR 1,200 SGM). Despite countries having different minimal thresholds, this level was

[15] The only public data available refers to 2005. Source: Hungarian Agricultural and Rural Development Agency.

[16] The land size limit for being eligible to SAPS payments was set at 0.3 (instead than 1 ha), because of plots parcelisation.

chosen to catch the most relevant part of the economic activity but it fails to assess the structural and economic situation of smaller and poorer farms which do not benefit from public support.

Finally, we must underline the preliminary explorative role of these analyses, which have been influenced (in the methodologies and time period chosen) by the persisting limitations in official statistics, especially at disaggregated levels. Further analysis, which will benefit from a longer time series for GDP p.c. PPS and CAP support data at the sub-regional level, will consist in an ex-post evaluation of the EU structural and cohesion funds in Hungary at the NUTS 3 level, in order to understand the role of national governance and managing authorities in planning and implementing policy measures co-financed by the EU instruments for cohesion.

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Marlen GOLDSCHMIDT* and Franz X. BOGNER*

Associations with plant genetic engineering: A perception analysis of students' hopes and fears

Public perceptions of plant genetic engineering are of increasing research interest. Although within the current debate on the cultivation of genetically modified plants many related ethical, political and economic issues need specific consideration, young students' views on this socio-scientific issue are largely unexplored. Therefore, our current analysis focussed on perceptions of Bavarian tenth graders (N = 572) with regard to their hopes and fears in the context of plant genetic engineering. By applying a mixed-methods approach, students rated their individual hopes and fears on a 4-point Likert scale (quantitative part) and gave a written statement about their individual associations (qualitative part): Hereby, hopes scored much higher than fears (medium effect). The subsequent categorisation of qualitative data resulted in five categories for hopes and four categories for fears. Hopes were mainly associated with economic or ecological aspects as well as with the overall fight against world hunger. Fears dealt mainly with negative consequences on human health and the fate of the environment. Additionally, subjective and objective knowledge were analysed for their influence on students' perceptions. Subjective knowledge had a significant influence on hopes, objective knowledge did not. This background information is relevant for the age-appropriate preparation of biology lessons: Hopes and fears need to be specifically addressed in order to optimise educational efforts and to support students to become responsible citizens.

Keywords: associations, genetically modified food, mixed methods approach, knowledge, science education

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Introduction

Genetic engineering as a "process of inserting new genetic information into existing cells for the purpose of modifying one of the characteristics of an organism" (UN, 1997, p.36) is a highly discussed public issue. The cultivation of genetically modified (GM) plants and their availability on the global market have rapidly increased during the last decade (Maghari and Ardekani, 2011), reaching even a 100-fold increase since the mid-1990s (James, 2012). The most widely cultivated GM plants are soybean and maize followed by cotton and canola (FAO, 2012). Although European countries such as Spain, Portugal, Czech Republic, Slovakia and Romania cultivate GM maize (James, 2012), in Germany, the support for GM products is negligible to non-existent. In Bayern, for instance, cultivation of GM plants was completely terminated in 2009. By contrast, in developing countries genetic engineering is often thought to offer new opportunities for improving agricultural systems and positively supplement traditional techniques. For instance, GM plants when specially adapted to local environmental conditions may considerably increase harvest success and help to feed a fast-growing population.

Not surprisingly, genetic engineering became an important but controversial socio-scientific issue with regard to ethical, social, political and economic questions. On the one hand, supporters emphasise huge benefits for farmers and consumers as well as even substantial environmental advantages, for example with regard to the potential reduction in pesticide pollution. On the other hand, opponents tend to put specific emphasis on hazardous risks and unpredictable long-term effects (Knight, 2009). Nevertheless, plant genetic engineering practices mainly affect industrial countries and emerging nations (James, 2012), while developing countries currently benefit only slightly. This dissemination raises the question whether world hunger really is a main focus of this technique or if it is simply a matter of financial gain. In Europe, the public debate over genetic engineering typically is accompanied by extensive reporting in the media. This journalism within a large volume of information often dramatises risk information, and therefore acts as a kind of risk amplifier (Frewer *et al.*, 2002). Owing to such possibly one-sided reports, a fair potential for misinforming the general public exists.

Public opinion towards genetic engineering differs widely: While the US public is relatively unconcerned (Sjöberg, 2008), Germans almost entirely oppose the issue. This is reflected by the fact that GM products (or products containing GM ingredients) in Germany by law require mandatory labelling whereas on the American market they do not (Gruère *et al.*, 2008). The results of the Eurobarometer survey in 2010 showed European opponents on average outnumbering supporters by far. Currently, in Europe, the level of support has dropped to the level measured in 1993 (Gaskell *et al.*, 2011). The US public is generally more supportive: In 2010, only one third of US consumers were concerned about GM products (Deloitte, 2010). In Germany, public rejection of genetic engineering is at a very high level and even impacts scientific research. Owing to restricted conditions, a substantial number of research groups as well as companies have scaled down their research activities or have moved abroad.

In educational contexts, teachers need to give attention to socio-scientific issues in order to prepare young students to become responsible members of society. Consequently, in Germany, national education standards demand socio-scientific issues to be included as essential parts of biology lessons in order to enable students to individually reflect on issues such as genetic engineering (Sekretariat der Kultusministerkonferenz, 2005). Regarding plant genetic engineering, students should not only understand the methodology, but also need to develop awareness about the public debate and the most relevant potential risks and benefits. Thus, specific knowledge about students' perceptions would help teachers in implementing appropriate teaching in classrooms.

Debates over genetic engineering have led to a number of studies on public perceptions. The most frequently reported perceptions were negative ones pointing to anxiety, anger and fear (WHO, 2005). For instance, fear about genetic engineering is positively influenced by consumer concern for the environment and negatively by faith in the technology of food production (Šorgo *et al.*, 2012). Industry representatives and scientists particularly suspect that education, simply by imparting knowledge, may substantially help to reduce individual fears about genetic engineering (House *et al.*, 2004; Connor and Siegrist, 2010). Nevertheless, factual knowledge alone may not have a large impact on perceptions of genetic engineering: Šorgo and Ambrozic-Dolinsek (2010) reported a substantially higher influence of perceptions than of knowledge on the acceptance of GM products. Other studies, however, did not support any relationship between knowledge and acceptance (e.g. Christoph *et al.*, 2008; Ekborg, 2008; Connor and Siegrist, 2010).

Verdurme and Viaene (2003) saw a knowledge increase not necessarily as leading to more positive perceptions or higher acceptance due to the fact that well-informed consumers ask more critical questions or that existing negative perceptions are strengthened by providing more information. Nevertheless, Gupta *et al.* (2012), in reviewing socio-psychological determinants of acceptance and perceptions related to emerging technologies such as genetic engineering, reported cognitive factual knowledge as one of the most often stated or cited determinants. In line with this, various further studies support the positive influence of knowledge on perceptions (e.g. Prokop *et al.*, 2007; Wnuk and Kozak, 2011; Fonseca *et al.*, 2012). Summing up these controversial findings, no clear answer about a potential knowledge impact on students' perceptions is currently possible.

Consequently, our present study focused on the investigation of students' perceptions of plant genetic engineering and the relationship to students' knowledge. We based our study on the research of Gebhard *et al.* (1994) which monitored young cohorts' hopes and fears with regard to genetic engineering and reproductive biology. Their mixed methods approach consisting of a quantitative and qualitative survey revealed hopes and fears as just moderately rated, on average. Hopes referred to the cure of diseases as well as to the optimisation of agriculture, but participants were very frightened of misuse of genetic engineering and of undesirable side effects. Gebhard *et al.* (1994) concluded that education in the context of genetic engineering, besides imparting knowledge, needs to acknowledge students' hopes and fears. Todt and Götz (1997) used a questionnaire to collect the most common hopes and fears as well as to evaluate the related risks. In general, their results were similar to those of Gebhard *et al.* (1994), with students expressing their hopes for the cure of diseases and being frightened of misuse.

Our study, in line with Gebhard *et al.* (1994), focussed on students' individual scoring of their hopes and fears on the one hand, and their associations regarding plant genetic engineering on the other. In contrast to Gebhard *et al.* (1994), we monitored a younger age-group (between 15 and 18 years of age) and focused particularly on plant genetic engineering. Besides the continuous debate about genetic engineering during the last two decades, scientific research has advanced and applications have been refined, thus leading to possible changes in students' perceptions. Considering students' knowledge regarding plant genetic engineering, we assessed their subjective and objective knowledge and analysed the relationship between knowledge and students' hopes and fears. Subjective knowledge refers to what students think they know about plant genetic engineering, while objective knowledge is defined as their real knowledge (Costa-Font *et al.*, 2008). It is important to distinguish between subjective and objective knowledge due to the fact that they might affect students' perceptions differently (House *et al.*, 2004; Connor and Siegrist, 2010). We posed three research questions: (a) how do students score their hopes and fears regarding plant genetic engineering; (b) what kind of associations do students have regarding plant genetic engineering, and (c) what kind of relationship exists between students' knowledge and their hopes and fears?

Methodology

We applied a mixed methods approach by combining qualitative and quantitative approaches (Johnson and Onwuegbuzie, 2004). Consequently, we used a two-part paper-pencil and-test based on the study of Gebhard *et al.* (1994). The quantitative part consisted of two 4-point Likert scales (no – little – some – much hope/fear) with which students rated their hopes and fears regarding plant genetic engineering. For the qualitative part, students were asked to write a short statement about their hopes and another about their fears. The qualitative analysis of these statements would provide a deeper insight into students' perceptions. In order to assess students' objective knowledge, a paper-and-pencil multiple choice questionnaire with 14 questions was used (Table 1). Additionally, students' subjective knowledge was surveyed with a 3-point Likert scale (ill-informed – moderate – well-informed) on which students rated their individual knowledge of plant genetic engineering.

Table 1: Sample questions from the multiple choice questionnaire completed by the students in the survey.

Question	Alternative answers
In Germany, GM foodstuffs:	(a) are prohibited goods (b) have to be labelled [correct] (c) are not sold (d) are banned export goods
What is the mandatory distance between fields with GM plants and fields with conventional plants?	(a) 15 metres (b) 150 metres [correct] (c) 1500 metres (d) 15000 metres

Source: own composition

Our sample consisted of 572 Bavarian tenth graders (final class of *Realschule* (professionally oriented secondary school), M = 16.7; SD = 0.7) from 29 different classes (quasi-experimental design). Gender was about equally distributed (51.2 per cent females). Since genetic engineering is a compulsory part of the Bavarian tenth grade curriculum (Bavarian Ministry of Education, 2008), a basic knowledge about the applications, risks and benefits of this technique was expected.

For statistical analyses, we applied parametric procedures by using PASW Statistics 18 (Version 18.0.0). Quantitative data were compared by using a paired t-test and a one-way ANOVA. For *post-hoc* comparisons of the one-way ANOVA, we used Hochberg's GT2 test procedure in consequence of different subsample sizes (Field, 2009). Effect sizes were calculated according to Field (2009), considering values of 0.10 as small, of 0.30 as medium and of 0.50 as large effect (Cohen, 1992). Correlation analysis was performed applying Pearson's or Spearman's correlation coefficient according to the respective assumptions. Reliability analyses of the Likert scales resulted in Cronbachs' alpha scores of 0.85 for both scales, and of 0.74 for the knowledge questionnaire.

The qualitative data analysis followed the approach of Mayring (2008), iteratively categorising individual statements and following the method of inductive category development.

Results

In general, the individual scores of hopes and fears were low (hopes: M=2.01; 95% CIs [1.95-2.08]; fears: M=1.71; 95% CIs [1.65-1.77]). Most students (45.8 per cent each) rated both hopes and fears as low. Almost 28 per cent of the students reported no hopes and 43 per cent reported no fears, respectively[1]. About 24 per cent reported some hopes, while a mere 2.4 per cent scored high. About 11 per cent reported some or much fear (Table 2). When comparing all scores, hopes were significantly higher than fears ($t(571)=7.029$, $p<0.001$, effect size $r=-0.28$). Moreover, no correlation between both Likert scales was observed (Pearson's correlation coefficient $r=0.04$, $p=0.294$).

After the categorisation process, we extracted five main categories for hopes and four for fears. Consistency among raters was investigated by an intra- and inter-rater reliability analysis using Cohen's kappa statistic (based on 10 per cent of participants (randomly selected)) (Cohen, 1960). For the Cohen's kappa scores, see Table 3. According to Landis and Koch (1977), our Cohen's kappa scores can be regarded as 'substantial' (0.61-0.80) to 'almost perfect' (>0.80). Categorisation of students' statements was done according to our category system, while one statement could have been classified into several categories.

The most frequent categories mentioned for hopes were *farmers*, *world hunger* and *progress* (Table 4). The categories *consumers* and *environment* each accounted for more than 10 per cent of all statements. Fears often described *hazardous risks*, *human health* and *environmental impact*, while *ethics* only was listed by 7.6 per cent of all statements. Some rare statements did not match our main categories and these were collected into the category of 'others' (less than 2.5 per cent each). Note that about 50 per cent of the students did not give any statement on hopes (n=209) and about 43 per cent on fears (n=141) and these subsamples were excluded.

The most frequent combinations of categories were *world hunger+human health* (20.0 per cent) and *farmers+hazardous risks* (11.4 per cent). The combinations *farmers+human health* and *farmers+environmental impact* were often mentioned as well (each 9.5 per cent).

Analysis of students' subjective knowledge revealed that only 6 per cent of the students felt well informed, while 46 per cent felt moderately informed and 48 per cent ill informed. Considering the between-group comparison with regard to students' scoring of their hopes and fears, students' hopes differed significantly (ANOVA: $F(2, 561)=6.932$, $p=0.001$, $r=0.16$; Figure 1). *Post-hoc* comparisons using Hochberg's GT2 test procedure indicated that the well informed group rated their hopes significantly higher than the other groups. However, the ill informed and the moderately informed

Table 2: Distribution of Bavarian tenth graders' hopes and fears regarding plant genetic engineering (percentage of all answers; n=572).

Rating	Hopes (%)	Fears (%)
No	27.6	43.0
Little	45.8	45.8
Some	24.1	8.7
Much	2.4	2.4

Table 3: Cohen's kappa values for the intra- and inter-rater reliability analysis of the category system for the qualitative analysis (based on randomly selected 10 per cent of participants).

Perceptions	Cohen's kappa	
	Intra-rater reliability	Inter-rater reliability
Hopes	0.96	0.87
Fears	0.95	0.69

Table 4: Percentage of the main categories of Bavarian students' (a) hopes (n=205) and (b) fears (n=185) with regard to plant genetic engineering (percentage of all answers, one answer could have been classified into several categories), and exemplary excerpts for each category.

	Category	Percentage	Excerpt
Hopes	Farmers	40.0	"By using green genetic engineering farmers can be sure that their crops are bountiful and that they will not have any crop failures".
	World hunger	28.3	"Since production will increase, there will be more food. Thereby world hunger could be reduced".
	Progress	23.9	"Changes through green genetic engineering will facilitate a better life on earth".
	Consumers	11.2	"Consumers will get more and better products at cheaper prices".
	Environment	13.7	"Green genetic engineering could be applied for pest control without using chemical pesticides".
Fears	Hazardous risks	42.2	"Unpredictable side effects could appear, maybe years later when it is already too late".
	Human health	41.6	"We cannot know if the modified genes in plants will have any negative impact on human health".
	Environmental impact	53.1	"Nature could be damaged permanently through green genetic engineering".
	Ethics	7.6	"Through genetic engineering genes are modified, but humans should not interfere with nature".

Source: own composition

[1] For the subsequent qualitative analysis, all students without hopes (n=158) or without fears (n=246) on the rating scale (quantitative part) were excluded as they did not write any statements.

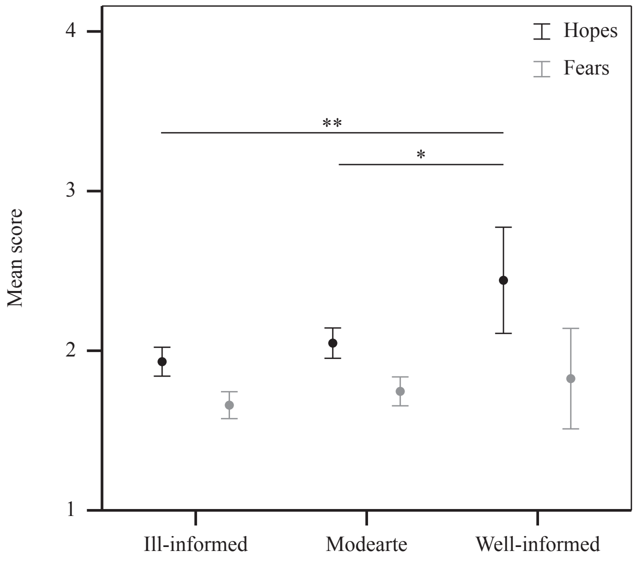

Figure 1: Comparison between ill informed, moderately informed and well informed groups of Bavarian students of the rating of their hopes and fears regarding plant genetic engineering (n=564).
Error bars represent 95% confidence intervals.

groups did not significantly differ with regard to their hopes. The relationship between subjective knowledge and students' hopes was significant (Spearman's correlation coefficient r=0.12, p=0.005). The scoring of students' fears did not differ significantly between the three groups of subjective knowledge (ANOVA: F(2, 561)=1.396, p=0.249; Figure 1) and the correlation analysis revealed no significant relationship (Spearman's correlation coefficient r=0.06, p=0.145).

Students' objective knowledge, according to the results of the multiple choice questionnaire, was rather low (M=5.30; 95% CIs [5.13-5.47]). Our analysis revealed no significant correlation between students' objective knowledge scores and their scoring of hopes and fears (Pearson's correlation coefficient: hopes: r=0.06, p=0.190; fears: r=0.08, p=0.070), but the relationship between students' subjective and objective knowledge was significant (Spearman's correlation coefficient r=0.16, p<0.001).

