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IZA DP No. 12407

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ABSTRACT

The Impact of Horizontal Job-Education Mismatches on the Earnings of Recent University Graduates in Russia*

This paper analyses the determinants and consequences of horizontal job-education mismatches, an increasingly relevant topic in debates about education and labour markets. This issue reflects the articulation of educational fields and occupations in the labour market. We evaluate the determinants of job-education mismatches and their impact on salaries of university graduates using comprehensive and representative national data for Russia. The study is based in graduates' assessment and statistical analyses. We find that one-third of graduates in Russia work in a job that is not related to their field of study. Moreover, graduates from fields that either generate more general human capital (social sciences, business, law, services) or where low pay is common (agriculture) are more likely to be in that situation. On the contrary, graduates from fields that generate specific human capital (e.g.: medicine) are considerably more likely to be matched. We find that mismatches negatively affect the earnings of university graduates and the higher the degree of mismatch, the higher the penalty for the mismatch. The study depicts that mismatch is penalized in the majority of fields except for low-paid ones (e.g.: agriculture).

JEL Classification: J24, J30, J31

Keywords: job-education mismatch, education-occupation mismatch, horizontal mismatch, graduate salaries, labor market outcomes, human capital

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Introduction

The issue of horizontal job-education mismatch attracts considerable attention among policy- makers and researchers as it reflects the congruency between higher education fields and labor market requirements. It emphasizes the relations between graduate supply and employers demand for human capital, specific fields and occupations, and shows how the labor market value skills produced during university studies. On the one hand, the dynamics of labor markets lead to rapid changes in the nature and structure of graduate jobs. Labor markets are frequently more dynamic than educational systems, which cannot immediately react to the change in technologies or demand for certain professions. This situation is defined as a race between education and technology (Goldin and Katz, 2009). On the other hand, in some countries, labor markets appear to not offer a sufficient amount of jobs requiring university education. The rapid expansion of higher education during the last two decades was not accompanied by substantial growth in high-skilled jobs, especially *in Southern European and Post-Soviet countries* (Marginson, 2016; Green, Henseke, 2017). Mass higher education can therefore create an oversupply of university graduates and result in labor market imbalances. These imbalances create a possible decrease of the graduate wage premium (GWP) as well as increasing job-education mismatches and the problem of overeducation.

Job mismatches among university graduates can be ***vertical*** and ***horizontal***. *Vertical* mismatch (overeducation) appears when university graduates work in non-graduate jobs. *Vertical mismatch is widely studied* and most researchers found a *significant wage penalty for overeducated graduates* in general (Wolbers, 2003; Chevalier, Lindley, 2009; Sloane, 2003; McGuiness, 2006; Robst, 2007; Mavromaras, Mc.Guiness, 2012; Meroni, Vera-Toscano, 2017). Our paper is mainly focused on ***horizontal mismatch***, which is defined in different papers as ***job-education mismatch*** (Robst, 2006) or education-occupation mismatch (Nordin, 2011). This problem appears when graduates are employed in a *job which is not related to their field of study*. For instance, graduates with a degree in Law or Engineering but who work in the service sector, tourism, hospitality, retail can be considered as horizontally mismatched. Alternatively, they can lack the appropriate skills needed for these jobs and then it is more connected with issues of over- and under- skilling (Chevalier, Lindley, 2009). *The problem of horizontal (job-education or occupation-education mismatch) is less studied due to the lack of relevant data on self-evaluated mismatched or incapability of building of statistical measures.*

The dominant point of view on the effects of job-education mismatches on graduate salaries is that job-education mismatches lead to the waste of the human capital accumulated

during graduates' study years and brings negative consequences– wage penalties and lower job satisfaction. This is confirmed by existing studies devoted to this problem (Robst, 2007; Nordin, et.al, 2010; Boudarbat, Chernoff, 2012). Nevertheless, job-education mismatch can be positive for some graduates as they can change their occupation after finishing their formal education and find a better match between their abilities and the characteristics of the job[1].

Job-education mismatch can be also viewed as a tool for individual labor market adjustment in the case of imbalances between demand and supply and the lack of vacancies for particular jobs. From this point of view, we may expect different effects of job-education mismatch for different fields of study. On the one hand, some fields of study (e.g.: Medicine, Computer Science, STEM, Law) imply the accumulation of occupation-specific hard skills, most of which are non-transferable to other sectors (Robst, 2007; Boudarbat, Chernoff, 2012). Graduates of these fields are less likely to be horizontally mismatched as it is very non-beneficial to choose another occupation due to a large waste of accumulated human capital. As a result, we may expect a higher penalty for job-education mismatch for graduates with a degree in fields which develop occupation-specific skills. On the other hand, there are some specializations which mainly develop general skills (Social Sciences, Arts and Humanities, Services). These general skills are easily transferable across sectors (Robst, 2007; Boudarbat, Chernoff, 2012). As a result, graduates in these fields are relatively more likely to be mismatched, but the penalty for mismatch could be very low, or insignificant, or we may expect even positive effects of mismatch.

The main purpose of the study is to evaluate the extent and determinants of job – education mismatch and estimate their impact on the salaries of recent university graduates in Russia. The study aims to answer the following questions: What is the proportion of mismatched graduates? Which groups of graduates are more likely to be mismatched in the labor market, regarding, in particular, their field of studies? How do such mismatches affect the salaries of university graduates? How do the effects differ by fields of study?

Our study contributes to the literature on horizontal job-education mismatches, their determinants and effects and increases attention to horizontal mismatches, which can be even more influential than vertical. Researchers found that the wage penalty for horizontal mismatch exceeds the penalty for overeducation (Robst, 2007; Budria and Moro-Egido, 2008; Domadenik et al.,2013). Russia is an interesting case-study for the analysis of the horizontal job-education mismatches due to the pace of higher education expansion and the size of its labor market, its

[1] Such cases of non-optimal degree choice are also better captured by self-reported measures of mismatch. We get back to this issue in the methods section of the paper.

high regional differentiation and, not the least, the post-communist transition that it experienced, which resulted in significant shifts both in the labor market and the educational system. The educational system created during the Soviet Era, on the one hand, had to adjust to new labor market requirements in the market economy. On the other hand, it experienced a very rapid expansion. The issue of the matching between education and job became and still is an important educational policy issue for the country. The paper develops the methodology of Robst (2006) and Nordin, et al (2010) to analyze the issue of horizontal mismatch in Russia using a large comprehensive national representative graduate dataset.

The study is structured as follows. Section 1 focuses on the main theories explaining the determinants and possible impact of horizontal job-education mismatches. Section 2 sets up the institutional peculiarities of the Russian higher education system and labor market. Section 3 describes the data and methodology of the study. Section 4 is devoted to a preliminary descriptive analysis of the data. Section 5 presents the results of the regression analysis of the determinants of job-education mismatches and their impact on the salaries of university graduates. The final section presents some main conclusions.

1. Horizontal job-education mismatches: theory and results of empirical studies

The problem of job-education mismatches is studied in multiple papers, but the majority of them are devoted to vertical mismatches or the problem of overeducation rather than horizontal mismatch. The literature on the problem of overeducation is thoroughly considered in Hartog (2000) and Mc Guiness (2006) and there is a rich empirical literature on this topic (Wolbers, 2003; Sloane, 2003; Lamo, Messina, 2010; McGuiness, Sloane, 2011; Mavromaras, Mc.Guiness, 2012; Baert. et al, 2013; Meroni, Vera-Toscano, 2017). A number of papers are also devoted to changes in the structure of graduate jobs, job polarization and its consequences for graduate labor markets and graduates working in non-graduate jobs (Elias, Purcell, 2004; 2013; Figueiredo et.al, 2017; Green, Henseke, 2017). The problem of overeducation and returns to higher education takes a lot of attention due to the massification of higher education and increasing government and household investments in higher education. It raises the question if these investments are efficient and contribute to the development of a knowledge economy or, due to a rigid employment structure, graduates work in non-graduate jobs and are overeducated.

