Legacy of Czar

The Russian Dual System of Schooling and Signaling*

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Abstract

Employers use the educational background as a signal of workers' latent abilities. This signaling effect decreases as employers learn about workers' abilities as the workers acquire work experience. The effect results in a negative coefficient of the interaction term between schooling and experience in a wage equation. Meanwhile, if schooling and experience are complements, it affects the coefficient in the other way. We expect the latter effect is more significant in case of the vocational schooling. Using a Russian dataset, we show that employer learning is more weakly observed for graduates of vocational tertiary schools than those of general tertiary schools. The results might apply to other European countries that have adopted the dual system of general and vocational schooling.

Keywords: European dual system; vocational schooling, employer learning; schooling and experience complementarity; Russia.
JEL: I26; J31; J24.

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1 Introduction

Workers' innate abilities, when they join the market, in particular, are private information. Thus employers use observable information such as schooling background as signal of abilities (Spence (1973); Hungerford and Solon (1987); Belman and Heywood (1991); Heywood (1994); Jaeger and Page (1996); Belman and Heywood (1997); Park (1999); Ferrer and Riddell (2008); McGuinnes (2003); Trostel and Walker (2004); Trostel (2005); Münich, Svejnar and Terrell (2005); Pons and Blanco (2005); Silles (2007, 2008)Bitzan (2009); Fadlon (2015); and Olfindo (2018)).

The signaling effect of schooling intrinsically depends on the risk incurred by employers due to the asymmetric information of workers' ability. Indeed, under the performance payment where employers observe output first, signaling effects of schooling are smaller, and the payment is more closely correlated with innate abilities (Hoon and Parent (2013)).

In any case, as workers acquire work experiences, employers gradually learn about workers' innate abilities from information about their outputs, career paths, or promotions and the productivity risk decreases. Therefore, the signaling impact of schooling is high in the early stages of workers' careers and then gradually attenuates (Habermalz (2006)).

This attenuating effect is called employer learning. It is typically observed as a negative coefficient of the interaction term between years of schooling and years of work experience in a Mincerian wage estimation equation whose dependent variable, wage, is presented by a logarithmic term (Farber and Gibbons (1996)). Empirical results especially based on American datasets support this theoretical prediction (Altonji and Pierret (2001); Pinkston (2006); Schönberg (2007); and Lange (2007)).

Meanwhile, if skills acquired by education and those acquired at workplaces are complements, then, it works to push the coefficient of the interaction term between years of schooling and years of work experience into the positive territory. Arguably due to this vector with the opposite direction, empirical results on the employer learning are sometimes mixed depending on age or job types (Gibbons and Waldman (2006), pp. 74–75; Mansour (2012); Waldman (2013), pp. 524, 536–537; and Light and McGee (2015)). A significant example is the German labor market. Bauer and Haisken-DeNew (2001) and Lluis (2005) found that the employer effect, if any, only very weakly observed in the German dataset they used.

While the education system of the US and East Asian countries predominantly emphasize general education, Western European countries, the UK, some Common Wealth countries, and Russia adopt the tracking system. The system channels students who performed less in primary or secondary level into vocational schools. Vocational schools intend to provide skills complementary to those in workplaces.

Provided that proceeding to higher education significantly affects job gain and loss outcomes even after the collapse of the USSR and following substantial reforms of education (Gerber (2012)), Russian young students must have incentives to enhance signalling effects by earning a higher degree. However, the Russian early tracking system, and probably the European and British similar systems, could weaken the employer learning effect potentially in two ways. One is suboptimality of investment in schooling in workers. If the opportunity for the general tertiary schooling is opener as in the US and East Asia, workers might invest in

education longer than optimal given own innate abilities. This bias could potentially exacerbate the signaling effects in the US and East Asia. Indeed the literature of the signaling effects of schooling and the employer learning implicitly assumes a bias in this direction. Meantime, lower achievers with a lower discount factor of might cont the cost of general tertiary education higher and result in investment in education lower than optimal given own abilities (Card (2012)). The bias in this direction might be substantial under the European, British, and Russian systems that discourage lower achievers in their lower teens to proceed to the general tertiary education. If it holds, it might nullify the signaling effects of schooling of lower achievers.