Discussion

The main focus of our study was students' scoring of their hopes and fears (quantitative) as well as their associations with plant genetic engineering (qualitative). It was surprising how low hopes and fears scored regarding plant genetic engineering issues. About three-quarters of our students did not report any hope or, at least, scored it very low. Similarly, nearly 90 per cent did not report any fear or just low fears, respectively. This level in both perceptions was quite unexpected, especially in view of the high topicality of plant genetic engineering and the continuing presence in public media. Nevertheless, it is quite in line with Gebhard *et al.* (1994) who about two decades ago described a similar pattern: In that study a high percentage was low scoring in both the hope and the fear domain as well. Nevertheless, two decades of intensive controversial discussion raised expectations in producing impacts in our target perceptions. One reason for not doing this may lie in the high rejection rate of German consumers which maybe prevents any contact with this issue. In fact, the issue of plant genetic engineering may not play an important role in our students' daily life. The lack of relevance or a low interest and limited knowledge about this issue may provide a possible explanation. Additionally, students may simply be tired of reflecting about this issue, as Gebhard *et al.* (1994) already had hypothesised.

Furthermore, a general uncertainty about this issue may provoke our low scoring of hopes and fears. Poortinga and Pidgeon (2006) monitored opinions about GM food and rated about half of their participants as ambivalent towards support of or opposition to GM food, so that as a consequence the majority had an undecided position. Individual hopes scored significantly higher than fears (medium effect). While a quarter of all our participants reported some or much hope, only about 10 per cent reported high fear. This proportion, however, is quite in contrast to earlier studies where anxiety, anger or fears were always dominant variables (e.g. Laros and Steenkamp, 2004; Šorgo *et al.*, 2012). However, the percentage of the highly scoring hopes is similar to Gebhard *et al.* (1994) (about 25 per cent each), although their percentage of high fears was four times higher than ours (40 per cent to 10 per cent); this discrepancy may point to a strong decrease of students' fears during the last two decades. Today, we need to take into consideration that plant genetic engineering is not as new and unknown as it was 20 years ago. Therefore, nowadays students are more familiar with the discussion about this issue and the associated risks. Additionally, governmental control and legal regulations in Germany may have been conducive to decreasing fear. Laros and Steenkamp (2004) found a positive influence on the fear of genetic engineering of consumers' concern for the environment, and a negative influence of faith in the technology of food production. Referring to our results, this explanation would point to a low concern for the environment and a high faith in technology of our students. Unfortunately, in our present study we did not include a measure of adolescent environmental attitudes or behaviour as it would be available in the established 2-MEV scale or the GEB-scale (Bogner and Wiseman, 1999, 2006; Kaiser *et al.*, 2007; Roczen *et al.*, 2013).

The lack of correlation between hopes and fears suggests independence of both variables and supports their two-dimensionality. Most studies dealing with perceptions on genetic engineering prefer the independent measuring of positive and negative perceptions (e.g. risks and benefits; Siegrist, 2003; Poortinga and Pidgeon, 2006; worries and benefits; Stewart and McLean, 2008). Eiser *et al.* (2002) reported trust and risk perceptions as independently influencing attitudes towards particular food technologies. Based on the controversial discussion about plant genetic engineering, we presume such an independence of hopes and fears.

A statements analysis revealed for about half of our students no relevant associations towards plant genetic engineering: Either they were overwhelmed by this task, or writing a statement was of no importance for them, just reflecting their low rating of hopes or fears. Most associations of students' hopes dealt with economic advantages for farmers and consumers as well as with the general fight against world hunger. Another frequently mentioned category was *progress* by referring to general improvements and the facilitation of a better life on earth. These findings reflect the full range of aspects and arguments represented in the public debate. Similar to Gebhard *et al.* (1994), we found a high percentage of students referring to economic aspects, suggesting that students may take up the common position of genetic engineering supporters who promise high yields. The same holds true for the category *world hunger* as it, too, is an often mentioned argument of supporters. The societal benefit of fighting world hunger makes genetic engineering more acceptable and leads to the acceptance or even ignorance of fears since the trade-off is seen as advantageous enough (Stewart and McLean, 2008).

Our categories were similar to those of other studies (e.g. Knight, 2009). For instance, Massarani and Moreira (2005) conducted focus group discussions about the most important advantages of genetic engineering among Brazilian students concluding two main categories: increased productivity and the elimination of world hunger. Hill *et al.* (1999) reported for different age cohorts (age 11-12, 13-14 and 15-16 years) almost no change in individual perceptions. Such surprising constancies are quite in line with other studies in the environmental perception sector (e.g., Bogner, 1998; Kaiser *et al.*, 2013). Within the close field of our study, our results additionally appear similar to those obtained in other countries and other age groups. Interestingly, about 15 per cent of our students also expressed hope for positive effects on the environment (e.g. pest control without using chemical pesticides), in spite of the fact that the general public usually associates genetic engineering with a negative environmental impact (e.g. the hybridisation of GM plants with wild species). Those uncommon associations of students may indicate a more in-depth knowledge about GM plants within this specific subsample.

The most frequently stated fears reflected the common arguments as they feature in the public debate: Negative effects on human health, general hazardous risks such as unpredictable long-term effects as well as negative environmental impacts. Consequently, our categories of fears match other studies' findings (e.g. Todt and Götz, 1997; Ekborg, 2008). Stewart and McLean (2008) describe fears as the dominant emotion driving public opinion on genetic engineering. The potential environmental impact and possible personal risks are so drastic that fear plays an important role in the rejection of this technology (Stewart and McLean, 2008). In contrast to our results, Gebhard *et al.* (1994) reported a high percentage of participants being frightened of any misuse, concluding that genetic engineering is assessed positively in general but could develop negatively if falling into 'wrong' hands or getting out of control. This may indicate a general suspicion towards science and industry (Christoph *et al.*, 2008). Additionally, a lack of trust in food production processes and controlling institutions might be relevant (Pardo *et al.*, 2002; Stewart and McLean, 2008). Generally, students' fears focused on risks and possible negative effects, while ethical aspects such as interference with nature or religious reasons were mentioned only rarely.

Interestingly, the ambivalence of students' scoring of hopes and fears is apparent in their statements as well. The most frequent combination of categories is *world hunger* and *human health*, thus emphasising the conflict between possible societal and economic benefits, on the one hand, and potential personal health risks, on the other hand. Students' individual trade-off between both positions is crucial for their opinion making and their acceptance of plant genetic engineering (Stewart and McLean, 2008). Unfortunately, a measurement of acceptance was not included in our study and this would need consideration in further studies.

Subjective knowledge regarding plant genetic engineering was rated rather poor, only 6 per cent felt well informed; in contrast, nearly half of the students assessed themselves as ill informed. The first score is in contrast to Gebhard *et al.* (1994) where about a quarter of their sample announced a 'well informed' (24 per cent). Pardo *et al.* (2002) investigated the awareness and knowledge of genetic engineering in Europe and reported for 80 per cent of their sample a partial or minimal information level. Therefore, it was not surprising how low subjective knowledge was rated by the students, thus indicating a need for broader educational efforts in order to equip students with specific knowledge about plant genetic engineering. In line with this, students' objective knowledge scored rather low and correlated positively with the subjective knowledge, thereby showing that students assessed their own subjective knowledge exactly. Brucks (1985) and House *et al.* (2004) proved this correlation between objective and subjective knowledge in their studies as well. In contrast to the objective knowledge which bears no relationship to students' perceptions, the subjective knowledge significantly correlated with hopes: well informed students scored their hopes higher than moderately and ill informed counterparts. This relationship points to the specific importance of education in this context (see below). Gebhard *et al.* (1994) reported a similar relationship between subjective knowledge and hopes, on the one hand, and fears on the other. Furthermore, Pardo *et al.* (2002) detected corresponding effects when analysing the influence of subjective knowledge on peoples' perception of benefits and risks.

Focusing on the relationship between objective knowledge and perceptions, we are in line with several other studies reporting no significant correlation (e.g. Christoph *et al.*, 2008; Connor and Siegrist, 2010). The different effects of subjective and objective knowledge on perceptions of genetic engineering were reported in some other studies comparing both knowledge types (e.g. Costa-Font *et al.*, 2008; House *et al.*, 2004).

Conclusion

Commonly it is questionable whether factual knowledge alone can cause significant changes in the perceptions of genetic engineering and in the acceptance of GM products. Ruddell (1979) assumed that education in nutrition might reduce consumers' reliance on general information and increase the number of arguments involved in decision making, but will not initiate any changes in consumers' individual perceptions. Our data, however, strongly support for subjective knowledge a significant relationship to hopes by failing to interfere with fears; this is not true at all for objective knowledge. Therefore, educational efforts need to achieve both: the increase of knowledge about genetic engineering techniques and the addressing of students' perceptions in order to help them to find their individual positions on this issue. In this context, it is necessary to give attention to students' hopes and fears. Our study shows hopes and fears as generally based on the common arguments as pointed out in the public debate. Although the level of hopes was significantly higher than fears, most students were ambivalent in both their ratings and their associations, thus emphasising that there is need for further information on this socio-scientific issue.

Implications for teaching

In order to address both teaching factual knowledge about genetic engineering and acknowledging individual perceptions as well, we strongly suggest incorporating hopes and fears when building upon a solid fundamental knowledge base. Specific actual issues in the field of plant genetic engineering, for instance, the recent case of the GM potato 'Amflora', are excellent stepping stones to building upon everyday issues and might help to address individual hopes and fears. Consequently, hopes and fears which we have shown to be unrelated could be connected. The most important guideline for teachers is to handle this issue in a neutral manner, in order to encourage students to define and develop their individual points of view within this complex matter. Education should not interfere with pro- or contra-positions, it should support a student's critical thinking. Knowledge about individual hopes and fears for sure help teachers to provide appropriate lessons.

Further research needs to extend our present study: For instance, the acceptance of genetic engineering needs integration as well as environmental attitude and behaviour frameworks do (see above: Šorgo *et al.*, 2012). Considering our rather young age group, we assume an ongoing process of forming own opinions, thus the age group of undergraduates and graduates is expected to add further insights into the issue of this present study.

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An analysis of Hungarian agri-food export competitiveness

The main purpose of this study is to provide an overview of the export growth trends in the Hungarian agri-food sector over the last decade and to identify the obstacles hindering the sector's development. We used constant market share analysis to break down into components the changes in export growth. Almost without exception, the increasing market size accounted for most of the export growth to 14 countries. The commodity (market composition) and competitiveness effects produced varied results and were not so positive. This shows that the Hungarian export structure was less adaptive to changes in demand in the target export markets. There were positive examples however, such as Italy and Slovakia, where the competitiveness effect explained 82 and 64 per cent respectively of the Hungarian export growth. In Romania almost one third of the total Hungarian agri-food export growth was explained by the improved competitiveness. The negative examples are numerous; the most important is the trade relations with Poland where the competitiveness effect almost halved the measured export growth potential. By analysing the price and quality competitiveness of the cereal and oilseed commodities with unit value calculations we could show that the market position of these relatively lower-priced products could be improved.

Keywords: export competitiveness, food products, foreign trade, market position, unit value calculations

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Introduction

Much Hungarian and international research has dealt with the measurement of economic competitiveness, but although it has become a widely used term it is difficult to find a precise definition or an overall measurement of it. Begg (1999) remarked that 'Economic competitiveness, as we all know, is the path to economic nirvana' (p.795). While 'national competitiveness' is on the whole quite an elusive concept, even in the 1990s two prominent economists argued that competitiveness cannot be interpreted at a national level (Porter, 1990; Krugman, 1994). However, taking into consideration the contradictions that exist, there are definitions for competitiveness. For example OECD (2008) defined the competitiveness in international trade as 'a measure of a country's advantage or disadvantage in selling its products in international markets' (p.87). Instead of giving simple but less informative definitions Trabold (1995) and Schüller (2000) classified and defined the criteria of international competitiveness after four national 'abilities': (a) ability to sell on foreign markets; (b) ability to increase real income; (c) ability to adjust; and (d) ability to attract mobile factors of production.

For measuring the competitiveness of a country in foreign markets (i.e. *ability to sell*), and identifying the sectors in which a country is strong – based on Balassa's (1965) indicators – multiple specialisation and Revealed Comparative Advantage (RCA) indicators are usually applied. Although the changes of competitiveness occurred do not fully determine the changes of the market shares, they form an acceptable method for the measuring of the regional export competitiveness in the world market (Chen and Duan, 1999). Therefore we use in our study for analysing the competitiveness of external trade these two approaches, the change in the market share and the demonstration of the price competitiveness.

The *ability to earn* concepts use the maximising of the real income as the benchmark of competitiveness. They show the effectiveness by which the individual countries take part in the international division of labour. It is true that the most developed technology producing industries do not affect the competitiveness of other segments in the economy equally; it is highly influenced by the developed technology industry and the macroeconomic environment (Deason and Ferrantino, 2011). According to Schumacher *et al*. (1995) technological competitiveness, in a wider sense, does not only mean the knowledge accumulated by the companies, but also the knowledge they have at the level of the national economy.

The exponents of the *ability to adjust* (the adaptability of the economy) concept emphasise that for the competitiveness of one country the high real income and the standard of living is a fundamental condition. The faster an economy can adjust to the changing world economic conditions, the more competitive it will be. Such models use more general indicators, specifically the relative income position, the number of newly founded companies and information which is determined by the institutional environment (Levchenko, 2007).

According to the *ability to attract* concept the economic allure of one region (country) and international competitiveness are synonymous (Katzenbach, 1993). For the measurement of the competitiveness of the country for example the balance of the foreign direct capital investment and capital investments of the domestic companies is used, with the reasoning that the negative balance means that the investors do not consider this country to be a good capital investment target country. Because the analysis of the countries were made separately, the results of the different countries cannot be compared, just the advantages and the disadvantages of individual economies according to the quantity and quality indicators can be listed (Lesher and Mioudot, 2008).

Methodology

The constant market share (CMS) analysis of individual target markets was done for the first 24 commodity groups of the Harmonized Commodity Description and Coding System (HS): (a) *animals and animal products* (HS 01-05); (b) *vegetable* products (HS 06-14); (c) *animal or vegetable fats, oils and waxes* (HS 15); and (d) *foodstuffs* (HS 16-24).

In this part of the analyses we have used a lower level of aggregation: through breaking down to the level of product groups (HS-4), we have differentiated between agricultural commodity production and primary and secondary food industrial processing. The COMTRADE, EUROSTAT and the HCSO statistical databases have principally been used.

Before Hungary's accession to the European Union (EU) the export competitiveness of the Hungarian food industry was analysed many times with the help of the CMS model (Fertő, 2001; Fogarasi, 2008). But mainly before the time of EU accession, and with the aggregated products and country groups, and in both analyses the OECD SITC system database was used, which is in some aspects wider and in other aspects tighter than the HS structure used here. We extended the time interval of the previous analyses and with this method we analysed the developments in the period after EU accession. At the constant market share we broke down the products unlike the abovementioned authors in accordance with the HS code system. Because the CMS model is sensitive to the selection of the base period, we compared the averages of the periods 2001-2003 and 2008-2010.

On the basis of this built model we split the export growth into two parts, one in connection with the general growth of the reference market (characterised by two factors, namely the market scale and market composition effects), and the other is the residual, which is the competitiveness factor. This is the one step version of the CMS model where the three export increment determining factors can be described as follows (Fertő, 2001; Poor, 2010):

- The market size (or scale) effect shows the change of the receptivity of the reference market, which can also at constant market share modify the exports to the reference market. It shows, if the market share of the exporting country to a specific target market for a specific product did not change between two time periods, how much their whole exports can change due to the import growth of the target market;
- The market composition (or second order) effect shows the whole result of the competitiveness of the exporting country and the import structure of the reference market. A positive value shows that for such products the exports delivered to the target market has increased in the basis period, in which it realised a bigger share than which was the total branch share in the given commodity market. This effect can be viewed by the combination of changing import demand and export supply;
- The competition (or residual) effect originates from the changing in the exports on the competitiveness of the exporting country. We get the residual sub-total when in the period of review materialised exports we subtract those subtotals which we could get for each commodity class if the export market share has not been changed. A positive value means that on the commodity market the given country has been more competitive than the competitors and has therefore increased its exports.

To calculate the change (ΔM) between the base period value (M^0) and the period of review value (M^1) of the Hungarian food industry, this difference can be divided into three components as follows:

$$\Delta M = S^0\left(C^1 - C^0\right) + \sum\left(S_i^0 - S_{avr}^0\right)C_i^1 + M^1 - \sum\left(S_i^0 C_i^1\right) \qquad (1)$$

where C^0 and C^1 is the total food industry imports of the target market in the base period and in the period of review, S_i^0 is in Hungary in the base period in the HS code system at the i-th commodity group on the target market reached market share, S_{avr}^0 is in the base period on the target market reached average market share and C_i^1 is all imports in the target market in the period of review at the i-th commodity market in the HS-code system.

Another approach to the measure of exports and external trade competitiveness is indices which use the connection between price and quality (Aiginger, 1997; Fischer, 2007). In a comparison of the external trade competitiveness of countries, Gehlhar and Pick (2002) made a distinction between the one-way (if between two countries at one product group just the exports or imports exist) and two-way external trade. The authors defined four categories of two-way trade between two countries for a product group with the help of external trade balance and export-import equivalent price and quality:

- Category 1 (positive balance, lower export unit value): The external trade balance of the examined country against the reference market is positive for the given product, while the export unit value of the given product delivered from the examined country to the reference market is lower than the import unit value of the same product delivered from the reference market;
- Category 2 (negative balance, higher export unit value): The external trade balance is negative while the export unit value is higher than the import unit value;
- Category 3 (positive balance, higher export unit value): As category 1 except that the export unit value is higher than the import unit value;
- Category 4 (negative balance, lower export unit value): As category 1 except that the external trade balance is negative.

In categories 1 and 3 the commodity groups have a price and quality advantage in competitiveness while categories 2 and 4 show the weakness of the price and quality competitiveness.

Results

Results of the constant market share (CMS) analysis

The study involved 14 target markets and 77.1 per cent of total Hungarian food industry exports (as an average of the period 2008-2010). The selected EU Member States accounted for 69.4 per cent of Hungarian exports ('old' Member States: 40.3 per cent, 'new' Member States: 29.1 per cent), and 7.7 per cent of exports concerned the non-EU target markets. The export growth in the selected target markets was slightly in excess of the increase in total exports (EUR 2.268 million, or 83.8 per cent of revenue growth occurred between the two periods); this can mainly be attributed to the greater economic driving force of the EU Member States.