The issue of horizontal mismatches is considerably less studied than vertical mismatch or overeducation mainly due to the lack of relevant data on fields of studies of university graduates that could contribute to the creation of statistical measures of the mismatch as well as due to a

lack of self-evaluation data on job-education matching (Gimpelson, et al. 2010). However, the horizontal mismatch can be even more influential than vertical mismatch in terms of the effect on salaries of university graduates and job satisfaction and may equally lead to a considerable waste of accumulated human capital. The existence, determinants and the impact of job-education mismatches on graduate salaries can be explained by different labor market theories, including the human capital theory (Becker, 1964; Mincer, 1974), job matching theory (Jovanovich, 1979) and job assignment theory (Sattinger, 1993).

Human capital theory states that workers are distributed between the jobs according to the amount of accumulated human capital, which includes knowledge and skills, gained through formal education and on-the job training. From this viewpoint, differences in salaries are connected with differences in human capital, which depend on the years of schooling, quality of education, innate abilities and other factors. According to this view, job-education mismatch can be only temporary and seems inefficient both for workers and for employers. It raises the question: why does the job-education mismatch exist? Higher education contributes to the accumulation of general human capital, which is valuable regardless of industry of employment and specific human capital, which can be fully used and bring returns in terms of salaries, if the graduate is perfectly matched to the job. There can be significant differences in the relative share of general and specific human capital between fields. Robst (2006) in one of the first papers, which was devoted to horizontal mismatch, formulated the hypotheses that educational mismatch is more likely among workers with degree fields that provide general skills (Humanities, Social Sciences and Liberal Arts) and less likely among graduates of majors, which provide specific human capital (e.g. Medicine, Computer Science, Engineering, Technology).

The issue of job-education mismatches is then closely related with the issue of the choice of college major. We may assume that an individual chooses a particular field of education and invests financial resources and time in acquiring skills for a given field of study with the expectation of working in an occupation related to that field. From this point of view, job-education mismatch is likely to be inefficient for workers and result in wage penalties. The direction of the effect depends, however, on the nature of mismatch: if it is supply-related (initiated by the individual) or demand-related (due to lack of vacancies, high job competition etc.) (Robst, 2007; Nordin,2010).

A demand-related mismatch is likely to negatively affect salaries, due to the fact, that in most cases it is connected with either a lack of demand for a given field in the economy or adverse selection in mismatch status as graduates who are mismatched involuntary have lost competition

with their peers and are likely to have lower abilities then those who are matched. This may lead to the endogeneity in the empirical analysis of impact of job-education mismatch on salaries due to the fact that graduates with lower abilities are more likely to be mismatched and have lower salaries. On the other hand, if the negative impact of job-education mismatch is just a reflection of lower abilities, than the effect of job-education mismatch should be the same across different fields (Robst, 2007). Moreover, if mismatch is supply-related – it is likely to be not connected with sorting by abilities.

The effect of supply-related mismatch is likely to be ambiguous or even positive as mismatch is initiated by the individual and may be connected with changes in preferences of the individual after enrollment, acquisition of more information about job characteristics in the given field and others (Robst, 2007; Nordin, 2010). Job matching theory proposes that due to asymmetry of information, young workers and recent university graduates are unaware of the matching between their skills, abilities and job characteristics and requirements (Jovanovich, 1979). As a result, they try to find the best matching between their skills and jobs, which result in higher job mobility of university graduates and lead to voluntary job-education mismatch. This outcome can be also predicted by job assignment theory (see Sattinger, 1993) according to which, returns to education depend partially on the quality of assignment of heterogeneous workers to heterogeneous jobs.

There are also considerable differences in the narrowness of educational fields. For instance, in the US, education fields are very broad (Robst, 2007), while in Sweden fields are detailed (Nordin, 2010). In Russia, educational fields are extremely narrow. There are different ways to measure job-education mismatch, but most of them can be divided in two types: self-evaluation measures (see Robst, 2007) or synthetic (statistical) mismatch variables (Nordin, 2010). In our paper we use both of them. Self-evaluated measures have considerable drawbacks, which are connected with its subjective matter and endogeneity, which is related to the wages, as it is stated by Nordin (2010) – 'self-reported mismatch can be a rationalization of disappointment with wages'. On the other hand, all statistical mismatch variables are less likely to capture mismatch and are dependent on the method used as there are no common classifications matching education and occupation (job) and the nature of occupations is also rapidly changing.

2. Institutional framework: the case of Russia

Russia traditionally has a very high level of participation in HE mainly due to the large investment in education during the Soviet era. According to the OECD Education at a Glance (2018), the Russian Federation has the fourth highest share (56%) of adults who have attained tertiary education among all OECD and partner countries. The gross enrollment rate in tertiary education has been growing steadily in Russia since 1995. During the 1995-2016 period, Russia experienced a massive expansion of higher education further consolidating the massification of higher education which has been common for many countries across the world (Trow, 2000; Marginson, 2016). By the end of the Soviet era, Russia had a considerable stock of well-educated individuals and strong higher education capacity due to the huge investments in the education system in the Soviet Union. During the transition to a market economy, through radical economic reforms and the economic recession of 1990-s, government expenditures on higher education experienced a sharp decline. Despite the economic recovery in 2000-s the Russian government still underinvest in higher education.

The expansion of higher education in Russia during the last two decades was mainly driven by high demand for higher education and a large graduate wage premium, which arose as a result of economic reforms and the creation of the market economy (Lukiyanova, 2010). High demand for HE, low tuition fees and low expenditures on higher education has led, however, to a significant differentiation of education by quality and a decrease of the average quality of HE. HE expansion in Russia was achieved mainly by the appearance and growth of private universities, the rapid growth of part-time programs, which were mainly focused on Business, Administration and Law programs. These programs had very low quality and workload, low requirements for enrollment and worked as 'diploma factories' (Roshchin, Rudakov, 2017). However, the graduate wage premium has not decreased and holding a degree became a kind of universal pass to access white-collar jobs. Its absence, in turn, became a strong negative signal for employers (Andrushchak, Prudnikova, 2012).

However, the massification of HE in Russia has not led to the decrease of GWP and youth unemployment, due to the demographic trends and absorption of graduates by service sector, which has been growing since 1990-s (Rudakov, 2015). Regarding the composition of employment, young Russian university graduates mainly concentrate in the service sector (including trade, financial intermediation and retail), while the majority of Soviet university graduates worked in manufacturing. In terms of payment, sectors such as Education, Agriculture, to some extent Health and other mainly public sector industries are low paid, especially, in the

early stages of career and are less attractive to recent university graduates. While Education and Health still have prestige in society despite the relatively low salaries, Agriculture seems to be a sector with adverse selection of employees as the sector is both non-prestigious and low-paid: high school graduates who failed to compete for state-funded education in other specialties, are likely to choose agriculture due to relatively low competition for state funding for education in this field.

The rapid expansion of higher education in Russia differs significantly by field of study: the main increase was achieved by programs leading to a major in business, administration and law. According to the OECD, in 2015, 38% of Russian tertiary students graduated with degrees in business, administration and law, which is one of the highest shares across OECD and partner countries (while the OECD average is 24%). However, this trend is gradually changing and among new entrants in HEIs, engineering, manufacturing and construction are becoming the most popular programmes in Russia (24%) although business, administration and law is still very popular (22%) (OECD, 2018).

There is a broad discussion, debates and speculations among education authorities, politicians, mass media and employers in Russia about overproduction of graduates in particular spheres. For instance, there is a debate about the overproduction of specialists in economics, management and business, whose education was financed by government while the state 'needs specialists in engineering' for rapid development and economic growth. On the one hand, the proponents of the overproduction hypothesis claim that most of these graduates could hardly find a job related to their field of study and that this supply imbalance leads to a high job-education mismatch and inefficiency of expenditures on higher education. On the other hand, the results of previous research show that degrees in economics and law, together with degrees in engineering bring higher returns in terms of wages (Denisova, Kartseva, 2007; Gimpelson, et al 2009). It shows that in spite of the speculations about the overproduction of specialists in economics and law, a degree in these fields is still a worthwhile investment and the market absorbs these specialists and pays them good salaries, although they can be apparently job-education mismatched. Research on this topic also warns us against using a static vision of graduate labour markets and points out that many intermediate occupations have been transformed or newly created (e.g: new managerial specialists) and that these make effective use of graduate qualifications, not the least as an entry requirement (Elias, Purcell, 2013; Figueiredo et.al, 2017).

