

Heritage from Czar The Russian Dual System of Schooling and Signaling*

ISS Discussion Paper Series

F-163

September 2013

Aigerim Zhangaliyeva[†]

Masaki Nakabayashi[‡]

Institute of Social Science

The University of Tokyo

Abstract

Employers use educational background as a signal of a worker's latent ability. This signaling effect decreases as employers learn about the worker's ability with his/her work experience, which results in negative coefficient of interaction term between schooling and experience in wage equation. Meanwhile, if schooling and experience are complements, it works to make the coefficient positive. We show the latter complementarity effect dominates for vocational school graduates school in Russia. Given that European vocational school systems were introduced from the Russian Empire, our results at least partly explain why employer learning is only weakly observed in Europe.

Key words: Signaling, employer learning, complementarity of schooling and experience, vocational school, Russia.

JEL: J31, J24

*The authors thank the 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 for making these data available. This research has been funded by the JSPS Grant-in-Aid (22243022).

[†]Tokyo Electron Limited. The views expressed in this paper are those of the authors and do not necessarily reflect the views of Tokyo Electron Limited.

[‡]Corresponding address: Institute of Social Science, The University of Tokyo, Hongo 7-3-1, Tokyo 103-0033, Japan. E-mail: mn@iss.u-tokyo.ac.jp

1 Introduction

Workers' innate abilities, when they join the market in particular, are generally private information. As workers acquire work experiences, however, employers gradually learn about workers' hidden abilities from information about their outputs, career paths, or promotions. Then the relative impact of schooling record on wage determination is expected to decrease accordingly. This effect called employer learning is typically observed as a non-positive coefficient of interaction term between years of schooling the years of schooling and the years of work experience in a wage estimation equation in antilogarithmic terms or a negative coefficient 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 data sets support this theoretical prediction (Altonji and Pierret (2001); Pinkston (2006); Schönberg (2007); and Lange (2007)).

Meanwhile, if skills acquired by education and skills acquired at workplaces are complements, then, it works to increase the coefficient of interaction term between the years of schooling and the years of work experience. Arguably due to these vectors with opposite direction, empirical results on employer learning are sometime mixed.¹ A significant example is the German labor market. Bauer and Haisken-DeNew (2001) and Lluís (2005) found that the employer effect, if any, only very weakly observed in the German data set they used.

In some countries, especially in Western European countries and Russia, some schools intend to focus on skills directly useful in workplaces and some schools don't. The former is called vocational schools, and by definition, they intend to provide skills complementary to those in workplaces. Given the characteristics of panel estimation, we predict that employer learning effect is more weakly observed for the years of vocational schooling than for the years of general second or tertiary schooling and show that the prediction is supported using a Russian data set. Provided that vocational school systems in Western Europe were introduced from Russia in the late 19th century, our results on the Russian dual schooling and signaling system, at least partially, explain why employer learning is only weakly observed in European countries that have dual education systems.

In section 2, we present a prediction on employer learning effect for general and vocational schooling. Section 3 gives an overview of the Russian schooling system and introduce the data set. 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,

$$(1) \quad \log[w_{i,t}] = c + \alpha_1 s_i + \alpha_2 s_i^2 + \alpha_3 x_{i,t} + \alpha_4 x_{i,t}^2 + \alpha_5 s_i x_{i,t} + \gamma z_i + \epsilon_i + \zeta_{i,t},$$

where $w_{i,t}$ denotes wage for worker i , $i = 1, \dots, n$ in period t , $t = 1, \dots, T$, s_i denotes worker i 's years of schooling, $x_{i,t}$ denotes work experience worker i has earned until period t ,

¹See Gibbons and Waldman (2006), pp. 74-75 and Waldman (2013), pp. 524, 536-537.

vector z_i denotes observable characteristics other than schooling and experience, and ϵ_i and $\zeta_{i,t}$ respectively denote time invariant and innovative error terms.

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.”² However, any explicitly consistent reasoning was not provided.