According to the CMS analysis, the effect of the market size was everywhere positive, namely we have identified expanding markets and an increase in demand. Almost all of the increase in market size can be contributed to the growth in exports (Table 1).

The competitiveness of the Hungarian agri-food exports in the market of the EU-27 was analysed by the CMS method. Separating out the export growth factors shows that the market size effect was EUR 974 million (41.64 per cent), the market composition effect was EUR 89 million (3.83 per cent) and the competitiveness effect was EUR 1,275 million (54.53 per cent). This means that a large part of the export growth was due to the positive effect of competition on the Community market and only a smaller part was due to the increasing EU imports. The market composition effect – that is the response to the level of the change of the import structure of the EU – hardly changed at product level. Also, Hungary cannot adapt to certain aspects of the increasing demand in the EU.

From this standpoint the effect of the analysed target markets can be separated into three groups. Firstly, those EU Member States where the competitiveness effect of Hungarian exports is positive. These are, in order of priority, Germany, Romania, Italy, Slovakia, the Netherlands and France. The second group includes the EU Member States studied where the competitiveness effect is negative, namely Austria, Poland and the Czech Republic. In the third group of countries, those outside the EU, declining export competitiveness is, without exception, seen in these markets.

EU Member States where the competitiveness effect is positive

Hungary's largest export market is Germany. From the entire EUR 298 million export growth, three quarters is caused by market size expansion (EUR 223 million), the market composition effect is EUR 6 million (2 per cent) and the competitiveness effect is EUR 69 million (23 per cent). The mostly successful structural adaption was supported by analysis of the CMS at HS 2 level commodity breakdown. Among the most important products, the increase in exports of *oilseeds, miscellaneous grains, medicinal plants and straw* (HS-12) and *animal or vegetable fats, oils and waxes* (HS-15) of 83 and 91 per cent can be explained with the competitiveness effect, but for *cereals* (HS-10) it is only 18 per cent. The competitiveness effect of *meat and edible meat offal* (HS-02) and *edible preparations of meat, fish, crustaceans etc*. (HS-16) was negative, consequently Hungary's meat product exports to Germany stagnated and meat exports declined.

In 2010 Romania was Hungary's most important target market. Of the EUR 509 million increase in exports, 70 per cent (EUR 355 million) can be explained by the market size increase. The market composition effect was negative (EUR -14 million and -3 per cent) while competitiveness contributed EUR 168 million (33 per cent) to the result. Hungary's competitiveness with regards to its competitors increased in Romania. There were two product groups where the market share increased and the composition effect was positive: *dairy, eggs, honey and edible products* (HS-04) and *cereals* (HS-10), but for *milling industry products* (HS-11) Hungary's market share fell by 11 per cent.

More than one quarter of the export growth in the Italian market (EUR 79 million) was caused by the market size increase. The market composition effect was negative (EUR -23 million), i.e. Hungary could not take advantage of the change in the import structure. The competitiveness effect was EUR 248 million (81.5 per cent), so Hungary was able to hold on well against its competitors in the expanding Italian market. But there were only two product groups where both the market share increased and the market composition effect was positive: *cereals* (HS-10) and *residues from food industries, animal feed* (HS-23). *Meat and edible meat offal* (HS-02) and *edible preparations of meat, fish, crustaceans etc*. (HS-16) exports lost 1 percentage point from the market share. On the other hand, thanks to its vigorously growing

Table 1: Results of the constant market share model calculations for the first 24 commodity groups of the HS codes comparing the time periods 2001-03 and 2008-10.

Country	Market size effect	Market compound effect	Competitiveness effect	Change in value of imports from Hungary*
EU-27	974	89	1275	2339
Germany	223	6	69	298
Romania	355	-14	168	509
Italy	79	-23	248	305
Austria	198	17	-119	97
Slovakia	119	10	236	366
Netherlands	48	-7	70	111
Poland	202	22	-129	94
Czech Republic	123	37	-41	119
France	32	8	44	84
Russia	280	-16	-116	148
Ukraine	69	29	-2	96
Switzerland	66	1	-46	21
Japan	38	-20	-7	11
USA	27	-1	-35	-9

* In EUR million for EU Member States and USD million for non-EU countries
Source: AKI calculations from Eurostat, Comtrade and HCSO data

milk exports Hungary's market share in *dairy, eggs, honey and edible products* commodity group (HS-04) increased by 1.5 per cent.

Hungarian exports to Slovakia increased by EUR 365 million, from this 33 per cent (EUR 119 million) was due to the increase in market size, the market composition effect accounted for 3 per cent (EUR 10 million) and the competitiveness effect for 64 per cent (EUR 236 million). Slovakia was one of those few countries where all three factors were positive. For five commodity groups both the market share increased and market composition effect showed a positive result: *live animals* (HS-01), *meat and edible meat offal* (HS-02), *cereals* (HS-10), *animal or vegetable fats, oils and waxes* (HS-15) and *cocoa and cocoa preparations* (HS-18). An almost 4 percentage point fall occurred only for *preparations of vegetables, fruits, nuts etc*. (HS-20).

The Netherlands was Hungary's sixth most important market and the increase of the market size accounted for more than 43 per cent of the total growth in exports of EUR 111 million. The market composition effect was here also negative (EUR -7 million), but the competitiveness effect was EUR 70 million (64 per cent). There were only two commodity groups where the market share increased and the market composition effect also showed a positive result: *cereals* (HS-10) and *oilseeds, miscellaneous grains, medicinal plants and straw* (HS-12).

France was the ninth most important Hungarian agri-food export market with a value of EUR 175 million between 2008 and 2010, it was practically an unchanged market share. All three export increase model factors were positive. The growth of the market accounted for 38 per cent (EUR 32 million) of the total EUR 84 million growth. The market composition effect accounted for 10 per cent (EUR 8 million) and the competitiveness effect 52 per cent (EUR 44 million) respectively. Thus Hungary's competitiveness to France increased – maybe only to a small degree – against the competitors, and this fact was supported by detailed unit value calculations. There were two major commodity groups where both the market share and the market composition gave positive results: *dairy, eggs, honey and edible products* (HS-04) and *residues from food industries, animal feed* (HS-23).

EU Member States where the competitiveness effect is negative

Austria is Hungary's most important agri-food export market among the countries showing a negative competitiveness effect, being in fourth place in the period 2008-2010. Hungary's increase in exports (almost EUR 97 million) came almost solely from the growth of the market, which was EUR 198 million (206 per cent). The market composition effect was only EUR 17 million (18 per cent), while the competitiveness effect was EUR -119 million (-123 per cent). Among the commodity groups only *cereals* (HS-10) increased both the market share and the market composition effect. By contrast the market share of *meat and edible meat offal* (HS-02) exports fell by 11.5 per cent.

In Poland, the seventh most important Hungarian agri-food export market between 2008 and 2010, Hungary's more than EUR 94 million export growth came almost solely from the increase of the market size, EUR 202 million (214 per cent). The market composition effect was only EUR 21 million (23 per cent), while the competitiveness effect was EUR -129 million (-137 per cent). Both the market share and the market composition effect increased for *cereals* (HS-10).

Finally the increase of the market size in the Czech Republic gave entirely the EUR 119 million (104 per cent) increase, which was EUR 123 million. The market composition effect was EUR 37 million (31 per cent), while the competitiveness effect was negative (EUR -41 million and -35 per cent). For three commodity groups both the market share and the market composition effect showed positive results: *miscellaneous edible preparations* (HS-21), *beverages, spirits and vinegar* (HS-22) and *residues from food industries, animal feed* (HS-23). At the same time Hungary's market share in *meat and edible meat offal* (HS-02) fell by 10 per cent.

Export markets outside the EU

In Switzerland the EUR 20.7 million increase was almost solely due to the USD 66.4 million increase in market size (319 per cent of the whole increase), while the market composition effect was only USD 806 thousand (3.9 per cent) and the competitiveness effect was USD -46.4 million (-223.3 per cent). It means that Hungary's negligible increase in exports is due only to a doubling of the entire Swiss imports. The market composition effect was unchanged; consequently Hungary could not adapt to the changed Swiss demand. We could not find any commodity group where Hungary's market share and the market composition effect gave a positive result. The *meat and edible meat offal* (HS-02) exports – even though something lost from the market share – increased by more than three-quarters, while the export market share of *edible preparations of meat, fish, crustaceans etc*. (HS-16) tripled, even so just more than 2 per cent.

At present Russia with its 3 per cent share is only in tenth place among Hungary's export markets, here the effect of the market size was USD 280 million (18.2 per cent), the market composition effect was USD -16 million (-11 per cent) and the competitiveness effect was USD -116 million (-65.8 per cent). It means that the USD 148 million increase is due only to the increase in the Russian demand. Hungary could successfully increase its export market share in *live animals* (HS-01), from this product the composition effect was only close to a third part. Hungary's *meat and edible meat offal* (HS-02) exports more than tripled, but its market share increased only negligibly. From the tripled Russian vegetable and fruit imports Hungary's market share fell to 7.7 per cent.

Ukraine is in 14th place amongst Hungary's export markets. From the USD 96 million increase in income from exports, USD 68.8 million is from the effect of market size and USD 29 million (30.2 per cent) is from the market composition effect, but the competitiveness effect was negative (USD -1.8 million, or -1.9 per cent). Between the two analysed periods Hungary's market share of *cereals* (HS-10) and *residues from food industries, animal feed* (HS-23) increase significantly and the composition effect was positive.

Agri-food exports to Japan based on market size effect calculation is USD 38.2 million (355 per cent), the market composition effect is USD -20.3 million (-189 per cent) and the competitiveness effect is USD -7.1 million (-65.8 per cent). Apart from *meat and edible meat offal* (HS-02) exports, where Hungary just held its negligible market share, in all important commodity groups Hungary's role declined.

The USA is the most unutilised agri-food target market. The Hungarian agri-food exports continued to decrease from the former low level in the past ten years. The market size effect is USD 26.5 million, but the market compound effect of USD -1 million and the competitiveness effect of USD -35 million brought its decrease. Consequently Hungary could neither take advantage of the increase in demand nor could its export structure or competitiveness respond to the changes in this market.

Results according to the Gehlhar and Pick classification

According to the Gehlhar and Pick classification, the share of category 3 – where products may have qualitative and price benefits – decreased strongly in Hungary's exports to, and in the whole food economy foreign trade with, the EU between 2001-2003 and 2008-2010. Taking categories 1 and 3 together, the proportion of Hungary's competitive products declined in the exports from 88.3 per cent to 73.3 per cent and in the whole food economy foreign trade from 70.3 per cent to 51.2 per cent (Table 2).

Table 2: Hungarian food industry external trade with all EU Member States in 2001-03 and 2008-10 according to the Gehlhar and Pick rating.

Category	Exports	External Trade*	Exports	External Trade
	2001-2003 average		2008-2010 average	
1	46.93	37.55	48.36	32.52
2	5.51	14.59	13.57	25.43
3	42.37	32.71	24.91	18.67
4	5.19	15.14	13.16	23.39

* Whole food industry external trade = exports + imports
Source: AKI calculations from Eurostat data

However, these results tell us little about the competitiveness of the Hungarian food export products in the individual EU Member States. Thus we made a more detailed competitiveness examination by analysing separately Hungary's five most important export markets (Romania, Germany, Italy, Austria and Slovakia) on the basis of the Gehlhar and Pick classification (Figure 1).

For Germany the comparison of the two periods indicated that the share of category 3 in the exports (for example exports of meat products fell) by more than than half. Taking categories 1 (e.g. oil plants and plant oil) and 3 together, then the proportion of Hungary's competitive products in the exports fell from 93.8 per cent to 90.3 per cent between the two periods, so a strong restructuring occurred between categories 1 and 3.

The proportion of category 3 in the exports to Romania increased more than threefold. Taking categories 1 and 3 together, then the share of Hungary's competitive products in the exports rose from 96.2 per cent to 99.3 per cent between the two periods (that is to say non-competitive Hungarian products hardly existed), so from the viewpoint of categories 1 and 3 (e.g. maize and wheat) a strong improvement occurred.

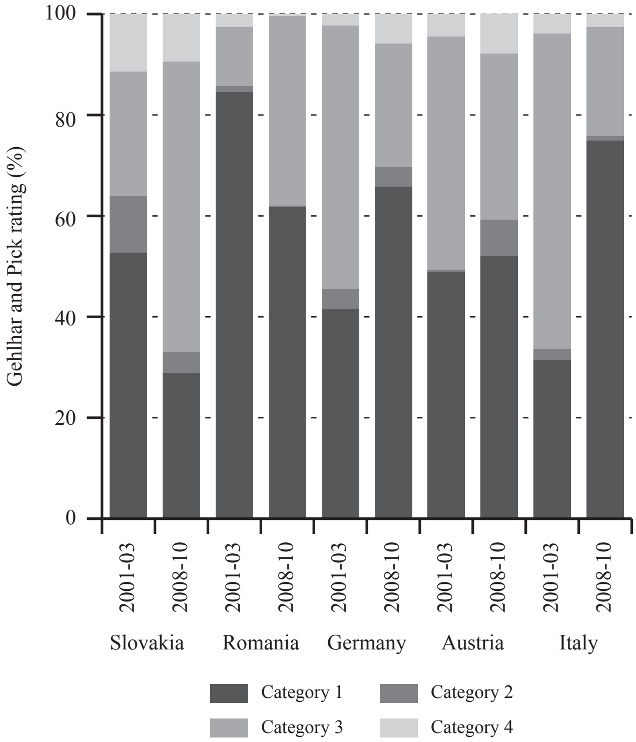

Figure 1: Hungarian food industry external trade with five EU Member States in 2001-03 and 2008-10 according to the Gehlhar and Pick rating.
Source: AKI calculations from Eurostat data

In Hungary's exports to Italy, the share of category 3 (e.g. poultry meat or pet food) decreased strongly, declining by almost two thirds between the two analysed periods. On the other hand the share of category 1 (as a result of the increase of grain and milk exports) greatly increased. The common share of categories 1 and 3 increased from 93.8 per cent to 96.5 per cent between the two periods.

In the case of Austria the proportion of category 3 (e.g. poultry meat) in exports showed a strong decrease, falling by nearly one third. On the other hand the share of category 1 (e.g. cereals) increased by three percentage points, but the share of category 2 (e.g. pork) rose above 7 per cent. The common share of categories 1 and 3 decreased from 95 per cent to 83 per cent.

In the agri-food exports to Slovakia the proportion of category 3 (e.g. pork and poultry meat) increased more than 2.3-fold. On the other hand the share of category 1 (e.g. maize) decreased by half. The common share of Hungary's competitive products in categories 1 and 3 increased from 81.5 per cent to 86.3 per cent.

Discussion

Our results show that the trend did not change since the analysis of Fertő (2001), Juhász *et al*. (2002) and Fogarasi (2008). The main source of the increase in Hungarian food industry exports to the analysed markets is the general increase of the imports there. But the commodity structure of Hungary's exports frequently did not fit to the most increasing import segments.

We accounted altogether 38 different subgroups on the 14 selected markets at the unit value calculations, which reflects the change of the general survey of the certain sections in detail. The total price income of these subgroups exceeded the determined euro margin of the markets in the average of 2008-2010. We analysed these in detail based on the unit value and the market share.

The CMS analysis shows that the grain sector is the success sector, it is represented only by maize and wheat. In ten markets maize was the most important product (only in four non-EU markets was this not the case) and wheat appeared in the examination of five countries. Based on the unit price we can say that Hungary's transportation radius defined by the export efficiency is smallish for both grains. The feed grain is delivered preferentially to the neighbouring countries and Hungary is competitive with seed grain only in the more distant markets. Hungary's market share of maize decreased between the two analysed periods only in the non-EU markets (Russia and Ukraine), but for wheat Hungary suffered a bigger market loss in Austria.

The analysis yielded similarly good results in the oil plant sector, although the export market circle is significantly narrower: rapeseed and sunflower seed were found amongst the more important products in only four countries each, including the German and the Dutch market in both cases. Hungary's unit value improved everywhere, apart from sunflower seed to Italy, and its market share increased without exception. Hungary's sunflower seed oil exports broke into totally new markets, in the German and Swiss market Hungary attained a large market share, and in the Romanian market a dominant one.

In the product lines of Hungary's meat sector the poultry meat dominated in 12 cases, namely it is one of Hungary's most important products in every markets Poland and the USA. The fact that in Hungary's exports the products have fairly differing values (goose liver, 65 percentage duck, etc.) makes the examination of its poultry meat exports based on a unit value difficult, but essentially Hungary's unit value improved in most markets. As regards to market share the situation is not so favourable; Hungary's market share decreased in the most important markets and improvements were achieved only in Romania and Slovakia.

Pork figured in only six markets and the lack of the big western European markets was prominent. Towards Romania and Slovakia Hungary's market share increased, and its unit value increased everywhere except in Italy. Beef was exported only to the Netherlands in a bigger quantity, but Hungary's market share is insignificant there too. Rabbit meat in the Swiss market and the cutting by-products on the Russian market are important items. Hungary's processed meat products are represented in only two markets.

Horticultural products figure among the analysed products rather in processed form; other fresh vegetable are exported in a bigger quantity only to Austria. On the other hand tinned vegetables appear five times. Among the other subgroups of the sector Hungary delivers fruit and vegetable juice to the German and Austrian market, while preserves also find customers in the German market.

Among the other subgroups pet food had the second most incidences, apart from two non-EU countries it was not included in the more important products only in the Dutch and Slovak markets. Hungarian honey, which is a *Hungaricum*, appeared in the more important products in only three markets. The unit value of Hungarian exports increased, but good quality products were present on this market to no avail, as Hungary suffered a loss of market share to the cheaper products of competitors.

The Gehlhar and Pick rating on the EU market showed that the share of competitive export products between the two time periods decreased from 88.3 per cent to 73.3 per cent. From the most important export markets in Germany and in Austria decreased the share of competitive categories, while on the other markets the situation of the Hungarian export products improved. In the individual branches there were significant differences between the two time periods. The biggest improvements in the competitiveness effect were with grain and oilseeds, but significant positive change also occurred with vegetable oils. The biggest negative change in the competitiveness effect was with meat products.

