Picture 1. Migration routes show geolocator data from two female red-footed falcons tagged in north-central Kazakhstan. Filled circles are summer and winter locations, triangles show directionality of migration travel; unfilled triangles representing data with l s confidence (those recorded during es the equinox); squares are stopovers; dotted lines are periods with no data. The buffer around the lines is the average error from known locations estimated during the breeding period. The Sahara desert, a dangerous crossing, is dotted.

Neycheva, M.,
Associate Professor, PhD in Economics,
Burgas Free University, Burgas, Bulgaria

HUMAN CAPITAL AND VERTICAL SKILL MISMATCH: THE CASE OF THE NEW EU MEMBER STATES FROM EASTERN EUROPE

Abstract
The purpose of this study is to shed light on the link between human capital and vertical mismatch in the 11 new EU member states from Eastern Europe. Human capital is measured by the percentage of the active population having completed higher education. In the economies under consideration both the number of tertiary education graduates and the degree of the skill mismatch have been sharply increasing since the year 2000. The rate of the job mismatch appears to be positively influenced by the share of female graduates. On the other hand, it is negatively linked to the gross value added of the trade-related services.
Keywords*: human capital, higher education, skill mismatch, labor market, new EU member states.*

1. Introduction.
According to the theoretical studies, the quantity of human capital measured by the educational attainment of the population is one of the major factors which fuel growth in the con-

temporary economies. However, the studies examining the developed countries particularly call into question that theoretical outcome (e.g. Islam 1995; Knowles and Owen 1995; Neycheva 2016). One of the explanations suggested in the empirical literature is that the quality of human capital is more important than its quantity. Therefore, some papers place emphasis on the quality of education (Hanushek and Woessmann 2008; Jones 2012; Castello-Climent and Hidalgo-Cabrillana 2012; Jin and Jin 2014). The most popular indicators for measuring the human capital quality include scores from internationally recognized tests which assess the student cognitive skills such TIMSS, PISA (Hanushek and Kimko 2000), national IQ test scores (Lynn and Vanhanen 2002), educational expenditure per capita (Kiran 2014).

In light of the abovementioned, this study focuses on the quality of human capital. The nation's stock of human capital is approximated by the labor force having completed tertiary education that is educational levels from 5 to 8 according to the International Standard Classification of Education (ISCED). The indicator of the human capital quality being used here is the rate of vertical skill mismatch which is defined as employment below the theoretical skill level acquired (Eurostat 2009).

The sample includes the eleven new EU member states from Central and Eastern Europe (CEE), henceforth NMS: Bulgaria, Czech Republic, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovakia. The primary reason to focus particularly on this region is that the percentage of tertiary education graduates in the labour force has been significantly accelerating over the last two decades thus reaching on average 30.1% in 2016 compared to only 18.5% in 2000. That provides an opportunity for research on whether and how the positive trend in the human capital development affects the job (mis)match.

Skill mismatch has been referred to in the empirical studies on long-run unemployment (Birk 2001), labor productivity (McGowan and Andrews 2015) or wage inequality (Budria and Moro-Egido 2008). Morgado et al. (2015) find a significant negative effect of vertical mismatch on per capita output in Europe. The major contribution of the current study is that it investigates the post-communist economies particularly and tries to find the factors which determine the skill mismatch in those countries.

The paper is structured in the following way. Section 2 presents descriptive statistics on the vertical skill mismatch in the countries under examination. Section 3 discusses the methodology of the study and the econometric output. Some concluding remarks could be found in the last section 4.

2. Materials and methods: Link between job mismatch and higher education in the NMS.

Generally speaking, vertical mismatch is defined as employment below the theoretical skill level acquired. With regard to higher education, it comprises university graduates with any occupation different from managers, professionals, technicians and associated professionals since they require an academic degree according to the International Standard Classification of Occupations (ISCO-08). It is reasonable to accept the degree of vertical qualification mismatch as a measure of the quality of the nation's stock of human capital. As the competition among graduates at the labor market tightens, the most qualified ones are expected to be hired for job positions which are most closely related to the completed level of education.