Another cliché is the importance of matching jobs with education trajectories that comes as a legacy of the Soviet education system and an economy with a mandatory graduates' distribution system among employees. From this point of view, job-education mismatch is seen as an inefficiency of the higher education system and a waste of government funding. The listed factors emphasize the importance of studying the issue of job-education mismatch and its labor market consequences. Russia is an example of the extremely detailed system of educational fields, which is a legacy of the Soviet educational system and economy with mandatory distribution of graduates. In the Soviet period, multiple ministries and their affiliated enterprises competed with each other for an ability to mandatory distribute graduates and some subfields, especially in Engineering, were created to serve for particular enterprises. In that logics, the more detailed and narrow is a subfield of study – the higher is the probability for the enterprise to receive recent graduates (Gimpelson et al., 2010). After the transition to a market economy, these subfields were too narrow and inadequate to labor market requirements, but the education fields system has not been reformed yet. The extreme narrowness of the Russian educational fields system is another argument for the relevance of the Russian case within the international economic literature on this topic. On the basis of the considered theories and the institutional peculiarities of the Russian higher education system, we formulate the following hypothesis:

1. Job-education mismatches are more prevalent among graduates in fields, which contribute to the accumulation of general human capital (Social Sciences, business, law, Arts and humanities, Services)
2. Job education mismatches are less likely for graduates in fields, which contribute to accumulation of specific human capital (Health, Engineering)
3. Job-education mismatches negatively affect salaries
4. The effect of job-education mismatches differs by fields of education:
    - it is strongly negative for graduates in fields accumulating specific human capital and insignificant for fields which accumulate general human capital.
    - it is negative for low-paid sectors, but can be positive or insignificant for low-paid sectors (e.g. Education and Agriculture).

3. Data and methodology

This study is based on the survey of Russian university graduates carried out in 2016 by the Russian Federal Statistics Service as an additional module to the Russian Labor Force Survey. The nation-wide (random) sample includes more than 20,000 observations on salaries as well as

other educational, socio-demographic and job characteristics of individuals who graduated from HEIs between 2010 and 2015. All graduates were surveyed in 2016. This dataset contains data on matching in the first job after graduation and in the current job of university graduates.

We calculate different measures of horizontal job - education mismatches following existing research on this topic (Robst, 2007; Nordin, 2010; Boudarbat, Chernoff, 2012). We use two different criteria: i) graduates' self-evaluation of their job – education match; and ii) the comparison of graduates' ISCED97 fields of study with measures of the modal field(s) of study in specific ISCO08 2-digit occupations with industry controls cells. The classification of the Russian higher education system in accordance with the ISCED97 codes is presented in Table A1. We calculated the modal ISCED field for each occupation, which was defined as a ISCO 2-digit code *100 + code for industry[2]. The statistical measure of mismatches reflects the actual distribution of graduates of different fields of education by occupation. The graduate is considered as matched if he/she has the same field of study as the mode of graduates in this job. Other graduates are considered as mismatched. The self-evaluated measure of matching is used as the main variable in our study.

We use logit regression (1) for the evaluation of the determinants of job-education mismatches and OLS regression (2) for the calculation of the impact of mismatches on the earnings of recent university graduates (based on the Mincerian wage equation).

$$Pr(Match_i) = \beta_0 + \beta_1 \cdot Acad_i + \beta_2 \cdot Field_i + \beta_3 \cdot SocDem_i + \beta_4 \cdot St_{Work_i} + \varepsilon \quad (1)$$

$$Ln(W_i) = \beta_0 + \beta_1 \cdot Match_i + \beta_2 \cdot Field_i + \beta_3 \cdot Acad_i + \beta_4 \cdot SocDem_i + \beta_5 \cdot St_{Work_i} + \beta_6 \cdot Job_i + \varepsilon \quad (2)$$

Where:

Ln (W_i) is the logarithm of average monthly salary of university graduates

$Match_i$ is a variable (dummy or categorical) which reflects either self-reported or statistical job-education match/mismatch

$Field_i$ is a categorical variable for the field of study of graduates

$Acad_i$ is a set of academic factors (degree, type of institution (public/private), funding (self-funded, government-funded), type of educational program (part-time, full-time))

$SocDem_i$ is a set of demographic factors (gender, age, marital status)

St_Work_i is a dummy variable for combining study and work (during studies in university)

Job_i is a set of labor market factors (industry, congruence between first and current jobs);

[2] As a robustness check, we also used detailed ISCO 3-digit jobs and 3-digit fields of study, but achieved almost the same results as in the basic specification

4. Descriptive analysis

In Table 1 we present the basic descriptive statistics. The average salary in our sample of graduates is 24.069 Russian roubles (RR). Salaries are observed in 2016 for graduates of 2010-2015. The average age of BA degree completion is 22, MA degree – 24 and Specialist degree- 23. Taking into consideration the 5 year's lag for graduates of 2010 and the methodology of the Russian Federal Statistical Service, which defines youth as individuals aged between 15 and 30[3], we restricted our sample to graduates aged between 20 and 30. The average age of graduates in our sample is 26.1 years. Average tenure is 2.2 years with a maximum of 5 years, as due to the survey methodology we account for tenure only after graduation. We do however include a control variable on whether the graduate was combining study and work prior to graduation.

Table 1 - Basic descriptive analysis of the main continuous variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Salary	8177	24069	12044	5000	180000
Age	15155	26,1	2,1	20	30
Tenure	11525	2,2	1,6	0	5

The details about the sample are presented in table 2. The overall sample size is 15.155 graduates, who have completed university studies during 2010-2016. The number of graduates in 2015 is considerably higher than in other years due to the emergence of the first wave of mass graduation of BA students as a result of the reforms of 2011. As a result, 2015 was a year of graduation of 5-years Specialists students and 4-years BA students. Average salary by year of graduation grows with experience. Only 2014 graduates earn slightly less than the graduates of 2015, probably because of the economic crisis of 2014-2015. Differences between matching status by year of graduation are insignificant and do not reflect any trend.

Table 2 – Descriptive analysis by year of graduation

Year of graduation	N	Percent	Salary	Match (self-evaluation)
2010	2214	14,6	25906	68,5
2011	2252	14,9	25136	68,3
2012	2474	16,3	24658	68,0
2013	2509	16,6	24003	67,8
2014	2472	16,3	22570	66,4
2015	3234	21,3	22716	69,2
Total	15155	100,0	24096	68,1

[3] Russian Federal Statistics Service definition of youth

We use a number of different measures of job-education match: a categorical variable for the self-evaluation of the current job-education matching status, a dummy variable for the same measure, a categorical variable for the self-evaluation of the first job-education match, a variable for statistical matching (on the basis of the mode ISCED97 fields for ISCO 2-digit occupations with industry controls) (Table 3). More than half of university graduates (54%) report that they work in a job which is related to their field of study, the partially matched are 14%. Partially mismatched are 6% and absolutely mismatched in terms of their relatedness of their current job to field of study are 26% of Russian graduates. The distribution of respondents by the matching status is almost equal for the first and current jobs. Regarding salaries, there is a very well observed trend, which shows that *the higher the degree of matching of the job with education obtained – the higher is the salary* of university graduates.

Table 3 - Descriptive statistics of different matching variables

	N	Sample (%)	Salary (RR)	%
Current job-education match (self-evaluation)				
Yes (perfect match)	6913	53,6	25481	18,4%
Rather, yes (good match)	1869	14,5	23702	10,1%
Rather, no (some mismatch)	802	6,2	22813	6,0%
No (absolute mismatch)	3320	25,7	21524	reference
Total	12904	100	24068	
Current job-education match (self-evaluation)- dummy variable				
Matched	8782	68,1	25103	15,3%
Mismatched	4122	31,9	21771	reference
First job-education match (self-evaluation)				
Yes (perfect match)	7167	52,3	25458	17,0%
Rather, yes (good match)	1927	14,1	23620	8,5%
Rather, no (some mismatch)	874	6,4	23327	7,2%
No (absolute mismatch)	3,739	27,3	21767	reference
Total	13707	100	24068	
Statistical job-education match (Mode ISCED fields for each industry)				
Matched	8524	60,5	24109	0,4%
Mismatched	5560	39,5	24007	reference
Total	14084	100	24068	
Vertical mismatch (statistical)				
Horizontal match (specialists, managers)	9260	66,7	24840,8	2,10%
White-collar jobs (weak match)	2071	14,9	20388,8	-16,20%
Blue-collar jobs (mismatch)	2556	18,4	24321,1	reference
Total	13887	100		

We created a dummy variable for the current job-education match, which is a stricter version of the categorical variable: respondents, who answered that they are matched or ‘rather,

matched' are considered as matched, and those who reported that they are 'rather mismatched' or 'mismatched' are considered as mismatched. According to this estimation, the share of mismatched graduates by self-evaluation measure in Russia is 32%. The statistical measure of mismatch shows that 39.5% of Russian graduates are mismatched, but the differences in average salaries between matched and mismatched graduates are slight.