The most important problem and disadvantage of the logistics of the Hungarian agricultural sector is the weaker transport infrastructure compared to the competitors, i.e. the still unsatisfactory quantity, quality and geographical location of the storage and transport capacity and the lack of special transport vehicles. Kartali (2008) summarised the Hungarian food industry market structure as follows: in the current financial situation the logistical problems cannot be solved in the short term neither from EU funds nor from the national budget, and private equity is providing only modest financing for these kind of developments. Thus it is not likely that the weaknesses in the agri-food exports logistics can be solved in the short term.

After the liberalisation of the railway transport from 1 January 2007, the domestic railway network is open for all countries, therefore the competitiveness of the international railway transport companies has become stronger. The railway transport has to cope with severe competitiveness problems in Hungary, because the use charges are very high in European comparison, the turnaround time is long and mostly there is no return transport. Although with the broadening of the sales market the Hungarian crop products come from year to year to newer markets. The main target markets of the bulk dry products transported by rail were by ranking order the sea ports (Koper, Rotterdam, Constanţa), the French, German, Italian and Belgian and Dutch headquarters of food industry companies, and the Italian and Romanian mills.

The effect of the direct transaction costs of the external trade infrastructure costs are generally characterised in the gravitation model only by distance. Djankov *et al*. (2004) contrarily appreciate with the help of a much more precise information supplying database. The database had information about 126 countries, the container delivered goods, the delivering time and the costs. At the current developed logistic system the effect of the transport on the trade cannot be eliminated. A one day logistic lag can decrease the trade potential of a given country on average by 1 per cent and has an effect equivalent to being 70 km further away from the trading partner. It indicates also the disadvantage of Hungary, because their analysis has a particularly big effect on the agricultural and industrial products and on the countries without a coast.

Furthermore, according to Török and Déli (2004) the hidden, not customs like restrictions at national cases therefore were not particularly diverse, because the agriculture built industries are generally open and attached to strong political interests. Furthermore the big international retail chains had to accomplish stronger state quality requirements for their foreign suppliers. Hungarian companies often cannot meet these requirements. In Austria the high authorisation and procedure costs made it harder for the foreign producers to come on the market. This system earlier from the EU very independent way, worked on local nature. In many countries the domestic agricultural and food exporters found that the certifications of accredited Hungarian laboratories were not approved and that the local qualification has significant extra costs.

Juhász and Wagner (2012) also showed that ranking by the national density of law and by the effectiveness of trade logistics (cost, time interval and number of the documents) is almost contradictory. Most of the western European countries are 'good traders', they form an efficient distributional system and they are – from a general economic interest – remarkably open toward the foreign trade. Nevertheless these countries also use vigorously the indirect methods of market protection, and imports are hindered by public health, consumer protection or other reasons.

Despite the abovementioned facts the eastern EU Member States are leaders in terms of trade effectiveness and have characteristically not learned the 'gentle' market defence methods, and the number of such measures is generally low. From the 'old' Member States Italy and Spain are exceptions because both are ranked at the top, so their level of effectiveness of foreign trade logistic is low and they apply the braking effect of their indirect law measures to the maximum.

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Terms of trade, capital accumulation and the macro-economy in a developing country: a theoretical analysis

This paper attempts to explain the terms of trade adjustment and the process of capital accumulation in a monetary model of sectoral interlinkage under rational expectation. The paper utilises a very standard dual economy framework in which industry and agriculture are two distinct sectors of production. Agriculture production is supply constrained. This may arise due to fixed endowment of land, weather condition etc. On the other hand, employment and output in the industrial sector are determined on the basis of profit maximisation in the presence of wage indexation. The asset structure of the economy includes the stock of primary commodities as one form of asset holding. Since the stock of agricultural commodities is one of the financial assets, its demand is subject to speculation which may entail fluctuating agricultural prices. Many factors have effects on fluctuating agricultural prices. These include monetary shock, parametric changes in agricultural production, changes in government expenditure etc. In this paper we discuss the comparative static effects of parametric changes of these factors. The paper shows that the short run and long run effects of any particular shock are quite different, not only quantitatively, but also qualitatively. Accordingly, the policy message of the paper is that the short run response may not be a reliable guide to the design of policy.

Keywords: industry-agriculture interlinkage, capital accumulation, terms of trade dynamics

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Introduction

In recent years there has been increasing interest in macroeconomic models of sectoral interlinkage in which commodity price fluctuation is put at the centre of all concerns. This concern is easily understandable, since fluctuations in commodity prices induce fluctuations in real national income and pose problems for macroeconomic management. These models have been seen as a way to formulate policy guidelines to reduce these fluctuations. A key element in many of these models is overshooting of agricultural prices[1] caused by unanticipated monetary expansion. The point is obvious. If a stock of primary good is an asset and its price adjusts instantaneously, while industrial price adjusts slowly, agricultural price overshoots in response to monetary expansion.

The academic interest in the possible impacts of monetary policy on agricultural markets is of recent origin. Frankel (1986) set up a closed economy model to explain overshooting of agricultural prices following an unanticipated expansion in money stock. He emphasised the distinction between fixed price sectors (manufacturing), where prices adjust slowly and a flex price sector (agriculture), where prices adjust instantaneously in response to a change in the money supply[2]. Lai *et al*. (1996) employed Frankel's framework to investigate how anticipated and unanticipated monetary shocks influence commodity prices. Moutos and Vines (1992) also examined the role of commodity prices in the macroeconomic process of output and inflation determination. The econometric models of Orden and Fackler (1989) and Ghironi (2000) show that an increase in money supply raises agricultural prices relative to the general price level for more than a year, indicating persistence of the effect of monetary changes on relative agricultural prices both in the short run and in the long run. Saghaian *et al*. (2002) also explained short run and long run effects on agricultural prices in response to unanticipated monetary shocks. Bakucs and Fertő (2005) tested the overshooting hypothesis with reference to Hungarian agricultural prices. Saghaian *et al*. (2002) studied the overshooting of agricultural prices in four Asian countries (Korea, Philippines, Thailand and Indonesia).

Once we get a story of commodity price fluctuations, however, there arise some immediate questions. Is this fluctuation solely attributable to monetary shock? Do the existing monetary macro models provide an appropriate framework to predict commodity prices and more generally terms of trade behaviour? And, what are the macroeconomic implications of fluctuations in terms of unemployment and output?

We develop a monetary macro model specially designed for a developing country. In particular, this paper makes a theoretical attempt to find answers to these questions. Firstly, we introduce the medium term dynamics through adjustment of capital stock[3]. Secondly, the paper addresses the issue of unemployment of industrial labour. In the model of the existing literature, full employment of labour is assumed and money is neutral in the long run. On the contrary, we incorporate unemployment through wage indexation. Specifically, we assume that industrial wages are indexed to the consumer price index. Thirdly, the paper pays explicit attention to both monetary and real shocks as sources of volatility of terms of trade. The model in this paper is a structuralist

[1] Overshooting of prices is defined as a temporary change in its value beyond its long run equilibrium.

[2] Frankel's model can be seen as an application of Dornbusch's model of exchange rate dynamics.

[3] There exists a literature on the medium-term adjustment in a dual economy. Cardoso (1981) applied a dual economy framework to capture the relationship between agricultural inflation and wage formation. The dynamics in the Cardoso model are located in structural disequilibrium, namely the mismatch between wage goods constraint and non-fulfilment of aspirations of different groups. Taylor (1985) extended the model to include the capital accumulation process in an analysis of steady-state dynamics. Rattsø (1989) offered a similar investigation of the medium-run dynamics for a dual economy. However, these works left aside the role of speculation in inducing volatility in agricultural price.

Figure 1: Price developments of agricultural commodities, 1980-2006 (index, January 1980 = 100).

Source: Böwer *et al*. (2007)

monetary model focusing on terms of trade volatility, capital accumulation, employment and output determination in the industrial sector under rational expectation and supply constraints imposed by the agricultural sector. Our model is more complex than the existing models due to two major modifications which are prompted by structural features in a developing country, namely unemployment and medium term dynamics through capital accumulation.

The paper is organised as follows. In the next section we build up the model and then we examine dynamic adjustment and examine saddle path stability of the system. Consideration of a few comparative static exercises follows, while the final section concludes the paper.

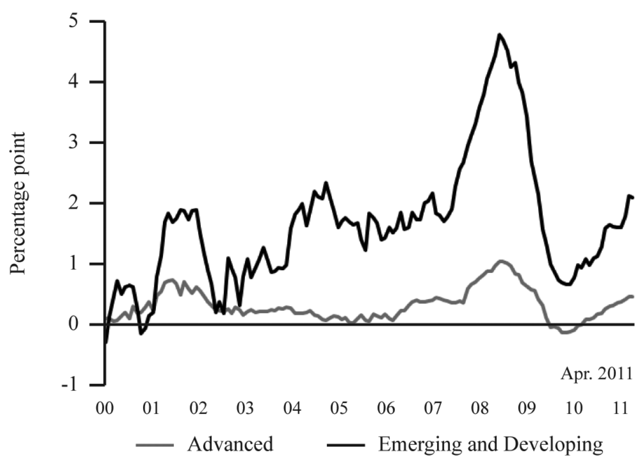

Figure 2: Contribution of food to headline inflation.

Source: Loungani (2012)

The model

Here we attempt to develop a monetary macro model of sectoral interlinkage. The model combines elements from recent research on commodity price fluctuations in a rational expectation framework with (somewhat old) structuralist macroeconomic models of sectoral interlinkage in a dual economy structure. We integrate dual economy interlinkage in a developing country with full stochastic rational expectations equilibrium in a monetary framework. Such integration and use of the model to study the macroeconomic implications of commodity price fluctuations induced by a variety of shocks are the purposes of this paper.

The goods produced are manufactures (produced in the industrial sector) and primary commodities (produced in the agricultural sector). We assume wage indexation for industrial workers, which allows for unemployment in the economy. Food price is a jump variable, which instantaneously guarantees asset market equilibrium. In fact, prices of many agricultural commodities show a high degree of volatility caused by time lags between production decisions and delivery to the market; delayed and inappropriate responses by producers to price signals; inelastic supply and natural shocks. This volatility aspect of commodity prices is evident from Figure 1.

Furthermore, the contribution of surging prices of primary commodities in overall inflation is quite substantial for developing countries compared to the advanced countries (Figure 2).

On the other hand, industrial price is sticky which leads to disequilibrium in the market for industrial goods. Moreover, we assume that the economy is closed. Thus, the model in this paper is a disequilibrium, dual economy model with unemployment and perfect foresight.

This section is subdivided into three subsections. The first contains a description of the supply side and this is followed by a description of asset structure with portfolio choice. The demand side is analysed in the third subsection along with an inflation mechanism for industrial goods.

The supply side

Agricultural output: Agricultural output (F) is fixed in the time frame of our model[4]. Thus, we get the following supply function of the agricultural output:

$$F = \overline{F} \tag{1}$$

Industrial output: Labour (L) and capital (K) are used to produce the industrial output (Y). The production function for industrial production takes the following form:

$$Y = f(L,K),\ f_L > 0,\ f_{LL} < 0,\ f_{LK} > 0 \tag{2}$$

Employment in the industrial sector is derived from the condition of profit maximisation, namely equality between marginal product of labour and real product wage. Thus we get the labour demand function as:

$$L = L\left(\frac{W}{P_Y}\right),\ L' < 0 \tag{3}$$

where W is the money wage and P_Y is the price of industrial output.

Next we consider money wage determination. Instead of assuming flexible adjustment in money wage, we take money wage to be determined as an outcome of a bargaining process. Specifically, we assume that money wage is determined by a social pact which protects the real consumption wage. In other words, money wage is linked to the consumer price index:

$$W = P_Y^{\alpha} P_F^{1-\alpha}\ 0 < \alpha < 1 \tag{4}$$

where α and $1{-}\alpha$ are constant expenditure shares of industrial goods and agricultural goods respectively and P_F is the price of agricultural output.

Now, $\frac{W}{P_Y} = \theta^{1-\alpha}$ (5)

where $\theta = \frac{P_F}{P_Y}$, is the terms of trade.

From equations (1), (3) and (5) we get the supply function of industrial goods:

$$Y_s = Y_s(\theta) \text{ with } Y_s' = \frac{dY_s}{d\theta} = \left(\frac{f_L}{f_{LL}}\right)(1-\alpha)\theta^{-\alpha} < 0$$

Aggregate output: Let Z denote aggregate output (or real income) measured in units of industrial goods:

$$Z = \theta F + Y_s(\theta) \tag{6}$$

In what follows we take $\frac{dZ}{d\theta} > 0$ [5]

The financial sector

In the conventional dual economy models, food price equates to the flow supply and flow demand for agricultural output. Here, by contrast, we focus on the role of stock of primary goods as financial assets and we study the effect of forward-looking food price expectation[6]. We assume that stocks of food grains and government bonds are perfect substitutes. The financial sector is represented by the following equations:

$$\frac{M}{P_Y} = aZ - lr\ a,l > 0 \tag{7}$$

$$\frac{\dot{P}_F}{P_F} + s = r \tag{8}$$

where s is the difference between the convenience yield and the storage cost of holding primary commodities and is taken to be positive.

Equation (7) represents the money market equilibrium where M is the nominal money balance, which is deflated by the price of manufactured goods. We choose a linear money demand function where demand for the real balance depends negatively on the interest rate and positively on real income.

Unlike manufactured goods, primary commodities are used as one form of asset along with money and bonds. Equation (8) reflects the assumption of perfect substitutability between stocks of primary commodities and bonds such that returns on these two assets are brought into equality through arbitrage. The term $\frac{\dot{P}_F}{P_F}$ represents expected change (and actual change under the assumption of perfect foresight) in food price. Hence, return on stocks of primary commodities is $(\frac{\dot{P}_F}{P_F} + s)$. The return on bonds is the interest rate (r)[7].

Demand side and industrial price inflation

We choose a linear consumption function such that total private consumption expenditure is $C = \beta Z$, where β is the marginal propensity to consume. Since α is the constant share of expenditure on industrial goods, the consumption demand for industrial goods is $\alpha\beta Z$. Investment expenditure on the industrial goods depends on the real interest rate $(r - \pi_y)$ where r is the nominal interest rate and π is the industrial inflation rate and we choose a linear investment function, namely $a - v(r - \pi)$ $(a > 0,\ v > 0)$. Government expenditure (G)

[4] Availability of land emerges as a binding constraint on agricultural growth. The potential of further expansion of the net sown area is practically non-existent and, given the environmental commitments, it may further decline. Moreover, a feeble price response is attributable not only to a reasonably fixed land supply, but also to lower initial input intensity and crop pattern governed by agro-climatic factors. One can introduce capital accumulation for the agricultural sector as well. However, agriculture in most developing countries has not experienced any major surge in private investment. In any case, industrial investment occurs more quickly and at a faster rate, compared to investment in the agricultural sector.

[5] The response of Z in response to θ is calculated as follows:

$$\frac{dZ}{d\theta} = F + Y_s' = \frac{P_F F - WLe_L}{\theta}$$

where e_L is the elasticity of demand for labour in the industrial sector.

Clearly, $\frac{dZ}{d\theta} > 0$, if $\frac{P_F F}{WL} > e_L$

This condition is more likely to be satisfied in a dual economy with a significant share of agricultural output in national income.

[6] We note that the price of manufactured goods is used as the deflator to express real income measured in units of industrial goods. However the model abstracts from adjustment in the stock of agricultural goods. Though this is a limitation of the model, this is a purposive abstraction which we make to keep the model within tractable limits. The similar abstraction is also made by Frankel (1986) and Moutos and Vines (1992).

[7] Thus we use an asset approach to examine food price dynamics.

is parametrically given. Thus the aggregate demand for the industrial goods is $(\alpha\beta Z + a - v(r-\pi) + G)$.

Next, we consider inflation dynamics. Instead of allowing instantaneous market clearing of industrial goods, we assume the industrial price to be sticky. However, the inflation rate can change in response to excess demand for the industrial goods. Now a few comments on the industrial price are in order. Since the price of industrial goods cannot jump, the industrial sector can remain in disequilibrium. The form of disequilibrium determines the inflation rate. Thus, the current industrial price level is determined by the past rates of inflation and the current inflation rate determines the future price level. At any particular point in time the industrial price is predetermined. Now the inflation rate of industrial price is:

$$\frac{\dot{P}_Y}{P_Y} = \pi_y = \delta\{(\alpha\beta Z + a - v(r-\pi) + G) - Y_S\}, \delta > 0 \qquad (9)$$

Dynamic adjustment and stability

Firstly we consider dynamic adjustment of the terms of trade. Equations (8) and (9) can be combined together to produce the dynamic adjustment in the terms of trade. Noting that $\theta = \frac{P_F}{P_Y}$, we get:

$$\frac{\dot{\theta}}{\theta} = \frac{\dot{P}_F}{P_F} - \frac{\dot{P}_Y}{P_Y} = r - s - \pi\{(\alpha\beta Z + a - v(r-\pi) + G) - Y_S\} \quad (10)$$

In an implicit form the terms of trade dynamics can be expressed as:

$$\frac{\dot{\theta}}{\theta} = g(\theta, K, F, G, M) \qquad (11)$$

with $g_1>0$, $g_2>0$, $g_3>0$, $g_4<0$, $g_5<0$ where:

$$g_1 = A + \theta\frac{\delta r}{\delta\theta} - \theta\left[\delta\left\{\alpha\beta\frac{\delta Z}{\delta\theta} - v\frac{\delta r}{\delta\theta} + v\frac{\delta\pi}{\delta\theta} - Y_s'\right\}\right] > 0\left(\frac{\delta r}{\delta\theta}, \frac{\delta Z}{\delta\theta}, \frac{\delta\pi}{\delta\theta}\right) > 0$$

and we assume that food price inflation is greater than industrial price inflation and A is a constant.

$$g_2 = \theta\left[\frac{\delta r}{\delta K} - \delta\left\{-v\frac{\delta r}{\delta K} + v\frac{\delta\pi}{\delta K} + \frac{\delta Y_s}{\delta K}\right\}\right] > 0\left(\frac{\delta r}{\delta K} > 0, \frac{\delta\pi}{\delta K} < 0, \frac{\delta Y_s}{\delta K} > 0\right)$$

$$g_3 = \theta\left[\frac{\delta r}{\delta F} - \delta\left\{\alpha\beta\frac{\delta Z}{\delta F} - v\frac{\delta r}{\delta F} + v\frac{\delta\pi}{\delta F}\right\}\right] > 0\left(\frac{\delta r}{\delta F} > 0, \frac{\delta Z}{\delta F} < 0, \frac{\delta\pi}{\delta F} > 0\right)$$

and we assume that food price inflation is greater than industrial price inflation.

$$g_4 = -\theta\delta < 0$$

$$g_5 = \theta\left[\frac{\delta r}{\delta M} - \delta\left\{-v\frac{\delta r}{\delta M} + v\frac{\delta\pi}{\delta M}\right\}\right] < 0\left(\frac{\delta r}{\delta M} < 0, \frac{\delta\pi}{\delta M} > 0\right)$$

The intuitive explanation of sign restrictions are as follows:

We begin with an initial steady state value θ such that $\frac{\dot{\theta}}{\theta} = 0$ and examine the effect on $\dot{\theta}$ following any change in variables that appear in equation 11. A rise in θ leads to an increase in the real income and hence the demand for money goes up which leads to an increase in interest rate and causes food price inflation. This follows from equations (7) and (8). On the other hand, a rise in θ leads to a fall in the industrial output. On the demand side, private consumption expenditure on industrial good rises, but private investment falls. For reasonably low interest elasticity of private investment, we can assume that there is an increase in the excess demand for industrial goods and a consequent increase in the rate of industrial price inflation. However, we assume that the rate of food price inflation exceeds that of industrial price inflation in response to the rise in θ such that $g_1>0$.