Table 1. Vertical qualification mismatch in the new EU member states (2000-2016)

Country	Active population with tertiary education (%)			Vertical qualification mismatch (%)[a]		
	2000	2016	Cumulative change (%)	2000	2016	Cumulative change (%)
Bulgaria	20.5	31.0	51.2	17.9	23.1	29.0
Czech Republic	11.8	23.5	99.2	7.24	14.3	97.5
Estonia	29.6	38.9	31.4	23.9	24.8	3.77
Croatia[b]	15.5	26.3	69.7			

Latvia	19.3	35.0	81.3	16.2	18.8	16.5
Lithuania[c]	42.5	42.0	-1.2	41.7	22.8	-45.3
Hungary	16.2	25.3	56.2	10.9	15.3	40.4
Poland	12.3	32.6	165.0	7.28	20.8	185.7
Romania	8.60	20.0	132.6	11.3	19.3	70.8
Slovenia	16.5	33.9	105.5	9.0	17.5	94.4
Slovakia	10.6	22.6	113.2	8.0	21.9	173.8
Average value	18.5	30.1	62.7	15.3	19.9	29.5

[a]Share of employed having completed tertiary education (ISCED 5-8) who are hired at a job position below the theoretical level acquired.
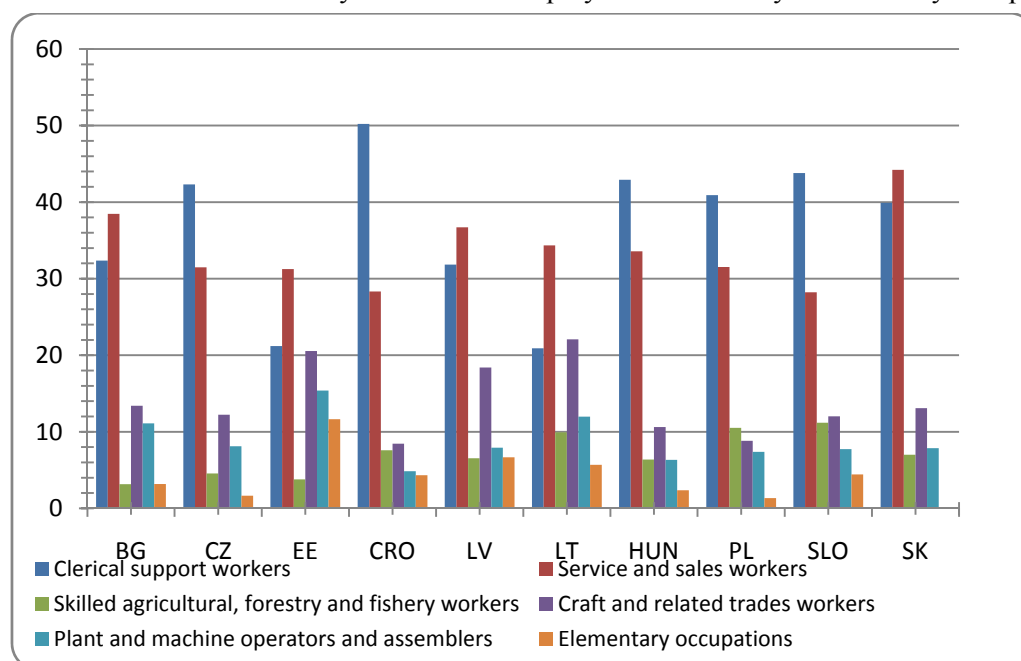[b]The data for Croatia refer to the period 2002-2016.
[c]The negative growth reflects a break in the data series in 2002. The drop in the data in year 2001 was caused by the classification of special secondary school (technical school). Until year 2000, persons who have graduated from special secondary school were included in tertiary education. Since year 2001 they are included in post-secondary non-tertiary education.
Source: Eurostat, National Statistics of Croatia, National Statistics of Lithuania.

Table 1 presents statistics on the active population with tertiary education (ISCED 5-8). The percentage has been continuously increasing, thus reaching on average 30% in 2016 compared to 18% in 2000. In four countries – Poland, Romania, Slovenia and Slovakia – the cumulative rise exceeds 100%. During the observed period the rate of vertical job mismatch was growing up parallel to the broadening share of tertiary education graduates in the active population. At least a two digit cumulative percentage increase has been observed in all countries but Estonia and Lithuania. This tendency is more clearly expressed in countries with a lower starting level of the most educated human capital such as Poland, Slovakia, Czech Republic, and Romania.

