PRODUCTIVITY AND REMUNERATION OF LABOUR: DISPARITIES ACROSS SECTORS AND COUNTRIES

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Abstract

The aim of this paper is to investigate the relationship between labour productivity and labour remuneration among agricultural and non-agricultural sectors in selected EU countries. The issue under investigation pertains to the question of whether remunerations for labour and their rate of growth are attributable to changes in labour productivity. The problem is analyzed via static and dynamic approaches. To carry out the research, the authors' own analytical approach is used, while appropriate statistical data for 1995–2013 and methods are used to verify the hypothesis. The conclusion of the study is that the relationship between remuneration and productivity substantially differ across sectors and countries. Especially in the agricultural sector, one can observe that the level of remuneration and growth are weakly related to productivity growth.

PRODUKTYWNOŚĆ A WYNAGRODZENIE CZYNNIKA PRACY – ZRÓŻNICOWANIE MIĘDZYSEKTOROWE I MIĘDZYNARODOWE

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Abstrakt

Celem opracowania jest przedstawienie związków między produktywnością a wynagrodzeniem czynnika pracy między sektorem rolniczym a sektorami pozarolniczymi w wybranych krajach UE. Problem badawczy odnosi się do odpowiedzi na pytanie, czy wynagrodzenie czynnika pracy i jego

zmiany są powiązane ze zmianami produktywności pracy. Odpowiadając na to pytanie, wykorzystano zarówno statyczne, jak i dynamiczne podejście. Badania oparto na własnym podejściu analitycznym, a odpowiednie dane statystyczne z lat 1995–2013 wykorzystano do weryfikacji hipotezy badawczej. W świetle badań relacje wynagrodzeń do produktywności znacząco się różnią między sektorami i krajami. Szczególnie w przypadku sektora rolnego wynagrodzenie czynnika pracy i jego zmiany jest słabo powiązane z jego produktywnością.

Introduction

The remuneration/productivity ratio is a key issue in economic research. The ratio indicates the rationality of business management and has a significant effect on competitiveness. Research shows that the ratio can vary across sectors and countries (LAGAKOS, WAUGH 2013). Of special interest might be the diversification of the remuneration/ productivity ratio between agriculture and non-agriculture, as well as the possible elimination of disparities across countries (convergence). This constitutes the research focus of our paper.

So far, attention has been paid to the issue of lower labour productivity in agriculture relative to non-agricultural sectors (CAI, PANDEY 2013). In this respect, greater disparities are shown to exist in less developed countries. One of the reasons for this diversification is the underestimation of production in agriculture due to the low level of marketability of production in these countries (GOLLIN et al. 2004, HERRENDORF, SCHOELLMAN 2012). It has also been indicated that across countries, diversification in labour productivity in agriculture is greater than in non-agricultural sectors (CASELLI 2005, RESTUCCIA et al. 2008). The processes of eliminating disparities in labour productivity across countries are less effective in agriculture than in non-agricultural sectors. This stems from factors such as the cost of technology transfer or imitation, trade barriers or political barriers (BARRO, SALA-I-MARTIN 1995, GUTIERREZ 2002).

Ratios of productivity and remuneration of factors of production form the basis for effective allocation of production factors across business entities and sectors of the economy in the long run. The ratio of remuneration of labour to labour productivity is reflected in one of the most important economic categories, the Unit Labour Cost (ULC). Cross-sectoral remuneration disparities between agriculture and non-agriculture should have an effect on the reallocation of labour resources from agriculture to non-agricultural sectors (HAYAMI, RUTTAN 1985). Thus, what should follow is cross-sectoral convergence in the relation between remuneration and productivity. It does not always happen, hence the ineffective allocation of production factors. Among the reasons for overemployment in agriculture may be the necessity to safeguard food security (food problem), barriers to move out of the agricultural sector or the country's

policy (CASELLI, COLEMAN 2001, GUTIERREZ 2002, LAGAKOS, WAUGHT 2013). VOLLRATH (2009) estimates that about one third of disparities between agricultural and non-agricultural income may be explained in terms of an ineffective allocation of production factors.