The other possible and bright way for the European, British, and the Russian system to weaken the employer learning effect is the complementarity between the skill earned at vocational schooling and those acquired at workplaces. The complementarity would force the coefficient of the interaction term between the years of schooling and the work experience forward the positive territory. In Germany, the complementarity is upheld by the streamlined connection of vocational schooling with the apprentice system (Pischke and von Wachter (2008)). Where vocational schools are not connected to the well-organized apprentice system, the gain from vocational schooling could rise when it contains internship programs (Polidano and Tabasso (2014)). Recently, some countries implemented a reform to extend the contents of general education in vocational schools. Empirical works, however, do not find a positive outcome of such reforms and hence validate the intense focus on vocational training in vocational schools in the European dual system based on the strict tracking system (Hall (2016) and Zilic (2018)). European vocational education system is deeply connected with other institutions, and partial reform of it does not necessarily improve students' outcome.

In this paper, we focus on this possibly bright side of the European, British, and Russian systems that seek vocational schooling to provide workers with skills that are complementary with those acquired at workplaces. Considering the characteristics of panel estimation, we predict that the employer learning effect is more weakly observed for years of vocational schooling than for years of general schooling and show that the prediction is supported using a Russian dataset. Provided that vocational school systems in Western Europe be introduced from Russia in the late nineteenth century, our results on the Russian dual schooling and signaling system, at least partially, might explain why employer learning is only weakly observed in European countries that have dual education systems.

In section 2, we present predictions on the employer learning effect for general and vocational schooling. Section 3 gives an overview of the Russian schooling system and introduce the dataset. Section 4 presents empirical results. Section 5 concludes the paper.

2 Framework of analysis

2.1 Employer learning

Consider a Mincerian equation of wage estimation by the fixed effects model,

$$(1)\ \log[w_{i,t}] = \alpha_1 S_i + \alpha_2 S_i^2 + \alpha_3 X_{i,t} + \alpha_4 X_{i,t}^2 + \alpha_5 S_i \times X_{i,t} + \boldsymbol{\delta z_i} + \mu_i + constant + \zeta_{i,t},$$

where $w_{i,t}$ denotes wage for worker i, $i = 1, \ldots, n$, in period t, $t = 1, \ldots, T$, S_i denotes worker i's years of schooling, $X_{i,t}$ denotes years of labor market experience, $LMX_{i,t}$, which is years after graduation as of period t, or cumulative years of employment experience, $EMP_{i,t}$, which is cumulative years when worker i was in employment until period t, vector $\boldsymbol{z_i}$ denotes observable characteristics other than schooling and experience, μ_i is a dummy variable for worker i to control fixed effects, and $\zeta_{i,t}$denotes innovative error term.

Mincer (1974) found that the coefficient between schooling and experience, β_5 can be negative and mentioned that this describes "the apparent convergence of experience profiles" (Mincer (1974), pp. 92–93). However, he did not provide logical reasoning.

Meanwhile, from Hansen, Weisbrod and Scanlon (1970), the signaling effect has attracted both theoretical and empirical attention. Twenty years later, Farber and Gibbons (1996) established the explicit link between two strands. If employers learn about the innate ability of a specific worker as the worker earns work experience, the signaling effect of schooling declines as well, which results in a negative coefficient of the interaction term between schooling and experience in a Mincerian wage equation.

2.2 Learning by employers and skill acquisition by workers

At the same time, by the definition of the normal equation of regression, α_5 increases in covariance of $w_{i,t}$ and $S_i \times X_{i,t}$. If $w_{i,t}$ can be assumed to increase in output of worker i, then the complementarity between schooling and experience works to make α_5 positive. Thus, only if the employer effect is sufficiently strong, α_5 can be non-positive(Farber and Gibbons (1996), p. 1117). More specifically, in a panel estimation, α_5 captures both the employer learning of workers' innate abilities and the workers' skill acquisition over time. If a schooling system is well tailored to make itself complementary to skills acquired through work experience, the complementarity might even rise over time while employers learn workers' abilities.

A straightforward inference is thus that the observed intensity of the employer learning depends on the extent of the complementarity between schooling and experience. Bauer and Haisken-DeNew (2001) and Lluis (2005) showed mixed results of the employer learning prediction for the German case. Bauer and Haisken-DeNew (2001) and Lluis (2005) established that the employer learning effect as a negative coefficient of the interaction term between schooling and experience is, if any, only weakly observed for the German dataset they used. If some schools in Germany invest in skills that are more complementary to work experience under the apprentice system that directly links schooling to experience (Pischke and von Wachter (2008)), the results of Bauer and Haisken-DeNew (2001) and Lluis (2005) are somewhat reasonable.