Figure 1. Distribution of the vertically mismatched employees with tertiary education by occupation (%)[a]

[a]Average values over the period (2000-2016) for every country are presented. For Croatia the data span over (2002-2016). Armed forces occupations are excluded.
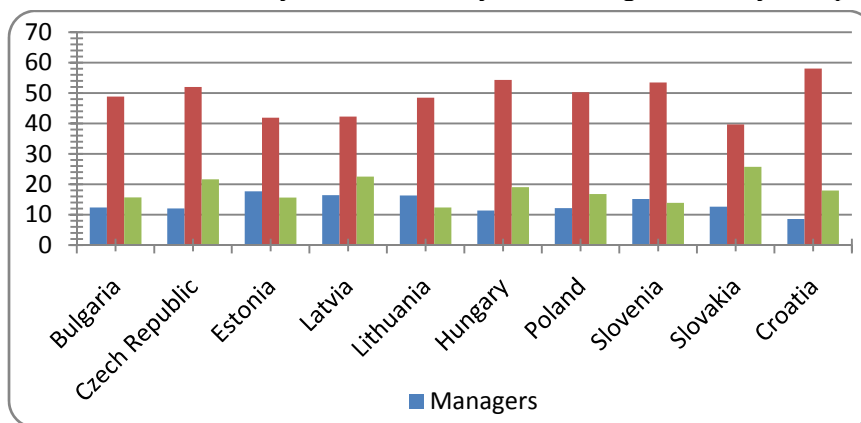Source: Eurostat, author's calculations

Figure 1 displays the distribution of the vertically mismatched employees with tertiary education by occupation according to ISCO-08. The yearly data for each economy are averaged over the period (2000-2016). The prevailing percentage (about 70%) is employed as service and sales workers or clerical support workers. This pattern can be clearly seen in Croatia for which, on avera-

ge, half of the graduates (50.2%) are employed in the latter job category. However, this percentage has been gradually diminishing from 52 in 2002 to 44 in 2016 on behalf of employment in jobs related to services and sales. The third place is taken by craft and related trade workers (about 8%). In Estonia and Lithuania the pattern is different since the corresponding figure is about 21%.

The next two figures – figure 2 and figure 3 – shed light on the vertically matched employees. Regarding tertiary education, the latter comprise people who occupy one of the following positions: Managers, Professionals, Technicians and Associate Professionals since these require skills and knowledge which is acquired at university. The last available Eurostat data (2016) are displayed. The prevailing part of employed (49% on average) works in the second job category. The share ranges from 39.7% in Slovakia to more than 58% in Croatia. The second most popular occupation is Technicians and Associate Professionals – about 18% for the overall sample.

Figure 2. Distribution of vertically matched tertiary education graduates by occupation (2016)

Source: Eurostat, author's calculations

Only 13.5% work in the most qualified category – Managers. Though, the percentage shows great variations – from 8.6% in Croatia to 17.7% in Lithuania. As figure 3 implies, manager jobs are predominantly occupied by males – almost 58% on average. The gender imbalance is most clearly presented in the Czech Republic where 74.5% of managers are males, Slovakia (63.2%) and Hungary (59.5%). Latvia is the only country in which females prevail in all job categories since males account for only 26% of all vertically matched university graduates. As a whole, women take positions primarily as professionals, and, to a lesser extent, as technicians and associated professionals.