Next, we consider a rise in K. This causes industrial output to rise. Since aggregate income rises for any given value of θ, the interest rate rises to maintain money market equilibrium, which leads to food price inflation (this follows from equation 8).

On the other hand, a rise in the industrial output and fall in investment reduce the rate of industrial price inflation. Hence, $g_2>0$. Now, a rise in F increases the real income, which causes interest rate to rise. As a result the rate of food price inflation increases. However, the effect on the inflation rate of industrial price is ambiguous. On the one hand, we have an increase in consumption expenditure on the industrial output and on the other we have a fall in investment expenditure. However, we assume that the rise in food price inflation exceeds any possible increase in the rate of industrial price inflation such that $g_3>0$. The explanation for $g_4<0$ is simple. A rise in government expenditure increases the rate of industrial price inflation and hence makes $\frac{\dot{\theta}}{\theta} < 0$, i.e. $g_4<0$.

Lastly, we consider the effect of increase in money supply on $\frac{\dot{\theta}}{\theta}$. A rise in money supply entails a fall in the interest rate such that the rate of food price inflation falls and a rise in investment leads to an increase in the rate of industrial price inflation. This leads to $\frac{\dot{\theta}}{\theta} < 0$, i.e. $g_5<0$.

Next, we consider the dynamics of capital accumulation. Beyond the short run, investment alters the size of the capital stock: $\dot{K} = a - v(r-\pi) - \delta(K), \delta' > 0$, where δ is the rate of depreciation and is positively related to the stock of industrial capital. In an implicit form, the dynamics of capital accumulation can be expressed as:

$$\dot{k} = \phi(\theta, K, F, M) \qquad (12)$$

With the following restrictions on the signs of partial derivatives: $\phi_1 < 0, \phi_2 < 0, \phi_3 < 0, \phi_4 > 0$.

$$\phi_1 = -v\frac{\delta r}{\delta\theta} + \frac{\delta\pi}{\delta\theta} < 0\left(\frac{\delta r}{\delta\theta} > 0, \frac{\delta\pi}{\delta\theta} > 0 \text{ and we assume that } \frac{\delta r}{\delta\theta} > \frac{\delta\pi}{\delta\theta}\right)$$

$$\phi_2 = -v\frac{\delta r}{\delta K} + \frac{\delta\pi}{\delta K}\left(\frac{\delta r}{\delta K} > 0, \frac{\delta\pi}{\delta K} > 0 \text{ and we assume that } \frac{\delta r}{\delta K} > \frac{\delta\pi}{\delta K}\right)$$

$$\phi_3 = -v\frac{\delta r}{\delta F} + \frac{\delta\pi}{\delta F}\left(\frac{\delta r}{\delta F} > 0, \frac{\delta\pi}{\delta F} > 0 \text{ and we assume that } \frac{\delta r}{\delta F} > \frac{\delta\pi}{\delta F}\right)$$

$$\phi_4 = -v\frac{\delta r}{\delta M} + \frac{\delta\pi}{\delta M}\left(\frac{\delta r}{\delta M} < 0, \frac{\delta\pi}{\delta M} > 0\right)$$

Intuitive explanations for these sign restrictions are as follows:

A rise in θ, K and F lead to an increase in the interest rate and hence reduce investment, while a rise in M leads to a fall in the interest rate and hence a rise in investment.

In the steady state $\frac{\dot{\theta}}{\theta} = 0$ and $\dot{K} = 0$

The slope of $\dot{\theta} = 0$ is $\frac{d\theta}{dK}\Big|_{\dot{\theta}=0} = -\frac{g_2}{g_1} < 0$ and the slope of $\dot{K} = 0$ is $\frac{d\theta}{dK}\Big|_{\dot{K}=0} = -\frac{\phi_2}{\phi_1} < 0$

Equations (11) and (12) constitute a system of differential equations in the terms of trade and the capital stock. The terms of trade is free to jump in response to news, which includes unanticipated current and future changes in exogenous variables and policy instruments. However, the capital stock in the industrial sector is a predetermined variable which can change only on a flow basis in response to investment. We concentrate on a stable saddle path because it gives an economically meaningful result. In the presence of perfect foresight the existence of a unique convergent saddle path requires that there must be one positive and one negative characteristic root such that the determinant:

$\Delta = \begin{vmatrix} \phi_2 & \phi_1 \\ g_2 & g_1 \end{vmatrix} < 0$ i.e. $-\frac{g_2}{g_1} < -\frac{\phi_2}{\phi_1}$

This condition is satisfied if the $\dot{K} = 0$ locus is steeper than the $\dot{\theta} = 0$ locus (Figure 3). The saddle path SS is downward sloping and flatter than the $\dot{\theta} = 0$ locus. The equation of the saddle path is

$$(\theta - \bar{\theta}) = \left(\frac{\lambda_1 - \phi_2}{\phi_1}\right)(K - \bar{K}) = \left(\frac{g_2}{\lambda_1 - g_1}\right)(K - \bar{K})$$

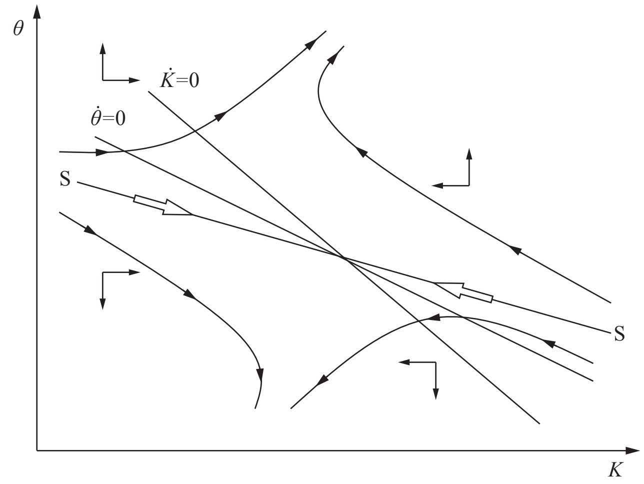

Figure 3: Phase diagram and saddle path stability with θ being the jump variable and K being the slow moving variable.

Source: own composition

Comparative statics

In this section we consider the effect on terms of trade and capital stock in response to a variety of shocks. The specific shocks examined are: (a) increase in money supply, (b) increase in government expenditure and (c) a rise in the agricultural output of food.

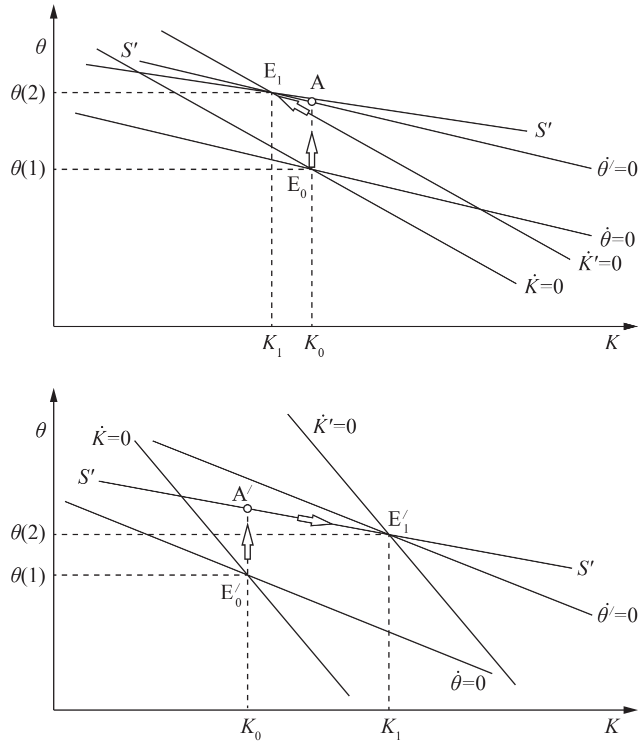

Figure 4: (a) Undershooting and (b) overshooting of θ associated with monetary expansion.

Source: own composition

Monetary expansion

In our model the real money supply in units of industrial goods is fixed. Thus money supply adjusts in response to inflation of industrial goods. In other words, money supply is proportional to the price of industrial goods. By monetary policy we mean change in this proportion[8]. An increase in real money balance may generate a contractionary effect on industrial output along with industrial price inflation. The explanation of the effect of monetary expansion is straightforward.

Let us consider an increase in real balance. This leads to a fall in the interest rate and hence it causes a fall in the rate of food price inflation. Again, private investment rises due to the fall in the interest rate, which entails a rise in the rate of industrial price inflation. On both counts, we have a fall in the rate of change in θ, that is, we have $\dot{\theta} < 0$, starting from $\dot{\theta} = 0$. Hence, θ will rise to maintain $\dot{\theta} = 0$. This is represented by an upward shift of the $\dot{\theta} = 0$ curve. Since interest rate falls, private investment rises and the $\dot{K} = 0$ curve shifts to the right. For any given value of the stock of industrial capital, the terms of trade increases leading to a rise in the real wage rate and a consequent fall in the industrial output. A possible long run outcome is a fall in the stock of industrial capital at the end the adjustment process. In the case of a fall in the capital stock, the terms of trade undershoots its long run equilibrium value. This will exacerbate the initial industrial recession. On the other hand, if capital stock increases, terms of trade overshoots in the long run (Figures 4a and 4b).

[8] We consider the cases where monetary changes are both unanticipated and implemented as soon as they are announced.

In Figure 4a (4b) the equilibrium initially jumps from point E_0 (E_0') to point A (A′) along the new saddle path. Since *K* cannot jump instantaneously, point A (A′) is the only transitional position. The transition towards the new steady state is characterised by the path between A (A′) and E_1 (E_1'), along which *K* declines (rises) and *θ* increases. In fact, a decrease (increase) in *K* causes a rise (fall) in *θ* causing undershooting of *θ*. The final and initial changes in *θ* are represented by following two equations respectively:

$$d\theta = \alpha_2 dM = \frac{-g_5\phi_2 + g_2\phi_4}{\Delta}dM \quad \begin{matrix} > 0 \; if -\frac{g_5}{g_2} > \frac{\phi_4}{\phi_2} \\ < 0 \; otherwise \end{matrix}$$

The initial change in *θ* is given by:

$$\theta(0) - \bar{\theta}(1) = \left(\alpha_2 - \alpha_1\left(\frac{\lambda_1 - \phi_2}{\phi_1}\right)\right)dM$$

Subtracting the second equation from the first equation we obtain the value of undershooting or overshooting of *θ* and this is given by:

$$\bar{\theta}(2) - \bar{\theta}(0) = \alpha_1\left(\frac{\lambda_1 - \phi_2}{\phi_1}\right)dM$$

If $\alpha_1 > 0$ i.e. capital stock increases, then the terms of trade overshoots. On the other hand, if $\alpha_1 < 0$ i.e. capital stock decreases the terms of trade undershoots[9].

Rise in government expenditure

An increase in government spending on manufactured goods leads to a rise in the rate of industrial price inflation. This in turn causes $\dot{\theta} < 0$, starting from $\dot{\theta} = 0$. Thus fiscal expansion shifts the $\dot{\theta} = 0$ curve upwards. For any given value of the stock of industrial capital, the terms of trade rises on impact and the economy is placed at point A. Over a period of time the capital stock begins to decline and the terms of trade rises further. Thus, the model shows undershooting of the terms of trade following fiscal expansion. The rise in terms of trade causes an initial contraction of the industrial sector, which is aggravated by a fall in the capital stock.

Our result needs to be contrasted with the general price overshooting model (Frankel, 1986; Moutos and Vines, 1992). In those papers, there was an unambiguous expansion of industrial output and an ambiguous effect on the terms of trade. Moreover, in their papers the terms of trade may either overshoot or undershoot. In our model, the terms of trade unambiguously move in favour of the agricultural sector and, given wage indexation in the industrial sector, a rise in the terms of trade invariably leads to a fall in industrial output. Moreover, capital stock decumulation in the industrial sector causes undershooting of the terms of trade.

This is illustrated in Figure 5 where the equilibrium initially jumps from point E_0 to point A along the new saddle path. Since *K* cannot jump instantaneously, point A is the only transitional position. The transition towards the new steady state is characterised by the path between A and E_1 along which *K* declines and *θ* increases. In fact, a decrease

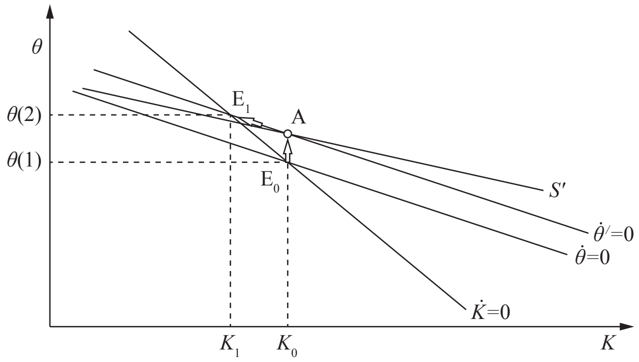

Figure 5: Undershooting of *θ* on account of a rise in government expenditure.

Source: own composition

in *K* causes a rise in *θ* causing undershooting of *θ*. The initial and final changes in *θ* can be captured by following equations:

$$d\theta = \alpha_4 dG = \frac{-g_4\phi_2}{\Delta}dG > 0$$

The initial change in *θ* is given by:

$$\theta(0) - \bar{\theta}(1) = \left(\alpha_4 - \alpha_3\left(\frac{\lambda_1 - \phi_2}{\phi_1}\right)\right)dG$$

Subtracting the second equation from the first equation we obtain the value of undershooting of *θ* and this is given by:

$$\bar{\theta}(2) - \bar{\theta}(0) = \alpha_3\left(\frac{\lambda_1 - \phi_2}{\phi_1}\right)dG$$

Since $\alpha_3 < 0$ i.e. capital stock decreases, the terms of trade undershoots.[10]

Rise in agricultural output and relaxation of supply constraint

Rising agricultural production is of great importance in promoting economic development. Since land is a major constraint, agricultural expansion requires significant technological progress. In this paper a rise in agricultural output may lead to an expansion in industrial output. This is amenable to easy economic interpretation.

Suppose we consider an increase in agricultural output. This leads to an increase in aggregate income and hence the demand for money rises. It follows from the money market equilibrium the interest rate rises, leading to $\frac{\dot{P}_F}{P_F} > 0$. On the other hand, the effect on excess demand for the industrial output is ambiguous. It has already been explained in the context of dynamic adjustment of the system, $\frac{\dot{\theta}}{\theta} > 0$ following an increase in the agricultural output. Hence, the $\frac{\dot{\theta}}{\theta} = 0$ curve shifts downwards (Figure 6). Again, a rise in interest

[9] See the mathematical appendix for derivation of both steady state effects and transitional dynamics.

[10] Long run and transitional dynamics of fiscal expansion can be calculated very easily by similar methods as in increase in money supply.

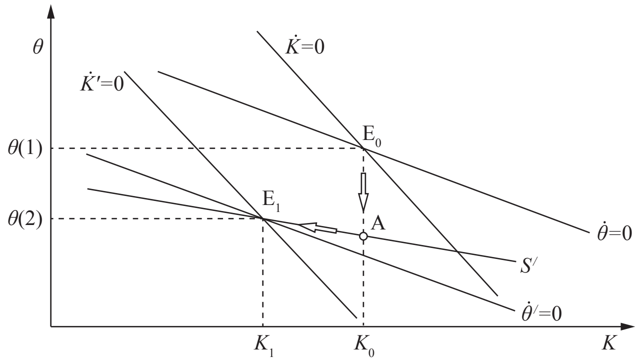

Figure 6: Overshooting of θ associated with an increase in agricultural output.

Source: own composition

rate reduces investment and the $\dot{K}=0$ shifts to the left. The effect on the stock of industrial capital is ambiguous. In case of a rise (fall) in the stock of industrial capital the terms of trade undershoots (overshoots) its long run equilibrium value. However, it is unambiguous that the terms of trade decline on impact, leading to an expansion of industrial output. The final effect on industrial output is, however, ambiguous. If the stock of industrial capital rises, the initial favourable effect on the industrial output is reinforced. In the case of a decline in the industrial capital the initial effect may be short-lived and industrial recession may follow, despite an increase in the agricultural output.