The aim of this paper is to present an analytical and empirical framework (from both a static and dynamic point of view) of the ratios of labour productivity and remuneration across sectors (agriculture and non-agriculture) as well as across countries. At the same time, it is important to evaluate the convergence of these ratios across sectors and countries. This problem has been discussed in relation to sectors of the Lithuanian economy (TAMASAUSKIENE, STANKAITYTE 2013) as well as the Eurozone (FELIPE, KUMAR 2011); but it has only been investigated relative to statistical relations between these variables.

Analytical framework

In accordance with the aim of this paper and relative to the literature on the subject, we assume that the ratios of remuneration for labour employed in various sectors and countries stem mainly from the ratios of labour productivity. In this respect, we assume the existence of some proportion, rather than an equal value.

This assumption can be based on the following analytical and theoretical foundations. In general, it can be assumed that remuneration of labour is determined by its productivity (it is a ratio of the production obtained over the employment of that factor) and product price. We can describe it as follows:

$$\varpi_L \approx \frac{Y}{L} \cdot p_Y \tag{1}$$

where:
ϖ_L – remuneration,
Y – production,
L – labour,
p_Y – prices obtained for goods.

The theoretical basis for determining remuneration is the marginal productivity of labour $\hat{\varpi_L}$ (p_Y given), which is connected with the producer equilibrium (rational choice), that is:

$$\varpi_L \succ \varpi_{\hat{L}} \approx \frac{\partial Y}{\partial L} \tag{2}$$

On the other hand, the level of remuneration so determined is affected by the impact of the equilibrium on the labour market:

$$\varpi_L \prec \varpi_L^E \approx \frac{S_L}{D_L} \tag{3}$$

where:
ϖ_L^E – remuneration resulting from market equilibrium,
S_L – labour supply,
D_L – labour demand.
Thus:

$$\varpi_L^E \succ \varpi_L \prec \varpi_{\hat{L}} \tag{4}$$

This expression indicates the complexity of determining the basis for remuneration. Any institutional and regulating factors, transfers or interventions are not considered here.

Therefore, we can assume that the relation between remuneration and labour productivity in agriculture and non-agricultural sectors should be describable as:

$$\frac{\varpi_L^A}{\varpi_L^N} = \frac{Y_A / L_A}{Y_N / L_N} = \frac{p_L^A}{p_L^N} \tag{5}$$

whereby:
A, N – indicate respectively: agricultural sector and other sectors,
p_L^A, p_L^N – labour productivity in agriculture and other sectors, respectively.

Presuming general equilibrium in cross-sectoral allocation, it can be assumed that remunerations of labour in sectors are proportional to the productivity of labour:

$$\frac{\varpi_L^A}{p_L^A} \approx \frac{\varpi_L^N}{p_L^N} \tag{6}$$

This issue can be analysed in terms of unit labour costs (ULCs). ULCs can be analysed via a static or dynamic approach. In the static approach, the UCL index in particular sectors can thus be expressed as follows:

$$\text{ULC}_A = \frac{\varpi_L^A}{p_L^A} \qquad \text{and} \qquad \text{ULC}_N = \frac{\varpi_L^N}{p_L^N} \tag{7}$$

The cross-sectoral ratio of labour costs l, which will be the object of our empirical analysis, can be expressed as follows:

$$l = \frac{\text{ULC}_A}{\text{ULC}_N} \tag{8}$$

Both approaches converge and indicate the rationality of business management in sectors and the competitiveness of microeconomic entities.