Additionally, we created the variable for vertical mismatches by using the ISCO classification: university graduates who work as managers and professionals were considered as horizontally matched, individuals in positions of 'clerical support workers', 'services and sales workers' were considered as weakly matched (due to the fact that they are more likely to work in 'white-collar' jobs). Individuals who worked as skilled workers, machine operators and in elementary occupations were considered as mismatched. We found that *33,3% of Russian graduates working in non-graduate jobs and are vertically mismatched.*

Graduates who are vertically matched earn the highest salaries, but individuals who are mismatched and work in blue-collar jobs earn 16.2% higher salaries than weakly matched graduates in white-collar jobs, which is an unexpected result. This result provides some evidence supporting the theory of compensating wage differentials (Rosen, 1986): university graduates, who work as 'blue-collars', are more likely to achieve compensation for the nature of their job, while those who are mismatched and decide to work as office clerks earn less. For the self-evaluation vertical mismatch variable, we found that those graduates, who reported that their education was useless in their first job, earn the lowest salaries.

The analysis of the correlation matrix shows that there is a very high correlation between first job matching and current job matching.

Table 4. Correlation matrix of matching variables

	Current job match (self-evaluation)	First job-education match (self-evaluation)	Statistical job-education match	Vertical job match in the first job
Current job match (self-evaluation)	1.0000			
First job-education match (self-evaluation)	0.8280***	1.0000		
Statistical job-education match	0.3618***	0.2959***	1.0000	
Vertical job match in the first job	0.4541***	0.3771***	0.2029***	1.0000

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The correlation between the statistical job-education match and the self-evaluation match is moderate (0.36), which shows that the usage of statistical measures of mismatch is

limited due to biases, which may happen during the construction of synthetic variables. The correlation between vertical and horizontal mismatches, on the other hand, is rather strong (Table 4).

Among the most popular degrees for Russian university graduates in our sample are those in the fields of Social Sciences, Business and Law (35.3%), Arts and Humanities (16.4%), Education (14.5%), Engineering, Manufacturing, and Construction (13.3%), Sciences, Math and IT (8.7%). Other fields of studies are considerably less common (see Figure 1).

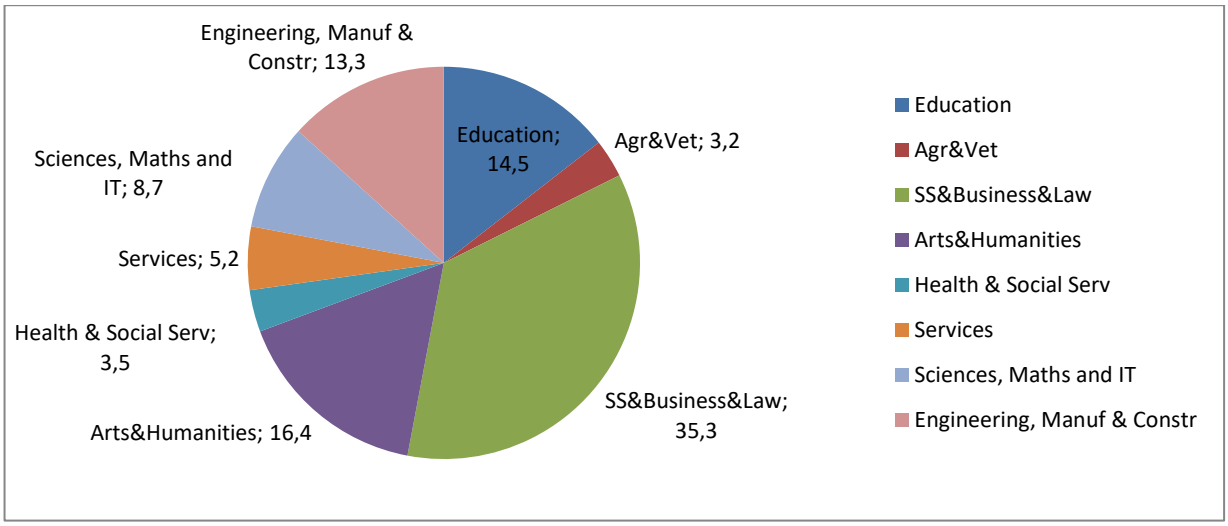

Figure 1. Distribution of university graduates by ISCED fields of study (%).

The analysis of the probability of job-education mismatch by ISCED fields of education shows that graduates with a degree in Health have the highest probability of being matched. The probability of a match is also above average for graduates in Sciences, math and IT, Education, Engineering, Arts and humanities, Social Sciences, business and law. The lowest probability of being matched is for graduates in Services and in Agriculture (Figure 2). These results provide some support for our hypothesis, that the probability of a mismatch is higher for disciplines which provide general human capital (services, social sciences) and lower for disciplines which provide very specific skills – Health. However, the probability of a mismatch for graduates in Arts and Humanities is close to average, which contradicts our initial assumptions.

The high dispersion between the statistical and self-evaluated measures of mismatch is connected to the imperfection of the statistical measure – it overestimates matching for fields with high share of graduates (SS&Business and Law) and underestimate- for fields with low share of graduates and/or that are dispersed between different occupations (Services).

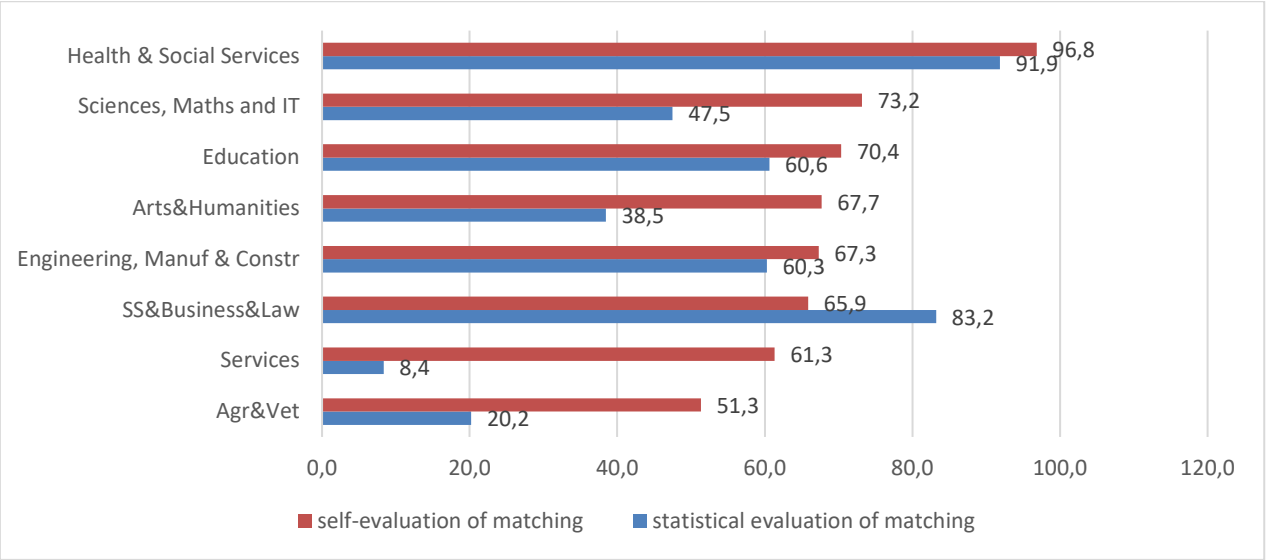

Figure 2. Share of matched graduates by ISCED fields of study (%)

Graduates in Engineering, Manufacturing and Construction and in Sciences, Math and IT earn the highest salaries, while the lowest salaries are common for graduates in Education and in Agriculture and Veterinary (Figure 3).