2.3 Testable prediction

Then a remaining issue is whether the estimated employer learning effects are different for different kinds of schooling. While general schools train general cognitive skills, higher education can work as a signal to differentiate workers who have better innate abilities that enable them to progress to higher education at lower costs. Meanwhile, vocational schools designed

to seamlessly streamline connection between schools and workplaces by training professional skills immediately useful in workplaces and hence those professional skills are reasonably presumed to be more complementary to those acquired through work experience than general cognitive skills.

To identify possibly particular effects of vocational schooling, we consider a Mincerian wage equation,

$$\begin{aligned}\log[w_{i,t}] = \beta_1 S_{g_i} + \beta_2 S_{g_i}^2 + \beta_3 S_{vi} + \beta_4 S_{v_i}^2 + \beta_5 X_{i,t} + \beta_6 X_{i,t}^2 \\ + \beta_7 S_{g_i} \times X_{i,t} + \beta_8 S_{vi} \times X_{i,t} + \boldsymbol{\delta z_i} + \mu_i + \zeta_{i,t},\end{aligned} \tag{2}$$

where s_g denotes the total of years of primary schooling, secondary schooling, and years of general tertiary schooling, and s_v denotes the total of years of primary schooling, secondary schooling. Then our straightforward prediction is as follows.

Prediction 1. *Suppose that there are two kinds of schools; general and vocational schools. Then, the employer learning effect is more saliently observed for general schooling than for vocational schooling;* $\beta_7 < \beta_8$.

We test this prediction using the Russia Longitudinal Monitoring Survey from 1998 to 2006 in the following sections.

3 Education system and labor market of Russia

3.1 Dual system

The mandatory nine years of schooling in Russia consists of primary education from the 1st to the 4th year and general education from the 5th year to the 9th year. Then students proceed to the general secondary education for two years followed by the university level education for 4–5 or to vocational schools for three years. While this is the primary structure, some students move between these two tracks. For instance, students who have graduated vocational schools might enter related departments of universities (Nikolaev and Chugunov (2012), pp. 1, 19–33, 39–45, 48–57). A point relevant to our study is in that each vocational school focuses on a specific industry. In other words, they intend to invest in industry-specific skills.

3.2 Historical origin of European vocational education

This dual system after the general compulsory education reminds us, for example, of the German system. However, the vocational education system now dominant in Continental Europe was introduced in the late 19th century from the Russian Empire. The Russian vocational education system was introduced to Austria-Hungary first in 1878, and to Prussia in 1879. These vocational education systems are thought to have combined with apprenticeship systems, which needed to adjust to the modern manufacturing and service industries, as typically in the metalworking and electrical engineering in Schuckert, MAN, Krupp, Siemens, and

Bosch from the 1890s to the 1910s. Thus, the Russian dual system is an issue relevant to understand not only contemporary Russia but also Continental Europe (Wiemann (2004)).

3.3 Data

For our analysis, we use the Russia Longitudinal Monitoring Survey on the Russian Federation conducted since 1992.[1] Attrition of each round is supplanted and hence it is an unbalanced panel dataset. While the primary goal of the survey was to monitor the process of structural reforms in Russia after the collapse of the USSR, the rich information the panel data contain has yielded a wide range of works in economics, which include Ogloblin and Brock (2005); Richter (2006), Baltagi and Geishecker (2006), Linz and Semykina (2010); Danzer (2013), Decancq (2014) and, von Hinke and Leckie (2017), epidemiology, and sociology. Within this concurrent survey data, we use 8 round years from 1998 to 2006 for the data consistency.