In the dynamic approach, the ratios of UMCs indicate changes in the competitiveness level and rationality of business management. We can express it as follows:

$$l' = \frac{\text{ULC'}_A}{\text{ULC'}_N} \tag{9}$$

where:

$$\text{ULC'}_A = \frac{\Delta \varpi_L^A}{\Delta p_L^A},$$

$$\text{ULC'}_N = \frac{\Delta \varpi_L^N}{\Delta p_L^N},$$

Empirical analysis

We now examine the extent to which the above analytical approach and the formulated assumptions are reflected in economic practice and statistical data. We first refer to the data and methods used. Then, we attempt to compare productivity and remuneration and analyse the changes in agricultural and industrial sectors in selected countries of EU.

Data and methods applied

In the empirical analysis, we have used data concerning labour productivity and remuneration taken from National Accounts in the nomenclature of ESA95, NACE Rev2 (Source: ECB/Eurostat). Productivity and labour remuneration are presented nominally as EURO/hour's work (data are not adjusted due to full-time employment). Labour productivity reflects the output that can be produced with a given input of labour. It is measured as GDP divided by total hours worked. Compensation per employee is the total remuneration, in cash or in kind, that is payable by employers to employees in return for work, i.e. gross wages and salaries, as well as bonuses, overtime payments and employers' social security contributions, divided by total hours worked. Unit labour costs are calculated as the ratio of compensation to labour productivity.

The data analysed is from 2000 to 2013. In the case of Poland, data is only available from the year 2005 onwards. Therefore, that data has not been included in the statistical analyses. The empirical analysis entails the comparison of two sectors. The first sector: agriculture, forestry, and fishing are together referred to as agriculture. Non-agricultural sectors are represented by industry, embracing mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply; sewage, waste management and remediation activities. The general name for this sector is non-agriculture.

The empirical research is based on assumptions presented in the analytical section. In the empirical evaluation of productivity changes and changes in remuneration as well as their ratios methods of central tendency analysis (average – Av), dispersion (coefficient of variation – Cv), and dynamic indexes have been used. The results have been presented in the form of tables and graphs.

Labour productivity, remuneration, and Unit Labour Costs

Table 1 presents data from 2000 to 2013 indicating productivity and remuneration in the agricultural and non-agricultural sector in the old and new member states of the European Union (OMS, NMS, respectively). The statistical data and calculated averages confirm significant cross-sectoral differences both in productivity and remuneration, according to which non-agriculture compares favourably with agriculture. In the OMS, productivity and remuneration are several times higher than in the NMS.

The levels of both analysed variables are extremely diversified across countries. This is indicated by the high values of the coefficient of variation (Cv). The data show that the diversification of productivity and remuneration

Table 1

Labour productivity and labour remuneration in agricultural and non-agricultural sectors of EU countries (euro/hour)

