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Area Development and Policy

ISSN: 2379-2949 (Print) 2379-2957 (Online) Journal homepage: http://www.tandfonline.com/loi/rard20

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To cite this article: Sergey M. Kadochnikov & Anna A. Fedyunina (2018): High-skilled interregional migration and high-growth firms in Russia, Area Development and Policy, DOI: 10.1080/23792949.2018.1446345

To link to this article: https://doi.org/10.1080/23792949.2018.1446345

Published online: 02 Apr 2018.

AREA DEVELOPMENT AND POLICY
2018, VOL. 00, NO. 00
https://doi.org/10.1080/23792949.2018.1446345

Routledge
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Regional Studies Association

RESEARCH ARTICLE

High-skilled interregional migration and high-growth firms in Russia

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ABSTRACT

This study identifies a non-linear and 'U'-shaped relationship between interregional human capital mobility, measured using a data set on the mobility of university graduates from the top-100 Russian universities, and the presence high-growth firms (HGFs) in Russian regions. The initial rise in the number of HGFs is due to the relatively low concentration of highly skilled migrants and the confinement of innovation to a small number of firms. When the number of high-skilled migrants increases and a larger number of firms innovate, the competition effect strengthens which, in turn, leads to the decrease in a number of HGFs.

ARTICLE HISTORY

Received 26 June 2017; Accepted 24 February 2018

KEYWORDS

high-growth firms, high-skilled migration, university graduates, Russian regions

JEL

D22, R23

摘要

俄罗斯高技术人才的区域间迁移与高增长企业研究. *Area Development and Policy*. 本研究通过使用一组俄罗斯排名前100的大学的毕业生流动数据，计算得出了俄罗斯区域间人力资本流动与高增长企业（HGFs）存在和发展之间的非线性U型关系。HGFs最初的数量增长是由于高技术移民的集中性相对较低，而且从事创新活动的企业数量较少。当高技术移民的数量增多，并且大量的公司开始创新，竞争变得激烈，这反过来又造成了高增长企业数量的减少。]

关键词

高增长企业, 高技术人才迁移, 大学毕业生, 俄罗斯地区

RESUMEN

Migración interregional altamente cualificada y empresas de alto crecimiento en Rusia. *Area Development and Policy*. En este estudio se identifica una relación no lineal y en forma de U entre la movilidad interregional de capital humano, medida utilizando un grupo de datos sobre la movilidad de licenciados universitarios de las 100 universidades rusas más importantes, y la presencia de empresas de rápido

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crecimiento en las regiones rusas. El auge inicial en el número de empresas de rápido crecimiento se debe a la concentración relativamente baja de migrantes altamente cualificados y el confinamiento de innovación en un pequeño número de empresas. Cuando crece el número de migrantes altamente cualificados y hay innovación en un gran número de empresas, el efecto de competencia se refuerza ocasionando a la vez una disminución del número de empresas de rápido crecimiento.

PALABRAS CLAVE
empresas de alto crecimiento, migración altamente cualificada, licenciados universitarios, regiones rusas

АННОТАЦИЯ
Высококвалифицированная межрегиональная миграция и быстрорастущие фирмы в России. *Area Development and Policy*. В данном исследовании выявлена нелинейная и U-образная связь между межрегиональной мобильностью человеческого капитала, измеренная с помощью набора данных о мобильности выпускников вузов из топ-100 российских вузов, и наличием быстрорастущих компаний (БРК) в российских регионах. Первоначальный рост числа БРК обусловлен относительно низкой концентрацией высококвалифицированных мигрантов и сосредоточением инновационной деятельности в небольшом числе фирм. Когда растет число высококвалифицированных мигрантов и все большее число фирм внедряют новшества, усиливается эффект конкуренции, что, в свою очередь, приводит к сокращению числа БРК.

КЛЮЧЕВЫЕ СЛОВА
быстрорастущие фирмы, высококвалифицированная миграция, выпускники вузов, регионы России

INTRODUCTION

High-growth firms (HGFs, sometimes called gazelles) attract the interest of academics and policy-makers since they generate positive spillovers for the whole economy and higher economic growth rates. A small number of HGFs accounts for a disproportionately large amount of job creation (Coad, Daunfeldt, Holzl, Johansson, & Nightingale, 2014), while the average firm has a limited economic impact. Moreover, the existence of HGFs provides for further path-dependent economic growth (Bos & Stam, 2013).

Although there is a possibility that HGFs will decrease their local or regional involvement and move overseas, looking for bigger markets and greater efficiency, most will mature into medium-sized enterprises with a strong involvement in the regional economy (Li, Goetz, Partridge, & Fleming, 2015). This result establishes a relationship between the future prosperity of a region and the success of its most dynamic firms or firms with relatively high entrepreneurial potential.

This research starts from the idea that high-skilled migrant-driven knowledge diffusion increases the aggregate productivity of a host region from industry structure and export composition perspectives (Andersen & Dalgaard, 2011; Bahar et al., 2014; Kerr, 2008Limonov, Nesena, 2016). Thus, if migrant-related knowledge diffusion can increase aggregate productivity and induce local sectoral economic shifts, higher numbers of high-skilled migrants in an area should be associated with higher entrepreneurial activity, higher numbers of HGFs and an increase in productivity or changes in industry structure and resource reallocation.