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

2.2 Longitudinal and cross-sectional effects

At the same time, from the definition of normal equation, β_5 increases in covariance of $w_{i,t}$ and $s_i x_{i,t}$. If $w_{i,t}$ is assumed to increase in output of worker i , then complementarity between schooling and experience serves to make β_5 positive. Thus, only if the employer learning effect is sufficiently strong, β_5 can be non-positive.³ More specifically, in a panel estimation, β_5 consists of the longitudinal effect that changes in period t and the cross-sectional effect that depends only on time invariant variance between cross-sections. The employer learning effect is captured solely as the longitudinal effect and the complementarity effect between schooling and work experience is primarily as the cross-sectional effect (Nakabayashi (2011)).

A straightforward inference is thus that observability of the employer learning depends on the extent of complementarity between schooling and experience, which makes β_5 positive. A representatively mixed result of the employer learning prediction is provided for the German case. Bauer and Haisken-DeNew (2001) and Lluís (2005) showed that the employer learning effect as a negative coefficient of interaction term between schooling and experience is, if any, only weakly observed for the German data set they used. If some schools in Germany invest in skills more complementary to work experience under the apprentice system that links schooling to experience (Pischke and von Wachter (2008)), results of Bauer and Haisken-DeNew (2001) and Lluís (2005) are rather reasonable.

2.3 Testable prediction

Then a remaining issue is whether the employer learning is differently observed for different schools. While general schools train general cognitive skills, higher education can work as a signal to differentiate workers who have better innate ability that enables them to progress to higher education by lower costs. Meanwhile, vocational schools intend to seamlessly streamline connection between schools and workplaces by training professional skills directly useful

²See Mincer (1974), pp. 92-93.

³See Farber and Gibbons (1996), p. 1117.

in workplaces and those professional skills are reasonably presumed to be more complementary to work experience than general cognitive skill.

Differentiating schools into general ones vocational ones and consider a Mincerian wage equation,

$$(2) \quad \log[w_{i,t}] = c_i + \beta_1 s_i + \beta_2 s_i^2 + \beta_3 s_v i + \beta_4 s_v i^2 + \beta_5 x_{i,t} + \beta_6 x_{i,t}^2 \\ + \beta_7 s_i x_{i,t} + \beta_8 s_v i x_{i,t} + \gamma z_i + \epsilon_i + \zeta_{i,t},$$

where s_v denotes the years of vocational schooling. Compared with equation (1), equation (2) controls for the effect from vocational schooling on human capital acquisition that is potentially complementary to work experience. Then our simple prediction is as follows.

Prediction 1. *Suppose there are two kinds of schools; general and vocational schools. Then,*

- a the employer learning effect is more strongly observed when controlling for vocational schooling than otherwise; $\alpha_5 > \beta_7$, and,*
- b the employer learning is more strongly observed for general schooling than for vocational schooling when controlling for vocational schooling; $\beta_7 < \beta_8$.*

We test this prediction using the 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 9 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 2 years followed by university level education for 4-5 or to vocational schools for 3 years. While this is the basic structure, some students move between these two tracks. For instance, students who have graduated vocational schools might enter related departments of universities. 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 human capital.

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, to Prussia in 1879. These vocational education system is thought to have combined with apprenticeship system, which

needed to adjust modern manufacturing and service industries, as typically in the metal working 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 1992.⁴ The primary goal of the survey is to monitor the process of structural reforms in Russia after the collapse of the USSR, the rich information enable us to consider implication of education system on the welfare beyond Russia's own experience. Within this concurrent survey data, we use the rounds 8years from 1998 to 2006 for data consistency.

4 Empirical results

4.1 Overview of employer learning

Empirical results of the employer learning effect are shown by random effect models in **Table 1**. For detailed definitions and descriptive statistics, see **Appendix**. Model 1-1 provides a benchmark by regressing hourly wage (w) on age (a), age squared (a^2), the years of general schooling (s_g), the squared years of general schooling (s_g^2), the years of work experience (x), the squared years of work experience (x^2), and the interaction term of schooling and experience (s_gx). Considering potential inflexibility as a heritage from the Soviet period as well as the impact of drastic reform after the collapse of USSR, working for a state-owned enterprise dummy (D_{SE}), working for a foreign-owned enterprise dummy (D_{FE}), and the dummy of entering the labor market after the collapse of the USSR ($D_{PostUSSR}$) are controlled. Gender (D_g) and region (D_{SITE}) are controlled for as well. Then the interaction term of schooling and experience (s_gx) has a significantly negative coefficient. The employer learning effect is observed in the post-Soviet Russian labor market.