Figure 3. Gender balance in vertically matched higher education graduates: percentage of males occupying the corresponding job position (2016)
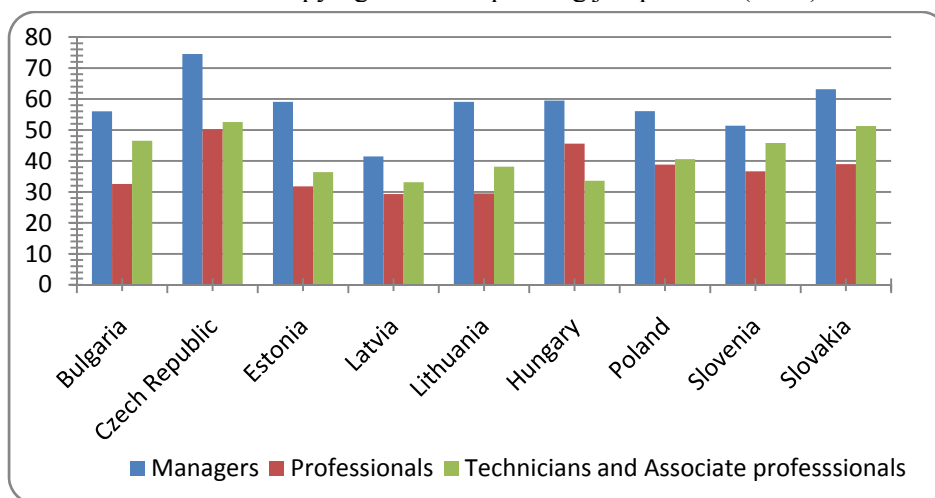
Source: Eurostat, author's calculations

3. Results: a cointegration analysis of the factors for vertical mismatch.

In order to illuminate the factors which influence the degree of vertical mismatch among the tertiary education graduates I run a regression model with variable *vmismatch* as a dependent variable. It equals the percentage of vertically mismatched employees with higher education (ICSED 5-8) expressed as a share of the labor force with tertiary education between 15 and 74 years of age. The rest regression variables include the active population aged between 15 and 74 years with higher education (the variable h5_8) as well as the share of females with tertiary education in the labor force (fem5_8). In view of the exploratory analysis presented in the previous section (Figure 1) I also add as a control variable Gross Value Added-to-GDP ratio for the trade-related services, specifically wholesale and retail trade, transport, accommodation and food service activities, real estate activities. All variables are expressed in logs. The sample consists of yearly data for the eleven new EU members described above over the period 2000-2016.

Table 2. Panel unit root test statistics[a]

Variable	Levin, Lin and Chu[b]	Im, Pesaran and Shin[c]	PP-Fisher Chi Square[d]	ADF-Fisher Chi Square
log vmismatch	1.501 (0.933)[e]	0.241 (0.595)	25.705 (0.265)	13.757 (0.910)
log h5_8	-0.249 (0.402)	-0.721 (0.235)	36.625 (0.026)	26.876 (0.216)
log fem5_8	-2.306 (0.011)	0.898 (0.816)	33.372 (0.057)	17.883 (0.867)
log GVA_sales	-0.236 (0.407)	-0.290 (0.386)	25.360 (0.280)	17.931 (0.710)

[a]H_0: Unit root. Two lags have been included. Newey-West automatic bandwidth selection. with Bartlett kernel.
[b] Levin, Lin and Chu (2002)   [d]Madalla and Wu (1999)
[c] Im, Pesaran and Shin (2003)   [e]p-values are presented in parentheses.

Empirical works based on time series data assume that the series is stationary generated by a stochastic random process. On the other hand, economic time series are often nonstationary since their means, variances and autocovariances are not time- invariant. With regard to the latter, I apply a number of tests which check the hypothesis that the time series included in the model have a unit root. The results are displayed in table 2. All four tests cannot reject the null for a presence of a unit root. This is a prerequisite for existence of a cointegrating relation between them. I check the latter both using Pedroni (1999, 2004) and Kao (1999) test which extend the Engle-Granger framework (Engel and Granger 1986) to the case of panel data. The reslut[1] confirms that the null hypothesis of a unit root cannot be rejected at the 5% significance level.

The cointegrating model is solved by the method of Dynamic OLS (DOLS) of Stock and Watson (1993). It accounts for potential endogeneity of the regressors as well as serial correlation in the error term by including additional terms for the lags and leads of the first differences of the explanatory variables denoted by $(\Delta X_{i,t+j})$ in eq. 1. The model has the following general form:

$$\log vmismatch_t = a_0 + a_i * X_{i,t} + \sum_{j=-k}^{k} f_i * \Delta X_{i,t+j} + \varepsilon_t \quad (1)$$

The impact of the potential determinants of the vertical skill mismatch is measured by the vector of slope coefficients [a_i]. Models with a constant, a linear trend and a quadratic trend have been solved. The leads and lags are specified automatically based on AIC criterion.