Although human capital is a critical factor for HGFs, the empirical evidence on this topic is very scarce. In one of the earliest papers, Hatch and Dyer (2004) found that investments in firm-specific human capital had a significant impact on learning and firm performance. They showed that human capital selection (education requirements and screening), development through training and deployment significantly improved learning-by-doing, which in turn improved performance. Lopez-Garcia and Fuente's (2012) study of Spanish firms between 1996 and 2003 found that better access to human capital was a key to increases in the number and growth of gazelles. In a similar vein, Arrighetti and Lasagni's (2013) study of Italian firms in 1998–2003 found that the quality of human capital was a strong feature of firms experiencing rapid employment growth: firms with a higher human capital index (measured by the ratio of 'white collar' to 'blue collar' workers, the percentage of employees engaged in research and development (R&D) activity, and the percentage of employees holding a university degree) and that were younger were more likely to be HGFs.

There are few studies of the determinants of HGFs in the Russian economy. Empirical papers on this subject are mostly descriptive in character and use case study methods. In particular, a number of studies argued that the presence of HGFs was explained by agglomeration effects and the number of HGFs in a region increased during periods of improvement in the economic and business climate (Vinkov, 2012; Vinkov & Polunin, 2011). Other papers provided evidence for a rise in the number of gazelles in regions that hosted nationwide projects such as the Sochi Winter Olympic Games (2014) (Barsukova, Kot, & Procenko, 2015; Zhoga, 2014).

The authors found only one study on the role of human capital and innovativeness across regions in determining the concentration of HGFs. In it, Zemtsov et al. (2015) found that human capital and research activity explained regional variations in HGFs in manufacturing industries in 2008–12. The authors proxied the level of human capital across regions by the average number of years of education of employees and regional research activity by the share of the employed population in R&D and patent activity. Note that the number of years of education of employees might vary little at the regional level within a country and by much less than between different countries. Thus, these results should be checked for robustness.

It should also be noted that the data on human capital across Russian regions are rather poor. The Federal State Statistics Service of the Russian Federation provides a number of standard indicators for the levels of education and number of students at different levels of education across regions. However, most of these indicators are significantly correlated with agglomeration economies and vary little across regions. This fact, in particular, explains why there are few studies on the regional effects of human capital and human capital migration in Russia. Most papers on human capital migration in Russia concentrate on the role of interregional migration in regional convergence. For example, Guriev and Vakulenko (2015) employed panel data for gross region-to-region migration flows in Russia in 1995–2010 and showed that lowering barriers to labour mobility resulted in convergence in wages and incomes followed by a reduction in labour mobility itself. They showed that this reduction was a result of lower interregional differences and, therefore, lower incentives to migrate. These results were in line with those of a number of previous studies on the effects of interregional migration on regional wages in Russia (Andrienko & Guriev, 2004; Gerber, 2006). To the best of our knowledge, no papers have estimated the effects of high-skilled interregional migration in Russia. On the one hand, there is lack of data and, on the other, most studies focus on poverty traps rather than on regional innovative and growth potential.

This paper presents pioneering empirical evidence on the effects of interregional human capital mobility and high-skilled migration on the number of HGFs in the Russian economy. More specifically, the research first finds a proxy for interregional high-skilled mobility across

Russian regions. This proxy comes from data on the mobility of university graduates from the top-100 Russian universities. A measure of the lagged inflow of university graduates (namely, high-skilled migrants) from other regions is considered to reflect the concentration of professional skills and the demand for innovations. Indeed, since migration is usually costly for people, they change their home region (or region of study) only if there are prospective benefits. This approach generates pioneering results relating to the effects of high-skilled interregional mobility in Russia.

Second, a distinction is made between technical and non-technical degrees of university graduates and the occurrence of HGFs in three sectors (manufacturing; wholesale and retail; andfinance and real estate) is calculated. These steps generate more accurate estimates of the impact of interregional human capital mobility on the presence of HGFs at a sectoral level. Indeed, university graduates with technical and non-technical degrees might be attracted to different sectors of a regional economy. These sectors, in turn, might be associated with differences in firm performance and, thus, different potential sectoral shifts and births of HGFs.

The paper is structured as follows. The next section describes the data and empirical research strategy. The third section outlines and discusses the main results. The fourth section concludes.

DATA, EMPIRICAL VARIABLES AND ECONOMETRIC MODEL

In order to explore the link between HGFs and high-skilled migration in Russian regions, a data set was compiled covering regional measures of the number of HGFs and socioeconomic variables.

The data on high-growth Russian firms were drawn from the Ruslana database provided by the Bureau van Dijk https://ruslana.bvdep.com/. This database provides information on the company name, legal status, industry and revenue for the period 2010–14. In accordance with the Organisation for Economic Co-operation and Development's (OECD) definition, a firm was designated a HGF if it had an average growth rate of 20% for three years. To exclude the smallest firms that might show high growth rates because of low initial values, firms were required to have a revenue base of at least 10 million rubles and to exceed 300 million rubles in 2014 (about US$10,000). According to the data, the number of HGFs in 2011–14 was 5849. This figure was highly correlated with the respective number for 2010–13. The correlation coefficient between two rows of HGFs in the two periods was 0.9992. The industrial distribution of HGFs is depicted in Figure 1. A similar structure has been found in other recent studies (e.g., Barinova, Sorokina, & Shestoperov, 2016; Vinkov & Polunin, 2011). A total of 25.6% of all HGFs were in the wholesale and retail sectors. This group was the largest because this sector was one of the fastest growing sectors in Russia during the period 2010–14. Growth of HGFs in manufacturing (22% of all HGFs) was mainly producers of building materials (from concrete, gypsum and cement) and metal structures and products for the construction industry, which experienced a phase of active growth in 2010–13 and was itself the third largest sector for HGFs. Again, these results are similar to those of Barinova et al. (2016) and Vinkov and Polunin (2011).