4 Empirical results

4.1 Overview of employer learning

We adopt the fixed effects model for all specifications and adjust standard errors for clusters of individual respondents of the survey. The appendix table provides the summary statistics of all variables we use. The dependent variable for all specifications is the nominal hourly wage in the logarithmic term. The gender dummy variable, D_g takes 1 if the respondent is female and 0 if male. We consider possible peculiarity inherited from the Soviet period as well as the persistent impact of reform after the collapse of USSR (Brainerd (1998); Pastore and Verashchagina (2006); and Flabbi, Paternostro and Tiongson (2008)), and hence, we control for the dummy variable regarding whether entering the labor market after the collapse of the USSR in 1998 ($= 1$ if graduating the last school after 1998 and $= 0$ otherwise, $D_{PostUSSR}$). By the same reason, we also control for working for a state-owned enterprise dummy ($= 1$ if working for a state-owned enterprise and $= 0$ otherwise, D_{SE}), working for a foreign-owned enterprise dummy ($= 1$ if working for a foreign-owned enterprise and $= 0$ otherwise, D_{FE}) The gender dummy ($= 1$ if male and 0 otherwise, D_g) controls for the gender inequality.

First, let us show the standard setting in specification 1–1. The interaction term between the total years of schooling and the labor market experience, $S_{i,t} \times LMX_{i,t}$, has a significantly negative coefficient. Also in specification 1–2, which replaces the years of labor market experience by the cumulative years of employment, $EMPX_{i,t}$, the interaction term between the total years of schooling and the employment experience, $S_{i,t} \times EMPX_{i,t}$ has a significantly negative coefficient. Thus, we observe a symptom of the employer learning in Russia when counting total years of schooling. The result is consistent with the sheepskin effect observed

[1] Russia Longitudinal Monitoring survey, RLMS-HSE, conducted by the National Research University Higher School of Economics and ZAO Demoscope together with Carolina Population Center, University of North Carolina at Chapel Hill and the Institute of Sociology RAS. The dataset is open for research. The instruction for application of the data usage and related data usage policy is available at `http://www.cpc.unc.edu/projects/rlms-hse`: last accessed on March 20, 2014.

before and after the transition from the communist regime in Czech Republic (Münich et al. (2005)).

Table 1 Employer learning effect on general and vocational school graduates.

		1–1		1–2		1–3		1–4		1–5		1–6	
Estimation method		fixed effects model											
Dependent variable		log(w)											
Cross-section		fixed											
Period (year)		pooled											
Independent variables		coefficient	t statistic	coefficient	t statistic	coefficient	t statistic	coefficient	t statistic	coefficient	t statistic	coefficient	t statistic
S		0.3286	10.69 ***	-0.0630	-1.38								
S^2		0.0005	0.54	0.0048	3.05 ***								
S_g						-0.0500	-1.17	-0.1042	-2.10 **				
S_g^2						0.0123	8.22 ***	0.0075	4.05 ***				
S_v						0.2598	7.43 ***	-0.0326	-0.61				
S_v^2						0.0006	0.56	0.0013	0.62				
S_{gt}										0.1254	4.63 ***	0.0821	2.56 **
S_{gt}^2										0.0013	0.48	0.0111	3.54 ***
S_{vt}										0.0341	1.44	-0.2085	-7.92 ***
S_{vt}^2										0.0009	0.40	0.0399	16.37 ***
LMX		0.3607	32.28 ***			0.3772	27.52 ***						
LMX^2		-0.0009	-7.31 ***			-0.0010	-7.48 ***						
$EMPX$				0.2607	23.65 ***			0.2587	19.27 ***	0.2365	29.45 ***	0.2568	35.84 ***
$EMPX^2$				-0.0014	-8.80 ***			-0.0014	-8.66 ***	-0.0013	-8.29 ***	-0.0011	-8.33 ***
$S \times LMX$		-0.0020	-3.68 ***										
$S \times EMPX$				-0.0020	-3.16 ***								
$S_g \times LMX$						-0.0024	-4.19 ***						
$S_v \times LMX$						-0.0012	-1.77 *						
$S_g \times EMPX$								-0.0019	-2.74 ***				
$S_v \times EMPX$								-0.0003	-0.39				
$S_{gt} \times EMPX$										-0.0025	-2.81 ***	0.0041	4.22 ***
$S_{vt} \times EMPX$										-0.0012	-1.27	0.0071	7.61 ***
$S_{gt} \times UNEMPX$												0.0254	17.36 ***
$S_{vt} \times UNEMPX$												0.0491	24.78 ***
D_g		-0.8945	-2.13 **	-1.3381	-2.03 **	-1.0875	-2.04 **	-1.3639	-2.03 **	-1.2955	-2.01 **	-1.0085	-2.10 **
D_{SE}		-0.0225	-1.07	-0.1840	-7.02 ***	-0.0237	-1.12	-0.1843	-7.03 ***	-0.1836	-7.01 ***	-0.1063	-4.45 ***
D_{FE}		0.1231	2.99 **	0.0879	1.70 *	0.1251	2.99 ***	0.0880	1.69 *	0.0863	1.67 *	0.1177	2.59 ***
$D_{PostUSSR}$		0.0592	1.33	1.0608	16.70 ***	0.0559	1.26	1.0585	16.49 ***	1.0500	16.42 ***	0.6551	10.85 ***
$Constant$		-7.7252	-21.53 ***	-0.5929	-1.28	-7.4249	-15.23 ***	-0.1702	-0.31	-0.8041	-2.60 ***	-1.7473	-7.25 ***
years over groups	minimum		1.0		1.0		1.0		1.0		1.0		1.0
	average		2.2		2.2		2.2		2.2		2.2		2.2
	maximum		6.0		6.0		6.0		6.0		6.0		6.0
groups included			8,960		8,960		8,959		8,959		8,959		8,959
included observations			19,728		19,728		19,718		19,718		19,718		19,718
R^2			0.5641		0.3021		0.5557		0.3026		0.3035		0.4175
F statistic			1,295.14 ***		347.62 ***		950.86 ***		265.84 ***		266.93 ***		382.40 ***