Sector	Agriculture				Non-agriculture			
Variable	p_L^A		ϖ_L^A		p_L^N		ϖ_L^N	
Year	2000	2013	2000	2013	2000	2013	2000	2013
Austria	5.11	8.08	10.55	12.98	38.06	54.83	22.03	32.81
Cyprus	5.43	5.13	3.64	5.80	16.52	18.46	7.07	11.07
Germany	9.02	13.84	13.82	14.80	38.02	50.35	27.49	36.13
Denmark	15.69	16.20	18.95	26.31	50.74	61.96	23.90	40.24
Spain	14.52	17.93	4.53	6.27	26.05	39.75	13.80	22.42
Finland	10.81	16.58	10.01	14.71	37.28	50.60	22.01	32.14
France	14.59	19.28	12.14	19.53	36.28	49.14	23.34	34.38
Greece	5.70	6.73	3.05	5.82	16.40	20.66	7.94	11.75
Italy	10.99	12.69	7.83	10.46	29.04	30.76	17.47	25.67
Netherlands	15.99	23.11	16.22	23.56	48.03	64.44	22.94	34.28
Portugal	3.11	4.97	4.19	5.68	11.92	17.30	6.47	9.34
Sweden	12.12	17.91	14.79	19.85	38.10	60.04	23.28	33.86
Bulgaria	1.52	1.31	0.82	2.86	2.71	4.87	1.40	3.48
Czech Rep.	3.55	5.62	2.73	6.90	6.56	17.58	3.55	8.97
Estonia	4.15	8.22	1.52	5.18	5.05	10.58	2.50	7.44
Hungary	2.16	4.34	1.84	4.33	7.12	9.68	3.03	6.61
Lithuania	1.70	5.03	1.10	4.20	5.02	12.71	2.52	6.39
Latvia	1.20	3.55	0.70	4.48	3.31	7.25	1.68	5.85
Slovenia	2.52	3.98	6.06	12.20	12.58	23.01	6.93	16.55
Slovakia	4.97	14.73	2.60	5.74	7.92	20.95	4.05	9.11
Descriptive statistics								
Av.: all	7.24	10.46	6.85	10.58	21.84	31.25	12.17	19.42
Av: OMS	10.26	13.54	9.98	13.81	32.20	43.19	18.14	27.01
Av.: NMS	2.72	5.85	2.17	5.74	6.28	13.33	3.21	8.05
Cv: all	0.70	0.60	0.82	0.65	0.72	0.64	0.76	0.64
Cv: OMS	0.42	0.43	0.52	0.51	0.37	0.39	0.39	0.38
Cv: NMS	0.47	0.65	0.75	0.47	0.46	0.46	0.51	0.45

Source: authors' own calculations based on Eurostat/ECB, ESA95 National Accounts.

in the new members states (NMS) is higher than in the old member states (OMS). The preliminary analysis of the data also indicates the lack of any greater changes in the diversification of labour productivity and remuneration in the OMS in the years 2000–2015. In the NMS, an increase in diversification of labour productivity in agriculture relative to 2013 is noticeable. At the same time, the diversification of remuneration across the NMS has decreased in the years 2000–2013.

From the perspective of neoclassical theory, labour remuneration should be determined by its productivity (expressions 2–4). However, it can be observed that we are dealing with a reversed relationship between productivity and remuneration within particular sectors (Table 1). In the agricultural sector of most countries, remuneration is higher than labour productivity. In 2013, the exceptions to this were Estonia, Finland, Spain, Greece, Italy, and Lithuania. In the case of the non-agricultural sector (industry), remuneration constitutes ca. 50-80 per cent of labour productivity.

The above observations are supported by the calculated average ULC presented in Figure 1. It can be observed that the non-agricultural ULCs in the NMS are lower than in the OMS. This condition gives greater competitiveness to the NMS, which allows less developed countries to catch up with more developed countries, hence some convergence. Symptoms of this convergence have already started to appear, and disparities between the NMS and the OMS have already begun to decrease.
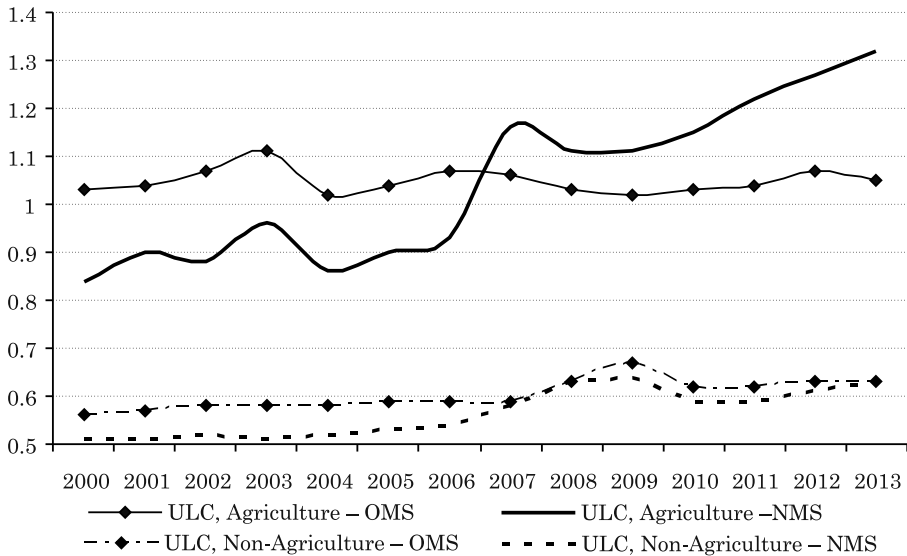