In this study, the main independent variable was high-skilled migration proxied by the number of graduates from the top-100 Russian universities and higher education institutions. The research used the earliest available data from the monitoring of the quality of enrolment in Russian universities in 2013 that recorded the mobility of students who graduated in 2012 and were employed within nine months of graduation. For each university or higher education institution on the list, data on the geographical distribution of employment of its graduates and the number of employed graduates in each region were obtained. University-level data

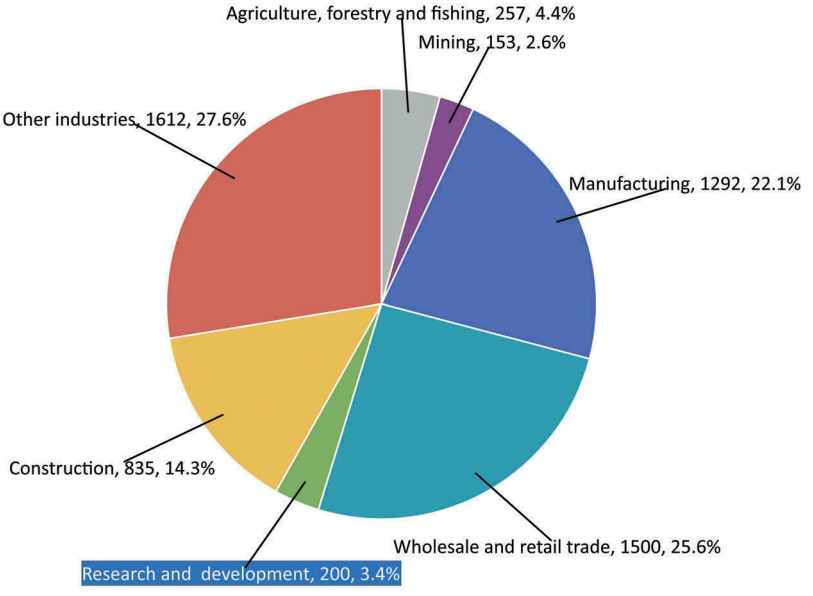

Figure 1. Distribution of high-growth firms (HGFs) by industry in 2011–14, in numbers and as a percentage of a total.

were aggregated up to the regional level and the total number of students from top-100 universities and higher education institutions who had graduated from each Russian region and were employed in other regions was calculated.

Based on the structure of the migration data, three different measures of migration were used:

- MI_i^{TD}: number of graduates holding technical degrees who migrated to and were employed in region i.
- MI_i^{NTD}: number of graduates holding non-technical degrees who migrated to and were employed in region i.
- $MI_i^{TD\ NTD}$: total number of graduates holding technical and non-technical degrees in region i.

A difference was expected between the potential effects of graduate migration between graduates with technical and non-technical degrees. A distinction was therefore made between two types of university and higher education institution and, correspondingly, two types of graduate migration flow. The first group of graduates with technical degrees comprised those from technical, agriculture and architecture universities and higher education institutions. The second group comprised students who graduated from classics, education, humanities and socioeconomic universities and higher education institutions.

Taking into account the cross-sectional nature of the data, the following empirical model was estimated:

$$HGF_i = \alpha + \beta MI_i + X'\gamma + \varepsilon_i \quad (1)$$

where HGF_i is a number of HGFs in region i in the period 2011–14; MI_i *is* a measure of high-skilled migration; X denotes a set of regional control variables; and ε is an error term. To

Table 1. Descriptive statistics of dependent and explanatory variables.

Variable	Observations	Mean	SD	Minimum	Maximum
Number of high-growth firms per 100 people	73	0.2986	0.1550	0	0.9237
Number of high-growth firms in wholesale and retail per 100 people	73	0.0883	0.0584	0	0.2483
Number of high-growth firms in manufacturing per 100 people	73	0.0800	0.0535	0	0.2103
Number of high-growth firms in finance and real estate per 100 people	73	0.0227	0.0352	0	0.2326
Incoming tech-degree migrants per 100 people	73	1.3003	1.7066	0	7.9276
Incoming non-tech-degree migrants per 100 people	73	3.0849	4.0386	0.3247	24.3312
Incoming tech- and non-tech-degree migrants per 100 people	73	4.3852	5.2691	0.4040	28.3174
GRP growth, 2002–10	73	4.3849	1.0657	3.1161	11.3730
Population growth, 2002–10	73	0.9627	0.0552	0.8579	1.1556

Note: Gross regional product (GRP); SD, standard deviation.

account for the different sizes of regions and, thus, for agglomeration effects, the dependent and migration variables were calculated per 100 people. The same regression was estimated for 2010–13 except that it was assumed that in this case an endogeneity problem caused by the contemporaneity of the migration and HGF data might arise. To avoid it, in the final specification with cross-section data the number of HGFs in the period 2011–14 and migration data for 2013 were used.