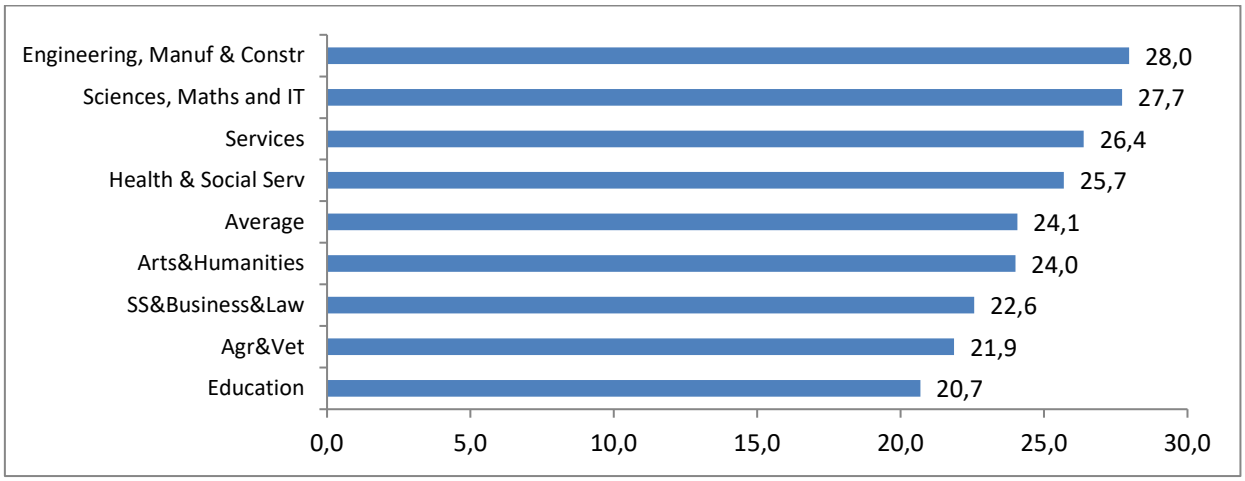

Figure 3. Average salary by ISCED fields of study (th.rub).

The descriptive analysis shows that the most popular industries for university graduates are trade (16%), public administration and defence (14,5%), education (12,2%), manufacturing (10,4%) and real estate, renting and business activities (9,7%). The highest salaries are earned by graduates who work in mining and quarrying, the lowest – by those who work in education. The highest probability of a self-evaluated job-education match is common for Health and Social Work and Education (87-88%). The lowest – for graduates who work in trade (Table 5).

Table 5. Average salary and probability of job-education match by industry

Economic activity	N	%	Salary (RR)	Match(self) (%)
Mining and quarrying	225	1,6	36715	74
Construction	710	5	27741	64,7
Transport, storage and communication	1021	7,3	26891	59,5
Real estate, renting and business activities	1361	9,7	26313	77,9
Electricity, gas and water supply	373	2,7	24831	75,4
Manufacturing	1457	10,4	24648	67
Financial intermediation	902	6,4	24562	74,4
Public administration and defence	2042	14,5	24503	71,4
Health and Social work	808	5,7	23193	87,5
Trade	2242	15,9	22534	44
Other community, social and personal activities	583	4,1	22260	59,1
Hotels and restaurants	303	2,2	21865	44,8
Agriculture	344	2,4	20472	57,9
Education	1713	12,2	19605	87,9
Total	14084	100	24068	68,1

The descriptive analysis by professional groups shows that the majority of university graduates work as professionals (59%) and managers (6.6%) and are vertically matched. Graduates, who work as professionals also have the highest probability to be horizontally matched. Vertically matched graduates who work as managers or professionals earn higher salaries than weakly matched graduates who work in white-collar jobs. However, graduates who are vertically mismatched but work in blue-collar jobs earn considerably high salaries, probably, due to compensating wage differentials (Table 6).

Female graduates are more likely than male graduates to work in a job which is related to their university field of study. There is a considerable gender wage gap: on average, male graduate earnings are 27% higher than female graduates (see Table 7). Graduates who combined their studies with a job are less likely to be job-education matched after graduation, which can be endogeneous due to reversed causality: individuals who understood during their studies that they will not work in the field related to the study start to combine study and work. On average, graduates who combined studies with part-time jobs earn, after graduation, slightly more. Graduates who combined studies with work related to their field of study are much more likely to be job-education matched and earn higher salaries (see Table 7).

Table 6. Average salary and probability of job-education matching by ISCO professional groups.

Major groups (ISCO-08)	Vertical matching status	N	%	Salary (RR)	Match(self) (%)
Managers	Vertically matched	932	6,6	28746	61,5
Professionals		8328	59,1	24446	87,1
Technicians and Associate Professionals	Weakly matched (white-collar jobs mostly)	1571	11,2	23685	53,1
Clerical Support Workers		608	4,3	20139	38,9
Services and Sales Workers		1463	10,4	20494	23,1
Skilled Agricultural, Forestry and Fishery Workers	Vertically mismatched (blue-collar jobs mostly)	84	0,6	21869	9,6
Craft and Related Trades Workers		490	3,5	24753	34,5
Plant and Machine Operators and Assemblers		411	2,9	26220	21,7
Elementary Occupations		198	1,4	20841	0
Total		14085	100	24068	68,1

Table 7. Average salary and probability of job-education match by gender group and combining study and work.

	N	%	Salary (RR)	Match(self) (%)
Gender				
Female	9080	59,9	21526	70
Male	6075	40,1	27399	65,6
Total	15155			
Combining of study and work				
Combined study with regular job	3124	20,6	24412	63,5
Combined study with part-time job	2692	17,8	24669	66,2
Did not work during studies	9339	61,6	23766	70,3
Total	15155			
Combining of study and work by relatedness to field of study				
Combined studies with work non-related to field of study	3062	52,7	23532	43,1
Combined studies with work related to field of study	2754	47,4	25571	87,7
Total	5816			

The descriptive analysis shows that the optimal strategy of school-to-work transition is connected to combining studies with work in a related field in order to accumulate necessary work experience, which will be valued by employers after graduation. These results are consistent with previous studies for the Russian labor market (Rudakov, Roshchin, 2017).

We also made a cross-tabulation of industries where graduates work and their ISCED fields of study (see Table A1). According to our results, graduates in Health and Education fields

are considerably more likely to be matched: 80% of graduates with a degree in Health, work in the Health and Social work industry and 59% of graduates with a degree in Education, work in the Education industry. Graduates of Education and especially Health are likely to accumulate specific human capital, which can be hardly transferred to other sectors, and graduates prefer to work in a related industry. Although graduates in Engineering are quite dispersed by industries, most of these industries are related to engineering: 25% work in Manufacturing, 15% - in Construction and 9% - in Electricity, gas and water supply. However, 10% of graduates in Engineering work in Trade and other 10% in Real estate, renting and business activities. Graduates in Sciences, Math and IT are among the most dispersed between the fields: 23% work in Real estate, renting and business activities, 13% work in Trade industry, 13% - in Manufacturing and the rest – in multiple other industries. This may occur due to the fact that IT specialists are needed in every industry and many fields require strong mathematical and IT skills, which are getting universal for many businesses.

Graduates in spheres which are frequently classified as those which generate general human capital are also likely to be dispersed between sectors and are frequently working in industries which are far from their university specializations. For instance, 30% of graduates with degrees in Arts and Humanities work in Public Administration, 15% - in real estate, renting and business activities, 11% - in trade, 10% - in other social community, social and personal activities. Graduates in Social Sciences, business and law frequently work in Trade (25%), Public administration (15%), Financial intermediation (13%). Graduates in Services work in Transport, storage and communication industry (27%), Trade (15%) and others (Table A1). In general, the analysis shows that graduates in Health and Education prefer working in related industries, graduates in Engineering also frequently work in industries connected to engineering, but also work in other fields. Graduates of fields like Arts and Humanities, Social Sciences, Services, Agriculture, Sciences, math and IT are considerably dispersed between different industries. This evidence supports the idea of classification of ISCED fields on ‘general’, whose graduates work in different areas, and ‘specific’, whose graduates work in related fields due to limited transferability of human capital.