The results (table 2) fully confirm the hypothesis that the increasing share of labor force with tertiary education (log h5_8) is a primary reason for the growing job mismatch between 2000

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[1]**The output of the panel cointegration test is available upon request**.

and 2016. The regression coefficient shows that a rise of one percentage points in the most educated labor force is expected to increase the rate of vertical mismatch by 0.75 to 0.92 percentage points.

It is not surprising that the female graduates are even more strongly affected by the job mismatch taking into account that they outnumber the male graduates. The regression coefficient of the variable logfem5_8 ranges between 1.09 and 1.38. It is also statistically significant at the 0.10 or lower level. Some evidence is found that Gross Value Added (GVA) of trade-related services negatively influences the rate of vertical mismatch.

Table 3. Determinants of vertical mismatch among active population with higher education

Dependent variable: log vmismatch		
	DOLS (Pooled estimation)	DOLS (Weighted estimation)
	Model 1	Model 2
log h5_8	0.917***	0.745**
	(0.336)	(0.298)
log GVA_sales	-0.435*	-0.315
	(0.226)	(0.247)
log fem5_8	1.375**	1.089*
	(0.671)	(0.567)
adj Rsqr.	0.953	0.953
Number of observations	174	174
Normality of residual test (p-value)[a]	0.617	0.724

[a]Null hypothesis: Errors are normally distributed

4. Conclusion.

The current study aims at quantifying the economic impact of rising educational attainment of the population in the eleven new EU member states from Eastern Europe. The quantity of human capital is measured by the active population having completed tertiary education. The study shows that the rising share of university graduates in the labor force leads to an increase of the extent of skill mismatch as well. The output of the cointegration analysis implies that the vertical mismatch is also determined by the growing share of females graduating from tertiary education and is negatively linked to the gross value added in the trade-related service sectors.

References

Birk A. Qualification-mismatch and long-term unemployment in a growth-matching model / A. Birk [Text]. – HWWA Discussion Paper. – No. 128, 2001.

Budria S.A., Moro-Egido, A. Education, educational mismatch, and wage inequality [Text]: evidence from Spain / S.A. Budria, A. Moro-Egido. – Economics of Education Review. – vol. 27, 2008. – p. 332-341.

Castelló-Climent A., Hidalgo-Cabrillana, A. The role of educational quality and quantity in the process of economic development [Text] / A. Castelló-Climent, A. Hidalgo-Cabrillana. – Economics of Education Review. – vol. 31, 2012. – p. 391-409.

Eurostat, The Bologna process in higher education in Europe. Key indicators on the social dimension and mobility [Text]. – 2009.

Hanushek, E., D. Kimko, Schooling, labor-force quality and the growth of nations [Text] / Hanushek, E., D. Kimko. – The American Economic Review. – vol. 90, 2000. – p. 1184-1208.

Hanushek, E., Woessman, L., The role of cognitive skills in economic development [Text] / E. Hanushek, L. Woessman. – Journal of Economic Literature. – vol.46, 2008. – p. 607-668.

Im, K.S., Pesaran, M.H., Shin Y. Testing for Unit Roots in Heterogeneous Panels [Text] / K.S. Im, M.H. Pesaran, Y. Shin. – Journal of Econometrics. – vol. 115, 2003. – p. 53–74.

Islam, N. Growth Empirics: A Panel Data Approach [Text] / N. Islam. – The Quarterly Journal of Economics. – vol. 110, 1995. – p. 1127-1170.

Jin, J. C., Jin, L. On the Relationship between University Education and Economic Growth [Text]: the Role of Professors' Publication / J. Jin C., L. Jin. – Education Economics. – vol. 22, 2014. – p.635-651.

Jones, G., Cognitive and technology diffusion: an empirical test [Text] / G. Jones. – Economic Systems. – vol. 36, 2012. – p. 444-460.

Kao, C. Spurious regression and residual-based tests for cointegration in panel data [Text] / C. Kao. – Journal of Econometrics. – vol. 90, 1999. – p. 1-44.

Kiran, B. Testing the impact of educational expenditure on economic growth [Text] / B. Kiran. – Quality and Quantity. – vol. 48, 2014. – p. 1181-1190.

Knowles, S., Owen, P. Health capital and cross-country variation in income per capita in the Mankiw-Romer-Weil model [Text] / S. Knowles, P. Owen. – Economic Letters. – vol. 48, 1995. – p. 99-106.