To control for the size of regional economy and its growth potential, the gross regional product per capita growth rate for 2002–13 was used (see also Gerasimova & Dunford, 2017). The population growth rate was an additional control variable representing regional growth prospects and regional attractiveness for migration. To control for the uneven distribution of firms and, in particular, HGFs across Russian regions, a set of dummy variables for Russia's federal districts was introduced. In addition, Moscow, the Moscow region and St Petersburg were excluded, since these agglomerations generate specific agglomeration effects that cannot be explained by this model and, even after transformation by dividing by population, remain as outliers.

The descriptive statistics and variable descriptions are presented in Table 1 and Table A1 in the supplemental data online. Table 2 records the correlations between key variables.

Figures 2 and 3 plot the number of HGFs and migrated high-skilled technical and non-technical degree students across Russian regions. There is a seemingly positive correlation between the number of HGFs and high-skilled migration. However, it is obvious that agglomeration economies explain simultaneously higher numbers of HGFs and university graduates in the same regions. Thus, in Figure 4 the same indicators are plotted with both measured per 100 population.

Even after correcting for the regional population, there are still agglomeration effects that allow regions to host higher numbers of HGFs and simultaneously attract more high-skilled

Table 2. Correlation matrix.

	Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	Number of high-growth firms	1								
(2)	Number of high-growth firms in wholesale and retail per 100 people	0.696*	1							
(3)	Number of high-growth firms in manufacturing per 100 people	0.513*	0.449*	1						
(4)	Number of high-growth firms in finance and real estate per 100 people	0.528*	0.099	–0.051	1					
(5)	Incoming tech-degree graduates per 100 people	0.249*	0.020	0.075	0.349*	1				
(6)	Incoming non-tech-degree graduates per 100 people	0.367*	0.136	0.246*	0.107	0.619*	1			
(7)	Incoming tech- and non-tech-degree graduates per 100 people	0.362*	0.112	0.213	0.195	0.799*	0.967*	1		
(8)	GRP growth, 2002–10	0.297*	0.007	–0.13	0.578*	0.092	–0.087	–0.038	1	
(9)	Population growth, 2002–10	–0.099	–0.113	–0.209	0.086	0.149	0.055	0.091	0.0001	1

Notes: Gross regional product (GRP).
*Correlation significant at the 5% level.

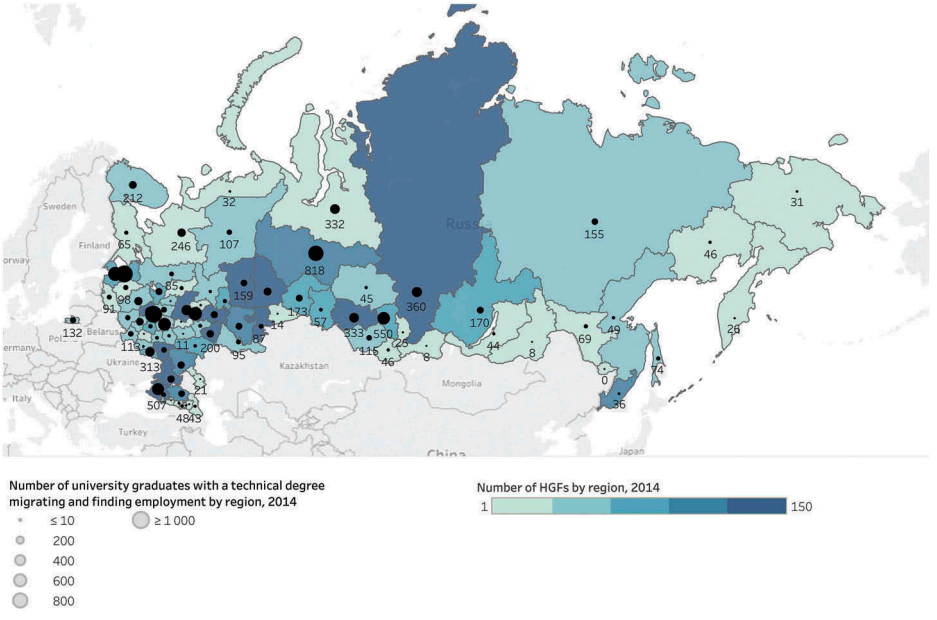

Figure 2. Numbers of high-growth firms (HGFs) and university graduates with a technical degree migrating and finding employment by region, 2014.