Source : The Russia Longitudinal Monitoring Survey, RLMS-HSE (http://www.cpc.unc.edu/projects/rlms-hse).

Note : Standard errors for F and t statistics are adjusted for clusters of groups. ***: $p<0.01$. **: $p<0.05$. *: $p<0.1$.

4.2 General and vocational graduates

Next, specification 1–3 splits the tertiary level into the general one and the vocational one such that $S_{g_{i,t}} = S_{ps_{i,t}} + S_{gt_{i,t}}$ and $S_{vi,t} = S_{ps_{i,t}} + S_{vti,t}$, where $S_{ps_{i,t}}$ denotes years of the general primary and secondary level, $S_{gt_{i,t}}$ denotes years of the general tertiary level, and $S_{vti,t}$ denotes years of the vocational tertiary level. Then, the negativity of the interaction term between the years of general schooling and the labor market experience, $S_{g_{i,t}} \times LMX_{i,t}$ is greater than that of the one between the years of vocational schooling and the labor market experience, $S_{vi,t} \times LMX_{i,t}$, which is consistent with prediction 1.

Furthermore, in specification 1–4, which replaces years of the labor market experience, $LMX_{i,t}$ by years of the cumulative years of employment, $EMPX_{i,t}$, not only the absolute value of the coefficient of the interaction term between the years of vocational schooling and the employment experience, $S_{vi,t} \times EMPX_{i,t}$ is smaller, the coefficient is not significant anymore. The result is again consistent with our prediction.

Under the Russian education system, years of proceeding from the secondary education to the tertiary education vary depending on workers' choices. In specifications 1–3 and 1–4, both of the years of general schooling $(S_{g_{i,t}})$ and years of vocational schooling $(S_{vi,t})$ contain the years of general primary and secondary schooling $(S_{ps_{i,t}})$. While the variance of S_{ps} over groups is substantial, they do not evolve after completing the tertiary level. Thus, as a robustness check, we consider

$$\begin{aligned}\log[w_{i,t}] = {} & \gamma_1 S_{gt_i} + \gamma_2 {S_{gt_i}}^2 + \gamma_3 S_{vti} + \gamma_4 {S_{vti}}^2 + \gamma_5 EMPX_{i,t} + \gamma_6 {EMPX_{i,t}}^2 \\ & + \gamma_7 S_{gt_i} \times EMPX_{i,t} + \gamma_8 S_{vti} \times EMPX_{i,t} + \boldsymbol{\delta z_i} + \mu_i + \zeta_{i,t},\end{aligned} \tag{3}$$

which drops the years of primary and secondary schooling that is likely to be controlled for by the fixed effects in specification 1–5. As expected, the employer learning effect of the general schooling is more salient than in specification 1–4 while the interaction term between the years of vocational tertiary schooling and the employment experience does not have a significant coefficient.