4.2 General and vocational graduates

Then model 1-2 adds the years of vocational schooling (s_v), the squared years of vocational schooling (s_v^2), and interaction term of the years of vocational schooling and the years of work experience (s_vx) as regressors. **Prediction 1-a** predicts that term s_gx of model 1-1 has a greater coefficient than term s_gx of model 1-1 has, which is significantly supported. Further, **Prediction 1-b** predicts that in model 1-2 term s_vx has a greater coefficient than s_gx . In model 1-2, term s_vx has a significantly positive coefficient and term s_gx has a significantly

⁴Russia 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 data usage policy is available at <http://www.cpc.unc.edu/projects/rlms-hse>

negative one, which means the effect of complementarity between schooling and work experience dominates the employer learning effect for vocational schooling and our prediction is strongly supported.

Under the Russian education system, year of proceeding from the secondary education to the tertiary education varies depending on workers' choices. Here, both of the years of general schooling (s_g) and the years of vocational schooling (s_v) contains the years of general primary and secondary schooling (s_{ps}). As a robustness check, model 1-3 decomposes the years of general schooling (s_g) into the years of general primary and secondary schooling (s_{ps}) and the years of general tertiary schooling (s_{gt}) and the years of vocational schooling into s_{ps} and the years of vocational tertiary schooling (s_{vt}) such that $s_{ps} + s_{gt} = s_g$ and $s_{ps} + s_{vt} = s_v$. Then, the interaction term between vocational tertiary schooling and work experience ($s_{vt}x$) has a significantly positive coefficient while the interaction term between general tertiary schooling and work experience ($s_{gt}x$) has a significantly negative coefficient, which supports the result of model 1-2.

4.3 Social sustainability of the dual system

We have found that vocational schooling and work experience are complements and that effect dominates signaling effect of schooling. Then a derivative question is whether the dual system of general and vocational schooling is socially stable. In **Table 2**, we regress product of the satisfaction of life and hourly wage ($\log[Hw]$) instead of hourly wage (w) on human capital components and control variables. Then, while the years of general schooling (s_g) has a much larger coefficient than the years of vocational schooling (s_v) has in model 1-2 in **Table 1**, s_v has larger coefficient in model 2-1 in **Table 1**. Although graduates of vocational schools earn lower wages, they have on average a larger satisfaction of life. Model 2-2 gives a hint of the reason. With controlling for foreign-owned enterprise dummy, the impact of vocational schooling (s_v) becomes smaller. In other words, vocational schools bring better satisfaction by providing skills of adjustment in the post-Soviet period. Role of vocational does not decrease in the rapid reform after the collapse of the USSR.

5 Conclusion

Schooling can have a signaling effect, 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 dominates the former in the case of vocational tertiary school graduates while the former effect dominates in the case of general tertiary school graduates using the Russian data set. After the Russian vocational school system dispersed in the Western Europe in the late 19th century and were combined with existent apprenticeship system, Western European countries have remained the dual education system as well. Signalling effect of schooling, which is clearly observed in the US data set, sometime gives mixed results for European data sets. Our results on the Russian labor market suggest a potential complementarity effect between

vocational schooling and work experience in Western Europe, and urge further inquiry on different effects of signaling and different direction of human capital investment in general and vocational schools in Europe.