Table A1. Cross-tabulation of industry of current job and ISCED field of study (%)

	Industry (OKZ)/ ISCED Code	Education	Arts& Humanities	Social Sciences &Business and Law	Sciences, Math and IT	Engineering, Manufacturin, Construction	Agriculture&Veterinary	Health & Welfare	Services	Total
1	Agriculture and fishing	1,6	1,0	2,2	1,7	1,7	**24,9**	0,4	2,0	2,5
2	Mining and quarrying	0,3	0,5	0,9	7,8	2,5	1,1	0,0	1,6	1,6
3	Manufacturing	3,4	6,4	9,3	13,3	**25,2**	10,6	0,4	8,9	10,2
4	Electricity, gas and water supply	0,7	1,2	1,9	3,1	**9,3**	3,2	0,0	1,2	2,7
5	Construction	1,9	3,1	3,9	3,9	**15,1**	4,5	0,0	6,5	5,0
6	Trade	8,2	10,8	**24,7**	13,3	10,3	15,3	13,8	15,1	15,9
7	Hotels and restaurants	1,2	1,7	2,8	1,1	2,5	2,3	0,0	4,5	2,2
8	Transport, storage and communication	2,7	4,2	7,6	7,8	8,9	5,8	0,0	**26,7**	7,2
9	Financial intermediation	2,4	4,1	13,4	4,5	1,5	0,9	0,0	1,7	6,4
10	Real estate, renting and business activities	3,8	14,9	7,8	**22,7**	10,0	3,8	0,0	8,9	9,6
11	Public administration and defence	8,0	**30,8**	14,8	8,1	9,2	11,9	2,6	14,7	14,5
12	Education	**58,8**	8,1	3,8	8,1	1,5	2,3	0,8	2,4	12,2
13	Health and Social work	2,4	3,3	3,8	1,9	0,7	12,1	**80,1**	1,5	5,8
14	Other community, social and personal activities	4,7	9,9	3,2	2,8	1,5	1,4	1,8	4,4	4,2
Total		100	100	100	100	100	100	100	100	100

5. Results.

Determinants of job-education matching

The regression analysis of the determinants of job-education matching, based on the logit regression, was conducted for self-evaluated matching. We found that graduates with a degree in Health are considerably more likely to work in a related field (29%).

Table 8. Regression analysis of the determinants of job-education matching (marginal effects)

	1
VARIABLES	Self-evaluated matching
ISCED field of study: reference group 'Education'	
Arts and Humanities	-0.00531
	(0.0151)
SS&Business&Law	-0.0268**
	(0.0132)
Sciences, Maths and IT	0.0518***
	(0.0169)
Engineering, Manuf & Constr	0.000246
	(0.0158)
Agriculture&Veterinary	-0.166***
	(0.0268)
Health & Social Services	0.289***
	(0.0110)
Services	-0.0629***
	(0.0215)
Gender=male	-0.0531***
	(0.00907)
Age	0.00931***
	(0.00287)
Combining study and work: reference group 'have not worked during studies'	
Combined studies with regular job	-0.0147
	(0.0150)
Combined studies with part-time job	0.0109
	(0.0142)
Funding = state-funded	0.0316***
	(0.00914)
Degree= MA or Specialist	0.00543
	(0.0116)
Full_time studies	0.0649***
	(0.0144)
Public university	0.0001
	(0.0157)
Observations	12845

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

This result supports the hypothesis, formulated in our study following Robst (2007), that graduates who have accumulated specific human capital during their studies (e.g. in Medicine) are less likely to be mismatched. This specific human capital cannot be easily transferred to other

sectors, and graduates in these spheres are less likely to search for a job in other sectors. They are more likely to work in a job which is directly related to their field of study in order to use specific human capital, which was accumulated during studies. The empirical analysis shows that graduates in Agriculture and Veterinary, in Services and in Social Sciences, business and law have the highest probability of being mismatched (see Table 8).

These results partially support our hypothesis that in fields which contribute mainly to the accumulation of general human capital or in low-paid fields, the probability of a mismatch is higher due to the easy transfer of human capital to other spheres which are not directly related to the field of study and the lower opportunity costs. Mismatches for graduates in these fields are less likely to lead to a waste of human capital and a wage penalty. Graduates in these fields have an opportunity to find the best match between their field of study, abilities and job requirements, and switch between different sectors of the economy.

Regarding other variables, female graduates are more likely to work in the jobs which are related to their field of study (for a self-evaluated match). Graduates who studied on a state-funded basis and those who studied in full-time programs are considerably more likely to be matched in terms of job and education. The probability of a job-education match also slightly increases with the age of graduates. We did not find any significant differences in the probability of matching by degree and the type of university (public or private) (see Table 8).

The impact of the job-education match on graduates' salaries

The regression analysis suggests that there is a significant and robust *negative impact* of job-education mismatches on graduate salaries for the different self-evaluated and statistical measures (Table 10). The regression analysis shows that the mismatch wage penalty increases with the degree of mismatch. Graduates who reported a *good match earn 7% lower* salaries than those who reported a *perfect match*, graduates who reported *some mismatch experience an 11% wage penalty*, those who reported an absolute mismatch experience the most severe penalty – 15.5% compared to perfectly matched graduates. The impact of the mismatch in the first and in the current job on current salaries is almost equal. The dummy variable for self-evaluation of matching status shows that mismatched graduates earn 12% lower salaries than matched graduates. The wage penalty for the statistical mismatch is twice as lower as a penalty for a self-evaluated one: statistically mismatched graduates earn 6% lower salaries. This can be explained by the higher accuracy of self-evaluated measures but also may indicate that graduates are more likely to report that they are matched when they earn higher salaries.

Table 10. The impact of job-education mismatch on graduate salaries (OLS regression).

	(1)	(2)	(3)	(4)
VARIABLES	lnwage	lnwage	lnwage	lnwage
Matching in the current job- reference group (perfect match)				
Good match	-0.0708***			
	(0.0141)			
Some mismatch	-0.109***			
	(0.0208)			
Absolute mismatch	-0.155***			
	(0.0138)			
Matching in the first job- reference group (perfect match)				
Good match		-0.0725***		
		(0.0142)		
Some mismatch		-0.0899***		
		(0.0205)		
Absolute mismatch		-0.131***		
		(0.0130)		
Self-evaluated mismatch			-0.122***	
			(0.0120)	
Statistical mismatch				-0.0609***
				(0.0112)
Gender= male	0.173***	0.173***	0.173***	0.170***
	(0.0108)	(0.0108)	(0.0108)	(0.0108)
ISCED field of study: reference group 'Education'				
Arts and Humanities	0.0185	0.0247	0.0228	0.0401**
	(0.0197)	(0.0196)	(0.0196)	(0.0197)
SS&Business&Law	-0.0219	-0.0115	-0.0217	-0.0322*
	(0.0184)	(0.0183)	(0.0183)	(0.0188)
Sciences, Maths and IT	0.0222	0.0304	0.0255	0.0378*
	(0.0229)	(0.0229)	(0.0229)	(0.0229)
Engineering, Manuf & Construction	0.0708***	0.0792***	0.0731***	0.0785***
	(0.0215)	(0.0214)	(0.0214)	(0.0216)
Agriculture	-0.0250	-0.0236	-0.0243	-0.0108
	(0.0315)	(0.0316)	(0.0316)	(0.0319)
Health	0.0951***	0.103***	0.106***	0.111***
	(0.0349)	(0.0349)	(0.0349)	(0.0353)
Services	0.0626**	0.0705***	0.0651**	0.0992***
	(0.0260)	(0.0260)	(0.0260)	(0.0263)
Age	0.0199***	0.0199***	0.0201***	0.0205***
	(0.00339)	(0.00339)	(0.00339)	(0.00341)
Marital status	0.0165	0.0168	0.0148	0.0160
	(0.0104)	(0.0104)	(0.0104)	(0.0105)
Combining study and work: reference group 'have not worked during studies'				
Combined studies with regular job	0.104***	0.102***	0.105***	0.106***
	(0.0168)	(0.0168)	(0.0168)	(0.0169)
Combined studies with part-time job	0.0399***	0.0423***	0.0407***	0.0413***