Fig. 1. Average values of hourly Unit Labour Costs (ULC) in agricultural and non-agricultural sectors of EU countries
Source: authors' own calculations based on Eurostat/ECB, ESA95 National Accounts.

Since 2006 in the agricultural sector, the ULC has been lower in the NMS than in the OMS, being less than 1. Since 2007, agricultural remunerations in the NMS have been increasing faster than the productivity of labour employed. The average ULC in the NMS has increased significantly above 1, when compared to the level observed in the OMS. This may be related to the volume

of support for the NMS within the framework of Common Agricultural Policy (CAP), which is relatively greater than in the OMS with regards to labour productivity. This might decrease the pressure to improve labour productivity in agriculture in the NMS, because farming incomes are increasingly less dependent on labour productivity.

When we compare ULCs in the agricultural sector to the non-agricultural sector (expression 8), it can be observed that (Fig. 2) the ratios in agriculture compare unfavourably with non-agriculture both for the OMS and NMS. However, it may be noted that in the case of the aforementioned change, since 2007 the analysed ratios have been greater in the NMS, while they have been decreasing in the OMS. This can be considered as a manifestation of some convergence across sectors in the case of the OMS and divergence in the NMS case. In light of the dual economy theory, this does not seem to be a good characteristic of development processes in the NMS.
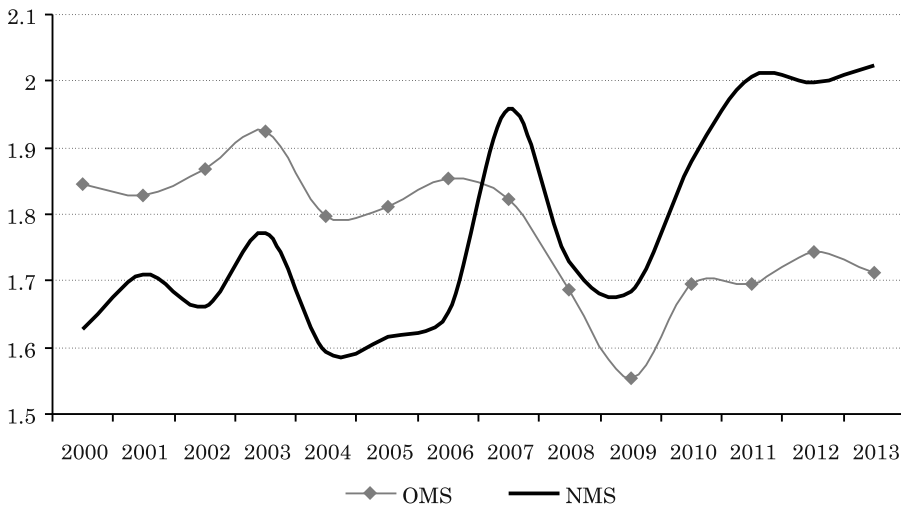

Fig. 2. Average index values of ULC in agriculture versus ULC in non-agriculture of EU countries
Source: authors' own calculations based on Eurostat/ECB, ESA95 National Accounts.

The values and graphs obtained may indicate an improvement in the ULC ratio across analysed sectors of the OMS, and a deterioration in the NMS. This confirms the observations formed on the basis of Figure 1. In the NMS, the dependence of income on productivity in agriculture has been decreasing relative to other sectors, while the opposite is occurring in the case of the OMS.