The final change in θ can be given as:

$$d\theta=\alpha_6 dF=\frac{-g_3\phi_2+\phi_3 g_2}{\Delta}dF \;\; <0 \; if -\frac{g_3}{g_2}>\frac{\phi_3}{\phi_2}$$
$$>0 \; otherwise$$

The initial change in θ is given by:

$$\theta(0)-\bar{\theta}(1)=\left(\alpha_6-\alpha_5\left(\frac{\lambda_1-\phi_2}{\phi_1}\right)\right)dF$$

Subtracting the second equation from the first equation we obtain the value of undershooting or overshooting of θ and this is given by:

$$\bar{\theta}(2)-\bar{\theta}(0)=\alpha_6\left(\frac{\lambda_1-\phi_2}{\phi_1}\right)dF$$

If $\alpha_6<0$ i.e. capital stock decreases, then the terms of trade undershoots. On the other hand, if $\alpha_6<0$ i.e. capital stock increases, then the terms of trade overshoots.

Discussion

In this paper we have examined the role of commodity prices in shaping the macroeconomic process of output, inflation and terms of trade determination. Our aim has been to show the important role which commodity prices can play in overall macroeconomic developments. The short run and long run impacts of different macroeconomic policy add to price and income instability, and influence financial viability of farmers tremendously.

The empirical relevance of such a model is also very robust. But we depart from these existing literatures in terms of two fundamental differences in the characterisation of a dual economy. The specific features of the model in this paper are completely suitable for a developing economy. One basic difference is the nature of determination of industrial output. The paper addresses the issue of unemployment of industrial labour. In the existing literature, most of the models assume full employment of labour and accordingly these models obtain long run neutrality of money. We depart from the existing literature in the sense that we incorporate unemployment through wage indexation.

The second difference is the medium run adjustment through the process of accumulation of industrial capital, which our paper focuses on. All medium run macro models are non-monetary macro models. On the other hand, the existing monetary macro models which explain the volatility of agricultural price is typically a short-run model in the sense that adjustment in capital stock is ignored. We try to integrate both approaches by incorporating adjustment of capital stock in a monetary, dual economy framework. The adjustment in the stock of industrial capital also leads to a difference in the short run and the long run effects of different macroeconomic shocks.

One possible extension of the paper is to introduce open economy dimensions into the model. One can realistically assume that the agricultural sector produces not only for the home market but also for the external market, particularly in the post-WTO situation and the industrial sector uses an imported input. There is hardly any literature on dual economy interlinkage in an open economy, monetary macro model[11]. Clearly the content of our paper can be suitably modified to accommodate relevant open economy issues.

Mathematical appendix

Saddle path derivation

From equation (11) and (12) we can write:

$$\dot{K}=\phi(\theta,K) \quad (1)$$
$$\dot{\theta}=g(\theta,K) \quad (2)$$

Taking Taylor series linear approximation around the initial steady state values $\bar{\theta}_1$ *and* $\bar{K}_1$ for period $t\leq T$,[12] we get:

$$0=\phi_2(K-K_1)+\phi_1(\theta-\theta_1) \quad (3)$$
$$0=g_2(K-K_1)+g_2(\theta-\theta_1) \quad (4)$$

Arranging (3) and (4) in matrix form, we get:

$$\begin{bmatrix}\dot{K}\\ \dot{\theta}\end{bmatrix}=\begin{bmatrix}\phi_2 & \phi_1\\ g_2 & g_1\end{bmatrix}\begin{bmatrix}K-\bar{K}_1\\ \theta-\bar{\theta}_1\end{bmatrix} \quad (5)$$

Similarly for period $t\geq T$,[13] we get:

$$0=\phi_2(K-K_2)+\phi_1(\theta-\theta_2) \quad (6)$$

[11] Orden and Fackler (1989), Ghironi (2000), Saghaian *et al.* (2002), Nag end Goswami (2005) and Asfaha and Jooste (2007) develop an open economy macro model which examines the issue of volatility of agricultural price.

[12] Here T denotes the time period at which a change in exogenous variable occurs.

[13] Here $t\geq T$, denotes the time period after a change in exogenous variable takes place.

$$0 = g_2(K - K_2) + g_1(\theta - \theta_2) \tag{7}$$

The dynamics in period $t \geq T$ are specified by

$$\begin{bmatrix} \dot{K} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} \phi_2 & \phi_1 \\ g_2 & g_1 \end{bmatrix} \begin{bmatrix} K - \bar{K}_2 \\ \theta - \bar{\theta}_2 \end{bmatrix} \tag{8}$$

Clearly eigen values λ_1 *and* λ_2 of equation 5 and 8 are identical. For the saddle path stability we require that $\lambda_1\lambda_2 = \Delta = \begin{bmatrix} \phi_2 & \phi_1 \\ g_2 & g_1 \end{bmatrix} < 0$. Let us assume that $\lambda_1 < 0$, $\lambda_2 > 0$.

Now, over the period $0 < t \leq T$, the solutions for K and θ are given by

$$K(t) = \bar{K}_1 + A_1 e^{\lambda_1 t} + A_2 e^{\lambda_2 t} \tag{9}$$

$$\theta(t) = \bar{\theta}_1 + \left(\frac{\lambda_1 - \phi_2}{\phi_1}\right) A_1 e^{\lambda_1 t} + \left(\frac{\lambda_2 - \phi_2}{\phi_1}\right) A_2 e^{\lambda_2 t} \tag{10}$$

Again, for the period $t \geq T$, the solutions for K and θ are:

$$K(t) = \bar{K}_2 + A_1' e^{\lambda_1 t} + A_2' e^{\lambda_2 t} \tag{11}$$

$$\theta(t) = \bar{\theta}_2 + \left(\frac{\lambda_1 - \phi_2}{\phi_1}\right) A_1' e^{\lambda_1 t} + \left(\frac{\lambda_2 - \phi_2}{\phi_1}\right) A_2' e^{\lambda_2 t} \tag{12}$$

It is noted that $\theta(t)$ and $K(t)$ do not diverge as $t \rightarrow \alpha$ when $A_2' = 0$ and hence the solutions would be:

$$K(t) = \bar{K}_2 + A_1' e^{\lambda_1 t} \tag{13}$$

$$\theta(t) = \bar{\theta}_2 + \left(\frac{\lambda_1 - \phi_2}{\phi_1}\right) A_1' e^{\lambda_1 t} \tag{14}$$

The remaining constants A_1, A_2 and A_1' are obtained by solving the equations:

$$A_1 + A_2 = 0 \tag{15}$$

$$A_1 - A_1' e^{\lambda_1 T} + A_2 e^{\lambda_{12} T} = dK \tag{16}$$

$$\left(\frac{\lambda_1 - \phi_2}{\phi_1}\right)(A_1 - A_1') e^{\lambda_1 T} + \left(\frac{\lambda_1 - \phi_2}{\phi_1}\right) A_2 e^{\lambda_{12} T} = d\theta \tag{17}$$

Here $d\theta$ and dK are shifts in the steady state corresponding to particular shift parameter. Now the stable saddle paths after time T are described by equations (11) and (12). Eliminating $A_1' e^{\lambda_1 T}$ from these equations we get:

$$(\theta - \bar{\theta}_2) = \left(\frac{\lambda_1 - \phi_2}{\phi_1}\right)(K - \bar{K}_2) = \left(\frac{g_2}{\lambda_1 - g_1}\right)(K - \bar{K}_2) \tag{18}$$

Comparative statics

Increase in money supply

Long run effects:

From equation (11) and (12) we get:

$$\dot{K} = \phi(\theta, K, M); \phi_1 < 0, \phi_2 < 0, \phi_4 > 0, \tag{11a}$$

$$\dot{\theta} = g(\theta, K, M); g_1 > 0, g_2 > 0, g_5 < 0 \tag{12a}$$

Differentiating equations (11a) and (12a) with respect to M and setting $\dot{K} = 0$ and $\dot{\theta} = 0$ respectively we get:

$$\begin{bmatrix} \phi_2 & \phi_1 \\ g_2 & g_1 \end{bmatrix} \begin{bmatrix} \frac{dK}{dM} \\ \frac{d\theta}{dM} \end{bmatrix} = \begin{bmatrix} -\phi_4 \\ -g_5 \end{bmatrix} \tag{19}$$

Applying Cramer's Rule we get:

$$\frac{d\theta}{dM} = \alpha_2 = \frac{-g_5\phi_2 + g_2\phi_4}{\Delta} > 0 \; if - \frac{g_5}{g_2} > \frac{\phi_4}{\phi_2} \quad < 0 \; elsewhere \tag{20}$$

$$\frac{dK}{dM} = \alpha_1 = \frac{-g_1\phi_4 + g_5\phi_1}{\Delta} > 0 \; if - \frac{g_1}{g_4} > \frac{\phi_1}{\phi_4} \quad < 0 \; elsewhere \tag{21}$$

Transitional details

To obtain the initial jump in θ after increase in M, we set $t=0$ and using $A_1 = -A_2$ in equation 10 we get:

$$\theta(0) = \bar{\theta}_1 + \left(\frac{\lambda_2 - \lambda_1}{\phi_1}\right) A_2 \tag{22}$$

Solving equations (16) and (17) we get:

$$A_2 = \frac{\left(\alpha_2 - \alpha_1\left(\frac{\lambda_1 - \phi_2}{\phi_1}\right)\right)}{\frac{\lambda_2 - \lambda_1}{\phi_1}} dM \tag{23}$$

Substituting the value of A_2 in equation (22) we get:

$$\theta(0) = \bar{\theta}(1) + \left(\alpha_2 - \alpha_1\left(\frac{\lambda_1 - \phi_2}{\phi_1}\right)\right) dM$$

$$\Rightarrow \theta(0) - \bar{\theta}(1) = \left(\alpha_2 - \alpha_1\left(\frac{\lambda_1 - \phi_2}{\phi_1}\right)\right) dM \tag{24}$$

Equation (24) represents initial jump in θ.

The value of overshooting or undershooting of θ we subtracting equation 24 from equation 20 and this is given by $\bar{\theta}(2) - \theta(0)$ ($\bar{\theta}(2)$ is the final steady state value of θ)

$$= \alpha_2 dM - \left(\alpha_2 - \alpha_1\left(\frac{\lambda_1 - \phi_2}{\phi_1}\right)\right) dM$$

$$= \alpha_1\left(\frac{\lambda_1 - \phi_2}{\phi_1}\right) dM$$

Since $\frac{\lambda_1 - \phi_2}{\phi_1} < 0$ from the slope saddle path, we get clearly undershooting of θ when capital stock decreases i.e. $\alpha_1 < 0$. On the other hand, if capital stock increases the terms of trade overshoots in the long run.

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Amarendra Pratap SINGH* and Krishnan NARAYANAN*

Did technological intervention help to spare land from agriculture: evidence from post liberalisation India

India has witnessed fairly high economic growth since economic liberalisation started in 1991. However, agriculture has remained excluded from the growth experienced in other economic sectors. This growth paradox has serious implications for the agricultural land use pattern. This study uses the Environmental Kuznets Curve hypothesis to examine the impact of agricultural technology and economic development on agricultural land expansion in India. Panel data regression is performed on an unbalanced sample covering information from 25 Indian states for the period 1990 to 2008. Our results suggest a nonlinear (N shaped) relationship between agricultural land expansion and Net State Domestic Product (NSDP) per capita. Two incomes turning points, showing the level of NSDP per capita at which inflection between agricultural land expansion and NSDP per capita takes place, occur at INR 20986.14 and INR 42855.10 respectively. We find mixed results as far as the impact of technological variables on agricultural land expansion is concerned. The study concludes that rapid economic growth in the post liberalisation period has failed to reverse agricultural land expansion in India.

Keywords: EKC, Agricultural technology, Javon's Paradox

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Introduction

One of the secondary consequences of economic transition of a country is a change in its land use pattern. A number of studies analysed *land use change* to identify the factors explaining it. These studies imputed population (Cropper and Griffith, 1994), agricultural technology (Kumar and Agarwal, 2003), law and governance (Barbier, 2004), international trade (Barbier, 2001), urbanisation (Hasse and Lathrop, 2003), economic growth (Dinda, 2004) and climate change (Lambin *et al*., 2001) as major factors explaining land use change. Agricultural land expansion remains an important factor determining land use change across countries. Given the fixed supply of land, agricultural land expansion comes at the cost of a declining area under forests, pastures and other natural habitats. It is widely believed that technology and economic development help to reverse agriculture-driven land use change (see Barbier *et al*., 2010). However, declining quality of agricultural resources due to increased intensification (Maston *et al*., 1997; Tilman *et al*., 2002) and climate change (Lambin *et al*., 2001) are environmental forces that can limit the potential of technology to reverse agricultural land expansion.

Assuming forest and agriculture to be competing land use activities, Barbier (2001) extended the Environmental Kuznets Curve (EKC) hypothesis[1] to study agricultural land expansion and factors explaining it. The changing structure of economic activities (Dinda, 2004), in general, and technological intervention in agriculture (Cropper and Griffith, 1994; Kumar and Agarwal, 2003), in particular, are two factors in any economy that can justify considering the EKC as the basis for agricultural land expansion. However, the dynamics between agricultural land expansion and development depend on complex interactions between agricultural technology and other complementary (environment, policies, institutions) factors (Figure 1). Policies and institutions play major roles in determining the impact of technology on agricultural land expansion. Lewandrowski *et al*. (1997), using information from European and Asian countries, showed that agricultural pricing policies had significant impacts on agricultural land expansion. Studying the determinants of agricultural land expansion in tropical countries, Barbier (2004) found institutions and governance playing major roles in explaining agricultural land expansion.

From the literature it can be argued that the shape of the EKC for agricultural land expansion will change with changing technological and institutional possibilities (Figure 1). The uppermost curve represents the shape of the EKC for agricultural expansion under traditional agriculture. Low yield and long fallows which are attributes of traditional agriculture force farmers to bring additional land into agriculture. However, technological inputs, by increasing crop yield, help to reverse agricultural land expansion at relatively low levels of economic development (curve 2). Furthermore, agricultural technology, by augmenting land, also minimises the extent of agricultural land expansion. This phenomenon is reflected by the lowering of the EKC peak in Figure 1. Furthermore, adequate institutional support and resource conservation policies further help farmers to adopt technology in a proper way. This scenario is represented by curve 3 in Figure 1.

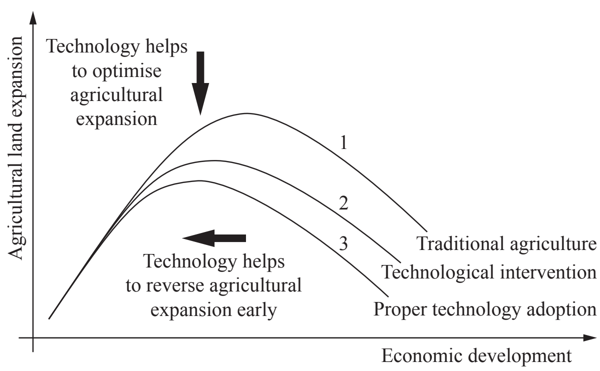

Figure 1: EKC for agricultural land expansion under various technological scenarios.
Source: own composition

[1] EKC hypothesis suggests that in the initial phase of development, environmental quality deteriorates but after attaining a certain threshold level of per capita income, environmental quality starts to improve.

Table 1: Growth rate of land use categories in India (1950-51 to 2008-09) (per cent per year).

Land use	1950-51 to 1965-66	1966-67 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-00	1996-97 to 2008-09	2000-01 to 2008-09
Forest	1.98 (7.42)**	0.51 (8.99)**	-0.04 (-0.73)	0.27 (10.3)**	0.08 (5.66)**	0.02 (1.97)*
Pasture	4.51 (7.97)**	-0.99 (11.20)**	-0.53 (5.36)**	-0.53 (5.83)**	11.8 (5.02)**	18.10 (3.80)**
Net cultivated area	0.94 (11.67)**	0.17 (1.94)**	-0.12 (-0.59)	-0.05 (-1.06)	-0.14 (-0.87)	0.18 (0.50)
Gross cultivated area	1.17 (10.48)**	0.61 (5.52)**	0.37 (1.61)	0.39 (4.12)**	0.21 (0.90)	0.92 (2.19)*
Cropping intensity	0.23 (6.07)**	0.45 (14.20)**	0.49 (7.53)**	0.44 (8.44)**	0.35 (4.01)**	0.74 (8.96)**
Net irrigated area	1.73 (31.90)**	2.73 (26.4)**	1.77 (7.64)**	2.02 (20.9)**	1.13 (3.98)**	2.20 (5.46)**

Notes: Compound annual growth rates are computed using a log linear model. t test is used to examine statistical significance of slope coefficient of trend line fit over data. Figures in parenthesis are t values. *P<0.05 and **P<0.01.
Source: DES (2011).

Heterogeneous policy and institutional environments across countries make it difficult to use the EKC hypothesis as a policy tool to study agricultural land expansion. In view of the lack of information on policy and institutions across countries, it is appropriate to apply the EKC hypothesis for studying agricultural land expansion in a region with homogenous agricultural policy and institutional structure. India possesses the world's second largest agricultural sector in terms of land area. It adopted agricultural technology in the mid 1960s and became a signatory of GATT in 1991. Despite liberalisation of other economic activities, agriculture in India is still highly regulated by government agencies. Governmental regulation of agriculture creates a homogenous policy environment across Indian states. This aspect of Indian agriculture provides an ideal environment for using EKC hypothesis to study agricultural land expansion across Indian states.

Unlike in tropical countries, agricultural (net cultivated area) expansion in India took place at the cost of other rural lands instead of forests (Table 1)[2]. Prior to technological intervention in agriculture, popularly known as the *Green Revolution* (1965-66), net cultivated area in India grew at a rate of 0.94 per cent per annum. The rate of growth in net cultivated area declined during 1966-67 to 1979-80 to a moderate 0.17 per cent per year, and was insignificant after 1980-81.

Technological intervention in agriculture, by increasing the yield per hectare of food grains, played an important role in restricting the growth of the net cultivated area in India. The contribution of land (area effect) in food grain production became irrelevant in the period from 1979-80 to 1989-90 (Table 2). It revived marginally during the years 1989-90 to 1999-2000 but again vanished for the rest of the period. This evidence suggests that technology (irrigation, fertilisers and high yielding varieties, HYV) facilitated land use diversification[3] without causing further expansion of net cultivated area.