References

- Altonji, Joseph G. and Charles R. Pierret**, “Learning and statistical discrimination,” *The Quarterly Journal of Economics*, Feb 2001, 116 (1), 313–350.
- Bauer, Thomas K. and John P. Haisken-DeNew**, “Employer learning and the returns to schooling,” *Labour Economics*, May 2001, 8 (2), 161–180.
- Farber, Henry S. and Robert Gibbons**, “Learning and wage dynamics,” *The Quarterly Journal of Economics*, Nov 1996, 111 (4), 1007–1047.
- Gibbons, Robert and Michael Waldman**, “Enriching a theory of wage and promotion dynamics inside firms,” *Journal of Labor Economics*, Jan 2006, 24 (1), 59–107.
- Hansen, W. Lee, Burton A. Weisbrod, and William T. Scanlon**, “Schooling and earnings of low achievers,” *The American Economic Review*, Jun 1970, 60 (3), 409–418.
- Lange, Fabian**, “The speed of employer learning,” *Journal of Labor Economics*, Jan 2007, 25 (1), 1–35.
- Lluis, Stéphanie**, “The role of comparative advantage and learning in wage dynamics and intrafirm mobility: Evidence from Germany,” *Journal of Labor Economics*, Oct 2005, 23 (4), 725–767.
- Mincer, Jacob**, *Schooling, Experience, and Earnings*, New York: National Bureau of Economic Research, 1974.
- Nakabayashi, Masaki**, “Acquired skill and learned ability: Wage dynamics in internal labor markets,” September 2011. ISS Discussion Paper Series, The University of Tokyo, F-153, <http://ideas.repec.org/p/itk/issdps/f153.html>.
- Pinkston, Joshua C.**, “A test of screening discrimination with employer learning,” *Industrial and Labor Relations Review*, Jan 2006, 59 (2), 267–284.
- Pischke, Jörn-Steffen and Till von Wachter**, “Zero returns to compulsory schooling in Germany: Evidence and interpretation,” *The Review of Economics and Statistics*, Aug 2008, 90 (3), 592–598.
- Schönberg, Uta**, “Testing for asymmetric employer learning,” *Journal of Labor Economics*, Oct 2007, 25 (4), 651–691.

Waldman, Michael, “Theory and evidence in internal labor markets,” in Robert Gibbons and John Roberts, eds., *The Handbook of Organizational Economics*, Princeton University Press Princeton, NJ 2013, pp. 520–569.

Wiemann, Günter, “*Lehrgangsausbildung*: A European prototype of a universal industry-based training method,” in The European Centre for the Development of Vocational Training, ed., *Towards a history of vocational education and training (VET) in Europe in a comparative perspective: Proceedings of the first international conference October 2002, Florence, Volume I The rise of national VET systems in a comparative perspective*, Office for Official Publications of the European Communities Luxembourg 2004, pp. 137–157.

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

	1-1		1-2		1-3	
Estimation method	panel extended generalized least squares					
Dependent variable	log(w)					
Cross-section	random effect					
Period (year)	pooled (no year dummy inserted)					
Independent variables	coefficient	t statistic	coefficient	t statistic	coefficient	t statistic
c	-1.7073	-9.6096 ***	-1.9420	-8.6613 ***	-3.7616	-10.0241 ***
a	0.0890	11.0701 ***	0.0810	9.9730 ***	0.1357	26.9429 ***
a^2	-0.0005	-5.8310 ***	-0.0005	-4.9469 ***	-0.0011	-20.3470 ***
s_{ps}					0.4896	6.2044 ***
s_{ps}^2					-0.0233	-5.4865 ***
s_{gt}					0.1336	13.8576 ***
s_{gt}^2					-0.0025	-2.8796 ***
s_{vt}					-0.0558	-4.9089 ***
s_{vt}^2					-0.0010	-0.7030
s_g	0.1207	7.1628 ***	0.1581	6.2619 ***		
s_g^2	-0.0012	-2.1079 **	-0.0015	-1.7760 *		
s_v			0.0654	1.8493 *		
s_v^2			-0.0059	-4.3199 ***		
x	0.0326	0.0000 ***	0.0242	3.8216 ***		
x^2	-0.0008	0.0000 ***	-0.0008	-8.6827 ***		
$s_{ps}x$					-0.0008	-3.8505 ***
$s_{gt}x$					-0.0011	-3.9555 ***
$s_{vt}x$					0.0012	3.0710 ***
s_gx	-0.0006	-3.1032 ***	-0.0014	-5.4716 ***		
s_vx			0.0018	4.6512 ***		
D_g	0.3209	17.6762 ***	0.3211	17.7137 ***	0.3152	17.3478 ***
D_{SE}	-0.3526	-24.7196 ***	-0.3539	-24.8224 ***	-0.3560	-24.9722 ***
D_{FE}	0.2156	7.0451 ***	0.2164	7.0770 ***	0.2182	7.1316 ***
$D_{PostUSSR}$	1.0765	36.1271 ***	1.0769	36.1635 ***	0.9977	35.6155 ***
D_{SITE}	yes		yes		yes	
cross-sections included	8,960		8,959		8,959	
periods included (years)	6 (1998-2006)		6 (1998-2006)		6 (1998-2006)	
included observations	19,728		19,718		19,718	
adjusted R^2	0.1329		0.1363		0.1333	
F statistic	252.8846 ***		208.5095 ***		190.5017 ***	