Changes in productivity, remuneration and unit labour costs

A question arises as to the dynamic of these processes. That is, what is the relation between the increase in remuneration and the growth of labour productivity (expression 10) in the NMS and OMS in the sectors under investigation? It can be assumed that in agriculture, the growth of productivity should be faster than the growth of remuneration relative to other sectors ($l' < 1$), especially in the NMS so as to eliminate the signalled disparities of income between agriculture and other sectors. In this respect, the analysis is possible on the basis of the data in Table 2.

Table 2

Changes in labour productivity and labour remuneration in 2000–2013 of EU countries

Sector	Agriculture			Non-agriculture			Ratio
Variable	Δp_L^A	$\Delta \varpi_L^A$	ULC'$_A$	Δp_L^N	$\Delta \varpi_L^N$	ULC'$_N$	l'
Austria	1.58	1.23	0.78	1.44	1.49	1.03	0.76
Cyprus	0.94	1.59	1.69	1.12	1.57	1.40	1.21
Germany	1.53	1.07	0.70	1.32	1.31	0.99	0.71
Denmark	1.03	1.39	1.35	1.22	1.68	1.38	0.98
Spain	1.23	1.38	1.12	1.53	1.62	1.06	1.06
Finland	1.53	1.47	0.96	1.36	1.46	1.08	0.89
France	1.32	1.61	1.22	1.35	1.47	1.09	1.12
Greece	1.18	1.91	1.62	1.26	1.48	1.17	1.38
Italy	1.15	1.34	1.16	1.06	1.47	1.39	0.83
Netherlands	1.45	1.45	1.01	1.34	1.49	1.11	0.91
Portugal	1.60	1.36	0.85	1.45	1.44	0.99	0.86
Sweden	1.48	1.34	0.91	1.58	1.45	0.92	0.99
Bulgaria	0.86	3.48	4.03	1.80	2.48	1.38	2.92
Czech Rep.	1.58	2.53	1.60	2.68	2.53	0.94	1.70
Estonia	1.98	3.41	1.72	2.10	2.98	1.42	1.21
Hungary	2.00	2.36	1.18	1.36	2.18	1.60	0.74
Lithuania	2.95	3.81	1.29	2.53	2.53	1.00	1.29
Latvia	2.96	6.40	2.16	2.19	3.48	1.59	1.36
Slovenia	1.58	2.01	1.27	1.83	2.39	1.31	0.97
Slovakia	2.96	2.21	0.74	2.65	2.25	0.85	0.87
Descriptive statistics							
Av.: all	1.65	2.17	1.37	1.66	1.94	1.19	1.14
Av: OMS	1.34	1.43	1.11	1.34	1.50	1.14	0.97
Av.: NMS	2.11	3.27	1.75	2.14	2.60	1.26	1.38

Source: authors' own calculations based on Eurostat/ECB, ESA95 National Accounts.

Any clear tendencies or observations in accordance with the assumptions that productivity growth should exceed an increase in remuneration, both within a sector and across sectors, cannot be observed. In general, the remuneration growth in EU countries is faster than the labour productivity growth (ULC'). Greater discrepancies occur in the NMS (the average values in agriculture and non-agriculture are 1.75 and 1.26, respectively) then in the OMS (the average values being 1.11 and 1.14, respectively).

In relation to expression 9, in most of the countries growth ratios *l'* are below (especially in Germany and Hungary) or close to 1. This may indicate the equalization of ratios of remuneration and productivity across sectors, which reflects some convergence across sectors and solving the income disparity problem in the market. In the case of Cyprus, Greece, Finland (in the OMS) and Bulgaria, Czech Republic, Estonia and Lithuania (in the NMS), the growth of remuneration relative to productivity in agriculture is greater than in non-agriculture. In these countries, cross-sectoral differences are worsening (given the already existing disparities), which can indicate some risk of an ineffective allocation of labour in these economies.