The GDP growth rate in India gained momentum after the liberalisation of the economy started in 1991. However, apart from a short period of time (1990-91 to 1996-97) agricultural growth failed to attain any momentum. During the period from 1990-91 to 1996-1997, the Indian economy grew at a rate of 5.84 per cent per year. After the structural adjustment programme (SAP) ended, the growth rate of the economy further increased and reached 7.12 per cent per year during the period from 1997-98 to 2008-09. For the same reference periods, growth rate of agriculture was 3.58 and 2.21 per cent per year (Table 3). These statistics indicate that technology supported land diversification in agriculture went hand in hand with overall economic growth in post liberalisation India. However, whether agricultural technology and rapid economic growth succeeded in reversing agricultural land expansion in post reform India is still an unexplored research question. This study is an attempt to answer this question by examining the impact of economic development

Table 2: Sources of food grain production growth in India (million tonnes, 1950-51 to 2008-09).

Period	Change in production	Yield effect	Area effect	Interaction effect
1950-51 to 1965-66	21.53	10.35 (48.09)	9.28 (43.12)	1.89 (8.78)
1966-67 to 1979-80	35.47	26.78 (75.52)	6.38 (17.98)	2.30 (6.49)
1980-81 to 1989-90	41.45	41.31 (99.67)	0.10 (0.24)	0.032 (0.078)
1990-91 to 1999-00	33.41	41.44 (124.20)	-6.54 (-19.59)	-1.53 (-4.60)
1999-00 to 2008-09	37.66	34.23 (90.96)	2.89 (7.69)	0.50 (1.33)
1997-98 to 2008-09	42.21	44.14 (104.60)	-1.57 (-3.74)	-0.36 (-0.85)

Notes: The formula used for decomposition is $(P_1\text{-}P_0) = A_0(Y_1\text{-}Y_0) + Y_0(A_1\text{-}A_0) + (Y_1\text{-}Y_0)(A_1\text{-}A_0)$, where $(P_1\text{-}P_0)$ is change in production. The first term on the right hand side shows yield effect, second term shows area effect and the last one is interaction of yield and area change on food grain production. Figures in parentheses are contributions in percentage.
Source: DES (2010).

Table 3: Growth of Gross Domestic Product (GDP) in India (per cent per year).

Period	GDP	GDP agriculture and allied activities	GDP agriculture
1950-51 to 1965-66	3.84 (-35.56)	2.27 (-10.46)	2.33 (-8.82)
1966-67 to 1979-80	3.59 (-17.6)	2.43 (-6.1)	2.61 (-5.95)
1980-81 to 1989-90	5.17 (-25.6)	2.97 (-6.82)	3.09 (-6.67)
1990-91 to 1996-97	5.84 (-14.1)	3.58 (-7.15)	3.58 (-6.68)
1997-98 to 2009-10	7.12 (-25.73)	3.08 (-6.4)	2.21 (-3.77)
2000-01 to 2009-10	7.98 (-26.83)	4.02 (-5.3)	2.95 (2.90*)

Notes: Compound annual growth rates are computed using a log linear model. t test is used to examine statistical significance of slope coefficient of trend line fit over data. Figures in parenthesis are t statistic values. All t values except one are significant at P<0.01 level. *P<0.05.
Source: RBI (2012)

[2] The Indian land use classification system considers 'pasture' and 'agricultural land' as two different land use categories. Agricultural land includes net cultivated area, cultivable waste land and land under miscellaneous tree crops. Net cultivated (sown) area, the largest and actively growing component in agricultural land category, includes land under crops and orchards. Net cultivated area being the active component is the subject of our interest in this study.

[3] Land diversification, here, indicates increasing area under non food grain crops.

and technology on agricultural land expansion in post liberalisation India[4].

EKC for agricultural land expansion: a theoretical interpretation

We use the decomposition framework given in Angelson (2010) to derive the relationship between agricultural land, development and technology. We start by assuming an economy producing a homogenous agricultural output called 'food'. Food demand (Q^d_{it}) in any country i at time t will be equal to its supply (Q^S_{it}),

$$Q^d_{it} = Q^S_{it} \tag{1}$$

For country i year t, supply of food can be defined as the sum of domestic production (Q^p_{it}) and net exports (Q^T_{it}) of food from the country.

$$Q^c_{it} = Q^p_{it} \pm Q^T_{it} \tag{2}$$

Food consumption in country i at time t can be given by multiplying per capita consumption of food (q^c_{it}) with the population (M_{it}) of the country.

$$Q^c_{it} = q^c_{it} M_{it} \tag{3}$$

Using back substitution, we can expand Q^c_{it} in following manner,

$$Q^c_{it} = \frac{Q^c_{it}}{Q^p_{it}} \times \frac{Q^p_{it}}{L^g_{it}} \times \frac{L^g_{it}}{L^n_{it}} \times L^n_{it} \tag{4}$$

where L^g_{it} is *effective agricultural land* (gross cultivated area) and L^n_{it} is agricultural land[5].

The ratio of total production and effective agricultural land $\left(\frac{Q^p_{it}}{L^g_{it}}\right)$ gives food production per unit of effective agricultural land (yield), a measure of the state of technology. Similarly $\left(\frac{L^g_{it}}{L^n_{it}}\right)$ is another technology variable that measures technology supported *land augmentation* (cropping intensity). Transferring equation (3) into equation (4) gives:

$$q^c_{it} \times M_{it} = \frac{Q^p_{it} \pm Q^T_{it}}{Q^p_{it}} \times y_{it} \times I_{it} \times L^n_{it} \tag{5}$$

where y_{it} and I_{it} stands for yield and cropping intensity. The term $\left(\frac{Q^p_{it} \pm Q^T_{it}}{Q^p_{it}}\right)$ on the right hand side gives the extent of trade T_{it} that is necessary to fulfil the food demand in a country. Taking the log of equation (5) and rearranging it in terms of agricultural land gives:

$$\log L^n_{it} = \log q^c_{it} + \log M_{it} \mp \log T_{it} - \log y_{it} - \log I_{it} \tag{6}$$

Differentiating equation (6) with respect to time we get:

$$\hat{L}^n_{it} = \hat{q}^c_{it} + \hat{M}_{it} \mp \hat{T}^A_{it} - \hat{y}_{it} - \hat{I}_{it} \tag{7}$$

In equation (7) each term is expressed in terms of annual change. Equation (7) suggests determinants of change in net cultivated area with their expected signs in an ideal framework. However; the expected direction of these variables in determining change in agricultural land depends on the nature of economic development in a region. Applying Engel's income-consumption hypothesis, we can write per capita food consumption as a function of per capita income (z).

$$q^c_{it} = f(z_{it}) \tag{8}$$

Per capita income has a derived impact on agricultural inputs through demand for agricultural commodities (Lewandrowski *et al.*, 1997). Engel's hypothesis suggests that the share of expenditure on food items starts to decline after reaching an income threshold. Joining the two statements, we can hypothesise that, keeping other factors constant, agricultural land expansion has a nonlinear relationship with income per capita. Economic growth is an equally important factor as it helps to absorb an increasing labour force and reduces the population pressure from agriculture. We have considered Net State Domestic Product (NSDP) per capita and growth in NSDP as proxies for per capita income and economic growth respectively.

Population is another factor that affects agricultural land expansion (Cropper and Griffith, 1994; Lewandrowski *et al.*, 1997; Barbier, 2001, 2003, 2004). Rapid population growth shifts the food demand curve upwards and causes price rise in the economy. Increasing prices of agricultural commodities along with subsidised inputs induces agricultural land expansion. The side effects of population growth on agriculture may be more severe if other sectors of the economy fail to provide employment to the growing labour force. We consider growth in population as an explanatory variable for econometric analysis.

Modern agricultural technology has twin effects on agricultural production. The introduction of HYV seeds increases crop yields and the external supply of nutrients and water ensures the multiple use of agricultural land in a crop year (land augmentation). Two variables, cropping intensity and growth in cereal yields, are included in the regression analysis to capture the effect of technology on agricultural land use. Increasing cropping intensity can help to relieve land from agriculture by increasing the supply of effective land. On the other hand, increasing cropping intensity and crop yield can be incentives for farmers to expand agricultural operations on new lands if agricultural inputs are subsidised and terms of trade are favourable to agriculture[6]. Assuming subsidised inputs as normal good, input subsidies induce reallocation of resources from subsidised inputs to other

[4] We consider net cultivated area as a proxy for agricultural land. Hereafter, we use net cultivated area and agricultural land interchangeably.

[5] Effective agricultural land is defined as area under cultivation that can be used for growing more than one crop in a crop year i.e. gross cultivated area.

[6] This argument has quiet resemblance with 'the Jevons paradox'. Jevons (1866) observed that technological improvements in 19th century England increased the efficiency of coal use. Owing to this gain in efficiency, consumption of coal in England increased instead of decreased.

inputs (price effect). In such a case subsidised technology, in general, increases the area under agricultural operations, especially in favour of those crops that are more profitable. However, the latter effect will not sustain in the long run as more farmers start producing these commodities and prices will eventually fall.

Rapid growth in yields under a free trade framework does not guarantee the release of land from agriculture. Rather, high growth in crop yields under a free trade arrangement provides farmers with an incentive to increase agricultural land to reap more income by exporting. In this case, annual change in yield (yield growth) should be positively related with agricultural land expansion. However, this conclusion is fairly simplistic and prices of agricultural commodities (Barbier and Burgess, 1992) also play a role in determining the impact of yield on agricultural land expansion. If prices of agricultural commodities are regulated in the domestic economy then agricultural expansion may or may not take place given the trade policy of the Government for food and related commodities.

In addition, there is an employment side of agricultural technology. If employment elasticity in the other sectors of the economy is low then increasing yields added with input subsidies provide an opportunity to increase income by expanding agricultural operations in new areas. EKC studies on land use change have incorporated yield as an explanatory variable to explain both deforestation (Koop and Tole, 1999) and agricultural land expansion (Barbier, 2001, 2004).

Methodology

We use secondary data compiled from various sources for studying agricultural land expansion (Table 4). The sample made for the EKC estimation includes information from 25 Indian states covering the period from 1991 to 2008. Contrary to Barbier (2004), who followed the World Bank's definition, we have considered net cultivated area as a proxy for agricultural land; however, we accepted Barbier's approach to defining agricultural land expansion. This choice of proxy suits our objective to study the response of farmers to technology and economic development. A three year moving average of net cultivated area is computed before constructing the dependent variable. This exercise helps us to remove wild yearly fluctuations in the data (Arahata, 2003). Regression analysis in the study employs panel data estimation methods using a reduced form specification of the EKC (equation 9) (see Stern, 2004).

On the basis of the discussion above, the following econometric specification of the EKC will be estimated:

$$AGEXP_{it} = \alpha_i + \beta_1 NSDPPC_{it} + \beta_2 NSDPPC^2_{it} + \beta_3 NSDPPC^3_{it} + \beta_4 AGEXP_{i(t-1)} + \beta_5 EG_{it} + \beta_6 POPG_{it} + \beta_7 CI_{it} + \beta_8 CI^2_{it} + \beta_9 YLDG_{it} + \varepsilon_{it} \quad (9)$$

In the regression model given by equation (9), α is the time invariant intercept and ε is an error term, subscripts i and t stands for state and year. The definition and construction of variables in equation (9) is provided in Table 4.

Table 4: Definition and construction of the variables used in the econometric specification of the Environmental Kuznets Curve.

Variable	Notation	Definition	Data source
Agriculture expansion	AGEXP	$[\{A_{it} - A_{i(t-1)}\}/A_{it}]*100$ where, A_{it} is net cultivated area in state i at time t	CMIE (2012a)
Net State Domestic Product per capita	NSDPPC	in constant 1999-00 INR	RBI (2012)
Economic growth	EG	$[\{Y_{it}-Y_{i(t-1)}\}/Y_{i(t-1)}]*100$ where, Y_{it} is net state domestic product in state i at time t	RBI (2012)
Population growth	POPG	$[\{P_{it}-P_{i(t-1)}\}/P_{i(t-1)}]*100$ where, P_{it} is population in state i at time t	CMIE (2012b)
Cropping intensity	CI	(Gross cultivated area/ Net cultivated area)*100	CMIE (2012a)
Growth in cereals yield	YLDG	$[\{C_{it}-C_{i(t-1)}\}/C_{i(t-1)}]*100$ where, C_{it} is yield in state i at time t	CMIE (2012a)

Results

We start by exploring the summary statistics of the variables. The total sample size is 323 consisting of observations from 25 Indian states. Table 5 suggests very big differences among states for various development parameters used in the analysis. The correlation matrix (Table 6) shows that correlation among the right hand side variables is within tolerance limits.

Table 5: Summary statistics of the variables used in the econometric specification of the Environmental Kuznets Curve (323 observations).

Variable	Mean	Standard Deviation	Minimum	Maximum
AGEXP	0.38	1.21	-3.92	4.20
NSDPPC	18157	7315	6117	56021
EG	6.27	5.82	-12.01	32.18
POPG	1.96	1.15	-0.68	12.04
CI	139	23	104	189
YLDG	0.01	0.17	-0.71	0.69

Note: For abbreviations of the variables, see Table 4

Table 6: Correlation matrix of the variables used in the econometric specification of the Environmental Kuznets Curve.

	NSDPPC	EG	POPG	CI	YLDG
NSDPPC	1				
EG	0.189	1			
POPG	-0.176	-0.035	1		
CI	0.181	-0.05	-0.139	1	
YLDG	0.028	-0.284	0.003	-0.003	1

Note: For abbreviations of the variables, see Table 4

Regression results of the EKC for agricultural land expansion are given in Table 7. The estimates are based on the model given in equation (9). After getting pooled OLS estimates, we test for presence of heteroscedasticity in the data. We fail to reject the null hypothesis of homoscedasticity. The F test is used to test presence of panel effect in data. A statistically significant F test allows us to reject pooled

Table 7: Determinants of agricultural land expansion.

Independent variable	OLS	Fixed Effects	Random Effects
NSDPPC/10^3	0.29 (2.94**)	0.39 (2.98**)	0.29 (2.94**)
$(NSDPPC)^2/10^6$	-0.01 (-2.79**)	-0.01 (-2.86**)	-0.01 (-2.79**)
$(NSDPPC)^3/10^9$	0.0001 (2.70**)	0.0001 (2.67**)	0.0001 (2.70**)
LAGEXP	0.37 (6.87**)	0.22 (3.91**)	0.37 (6.87**)
EG	-0.002 (-0.19)	-0.01 (-0.75)	-0.002 (-0.19)
POPG	0.11 (2.09*)	0.01 (0.13)	0.11 (2.09*)
CI	0.13 (2.95***)	0.31 (4.01***)	0.13 (2.95**)
CI^2	-0.0004 (-2.80**)	-0.0009 (-3.30**)	-0.0004 (-2.80**)
YLDG	2.18 (5.73**)	1.55 (4.12**)	2.18 (5.73**)
Constant	-11.85 (-3.45**)	-28.04 (-5.11**)	-11.85 (-3.45**)
Adjusted R^2	0.23	within = 0.28 between = 0.07 overall = 0.09	within = 0.20 between = 0.65 overall = 0.25
F test for goodness of fit	11.64 (9,313)**	12.58 (9, 289)**	

Note: (1) *P<0.05 and **P<0.01. (2) For abbreviations of the variables, see Table 4

OLS estimates against panel data models. Further, we use the Hausman test to identify efficient model from fixed and random effects. The χ^2 statistic for the Hausman test has a higher level of statistical significance which supports the fixed effects regression estimates over random effects. Another issue with estimation of EKC is the degree of polynomials in per capita income (see Selden and Song, 1994). In the present case, we find that the inclusion of a cubic term is highly significant so we allow a cubic term of per capita NSDP in the regression model. Following the result of the Hausman test, we are interpreting fixed effects model estimates.

All the structural variables except economic growth and population growth are highly significant (Table 7). The estimated coefficients of level, square and cubic income terms in the model are different from zero with high statistical significance. The positive and negative signs of level and squared income coefficients suggest rejecting the null hypothesis of monotonically increasing agricultural land expansion with NSDP per capita. The significant cubic income coefficient with a positive sign indicates that the relationship between agricultural land expansion and GDP per capita for Indian states is N shaped. This N shaped relationship indicates future rebinding may occur between the two variables. This rebinding may be an outcome of diminishing returns to technology. In this regard, it is important to note that the potential of agricultural technology to satisfy future demand for agricultural commodities in India remains in serious doubt (for an early debate see Bhalla and Hazell, 1998). However, one must be cautious when interpreting predictions based on the EKC results as predictions are not controlled for future developments in technology and related environment. Whether or not a rebinding will happen depends on the future path of economic growth and development in the Indian economy.

To further illustrate the regression results, an enquiry of income turning points may be helpful. The first income turning point for the estimated EKC is approximately at INR 20,986.14 (at constant 1999-00 prices). The mean NSDP per capita of the sample is a standard to measure the distance of the economy from the income level at which income turns may occur. Sample mean for GDP per capita is INR 18157.24, which is below the first turning point of the estimated EKC. This indicates that economic development has failed to reverse agricultural land expansion in post reform India. The second turning point of the EKC falls at INR 42,855.10 (at constant 1999-00 prices) which too is above the mean NSDP per capita in the sample.

Including the lagged value of dependent variable helps us to correct for bias due to presence of endogeneity in the model. Agricultural land expansion is positively related and significant with its lag value of order one i.e. if there was an expansion in agricultural land last year, agricultural land will expand this year too and *vice versa*. It suggests that expectations play a vital role in inclusion or exclusion of land from agricultural operations.

Significant coefficients for the level and square term of cropping intensity suggest an inverted U-shaped relationship between cropping intensity and agricultural land expansion. This suggests that agricultural expansion increases firstly with increasing cropping intensity and then starts reversing at some higher value of cropping intensity. Observed estimates of cropping intensity in the regression model suggest that reversal occurs when cropping intensity reaches 170.80. In other words, agricultural land expansion will start reversing after 70.80 per cent of agricultural land can be used for growing more than one crop in a year. The mean value of cropping intensity in the sample (138.58) is well below this level.

Discussion

NSDP per capita, cropping intensity and cereal yield are factors which explain land expansion in agriculture during the study period. However, the study concludes that the economic development experienced by India in the post liberalisation period failed to reverse agricultural land expansion. The N shaped relationship between agricultural land expansion and per capita NSDP suggests future possibilities of agricultural land expansion after reversal.