Source : The Russia Longitudinal Monitoring Survey, RLMS-HSE.

Table 2 Satisfaction of life.

	2-1		2-2	
Estimation method	panel extended generalized least squares			
Dependent variable	log(H_w)			
Cross-section	random effect			
Period (year)	pooled (no year dummy inserted)			
Independent variables	coefficient	t statistic	coefficient	t statistic
c	-0.9817	-5.0998 ***	-0.6917	-3.3566 ***
a	0.1001	13.5390 ***	0.0943	11.7038 ***
a^2	-0.0007	-8.3861 ***	-0.0007	-7.4705 ***
s_g	0.0909	3.7190 ***	0.1039	4.1110 ***
s_g^2	-0.0010	-1.1713	-0.0013	-1.4573
s_v	0.1071	3.1379 ***	0.0962	2.7290 ***
s_v^2	-0.0055	-4.0420 ***	-0.0051	-3.6664 ***
x	0.0198	4.3173 ***	0.0239	4.7865 ***
x^2	-0.0008	-8.5707 ***	-0.0008	-7.9807 ***
D_g	0.2686	16.0663 ***	0.2363	13.4131 ***
D_{SE}			-0.3184	-21.6992 ***
D_{FE}			0.2203	6.9552 ***
$D_{PostUSSR}$	0.9289	33.1958 ***	0.8775	29.0196 ***
D_{SITE}	yes		yes	
cross-sections	9,847		8,945	
periods included	6 (1998-2006)		6 (1998-2006)	
included observations	22,689		19,656	
adjusted R^2	0.1008		0.1167	
F statistic	232.2823 ***		200.8316 ***	

Source : The Russia Longitudinal Monitoring Survey, RLMS-HSE.

Appendix Definition and descriptive statistics of variables

variable	definition	Mean	Median	Maximum	Minimum	Standard deviation	Skewness	Number of observation
w	Current hourly nominal wage. Russian ruble.	582.604	37.037	444,444.444	0.052	3,222.856	60.584	57,003
H	Satisfaction of life in 5-integer scale: From the happiest 5 to least happy 1.	3.265	3.000	5.000	1.000	1.164	-0.120	143,117
a	Age.	43.305	41.583	102.667	13.000	18.681	0.351	144,053
s_{ps}	Years of primary and secondary schooling.	9.051	10.000	12.000	0.000	1.927	-1.839	143,788
s_{gt}	Years of general tertiary schooling (college level or higher).	2.500	2.000	24.000	0.000	0.000	2.462	134,912
s_g	Years of general schooling, which includes primary and secondary schooling:	11.563	12.000	34.000	0.000	3.530	-0.324	135,160
s_{vt}	Years of vocational and professional tertiary	1.396	1.000	24.000	0.000	1.596	0.867	134,912
s_v	Years of vocational schooling, which includes primary and secondary	10.479	11.000	34.000	0.000	2.568	-1.073	134,912
x	Years of work experience.	21.097	21.000	75.000	0.000	15.609	0.126	69,279
D_g	Gender dummy: =1 if male, 0 if female.							
D_{SE}	Dummy variable of currently working for a state-owned enterprise: =1 if the questionee works for a state-owned firm.							
D_{FE}	Dummy variable of currently working for a foreign-owned enterprise: =1 if the questionee works for a foreign-owned firm.							
$D_{PostUSSR}$	Dummy variable of joining the labor market after the collapse of the USSR: =1 if the questionee joined the labor market in or after 1998, 0 otherwise.							
D_{SITE}	Region dummy.							

Source : The Russia Longitudinal Monitoring Survey, RLMS-HSE.