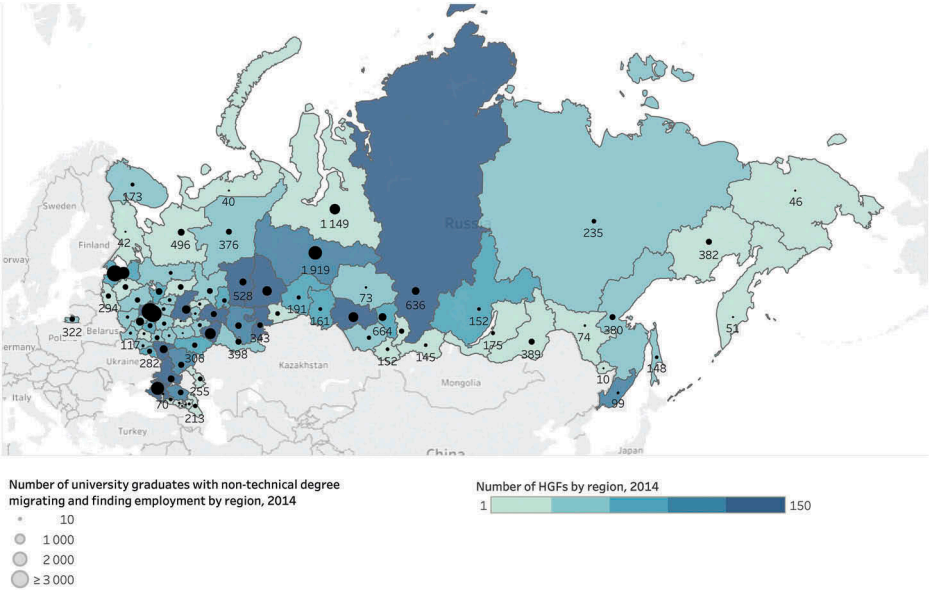

Figure 3. Numbers of high-growth firms (HGFs) and university graduates with a non-technical degree migrating and finding employment, by region, 2014.

people. Thus, the independent variables representing high-skilled migration may be potentially endogenous. In this situation life expectancy at birth may serve as good instrument for the following reasons. First, life expectancy explains regional attractiveness for high-skilled

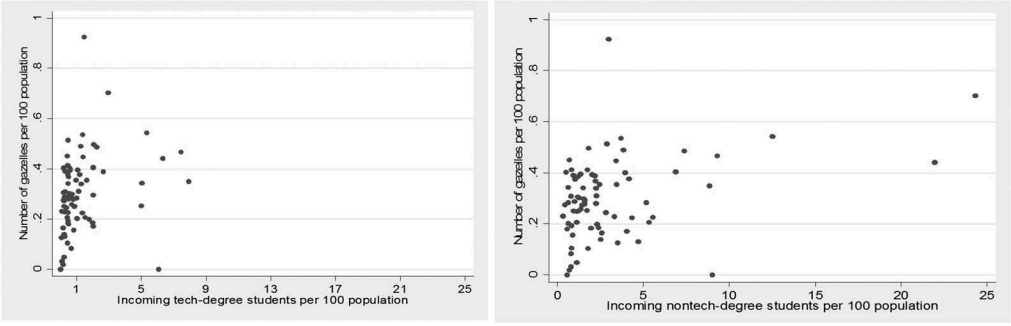

Figure 4. Number of high-growth firms (HGFs) and incoming technical (left) and non-technical (right) degree students per 100 people across Russian regions, 2014.

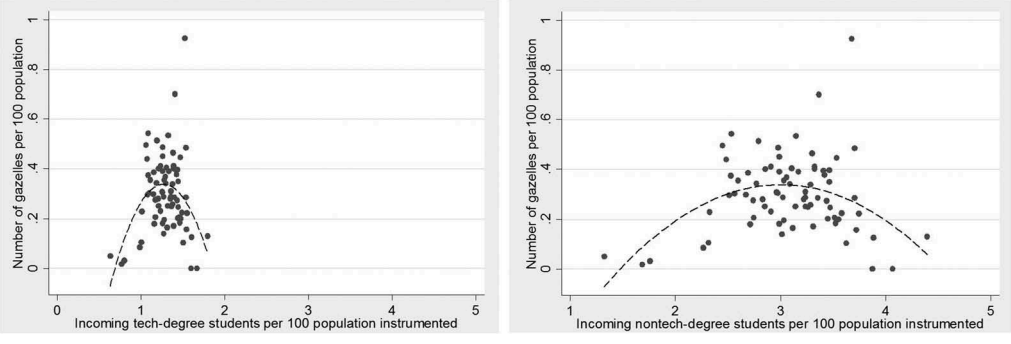

Figure 5. Number of high-growth firms (HGFs) and incoming instrumented technical degree (left) and non-technical degree (right) students per 100 people across Russian regions, 2014.

people, since high-skilled migration is driven by perceived differences in the quality of life. Second, life expectancy is not correlated with the activities of firms because HGFs may locate in areas with high concentrations of firms that have a negative environmental impact and adversely affect the quality of life. This is, in particular, the case in the Primorsk Krai and Arkhangelsk regions, which have HGFs in traditional ship and boat-building industries and also have rather low life expectancies because of relatively low standards of living and an inclement climate. Other examples are regions in the Urals (the Sverdlovsk and Chelyabinsk regions). These large industrial areas have a large number of factories that pollute the air and water with negative effects on life expectancy.

Figure 5 plots the same correlation between HGFs and high-skilled migration, but migration flows now are instrumented by regional life expectancy at birth. In this case there is a different 'U'-shaped non-linear relationship between the number of HGFs and high-skilled migration. To check this relationship empirically, a squared term was included in the specification of the model, as follows:

$$HGF_i = \alpha + \beta MI_i + \delta MI_i^2 + X'\gamma + \varepsilon_i \quad (2)$$

where HGF_i is the number of HGFs in region i in the period 2011–14; MI_i *is* a measure of high-skilled migration; X is a set of regional control variables including GRP and population growth in 2002–10; and ε denotes an error term. Equation (2) was estimated using ordinary

least squares (OLS) and two-stage least squares (2SLS) instrumental variables (IV), where MI_i is instrumented by life expectancy at birth.

