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SUSTAINABILITY AND COMPETITIVNESS

FENNTARTHATÓSÁG, VERSENYKÉPESSÉG

ANALYZING AGRICULTURE PRODUCTIVITY INDICATORS AND IMPACT OF CLIMATE CHANGE ON CEECS AGRICULTURE

SINGH, MAHESH KUMAR – KAPUSZTA, ÁGNES – FEKETE-FARKAS, MARIA

Abstract

The agriculture has an outstanding importance both in social and economic point of view, especially in the countries where the agriculture plays a vital role in economy. This paper mainly focuses on the situation in the Central and Eastern European countries (CEECs). The share of agriculture in CEECs is more significant both in GDP and employment than in the old member states of EU. To be competitive on the single market, we have to know the advantages and disadvantages, strength and weakness of different sectors of agriculture. Traditionally, in these countries to measure the effectiveness, the partial factor analyses are used. To get more accurate overview, we need to use more wide technique to sampling measurement. This paper summarizes the measurement techniques of effectiveness with environmental impacts on agriculture and examine, which one from them can be used in CEECs according to the available data.

Key words: sustainability, effectiveness, environment, agricultural policy, factor analysis

Introduction

Agricultural production differs from other sectors of the economy, such as industry and services, because it is dependent on the life cycles of plants and animals, on the seasons and climates, on the fertility of the soil, water supplies and so on. Agriculture is at the base of the food chain. This sector is thus fundamental. The first objective of agriculture is to produce food for people and animals. It also supplies nonfood products, for example row material for other industries. It must respect production standards (traditional or organic) and ensure the quality and safety of foods. As well as their role in producing the foodstuff which support all life, farmers also play an important part in caring for the environment, to the extent that they are in the front line for preserving the wealth of landscapes and biodiversity. Farmers also contribute also to the dynamism of rural areas and to the maintenance of balanced land development:

- they ensure the conservation of landscapes and paths, and the maintenance of forests and grassland to limit natural disasters,
- they preserve European biodiversity, flora and fauna,
- they fight against the rural exodus and overpopulation in towns,
- they stimulate rural development and the expansion of infrastructure in rural areas,
- they maintain economic activities in areas with low density population and create jobs in rural areas.

Summarizing, the agriculture is one of the main contributors of human welfare in different aspects.

The endeavors to increase the agricultural productivity can be found in almost every country's the long term national economy purposes. The reasons are wide due to the differences among countries together with the differences in historical periods. In recent decades the instruments of economy policy that affect agricultural productivity have had significant role especially in the developed countries, where the policies supporting intensive agricultural production caused overproduction, unfavorable resource allocation and significant welfare damages.

Agricultural production and trade is debated issuer on WTO, UN, FAO. The agreements effect on the performance of agriculture in developing countries, which have low level of self-sufficiency.

Motivation of research on agricultural productivity in CEECs

The examination is focusing on the situation of agriculture in CEECs, which follows many specialties:

- CEECs went through the transition from centrally planned economy to market economy
- Agricultural sector represents a high share in the total GDP
- High share of agriculture in total employment (Figure1.)
- EU membership and applying for Common Agricultural Policy (CAP)

With enlargement, 4 million farmers have joined the 7 million already existing in the Europe of 15. In the new Member States, agriculture provides on average three times more jobs than in the Europe of 15 (13.4 % in the new Member States as against 4 % in EU-15). This percentage is even higher in Bulgaria and Romania who will join the EU later (Agriculture in the new member states of the EU, 2004).
Agriculture in the CEECs tends to have a dual structure. On the one hand, there are large businesses, some of which are cooperatives, which have appeared during the re-organization of agriculture, generally cultivating in excess of 1000 hectares of land. These enterprises are generally market-oriented. Nevertheless, the methods of production they use are often far from efficient. It may be, therefore, that these businesses will undergo further restructuring and that their importance will diminish. On the other hand there are also small family farms that most often aim principally to feed the family. These farms are now faced with technological and financial pressures. However, they could well evolve in the future into a class of private farmers focusing on the markets. Family farms of middling size, integrated into the market, are also emerging, though they remain in a minority.