To decompose the labor market experience further, in specification 1–6, we include the interaction terms of the cumulative years of unemployment with the general tertiary schooling, $S_{gt_{i,t}} \times UEMPX_{i,t}$, and with the vocational tertiary schooling, $S_{vti,t}$. Then we have a substantially smaller negativity of the greater coefficient of the latter. It indicates that the skill depreciation might be slower for graduates of the vocational tertiary schools.

5 Conclusion

Schooling can have a signaling role, which is captured by a negative coefficient of the interaction term between schooling and work experience. Meanwhile, schooling might invest in skills complementary to skills acquired at workplaces. We have shown that the latter effect is greater

in the case of Russian vocational tertiary school graduates. The result is consistent with empirical works that validate the narrow focus on vocational training in vocational schools (Hall (2016) and Zilic (2018)) or a more intense vocational training and institutional coordination between schools and employers instead of free markets (Bol and van de Werfhorst (2011)) in the European context.

After the Russian vocational school system dispersed in Western Europe in the late nineteenth century and were combined with the existent apprenticeship system, Western European countries have remained the dual education system as well. The signaling role of schooling, which is typically observed in the US dataset, sometimes gives mixed results for European datasets. Our results on the Russian labor market suggest that a potential complementarity effect between vocational schooling and work experience in Western Europe might generate such mixed results, and prompt further inquiry on different effects of signaling and different directions of skill acquisitions in general and vocational schools in Europe.

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Appendix Definition and descriptive statistics of variables

variable	definition	Mean	Median	Maximum	Minimum	Standard deviation	Skewness	Number of observations
w	Current hourly nominal wage in terms of the Russian ruble.	582.6045	37.0370	444,444.4444	0.0521	3,222.8563	60.5844	57,003
a	Age.	43.3050	41.5833	102.6667	13.0000	18.6811	0.3507	144,053
S	Total years of schooling.	11.5633	12.0000	34.0000	0.0000	3.5303	-0.3244	135,160
S_{ps}	Years of primary and secondary schooling.	9.0513	10.0000	12.0000	0.0000	1.9269	-1.8385	143,788
S_{gt}	Years of general tertiary schooling (college level or higher).	2.4995	2.0000	24.0000	0.0000	0.0000	2.4619	134,912
S_{vt}	Years of vocational and professional tertiary schooling.	1.3959	1.0000	24.0000	0.0000	1.5956	0.8670	134,912
S_g	Years of general schooling, which includes primary and secondary schooling: $=S_{ps}+S_{gt}$.	10.1872	10.0000	26.0000	0.0000	3.2197	0.2430	134,912
S_v	Years of vocational schooling, which includes primary and secondary schooling: $=S_{ps}+S_{vt}$.	10.4794	11.0000	34.0000	0.0000	2.5685	-1.0734	134,912
LMX	Years of the labor market experience: $=a-(S_{ps}+S_{gt}+S_{vt})$	28.7729	26.1667	92.0833	0.0000	21.2790	0.3602	53,613
$EMPX$	Cumulative years of employment experience.	20.6489	20.0000	75.0000	0.0000	15.8341	0.1475	53,613
$UEMPX$	Cumulative years of unemployment experience: $=LMX-EMPX$	8.1240	4.2500	86.7500	0.0000	10.0497	2.4075	53,613
D_g	Gender dummy: =0 if male, and 1 if female.	0.4288	0.0000	1.0000	0.0000	0.4949	0.2876	144,053
D_{SE}	Dummy variable of currently working for a state-owned enterprise: =1 if the questioned works for a state-owned firm, and =0 otherwise.	0.6284	1.0000	1.0000	0.0000	0.4832	-0.5315	67,917
D_{FE}	Dummy variable of currently working for a foreign-owned enterprise: =1 if the questioned works for a foreign-owned firm, and =0 otherwise.	0.0396	0.0000	1.0000	0.0000	0.1951	4.7201	68,118
$D_{PostUSSR}$	Dummy variable regarding whether entering the labor market after the collapse of the USSR in 1998: =1 if graduating the last school, and =0 otherwise.	0.2128	0.0000	1.0000	0.0000	0.4093	1.4037	69,279

Source : The Russia Longitudinal Monitoring Survey, RLMS-HSE (http://www.cpc.unc.edu/projects/rlms-hse).