	(0.0129)	(0.0130)	(0.0130)	(0.0130)
Funding = state-funded	0.00193	0.000278	0.00325	0.00272
	(0.0104)	(0.0104)	(0.0104)	(0.0105)
Degree= MA or Specialist	0.0125	0.0117	0.0133	0.0124
	(0.0136)	(0.0136)	(0.0136)	(0.0136)
Full_time studies	0.136***	0.132***	0.138***	0.139***
	(0.0166)	(0.0166)	(0.0166)	(0.0166)
Public university	-0.0823***	-0.0777***	-0.0841***	-0.0860***
	(0.0191)	(0.0192)	(0.0192)	(0.0193)
Vertical matching: reference group (horizontaly mismatched - white collars)				
Horizontally matched	0.120***	0.142***	0.132***	0.186***
	(0.0160)	(0.0155)	(0.0159)	(0.0148)
Horizontally mismatched (blue-collars)	0.0840***	0.0897***	0.0828***	0.102***
	(0.0172)	(0.0172)	(0.0172)	(0.0172)
Year of graduation: reference group (2010)				
2011	0.00365	0.00238	0.00470	0.00220
	(0.0173)	(0.0173)	(0.0173)	(0.0174)
2012	-0.00295	-0.00300	-0.00320	-0.00435
	(0.0177)	(0.0177)	(0.0177)	(0.0178)
2013	-0.0141	-0.0161	-0.0146	-0.0160
	(0.0189)	(0.0189)	(0.0189)	(0.0190)
2014	-0.0400**	-0.0380*	-0.0404**	-0.0412**
	(0.0203)	(0.0204)	(0.0204)	(0.0205)
2015	-0.0304	-0.0284	-0.0300	-0.0311
	(0.0220)	(0.0220)	(0.0220)	(0.0221)
First job is not a current job	-0.0338***	-0.0235*	-0.0372***	-0.0472***
	(0.0119)	(0.0122)	(0.0119)	(0.0119)
Industry: reference group (manufacturing)				
Agriculture, hunting and forestry	-0.188***	-0.185***	-0.187***	-0.176***
	(0.0370)	(0.0371)	(0.0371)	(0.0372)
Mining and quarrying	0.326***	0.329***	0.330***	0.342***
	(0.0382)	(0.0383)	(0.0383)	(0.0384)
Electricity, gas and water supply	-0.0476	-0.0445	-0.0439	-0.0424
	(0.0305)	(0.0305)	(0.0305)	(0.0307)
Construction	0.0996***	0.0958***	0.0992***	0.0970***
	(0.0246)	(0.0247)	(0.0247)	(0.0248)
Trade	0.0226	0.0153	0.0188	0.0104
	(0.0193)	(0.0193)	(0.0193)	(0.0194)
Hotels and restaurants	0.0109	0.0113	0.00975	0.0138
	(0.0367)	(0.0368)	(0.0368)	(0.0369)
Transport, storage and communication	0.113***	0.113***	0.114***	0.118***
	(0.0227)	(0.0228)	(0.0228)	(0.0229)
Financial intermediation	0.0733***	0.0753***	0.0727***	0.0775***
	(0.0243)	(0.0243)	(0.0243)	(0.0244)
Real estate, renting and business activities	0.0437**	0.0445**	0.0434**	0.0501**
	(0.0208)	(0.0209)	(0.0209)	(0.0210)
Public administration and defence;	-0.0164	-0.0144	-0.0181	-0.00849
	(0.0192)	(0.0192)	(0.0193)	(0.0193)

Education	-0.201***	-0.193***	-0.195***	-0.191***
	(0.0230)	(0.0230)	(0.0230)	(0.0232)
Health and Social work	-0.100***	-0.0977***	-0.0981***	-0.0882***
	(0.0283)	(0.0283)	(0.0283)	(0.0284)
Other community, social and personal activities	-0.0447	-0.0453	-0.0479*	-0.0538*
	(0.0286)	(0.0286)	(0.0286)	(0.0287)
Constant	9.293***	9.262***	9.136***	9.196***
	(0.103)	(0.103)	(0.103)	(0.103)
Observations	8026	8026	8026	8026
R-squared	0.177	0.174	0.174	0.166

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

We found evidence of a considerable gender wage gap as male graduates earn 17% higher salaries than their female counterparts. Graduates who combined studies with full-time or part-time jobs earn respectively 10% and 4% higher salaries than those who did not get work experience. There are no statistically significant differences in earnings between graduates who studied on state-funded and fee-basis and those who got Specialists or Master and Bachelor degrees. Graduates who studied full-time, earn 13-14% higher salaries than those who studied part-time. Horizontal matching is a significant predictor of graduate salaries. Horizontally matched graduates earn 9-19% higher salaries compared to horizontally mismatched graduates who work in blue-collar jobs. Those graduates who are horizontally mismatched but work in blue-collar jobs earn 9% higher salaries than those who are mismatched and work in white-collar jobs. This is an interesting result, which can be partially explained by compensating wage differentials – graduates who work in blue-collar jobs receive compensation for working in less-prestigious, non-graduate jobs, which has negative non-pecuniary characteristics, and substitute graduates of vocational courses, who should take these workplaces. Employment in a white-collar non-graduate job is likely to be an adverse selection, which is not compensated for due to the lack of negative non-pecuniary characteristics. Working in an office is less likely to result in health damage. Moreover, these workplaces are more likely to be occupied by female graduates.

Taking employment in manufacturing as a reference group, we found that graduates who are employed in Mining and Quarrying earn the highest salaries (32-33% higher), graduates who work in Transport, storage and communication, in Financial intermediation and in Real estate, renting and business activities earn respectively 11%, 7% and 4% higher salaries compared to reference group. We also found a wage penalty for working in public sector industries, such as Education (-20%) and Health (-10%) and penalty for employment in Agricultural sector (-18%).

Differences in the impact of job-education matching on graduates' salaries by fields of study

The overall effect of the ISCED fields of study can be hidden by the simultaneous inclusion of controls for fields of study, industries and matching[1]. In order to avoid this problem, we used alternative specifications without industry controls. To reveal the differences in the effect of job-education matching by fields of study we used specifications with interaction terms between matching (self-evaluated and statistical) and the ISCED fields. The only difference between this model and the previous one is the absence of industry controls, all other control variables are the same. However, for simplicity we show the results only for the main outcome variables, as the other results are almost the same.

Regarding our key variable, the magnitude of the negative impact of job-education mismatches decreases slightly, from 12 to 11% for the self-evaluated matching status and from 6 to 4% in the case of the statistical matching. The results also indicate considerable differences in the impact of the ISCED fields of study on graduates' salaries compared to the full specification with industry controls. In the basic specifications (1-2) all dummies for fields of study are significant. Taking Education as a reference group, we found that graduates in all fields except for Agriculture earn significantly higher salaries: 20% in Engineering, manufacturing and construction, 20% in Services, 16%-18% in Sciences, math and IT, 14-16% in Health, 12% in Arts and humanities and 10% in Social sciences, business and law (Table 11).

The inclusion of interaction terms for matching and ISCED fields of study in the regression model (3-4) shows that self-evaluated mismatch is mostly penalized in Engineering, Services, Arts and Humanities (relative to matched graduates in those fields). However, the differences between the self-evaluated matched and mismatched graduates are insignificant for Education, Social Sciences, business and law as well as Health and Agriculture (Table 11). The analysis of the interaction effects for the statistical mismatch shows that mismatched Education graduates have the lowest relative penalty and that penalties for mismatch exists in all other sectors except for Agriculture. These results can be explained by the fact that Agriculture and Education are the sectors with the lowest salaries, and those, who are mismatched, may have chosen other sectors, which are better paid. These results support our hypothesis, that penalties for mismatch may differ between low-paid and well-paid sectors.