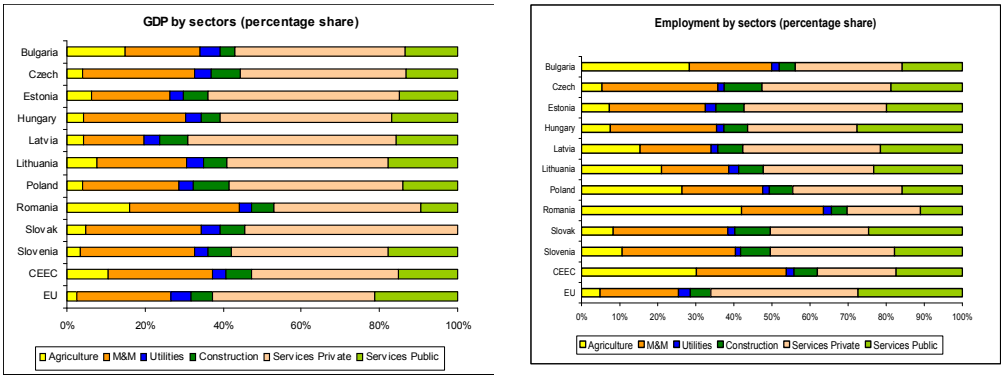
Land	UAA	UAA	GAV	Agriculture	Agricultural employment	Agricultural employment
	km²	% total area	€ millions	as % GDP		as % employment
Estonia	6 983	15%	175	2.2%	38 000	6.5
Latvia	15 955	25%	211	2.1%	151 000	15.3
Lithuania	29 025	44%	421	2.6%	265 000	18.6
Poland	168 912	54%	4 209	2.3%	2 713 000	19.6
Czech Republic	36 522	46%	866	1.1%	232 000	4.9
Hungary	63 259	68%	1 953	2.7%	233 000	6.1
Slovakia	22 364	46%	354	1.2%	139 000	6.6
Slovenia	5 047	25%	387	1.6%	89 000	9.7
Cyprus	1 367	15%	423	3.7%	17 000	5.4
Malta	97	31%	69	1.6%	3 000	2.1
EU-15	1 265 402	39%	148 491	1.6%	6 537 000	4.0
New Member States	354 177	53%	9 069	2.3%	3 880 000	13.4
EU-25	1 619 579	42%	157 560	1.6%	10 417 000	5.4
Bulgaria	53 247	48%	1 532	8.7%	299 000	10.7
Romania	148 190	62%	5 653	11.2%	3 683 000	37.7

UAA : Utilised agricultural area GAV : gross agricultural value

Figure1.: Role of agriculture in the CEECs
Sources: Agriculture in the new member states of the EU (2004)

Despite the fact that CEECs' agriculture was one of the first sectors hurt by the economic reforms, its importance in and consequences for national economy are still stronger that in the majority of the EU-15 as it shown on Fig. 2.

Figure 2: Share of agriculture in the economy



Source: Fekete-Farkas et al., (2004)

Agricultural Productivity Indicators

The two main objectives of the Common Agricultural Policy (CAP) of the EU are to increase agricultural productivity and to provide fair standard of living for the agricultural community.

Reflecting on the reforms to the CAP introduced under the title 'Agenda 2000', the Eurostat embarked on the development of new agricultural productivity indicators, which has caught the attention of both politicians and analysts.
The Economic Accounts for Agriculture (EAA), revised in 1997, and the closely related Agricultural Labour Input (ALI) statistics provide a consistent framework for defining the productivity indicators. The so-called agricultural income indices, regularly de-rived from EAA and ALI statistics, are in fact productivity indicators, which measure the state of the sector (Szabo, 2003).

Productivity, which measures the increase in outputs not accounted for by the growth in production inputs, is a closely watched economic performance indicator because of its contribution to a healthy and thriving economy. Agriculture, in particular, has been a very important sector in every country's economy in terms of productivity growth. Productivity growth in agriculture can be attributed to investments in research and development (R&D), extension, education, and infrastructure. Increased productivity can translate into increased farm income, at least in the short run. In the long run, additional farms adopt the more productive inputs and practices, leading to increased output supply and a possible lowering of farm output prices and farm income (Jet et al., 2000).

Productivity indicators can be classified into three categories:
1. partial productivity: relates an output indicator to a single input indicator,
2. multi-factor productivity: relates every output indicator to a bundle of input indicators,
3. Total factor productivity: occurs when the ratio of total outputs to total inputs increases, reflecting greater average output per unit of input.

These types have their advantages and disadvantages. Partial productivity is easy to measure and understand but it does not reflect the fact that in reality output can be de-pendent on the interaction of several production factors. The partial productivity is proposed as a secondary indicator only, mainly for comparing different industries within a single member state. Multi-

factor productivity is much better at that point but it requires a substantial amount of input data (Ball et al., 2001, Carter & Zhang, 1994).
The multi-factor productivity indicators have been given greater priority, because they allow a better comparison among the member states.

Several things must be taken into account when analyzing these indicators:

- Output refers only to production in the physical sense, but there are social and environmental factors as well (such as desertification etc.).
- Depreciation, used in the weighting of capital, may require empirical correction.
- The labour input data are not broken down by age, sex and education.