RESULTS

Table 3 presents the econometric results for the determinants of HGFs across Russian regions. Columns (1)–(3) record the OLS estimation results with non-instrumented migration data; columns (4)–(6) set out the 2SLS estimation results, where migration flows are instrumented by average life expectancy at birth across Russian regions. As anticipated, high-skilled migration measured by migration of top-100 university graduates has an inverted 'U'-shaped effect on the number of HGFs across Russian regions. The coefficients for migration and its squared term are significant at the 1% level for regressions with data for technical, non-technical, and technical and non-technical degree students.

The relationship between high-skilled migration and HGFs might differ by industry. Indeed, Kerr, Kerr, Özden, and Parsons (2017) mention that the geographical concentration and agglomeration of high-skilled migrants varies by occupation and sector. These variations can reflect responses of migration to local shortfalls in particular skills or migrants concentrating in occupations and industries that benefit from agglomeration or diaspora networks. Innovation areas in the United States (such as Silicon Valley, Boston or Seattle) tend, for example, to have higher levels of immigrant concentration in science and engineering professions compared with other areas. In a similar manner, the concentration of skills in industries may affect both the attraction of high-skilled workers and the creation of high-growth skills.

In this research, tests for the role of industrial structure in the attraction of high-skilled migrants and creation of HGFs were undertaken by distinguishing three groups of industries: manufacturing, wholesale and retail, and finance and real estate. On the one hand, more detailed industry classifications may produce more accurate estimations. In particular, manufacturing industries may require different proportions of technical and non-technical specialists and, more generally, different combinations of higher- and ordinary-degree specialists. On the other hand, manufacturing industries obviously require a higher proportion of technical-degree high-skilled specialists than the wholesale and retail and financial service sectors. Therefore, if there are different effects at a high level of aggregation, areas for further work will be opened up.

Table 4 records the econometric results for industry-specific estimates. Again, the results indicate that the mobility of both technical and non-technical high-skilled graduates has positive and statistically significant effects. At the sectoral level, the largest coefficients are for wholesale and retail. This effect holds for all three migration variables. In other words, the number of HGFs is more closely related to the number of high-skilled migrants to the region in the wholesale and retail sector. This result holds for both technical and non-technical degree students.

In general, the revealed inverted 'U'-shaped relationship between high-skilled migration and the number of HGFs at the regional level seems counterintuitive. Obviously, as stated above, larger markets attract more high-skilled people, offer more workplaces, provide more market niches and allow some firms to grow quickly. However, if controls are introduced for the size of the market, by adjusting variables for the size of the population, and for possible endogeneity problems, the relationship between high-skilled migration and HGFs is non-linear. This type of relationship may indicate a pro-competitive effect where a high number of HGFs in a region is possible only if there is a moderate concentration of high-skilled people. When the concentration of high-skilled people in a region is low, only a small number of firms can innovate, even though these firms may grow faster after the introduction of such innovations. Conversely, when there is a high concentration of high-skilled people in a region, a

Table 3. High-growth firms (HGFs) and high-skilled mobility: ordinary least squares (OLS) and two-stage least squares (2SLS) cross-section results.

	OLS (1)	OLS (2)	OLS (3)	2SLS (4)	2SLS (5)	2SLS (6)
Incoming TD per 100 people	0.1055***			0.1033***		
	(0.0182)			(0.0184)		
Incoming TD per 100 people squared	–0.01742***			–0.01702***		
	(0.0031)			(0.0031)		
Incoming NTD per 100 people		0.3098***			0.3032***	
		(0.0536)			(0.0539)	
Incoming NTD per 100 people squared		–0.1212***			–0.1183***	
		(0.0215)			(0.0216)	
Incoming TD and NTD per 100 people			0.07886***			0.07721***
			(0.0136)			(0.0137)
Incoming TD and NTD per 100 people squared			–0.00916***			–0.00895***
			(0.0016)			(0.0016)
GRP growth, 2002–10	0.00636**	0.00636**	0.00636**	0.00637**	0.00637**	0.00637**
	(0.0023)	(0.0023)	(0.0023)	(0.0023)	(0.0023)	(0.0023)
Population growth, 2002–10	–0.01169	–0.01169	–0.01169	–0.00819	–0.00819	–0.00819
	(0.0403)	(0.0403)	(0.0403)	(0.0459)	(0.0459)	(0.0459)

(*Continued*)

Table3. (Continued).

	OLS (1)	OLS (2)	OLS (3)	2SLS (4)	2SLS (5)	2SLS (6)
Constant	–0.1423*	–0.1807**	–0.1525*	–0.1429*	–0.1805**	–0.1529*
	(0.0574)	(0.0619)	(0.0585)	(0.0606)	(0.0647)	(0.0616)
Macro-regional fixed effects	No	No	No	Yes	Yes	Yes
R^2 adjusted	0.3248	0.3248	0.3248	0.3104	0.3679	0.3104
AIC	–428.7	–428.7	–428.7	–429.3	–429.3	–429.3
BIC	–417.2	–417.2	–417.2	–417.9	–417.9	–417.9

Notes: AIC, Akaike information criterion; BIC, Bayesian information criterion; Gross regional product (GRP); NTD, non-technical degree holders; TD, technical degree holders. Incoming TD, NTD and TD/NTD graduates are instrumented by average life expectancy at birth. Values are robust standard errors.
Significance levels: ***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

Table 4. High-growth firms (HGFs) and high-skilled mobility: two-stage least squares (2SLS) cross-sectional results by sector.