Summary

We have outlined an analytical framework with some empirical analysis of the ratios between productivity of labour and remuneration and their respective changes in relation to sectors (agriculture and non-agriculture), both in the NMS and OMS. An analysis of such ratios and their changes allows statistical and dynamic evaluations of the rationality of business management, eliminating income disparities across sectors or convergences. The analysis and observations are preliminary, indicating a new way of approaching this key economic issue, which determines competitiveness within and across sectors. The proposed analytical framework can be further enriched with statistical models allowing the computation of sigma and beta convergence.

Observations based on empirical analysis are not always unambiguous. Nevertheless, in the case of some countries (mainly the OMS) some positive processes can be observed, including convergence, levelling across sectors of ratios of remuneration and labour productivity, both in terms of the static and dynamic approach. The aforementioned positive relation between remuneration for labour and labour productivity cannot be observed in the agricultural sector of the NMS. One can observe an increasing disparity across sectors most frequently in these countries as well.

From an international perspective, one can notice a decreasing disparity between unit labour costs in non-agriculture between the OMS and the NMS.

In the case of agriculture, after the EU enlargement, the level of ULC in the NMS has significantly exceeded the level observed in the OMS. Thus, it can be concluded that we are not dealing with processes of convergence of ULC in the agricultural sector in the European Union.

References

ADAMOPOULOS T., RESTUCCIA D. 2010. *The Size Distribution of Farms and International Productivity Differences*. Unpublished Manuscript, University of Toronto.

BARRO R.J., SALA-I-MARTIN X. 1997. *Technological Diffusion, Convergence, and Growth*. Journal of Economic Growth, 2(1): 1–26.

CAI W., PANDEY M. 2013. *The Agricultural Productivity Gap in Europe*. Department of Economics Working Paper Number: 2013-05, The University of Winnipeg.

CASELLI F., COLEMAN W.J. 2001. *The U.S. Structural Transformation and Regional Convergence: A Reinterpretation*. Journal of Political Economy, 109(3): 584–616.

CASELLI F. 2005. *Accounting for Cross-Country Income Differences*. In: *Handbook of Economic Growth*. Eds. P. Aghion, S. Durlauf. Elsevier, Amsterdam.

FELIPE J., KUMAR U. 2011. *Unit labor costs in the eurozone: the competitiveness debate again*. Levy Economics Institute of Bard College Working Paper, 631.

GOLLIN D., ARENTE S.L.P., ROGERSON R. 2004. *Farm Work, Home Work and International Productivity Differences*. Review of Economic Dynamics, 7(4): 827–850.

GUTIERREZ L. 2002. *Why is agricultural labour productivity higher in some countries than others?* Agricultural Economics Review, 3(1): 58–78.

HAYAMI Y., RUTTAN V.W. 1985. *Agricultural Development: An International Perspective*. John Hopkins University Press, Baltimore.

HERRENDORF B., SCHOELLMAN T. 2012. *Why is Measured Productivity so Low in the Agriculture*. Working Paper, Arizona State University.

LAGAKOS D., WAUGH M.E. 2013. *Selection, Agriculture, and Cross-Country Productivity Differences*. American Economic Review, 103(2): 948–980.

REMBISZ W., BEZAT-JARZĘBOWSKA A. 2013. *Microeconomics of agricultural producer̀s income*. Lambert Academic Publishing.

RESTUCCIA D., YANG D.T., XIAODONG Z. 2008. *Agriculture and aggregate productivity: A quantitative cross-country analysis*. Journal of Monetary Economics, Elsevier, 55(2): 234–250.

TAMASAUSKIENE Z., STANKAITYTE A. 2013. *Evaluating of the Relationship between Wages and Labour Productivity in Lithuania: Territorial and Sectoral Approaches*. Socialiniai tyrimai / Social Research, 1: 24–31.

VOLLRATH D. 2009. *How Important are Dual Economy Effects for Aggregate Productivity*? Journal of Development Economics, 88(2): 325–334.