Partial productivity measures

Historically, economists have used and developed productivity measures which are based on the relationship between one or more outputs relative to a single key input, such as an acre of farm land or an index of farm labor input. These indicators are called partial factor productivity indicators. The most common partial productivity index economy-wide is a labor productivity measure.
The Table 1 shows the Gross Agricultural Production (GAP) per 1 ha Utilised Agricultural Area (UAA) in Bulgaria, the Czech Republic, Hungary, Poland, Romania and Slovakia (in EUR/ha, and percent of EU average) in corps, livestock and total. This ratio in analyzed countries reflects between cca. 20 - 40% (in both of areas and in total). This percent in Hungary is the most higher, in the Czech Republic and Poland is average, and in other countries lower.

Table 1 – Gross Agricultural Production (GAP) per 1 ha UAA in 2000

	EU-15	**BG**	**CZ**	**H**	**PL**	**RO**	**SK**
Crops							
EUR/ha	1 121	246	274	371	303	336	233
% of EU	100	22	24	33	27	30	21
Livestock							
EUR/ha	806	236	308	311	269	182	271
% of EU	100	29	38	39	33	23	34

Source: Novak et al, 2005

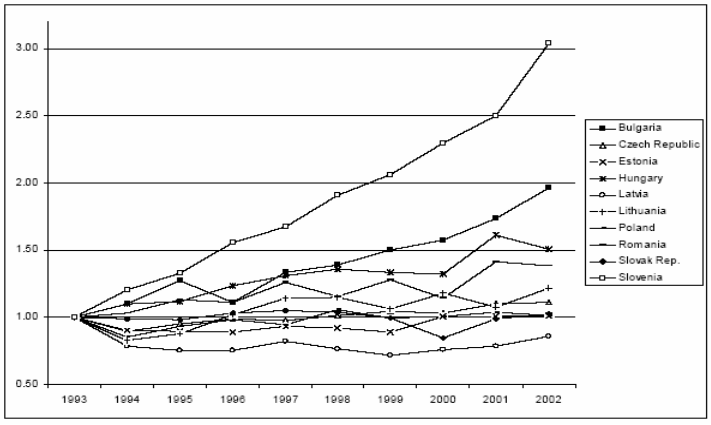


Figure 3.: Changes in Agricultural Labour Productivity (ALP) for the Ten CEECs (base 1993=1)
Source: Tonini, 2005

Figure 3, describes the changes in agricultural labour productivity (agricultural output per economic active person) for the ten CEECs for the period 1993-2002. In spite of the contemporaneous agricultural output and labour input contraction in the majority of the CEECs it is possible to envisage a rise in agricultural labour productivity (APL) for several countries such as Bulgaria, Hungary, Romania and Slovenia. This underlines that in those countries labour input went down faster then agricultural output.

Total Factor Productivity Measure

The traditional measurement techniques of effectiveness, both in partial and complex efficiency indexes (TFP – total factor productivity), calculated only with those factors that have direct linkage with the agricultural production and they can be measured in market transactions.
TFP index derives change in total output relative to the change in the use of all inputs. It is usually preferred to the more simple partial productivity measures that may provide misleading results especially when country are characterized by asymmetric changes in inputs (i.e. CEECs) (Roselle and Swinnen, 2004).

The Malmquist index of Total Factor Productivity (TFP)

Since agriculture is potentially an important contributor to environmental degradation, it may be especially important in agriculture to adjust productivity measures to reflect environmental impacts. Measurement of productivity is important, but it is not an unambiguous task, especially when un-priced (or poorly priced) inputs or outputs are involved. Recent years have seen growing importance of non-parametric approaches in the computation of agriculture productivity (especially the Malmquist productivity index) and environmental impacts.
The MI in comparison to the widely used Tornqvist Index (TI) it is more adequate when measuring TFP growth for CEECs for several reasons (Macours & Swinnen, 2000a,b). First the MI is less restrictive than the Tornqvist Index (TI) because it does not assume that the units under observation are contemporaneously technically and allocatively efficient, permitting to measure the degree under which countries moves towards or further away from the given technology. It is arguable and restrictive to consider that units are contemporaneously technically and allocatively efficient during a dynamic process of resource adjustments such as the transition reform. Second the MI does not necessarily require the imposition of strong behavioral assumptions that may be questioned for country level analysis. Third the MI does not require input prices that for CEECs may be only sparsely available and when available frequently affected by hyperinflation making arguable their use. Finally the MI allows the TFP growth to be decomposed into technical change and efficiency change, making possible to distinguish between different sources of productivity growth over time.

According to Tonini (2005) TFP calculation the results of TFP growth in agriculture for the ten CEECs show an average annual growth in agricultural total factor productivity of 0.29 per cent, with a negative efficiency change contributing 0.05 per cent per year and technical change contributing 0.34 per cent per year. This implies for the ten CEECs an overall limited and moderate growth of TFP in agriculture entirely driven by technical change. The moderate agricultural productivity growth has to be observed in perspective .