	Manufacturing	Wholesale and retail	Finance and real estate	Manufacturing	Wholesale and retail	Finance and real estate	Manufacturing	Wholesale and retail	Finance and real estate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Incoming TD per 100 people	0.0228***	0.0342***	0.0109**						
	(0.0046)	(0.0063)	(0.0033)						
Incoming TD per 100 people squared	–0.0040***	–0.0058***	–0.0018***						
	(0.0009)	(0.0010)	(0.0005)						
Incoming NTD per 100 people				0.0673 ***	0.1007 ***	0.0320 **			
				(0.0137)	(0.0185)	(0.0096)			
Incoming NTD per 100 people squared				–0.0278 ***	–0.0405 ***	–0.0126 ***			
				(0.0059)	(0.0071)	(0.0036)			
Incoming TD and NTD per 100 people							0.0171 ***	0.0772 ***	0.0082 **
							(0.0035)	(0.0137)	(0.0025)
Incoming TD and NTD per 100 people squared							–0.0021 ***	–0.0090 ***	–0.001 ***
							(0.0005)	(0.0016)	(0.0003)
GRP growth, 2002–10	–0.0001	0.0007	0.0016 **	–0.0001	0.0007	0.0016 **	–0.0001	0.0064 **	0.0016 **
	(0.0004)	(0.0005)	(0.0005)	(0.0004)	(0.0005)	(0.0005)	(0.0004)	(0.0023)	(0.0005)

(*Continued*)

Table4. (Continued).

	Manufacturing	Wholesale and retail	Finance and real estate	Manufacturing	Wholesale and retail	Finance and real estate	Manufacturing	Wholesale and retail	Finance and real estate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Population growth, 2002–10	–0.0079	0.0034	–0.0015	–0.0079	0.0034	–0.0015	–0.0079	–0.0082	–0.0015
	(0.0139)	(0.0144)	(0.0048)	(0.0139)	(0.0144)	(0.0048)	(0.0139)	(0.0459)	(0.0048)
Constant	–0.0153	–0.0459 *	–0.0197 *	–0.0236	–0.0584**	–0.0236 *	–0.0175	–0.1529 *	–0.0207 *
	(0.0165)	(0.0197)	(0.0083)	(0.0173)	(0.0213)	(0.0093)	(0.0167)	(0.0616)	(0.0086)
Macro-regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 adjusted	0.295	0.1791	0.394	0.295	0.1791	0.394	0.295	0.3104	0.394
AIC	–587.4	–557.5	–696.1	–587.4	–557.5	–696.1	–587.4	–429.3	–696.1
BIC	–576	–546	–684.7	–576	–546	–684.7	–576	–417.9	–684.7

Note: AIC, Akaike information criterion; BIC, Bayesian information criterion; GRP; NTD, non-technical degree holders; TD, technical degree holders. Values are robust standard errors. Incoming TD, NTD and TD/NTD graduates instrumented by average life expectancy at birth.
Significance level: ***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

larger number of firms can innovate, increasing competition and allowing a larger number of firms to acquire the status of an HGF. However, when the concentration of high-skilled people continues to increase and a larger number of firms innovate, the competition effect strengthens which, in turn, leads to the decrease in a number of HGFs.

The inverted 'U'-shaped relationship identified in this research reflects the competition–innovation relationship proposed by Aghion, Bloom, Blundell, Griffith, and Howitt (2005). According to these authors, competition may increase the incremental profits from innovation (the 'escape–competition effect'), but reduce innovation incentives for laggards (the 'Schumpeterian effect'). The balance between these two effects changes between situations in which competition is low and high, generating an inverted 'U'-shaped relationship.

CONCLUSIONS

This paper reports a first attempt to estimate the relationship between interregional human capital mobility and the presence of HGFs. Most recent empirical studies of interregional labour migration concentrate on the effects of migration on regional convergence. Empirical studies of HGFs in Russia are descriptive, and only one paper reports the use of econometric methods to estimate the impact of human capital on HGFs using the average number of years of education as an independent variable (Zemtsov et.al., 2015). This variable is in the view of the authors inappropriate as it has low variance across regions and does not measure the availability of high skills and the entrepreneurial potential of a region.

In this paper, data on the mobility of university graduates were used as a measure of interregional human capital migration and to explain the number of HGFs in Russian regions. The empirical results confirm the existence of an inverted 'U'-shaped relationship between the inflows of university graduates and the number of HGFs at the regional level.

These empirical results contribute to the literature dealing with the locational determinants of HGFs and interregional human capital mobility in that they, first, explore the graduate employment pattern and, second, relate regional human capital mobility to the distribution of HGFs. The results suggest that the inflow of graduates from top-100 Russian universities with both technical and non-technical degrees is a good predictor of the number of HGFs in a region. The initial rise in the number of HGFs is due to the relatively low concentration of high-skilled migrants and the confinement of innovation to only a small number of firms. When the number of high-skilled migrants increases and a larger number of firms innovate, the competition effect strengthens leading, in turn, to a decrease in the number of HGFs.

From a policy perspective, these results confirm the need for a more complex approach to stimulating the innovativeness of Russian companies. This approach should include not only stronger support for R&D at the firm level but also the stronger encouragement of inter-regional migration of high-skilled people. Based on these results and with regard to the perspectives of less developed territories, policy-makers should not overlook the potential of HGFs in Russian regions with low market and growth potential. In order to exploit such opportunities better, more incentives for the migration of a young high-skilled population to less developed regions and for the encouragement of entrepreneurship potential are required.