[1] VIF-statistics values for model estimated in Table 10 with industry controls are between 2.79 and 2.85, which shows that multicollinearity is not a significant problem. After removal of industry controls VIF-statistics values decreases to 1.68 - 1.72, showing even lower value of possible multicollinearity

However, the results regarding the interaction terms do not support our hypothesis, that penalties for mismatch differ between fields which contribute to the accumulation of general or specific human capital. For instance, despite our prediction, that graduates in Health are likely to have the most considerable penalty for mismatch because human capital accumulated during health studies can be hardly transferred to other sectors without considerable waste was not supported by results. Graduates in Health are not penalized for being mismatched in specification, which used self-evaluation measure. However, these results for Health field could be achieved because of low number of graduates in Health and very low number of mismatched graduates in this field.

Table 11. The impact of job-education mismatches on graduate salaries (OLS regression) – specifications without industry controls and with the inclusion of interaction terms

	1	2	3	4
VARIABLES	lnwage	lnwage	lnwage	lnwage
Self-evaluated mismatch (dummy)	-0.110***		-0.0453	
	(0.0121)		(0.0292)	
Statistical mismatch (dummy)		-0.042***		0.0538**
		(0.0112)		(0.0266)
ISCED field of study: reference group 'Education'				
Arts and Humanities	0.118***	0.132***	0.147***	0.165***
	(0.0176)	(0.0179)	(0.0209)	(0.0259)
SS&Business&Law	0.102***	0.0952***	0.116***	0.139***
	(0.0153)	(0.0156)	(0.0181)	(0.0189)
Sciences, Maths and IT	0.166***	0.175***	0.191***	0.247***
	(0.0209)	(0.0210)	(0.0243)	(0.0284)
Engineering, Manuf & Construction	0.202***	0.206***	0.235***	0.239***
	(0.0187)	(0.0188)	(0.0221)	(0.0237)
Agriculture	0.0319	0.0412	0.00502	-0.0636
	(0.0295)	(0.0299)	(0.0391)	(0.0636)
Health	0.150***	0.160***	0.164***	0.201***
	(0.0285)	(0.0287)	(0.0299)	(0.0314)
Services	0.204***	0.229***	0.242***	0.461***
	(0.0241)	(0.0247)	(0.0297)	(0.0664)
Interactions of education and matching (self-evaluated and statistical)				
Arts and Humanities##Mismatch			-0.0978**	-0.0877**
			(0.0382)	(0.0365)
SS&Business&Law ## Mismatch			-0.0491	-0.134***
			(0.0330)	(0.0341)
Sciences, Maths and IT ##Mismatch			-0.0879*	-0.163***
			(0.0460)	(0.0412)
Engineering, Manuf & Constr ## Mismatch			-0.107***	-0.0788**
			(0.0393)	(0.0370)
Agriculture##Mismatch			0.0351	0.0806
			(0.0595)	(0.0727)

Health##Mismatch			0.0242	-0.146*
			(0.133)	(0.0861)
Services## Mismatch			-0.117**	-0.030***
			(0.0504)	(0.0727)
Gender= male	0.194***	0.191***	0.190***	0.188***
	(0.0108)	(0.0108)	(0.0108)	(0.0110)
Combining study and work: reference group 'have not worked during studies'				
Combined studies with regular job	0.106***	0.107***	0.105***	0.105***
	(0.0171)	(0.0172)	(0.0171)	(0.0171)
Combined studies with part-time job	0.0411***	0.0411***	0.0415***	0.0402***
	(0.0132)	(0.0132)	(0.0132)	(0.0132)
Vertical matching: reference group (horizontaly mismatched - white collars)				
Vertically matched	0.108***	0.162***	0.113***	0.172***
	(0.0156)	(0.0142)	(0.0156)	(0.0145)
Vertically mismatched (blue-collars)	0.0858***	0.104***	0.0886***	0.108***
	(0.0171)	(0.0170)	(0.0171)	(0.0173)
Constant	9.030***	9.073***	9.073***	9.340***
	(0.103)	(0.104)	(0.104)	(0.106)
Observations	8026	8026	8026	8026
R-squared	0.140	0.134	0.142	0.137

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Conclusion

This study has focused on horizontal job-education mismatches (alternatively, occupation-education mismatches), an issue which has become increasingly relevant given the debates about mass higher education and its relevance to labor market requirements. By using a comprehensive dataset on Russian university graduates we evaluated the determinants of job-education mismatches and their consequences in terms of salaries. We used two different measures of job-education mismatches: one (the main) based on a self-evaluated mismatch and a statistical mismatch variable.

Both measures showed that there is a considerable wage penalty for being mismatched and that the penalty rises with the extent of the horizontal mismatch. Our analysis showed that 32% of Russian graduates are mismatched by self-evaluation measures (a value that increased to 40% when we used the statistical measure). We also found that there are considerable differences in the probability of job-education mismatches by fields of study. Graduates in fields which generate rather general human capital (e.g., Social Sciences, business, law, Services) or in relatively low-paid and non-prestigious fields (Agriculture) are more likely to be mismatched. Graduates in fields which generate specific human capital (e.g. Health) are considerably more likely to be matched. This can be explained by the relative non-transferability of specific human

capital to other sectors. On the contrary, general human capital, that can more easily be transferred to other industries, makes mobility between fields beneficial and increases the probability of a mismatch, though it reduces the penalty associated with it. Our analysis has shown that *job-education mismatches negatively affect salaries of university graduates and the wage penalty for mismatches depends considerably on the degree of mismatch*. *The analysis of interaction terms shows, that mismatch is not penalized in low-paid fields (Agriculture and Education) and is penalized in more well-paid occupations.*

Regarding vertical mismatches, we found that 33% of Russian graduates work in non-graduate jobs. There is a strong penalty for working in white-collar non-graduate jobs compared to white-collar graduate jobs, but those who work in blue-collar non-graduate jobs are not penalized for vertical mismatches. The latter, on the contrary, earn more than those who work in white-collar non-graduate jobs. This can be explained by compensating wage differentials, i.e., graduates that work in blue-collar jobs receive a compensation for working in less-prestigious non-graduate jobs which have negative non-pecuniary characteristics. Graduates who work in white-collar non-graduate jobs seem to be those who lost in the competition with graduates who work in white-collar graduate jobs, and earn less due to adverse selection and lack of compensation (as non-pecuniary job characteristics are neutral rather than negative).

Our results conform, in general, to human capital theory, which predicts that job-education mismatches will be penalized in terms of salaries due to a potential waste of human capital. The results mainly support the idea, formulated in Robst (2007) Nordin et al (2010) and Boudarbat, Chernoff (2012), that graduates in fields which accumulate more specific human capital are less likely to be mismatched relative to graduates in fields which contribute to the development of general human capital. Unlike Robst (2007) and Nordin (2010), we found that almost all fields, except for low-paid Agriculture and Education are penalized for mismatch.

We believe that our study will foster the discussion about horizontal dimension of job-education mismatch, which is important as it shows the congruency between educational fields of study and labor market requirements. The analysis proved that penalties for horizontal mismatch are considerable and affect salaries to an even higher extent than just vertical mismatch, a much better documented issue.

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Table A1. Higher education fields in Russia encoded in accordance with ISCED97 codes.

Russian HE specialties encoded in accordance with ISCED97 codes	
1 Education	
Education and Pedagogics	65
2 Humanities and arts	
Arts and Culture	67
Human Sciences	63
3 Social sciences, business and law	
Social Sciences, Law	64
Economics and Management	68
4 Science	
Physical and Mathematical Sciences	61
Natural Sciences	62
Information security	69
Informatics and Computers	622
Geology, Mineral Resources Exploring and Mining	628
5 Engineering, manufacturing and construction	
Power Engineering, Power Engineering Industry and Electrical Engineering	613
Metallurgy, Mechanical Engineering and Material Processing	614
Aviation and Rocket and Space Machinery	615
Weapons and weapons systems	616
Maritime Machinery	617
Instrument Making and Optical Equipment	619
Electronic Engineering, Radio Engineering and Communication	620
Automatic Devices and Management	621
Food and Consumer Goods Technology	624
Architecture and Construction	625
Chemical Technology and Biotechnology	627
6 Agriculture	
Agriculture and Fishing Industry	611
Reproduction and Processing of Forest Resources	623
Geodesy and Land Management	612
7 Health and welfare	
Public Health Service	66
8 Services	
Service Trades	610
Transport	618
Personal and Social Safety, Environmental Engineering and Protection	626