The results are justified when we consider the interaction of the socio-economic structure of India with agricultural technology. Technological intervention in Indian agriculture was justified not only for attaining food security but also on employment grounds. Technology in India was promoted by ensuring cheap supply of inputs and making domestic terms of trade favourable to agriculture (Swami and Gulati, 1986; Gulati and Sharma, 1995). These two policies, mixed with employment pressure on the agriculture sector, remain driving forces explaining expansion of agricultural land despite increasing cropping intensity or land augmentation. However, performing agricultural operations on marginal lands is not cost effective in the long term. Hence, after a threshold level, these marginal lands can be withdrawn from production and food requirements will be fulfilled by increasing cropping intensity only.

To explore the impact of land augmentation aspect of agriculture technology, we included cropping intensity as an explanatory variable in the EKC model. This aspect of agricultural technology is completely ignored in previous studies. Our results suggest that land augmentation using technology can help to spare land from agriculture. The growth in cereals yield shows a positive and significant relationship with agricultural land expansion. This positive relationship indicates that cereals are still profitable crops for farmers to grow but not at the cost of non cereal crops.

The positive relationship between the two variables shows that farmers add new lands to their operation when the yield of cereals increases. Similarly, they decrease the area under operation when there is a decline in cereal yield. Cereals being crucial to the public distribution system are covered by a minimum support price (MSP) in India. Ensured by high MSP, farmers perceive less risk in growing these crops which may be one reason for the high responsiveness of agricultural land to cereals yield in India. The positive relationship of growth in cereal yield and cropping intensity with agricultural land expansion supports the Jevon's paradox in the case of Indian agriculture.

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Short communication

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Which legal form of agricultural firm based on return on equity should be preferred? A panel data analysis of Slovak agricultural firms

This paper examines the impact of the legal form of agricultural firms on the benefit to their owners for a panel of Slovak agricultural firms. We use return on equity (ROE) as a measure of the benefit to owners. Using the repeated measures ANOVA technique, we find that the legal form of a firm is a relevant determinant of the benefit to owners. We conclude that from the point of view of ROE the legal form 'company' is preferable over 'cooperative'.

Keywords: legal form, agricultural firm, benefit of owner, return on equity

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Introduction

A number of studies have investigated the impact of legal, organisational and size structure on the performance of farms in central European countries (Macours and Swinnen, 2000; Ciaian *et al*., 2009; Latruffe *et al*., 2012). Before 1989, Slovak agriculture consisted only of cooperatives and state farms with large acreages. After 1989, when the centralised economy ceased to exist, all farms were privatised. Cooperatives were privatised by the issuing of cooperative shares and owners became the holders of these shares (Swain, 2007). Companies were established after 1989 to manage the land of failed cooperatives (Table 1).

In 2012 a substantial part of the agricultural land in the Slovak Republic was still farmed by entities with large areas, contrary to the situation in western European countries, where most of the agricultural area is farmed by small, family-based firms. These do not convert to factory-style corporate firms (Allen and Lueck, 1998; Brem, 2002; Gorton and Davidova, 2004). In the Slovak Republic production cooperatives and companies (joint stock company, JSC; limited company, Ltd.) are the main legal forms in terms of area (Table 1).

The purpose of this short communication is to show whether the legal form of an agricultural firm is a determinant of its performance, and the level of benefit to its owners.

Methodology

Our analysis was based on a database with individual company data including balance sheets and income statements for each firm over the period 2000-2011. The data are collected by the Slovak Ministry of Agriculture and the participation of all companies and cooperatives is obligatory. We used the entire dataset and split the firms into cooperatives and companies. To be able to perform the analysis from the entire dataset we analysed the panel data consisting of 479 firms which were in continual existence during the period 2000-2011.

We used return on equity (ROE) in 2000, 2003, 2007 and 2011 to measure the benefits to owners. ROE is a ratio between return (earnings after tax) and equity (own capital). It is a standard measure of the owner's benefit (Rábek and Čierna, 2012; Klieštik and Valášková, 2013). To verify the hypothesis that the legal form of a firm determines the level of benefit to owners we used Analysis of Variance (ANOVA) for repeated measures for a single dependent variable (ROE). The independent variable was legal form (cooperative or company). For the calculations we used IBM SPSS v.21.

Table 1: Distribution of agricultural firms in the Slovak Republic by legal form, in terms of numbers (2003-2012)* and share of land (2012).

legal form	2003	2005	2007	2010	2012	Share of land, 2012, %
Cooperative	644	603	603	584	570	37.87
Limited company	817	959	1159	1389	1594	35.02
Joint stock company	123	127	123	128	111	7.38
Natural persons	6550	7172	6893	6008	4847	16.55
Other	70	110	147	166	160	0.66
Total	8204	8971	8925	8275	7282	97.48**

* Annual data for the number of family-based farms are not available. According to census data, there were 16,179 farms in 2010. The estimate for 2012 was 9,151.
** The missing 2.52% is related to small family farms not registered in the business register of the Slovak Republic
Source: Data of the Agricultural Paying Agency of Slovakia

Results

Of the 479 firms, 303 were cooperatives and 176 were companies. In every year there is at least a 10 per cent difference in the mean values of ROE in favour of companies (Figure 1). The most significant difference in the mean values occurred in 2003 (over 16 per cent), when the cooperatives were struggling with a 9.5 per cent loss while the average profit of the companies was over 7 per cent. However, the development of ROE is very similar in both legal forms in the sense of year on year performance.

These differences in the mean values indicate a difference in the benefit to owners based on the legal form of the agricultural firm. The results of repeated measures ANOVA (Table 2) confirmed that the difference is statistically significant. However from the results of Mauchly's sphericity test ($p<0.05$), we conclude that there are significant differences in the variances of the ROE of cooperatives and companies (see also Figure 1) and that the results should be interpreted with caution as the sphericity of variances was violated.

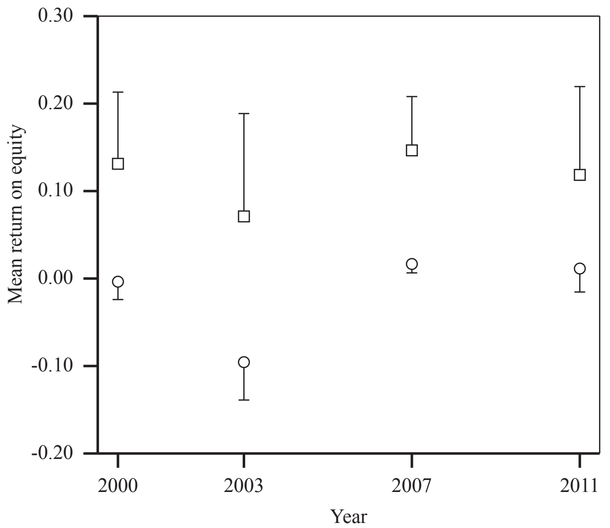

Figure 1: Mean return on equity and ± 95% confidence intervals for a sample of cooperative (circles, n = 303) and company (squares, n = 176) agricultural firms in the Slovak Republic in 2000, 2003, 2007 and 2011.

Source: own composition

Table 2: Tests of significance of difference in the mean return on equity values for agricultural firms in the Slovak Republic by legal form.

	Mean Square	F	Significance
Sphericity assumed	0.781	4.052	0.007
Greenhouse-Geisser	1.027	4.052	0.014
Huynh-Feldt	1.020	4.052	0.013
Lower-bound	2.344	4.052	0.045

We used a non-parametric approach (the Friedman test) to confirm the results. The probability distribution of the test statistic, Q, can be approximated by that of a chi-squared distribution. We obtained a chi-square value of 189.769 (n = 479, 3df) and the asymptotic significance was 0.000. We conclude that there is a statistically significant difference in ROE based on the legal form of the agricultural firms ($p < 0.05$).

Discussion

Slovak agriculture has its specific features (Pokrivčák *et al.*, 2005; Kadlečíková and Kapsdorferová, 2012). One of them is a relatively small share of family farms in terms of total acreage. This means that, in this sense, cooperatives and companies are the main legal forms. Our analysis shows two major results. Firstly, the companies generate higher benefit for their owners, measured by ROE, in comparison with cooperatives. From this point of view this legal form should be preferred over cooperatives. However, they do so with higher volatility with respect to the differences in equity. The lower volatility in the case of cooperatives is determined by their higher equity employed. The average equity of cooperatives is 90 per cent higher than that of companies. As this is the denominator of the ROE ratio it results in lower volatility (in case of cooperatives) on condition of the equality in return (earning after tax). These two observations correspond with the investment theory in the sense of the relationship between return and risk (Virlics, 2013).

Our results apply only to the Slovak Republic, where the average farm is much larger than the average farm in the EU. But the decision regarding the legal form of agricultural firm cannot of course be based solely on return on equity. For different types of farming activities different organisational forms will be the most suitable. The topic of organisational form in agriculture is addressed by Mathijs *et al.*, 1999; Lerman, 2001; Fandel, 2003; and Altman and Johnson, 2008.

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Abstracts of AKI publications

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STUMMER Ildikó and colleagues

The market developments of the most important commodities in 2012

Agroeconomic Information, published 2013

This publication discusses the market developments of the most important commodities in 2012, mainly by presenting price trends. The material is based on the price information and data of the Market Price Information System of the Research Institute of Agricultural Economics and of various Hungarian and international sources. In 2012, milling wheat producer prices increased by almost 17 per cent, and feed wheat and maize prices increased by 28 per cent and 16 per cent respectively. The producer price of sunflower seed increased by 14 per cent to HUF 128 thousand tonne-1. The price of rapeseed was HUF 140 thousand tonne-1, a 17 per cent increase over the previous year. The only sugar factory in Hungary purchased 848 thousand tonnes of sugar beet in 2012, from which 112 thousand tonnes of sugar were produced. As in previous years, in 2012 Hungarian pork prices followed the trends of prices in the European Union. Pig producer prices were 17 per cent higher than one year earlier. Producer prices of slaughter chickens increased by 8 per cent in 2012. Cattle producer prices in Hungary increased by 14 per cent and those of light lambs increased by 1.5 per cent in 2012. The producer price of raw milk in Hungary stagnated. The production of vegetables declined in 2012 compared to 2011, but the production of fruit increased because of the higher apple production. The processors' sale prices of table and regional wine increased by 16 per cent in 2012 compared to the previous year.

VÁGÓ Szabolcs (ed.)

Hungarian Food and Agricultural Statistics 2012

Agroeconomic Information, published 2013

The publication provides information on the results achieved in 2012 in agriculture, forestry and food industry. We assured the comparability of time-series in connection with the pocketbooks published in the recent years. Besides the national and branch indicators and data, the principal agricultural data are also given in details by counties. The international data are suitable to demonstrate the main trends. The published data are compiled on the basis of the publications of the Central Statistical Office, EUROSTAT, the Food and Agricultural Organization (FAO) and the Research Institute of Agricultural Economics.

JANKUNÉ KÜRTHY Gyöngyi, STAUDER Márta and GYÖRE Dániel

The productivity and profitability of the food sale sector in Hungary

Agroeconomic Book, published 2013

This study analysed the productivity and profitability of food sales in Hungary using classic financial methods. Our main source of data was the database of the Hungarian National Tax Office on the tax returns of the joint ventures operating in the sector in the period 2005-2010. We investigated separately the food retail and food wholesale sectors, and within these the sub-sectors, the different size groups of the firms and, in the case of the food retail sector, also the different shop types. In addition to the analysis of financial data and indexes we studied the different factors that influence the productivity and profitability of the sector, such as consumption, demand, competition, concentration and regulation. We also compared the Hungarian productivity and profitability indexes to international data. We concluded that the sector in Hungary entered a new phase in the second half of the 2000s. Market saturation is high and prospective newcomer chains have no desire to enter the Hungarian market. Furthermore, there are signs indicating that a trade war centred on the redistribution of the market has started. These factors influence the profitability of the sector. Financial data show that the profitability of the sector, especially of food retailing, declined significantly between 2005 and 2010 and that this trend has been especially evident in the case of large firms.

VARGA Eszter

The role of civil organisations in Hungarian rural development

Agroeconomic Study, published 2013

This study analysed the productivity and profitability of food sales in Hungary using classic financial methods. Our main source of data was the database of the Hungarian National Tax Office on the tax returns of the joint ventures operating in the sector in the period 2005-2010. We investigated separately the food retail and food wholesale sectors, and within these the sub-sectors, the different size groups of the firms and, in the case of the food retail sector, also the different shop types. In addition to the analysis of financial data and indexes we studied the different factors that influence the productivity and profitability of the sector, such as consumption, demand, competition, concentration and regulation. We also compared the Hungarian productivity and profitability indexes to international data. We concluded that the sector in Hungary entered a new phase in the second half of the 2000s. Market saturation is high and prospective newcomer chains have no desire to enter the Hungarian market. Furthermore, there are signs indicating that a trade war centred on the redistribution of the market has started. These factors influence the profitability of the sector. Financial data show that the profitability of the sector, especially of food retailing, declined significantly between 2005 and 2010 and that this trend has been especially evident in the case of large firms.

BIRÓ Szabolcs and colleagues

Innovation in Hungarian agriculture and rural development

Agroeconomic Book, published 2013

This publication explores the opportunities for the application of innovation in agriculture and rural development in Hungary. The creation of a knowledge and innovation-based, competitive and successful Hungarian economy is crucial, especially regarding the development of rural areas. Considering the global trends, apart from technological development innovation can nowadays be characterised by risk-reducing, well organised innovation systems and cooperation through networks. As well as offering economic benefits, innovation can have a decisive role in societal transformation. Compared to the European Union, innovation performance in Hungary is modest. The country lags significantly behind in R&D, in the innovation performance of firms and in relationship building between the innovation actors. In Hungarian agriculture and rural development the market based innovation system building on endogenous resources is not working. The innovation chain is narrow and underdeveloped, the majority of the innovations implemented in rural areas are small-scale and – without knowledge, equity and business relationships – are not viable. Slow dissemination is accompanied by problems that hit rural areas cumulatively, such as an unqualified workforce, a lack of entrepreneurial skills, slow information flow, underdeveloped basic infrastructure, and the risk avoiding, suspicious attitude of the majority of farmers coupled with a disinterest towards innovation. Our research shows that in agricultural innovation the primary areas of intervention are the innovative projects that boost the competitiveness and value added of farms and food processing enterprises, the utilisation of renewable resources and ICT development. At the same time in rural development the establishment of partnerships aiming at innovation dissemination can create the value added. Innovation in Hungarian agriculture and rural development needs systematisation and expansion of the innovation chain, while dissemination of innovation requires the promotion of innovation results and awareness-raising. Assessment and evaluation of the practice of innovation can be the future research direction of this study.

VARGA Edina, ALICZI Katalin and VŐNEKI Éva (eds)

The current status and the short- and mid-term outlook of the major agricultural production sectors in Hungary

Agroeconomic Study, published 2013

In this report, we evaluated the status of the major agricultural sectors in Hungary during the period 2008-2012. Furthermore we reviewed the projections by internationally acknowledge organisations and institutions (i.e. the OECD and the FAO, the European Commission and the USDA) about trends on the global agricultural markets which may affect market opportunities of Hungarian agricultural products in the next five to ten years. Given that the results of these international organisations and institutions repeatedly turned out to be incorrect, instead of modelling the short and medium-term structural changes in Hungarian agriculture, we outlined the likely developments in the domestic and international supply and demand situations.

NYÁRS Levente, GARAY Róbert and BÖGRÉNÉ BODROGI Gabriella

Industrial by-products as pig feed in Hungary

Agroeconomic Study, Published 2012

The efficiency and productivity of the Hungarian pig sector can only be substantially improved by decreasing production costs. A few percentage points saving in feeding costs, the largest cost element, can lead to a signifi cant improvement in profi tability. Competing western European pig farmers are feeding industrial by-products in order to lower costs, and many farms have changed to a wet feeding system which is more suitable for by-product feeding. Wet systems had been installed in many of the Hungarian pig farms prior to the political and economic changes, but they are rare today because the investment costs are higher and the operation is more diffi cult. Hungarian pig farmers are also looking for dry by-products, but owing to the decline in the food processing industry the available volume is rarely predictable and the quality offered is often variable. Development of the biofuel industry has been slow,and by products of alcohol production and oilseed crushing have attracted widespread attention only recently. The market prices of by-products depend on the valuation of the traditional products to be replaced (maize, soybean meal). Feeding by-products usually requires the use of amino acid supplements and special premixes. If Hungarian pig farmers have their own land, they tend to use their own produced grains and look only for additives, rather than rely on by-product feeding, even if the latter offers greater returns. This kind of caution is sometimes reasonable considering the potential quality problems. By-product feeding could be more widespread if farmers were more willing to make purchases together, thereby reaching better deals on bulk buying. Development of vertical integrations, and rebuilding trust between producers and feed manufacturers would also promote safe and effective by-product feeding, thereby saving on feeding costs.

BÉLÁDI Katalin and KERTÉSZ Róbert

The cost and income situation of the major Hungarian agricultural products in 2011

Agroeconomic Information, published 2012

This publication examines the cost and income situation of the major agricultural products in 2011 on the basis of data from the farms of the Hungarian FADN system. The processed data concerns the so-called 'determinant producer farms' that provide the dominant part of domestic production. In addition to the mean data the results of different farming groups are presented. The changes in the cost and income situation of arable crops, horticultural products (fruit and vegetables) and livestock products are analysed in separate chapters. After the extremely wet year in 2010, the weather conditions in 2011 were average and, as a consequence, the yields of the examined arable crops and horticultural products generally increased. The yields of grain maize and sugar beet fell, and the early spring frost caused the failure of some types of fruit crop. The lower unit cost of the arable crops and horticultural products – as a consequence of higher yields – and the higher selling prices resulted in most products being produced at a profit. Owing to subsidies, enterprises made a per-hectare profit in the case of all crops and this was significantly higher than in 2010. Amongst livestock products only the price of hens' eggs and chickens for slaughter did not provide an income greater than the costs of production, in contrast with the other major livestock products, all of which achieved a higher profit in 2011 than in the previous year.

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