Table 2. Average annual changes 1993-2005 in CEECs

Average annual changes 1993-2002			
Country	Efficiency Change (EC)	Technical Change (TC)	TFP Change
Bulgaria	0.9999	1.0036	1.0035
Czech Rep.	0.9996	1.0031	1.0027
Estonia	0.9991	1.0024	1.0014
Hungary	1.0000	1.0037	1.0036
Latvia	0.9991	1.0019	1.0011
Lithuania	0.9993	1.0029	1.0022
Poland	0.9992	1.0034	1.0027
Romania	0.9994	1.0034	1.0029
Slovak Rep.	0.9996	1.0027	1.0023
Slovenia	0.9995	1.0053	1.0048
Weighted Average	**0.9995**	**1.0034**	**1.0029**

Source: Tonini, 2005

The Tornqvist-Theil index of Total Factor Productivity (TFP)

There is a useful equivalency between the Malmquist productivity index and the commonly used Tornqvist-Theil (TT) productivity index. Caves, Christensen and Diewert (CCD) in 1982 established that when technologies are represented by certain functional forms, a Tornqvist-Theil index computed with shadow shares calculated from the Malmquist shadow prices provides the same productivity measure as the CCD version of the Malmquist.
A Tornqvist index is currently used to estimate agricultural productivity. In the past, the Laspeyres index, which uses base-period weights, was used in contrast to the Tornqvist, which uses prices from both the base period and the comparison period. The Tornqvist is preferred to the Laspeyres because it does not require the unrealistic assumption that all inputs are perfect substitutes in production.

Total Social Factor Productivity Measure

Conventional measures of total factor productivity (TFP) do not take into account inputs and outputs that are external to the production process, i.e. they only include factors that are managed by decision makers and do not include possible externalities that might arise from that process. Intuitively then it seems appropriate to include these negative (or positive) external effects within an amended measure of agricultural TFP to produce an measure of total social factor productivity (TSFP) that attempts to measure the full social costs and benefits of agricultural production showed in figure 4.

The TSFP index, which is calculated considering external effects, shows the complex social efficiency. It is highly accepted by many economists as an important index of sustainable development. Socially it is expected to increase productivity in such a way that no one from the mentioned indexes decreases (Gorton & Davidova, 2004).

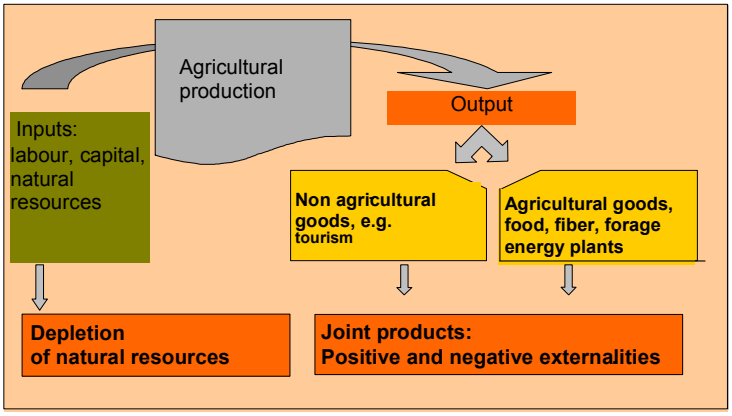


Figure 4.: Total value of agricultural production

The social value of agricultural production can be expressed with the following equation:

$$\mathbf{W = TU + \Delta NS}$$

Where: TU: usefulness from the consumption of agricultural products and services
Δ**NS** : devaluation of natural resources (present value of long time services' decrease)

Factors Affecting Agricultural Productivity

Several factors have been identified in the social science literature as the most important sources of productivity change in agriculture: research and development, extension, education, infrastructure, and government programs. Productivity measures do not provide any information about the separate role of each of these factors. However, an understanding of the potential sources of productivity growth is important for formulating appropriate policy tools to increase productivity and a society's standard of living.

Conclusion

The agricultural sector in Central and Eastern Europe is confronted by three huge problems simultaneously: (i) transition process (ii) competitiveness in the single market of EU and (ii) sustainability. Increasing of productivity and welfare is the main issues of future development pathway in the agriculture. Improving of total factor productivity helps to reach the mentioned goals. Institutions and social capital are very important for the performances of the government, the economy as whole, and realizing sustainable agriculture (with transaction cost of sustainability). Enlargement of EU had important impacts on the structure of agriculture in CEE region. It is likely to have some further effects on agriculture and agricultural policies in the future. One important factor could be on policy-making (CAP), if for nothing else than, because agreeing on important reforms will be even more complicated with 25 Member States than with 15 and with the requirement of sustainability.

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