Levin, A., Lin C.F., Chu C. Unit Root Tests in Panel Data [Text]: Asymptotic and Finite-Sample Properties / A. Levin, C.F. Lin, C. Chu. – Journal of Econometrics, 2002. – vol. 108, 1–24.

Lynn, R., Vanhanen, T. IQ and the wealth of nations [Text] / R. Lynn, T. Vanhanen. – Westport, CT: Praeger, 2002.

Maddala, G.S., Wu S. A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test [Text] / G.S. Maddala, S. Wu. – Oxford Bulletin of Economics and Statistics. – vol. 61, 1999. – p. 631-652.

McGowan A., Andrews D. Labor market mismatch and labor productivity [Text]: Evidence from PIAAC data / A. McGowan, D. Andrews. – OECD Economics department working papers, N. 1209, OECD Publishing, Paris, 2015.

Morgado A., Sequeira T.N., Santos M. et al., Measuring Labour Mismatch in Europe [Text] / A. Morgado, T.N. Sequeira, M. Santos. – CEFAGE-UE WP 13, University of Evora, Portugal, 2014.

Neycheva, M. Secondary versus Higher Education for Growth [Text]: the Case of Three Countries with Different Human Capital's Structure and Quality / M. Neycheva. Quality and Quantity. – vol. 50, 2016. – p. 2367-2393.

Pedroni, P. Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors [Text] / P. Pedroni. – Oxford Bulletin of Economics and Statistics. – vol. 61, 1999. – p. 653-670, Special I.

Pedroni, P. Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to PPP hypothesis [Text] / P. Pedroni. – Econometric Theory. – vol. 20, 2004 – p. 597-625.

Stock J., Watson M. A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems [Text] / Stock J., Watson M. – Econometrica. – vol. 61, 1993. – p. 783-820.

НЕЙЧЕВА, М.
АДАМИ КАПИТАЛ ЖӘНЕ ДАҒДЫЛАРДЫҢ СӘЙКЕС КЕЛМЕУІ: ШЫҒЫС ЕУРОПАДАҒЫ ЖАҢА ЕО-ҒА МҮШЕ МЕМЛЕКЕТТЕРДІҢ ЖАҒДАЙЫ

Зерттеудің мақсаты – Шығыс Еуропаның ЕО-ға мүше 11 жаңа мемлекетінде адами капиталдың және белгілі бір сәйкессіздіктер арасындағы байланысты жария ету. Адами капитал жоғары білімді меңгерген белсенді халықтың үлесі бойынша анықталады. Қарастырылып отырған елдерде 2000 жылдан бері жоғары білімді бітірушілер саны мен біліктілікке сай келмеу дәрежесі күрт өсті. Жұмыс орындарымен қамту мәселесі бойынша келіспеушілктер әйел түлектердің үлесімен, ал екінші жағынан көрсетілетін қызмет құнының артуымен байланысты.

Мақаланың мәнін ашатын сөздер: *адам капиталы, жоғары білім, шеберлікке сәйкес келмеу, еңбек нарығы, ЕО-ға мүше жаңа мемлекеттер.*

НЕЙЧЕВА, М.
ЧЕЛОВЕЧЕСКИЙ КАПИТАЛ И НЕСООТВЕТСТВИЕ ВЕРТИКАЛЬНЫХ НАВЫКОВ: СЛУЧАЙ С НОВЫМИ СТРАНАМИ-ЧЛЕНАМИ ЕС ИЗ ВОСТОЧНОЙ ЕВРОПЫ

Цель этого исследования – пролить свет на связь между человеческим капиталом и вертикальным несоответствием в 11 новых странах-членах ЕС из Восточной Европы. Человеческий капитал измеряется процентом активного населения, прошедшего высшее образование. В рассматриваемых экономиках количество выпускников высшего образования и степень несоответствия навыков резко возросли с 2000 года. На долю рассогласования рабочих мест, по-видимому, оказывает влияние доля выпускников женщин. С другой стороны, это отрицательно связано с валовой добавленной стоимостью связанных с торговлей услуг.

Ключевые слова: *человеческий капитал, высшее образование, несоответствие навыков, рынок труда, новые государства-члены ЕС.*