The nature of the data places some limits on this research. The authors intend to extend the analysis in two directions. The first is to examine more carefully the industry-specific HGF effects of graduate student mobility, and to control more precisely for regional economic, innovation, living and institutional conditions, checking for other instruments for high-skilled mobility. The second extension is to use higher lags for migration flows and to control for 'zero' observations in both the migration and HGF data. This extension will help account for time and spatial effects. These initial results nonetheless remain important and have policy implications for Russian regions and, in particular, for less developed territories.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

FUNDING

The paper was prepared within the framework of the Basic Research Programme at the National Research University Higher School of Economics (HSE) and supported within the framework of a subsidy granted to the HSE by the Government of the Russian Federation for the implementation of the Global Competitiveness Programme.

SUPPLEMENTAL DATA

Supplemental data for this article can be accessed at https://doi.org/10.1080/23792949.2018.1446345

REFERENCES

Aghion, P., Bloom, N., Blundell, R., Griffith, R., & Howitt, P. (2005). Competition and innovation: An inverted-U relationship. *Quarterly Journal of Economics*, *120*(2), 701–728.

Andersen, T. B, & Dalgaard, C-J. (2011). Flows of people, flows of ideas, and the inequality ofnations. *Journal Of Economic Growth*, *16*(1), 1-32. doi:10.1007/s10887-011-9060-7

Andrienko, Y., & Guriev, S. (2004). Determinants of interregional mobility in Russia. Evidence from panel data. *Economics of Transition*, *12*(1), 1–27.

Arrighetti, A., & Lasagni, A. (2013). Assessing the determinants of high-growth manufacturing firms in Italy. *International Journal of the Economics of Business*, *20*(2), 245–267.

Bahar, D, Hausmann, R, & Hidalgo, C. A. (2014). Neighbors and the evolution of the comparative advantage of nations: evidence of international knowledge diffusion?. *Journal Of International Economics*, *92*(1), 111–123. doi:10.1016/j.jinteco.2013.11.001

Barinova, V., Sorokina, A., & Shestoperov, A. (2016). *New insights in the SMEs' support in Russia: 'Gazelles'*. Moscow: Mimeo. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2731671

Barsukova, A., Kot, B., & Procenko, N. (2015). Yuzhnyie «gazeli» zapravilis goryuchim. *Expert Yug*, *21, 18-20*. (in Russian).

Bos, J. W., & Stam, E. (2013). *Gazelles and industry growth: A study of young High- Growth Firms in The Netherlands*. Industrial and Corporate Change,23(1), pp.145-169.

Coad, A., Daunfeldt, S.-O., Holzl, W., Johansson, D., & Nightingale, P. (2014). High-growth firms: Introduction to the special section. *Industrial and Corporate Change*, *23*(1), 91–112.

Gerasimova, I., & Dunford, M. (2017). Russian regional evolutions: Comparative gross regional product dynamics of the subjects of the Russian Federation, 1995–2013. *Area Development and Policy*, 1–28. doi:10.1080/23792949.2017.1359638

Gerber, T. (2006). Regional economic performance and net migration rates in Russia, 1993–2002. *International Migration Review*, *40*(3), 661–697.

Guriev, S., & Vakulenko, E. (2015). Breaking out of poverty traps: Internal migration and interregional convergence in Russia. *Journal of Comparative Economics*, *43*(3), 633–649.

Hatch, N. W., & Dyer, J. H. (2004). Human capital and learning as a source of sustainable competitive advantage. *Strategic Management Journal*, *25*(12), 1155–1178.

Kerr, S. P., Kerr, W., Özden, Ç., & Parsons, C. (2017). High-skilled migration and agglomeration. *Annual Review of Economics*, *9*, 201–234.

Kerr, W.R. (2008). Ethnic scientific communities and international technology diffusion. *Review Of Economics And Statistics*, *90*, 518–537. doi:10.1162/rest.90.3.518

Li, M., Goetz, S. J., Partridge, M., & Fleming, D. A. (2015). Location determinants of HGFs. *Entrepreneurship & Regional Development*, *28*(1-2), 97-125.

Limonov, L., & Nesena, M. (2016). Regional cultural diversity in Russia: Does it matter for regional economic performance? *Area Development and Policy*, *1*(1), 63–93.

Lopez-Garcia, P., & Puente, S. (2012). What makes a high-growth firm? A dynamic probit analysis using Spanish firm-level data. *Small Business Economics*, *39*(4), 1029–1041.

Vinkov, A. (2012). Oni ne begayut, oni letayut [They don't run, they fly]. *Expert [Expert]*, *21*, 44–48. (in Russian).

Vinkov, A., & Polunin, Y. (2011). Ermaki i Edisonyi [Yermaks and Edisons]. *Expert [Expert]*, *20*, 19–43. (in Russian).

Zemstov, S., Barinova, V., & Sorokina, A. (2015). What factors influence on the concentration of quick-growing companies in the Russian regions? *Russian Journal of Entrepreneurship*, *16*(22), 3959–3972; (in Russian).

Zhoga, G. (2014). Tabun-prizrak [Herd is a ghost]. *Expert Ural [Expert Ural]*, *26, 13-14*. (in Russian).