Journal of Comparative Economics 52 (2024) 271–296

Contents lists available at ScienceDirect

Journal of Comparative Economics

journal homepage: www.elsevier.com/locate/jce

Institutions, abilities, and the allocation of talent: Evidence from Russian regions

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ARTICLE INFO

JEL classification:
D02
I25
J24
O43

Keywords:
Institutions
Allocation of talent
Rent seeking
Human capital

ABSTRACT

Strong institutions attract talent to productive activities, whereas weak ones raise the appeal of rent seeking. We propose a theory that describes the impact of institutions on occupational choices over a range of abilities, and predicts that the sensitivity of such choices to the quality of institutions rises in talent when the latter increases from low to intermediate levels, and declines thereafter. To test these predictions empirically, we use a unique micro data set describing the choices of fields of studies by newly enrolled university students in Russian regions in 2011–2014. We show that the popularity of sciences and engineering, on one hand, and law and public administration, on the other, are linked to the quality of regional investment climate and another measure of institutional quality in a manner predicted by our theory.

1. Introduction

Institutions and human capital are broadly recognized as essential drivers of economic development, but their relative significance and interplay continue to be debated in the literature. A line of thought stemming from the seminal works by Douglass North emphasizes the primacy of institutions for economic growth; from this perspective, the conventional factors of growth, including education, "are not causes of growth; they *are* growth" (North and Thomas, 1973, p.2). According to the contrarian view, enabling institutions are brought about by human capital accumulation (Glaeser et al., 2004; Gennaioli et al., 2013). Empirical studies which hold "horse races" between institutions and human capital usually show that both are significant in each other's presence (Hanushek and Woessmann, 2008), but their relative saliences depend on the chosen estimation strategies, which can put either of these factors ahead of the other.

A possible explanation of such ambiguity is that institutions and human capital do not operate independently of each other, and in fact are complements, so that better institutions increase the macroeconomic payoff to human capital by re-deploying it towards more socially productive applications (Rossi, 2020). Such redeployment is driven by better protection of property rights and other "market-augmenting" features of strong institutions, which by the same token limit the appeal of socially unproductive rent seeking.

Of particular significance is the impact of institutions on the allocation of talent, i.e., of the human capital of individuals with higher and/or unique abilities, creativity, aptitude for innovation, etc. The impact of institution-driven allocation of talent appears to be especially important for top talents with highest abilities. When institutions are strong, most talented individuals are pivotal for economic development, assuming leadership positions of executives, entrepreneurs, top managers, etc., whereas poor institutions idle such development resource, essentially decapitating growth, or worse yet, draw top talents into growth-impeding rent seeking.

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https://doi.org/10.1016/j.jce.2023.11.003
Received 9 September 2022; Received in revised form 31 May 2023; Accepted 8 November 2023
Available online 22 November 2023

This is a powerful and seemingly compelling argument for institutional reform, which should advance growth via the improved allocation of talent, especially top talent (Baumol, 1990; Murphy et al., 1991).

While the importance of top talents' occupational choices for economic growth is undisputable, the above argument begs a question to which the existing literature gives no definitive answer — would the reaction of top talents to improved institutions be robust enough to have the predicted impact on economic outcomes? According to Lucas (1978), top talents organize and run businesses as entrepreneurs and managers, whereas Baumol (1990) argued that entrepreneurs choose between the deployments of their talents for productive activities or rent seeking depending on the rules of the game. Brought together, these two arguments indeed suggest that the allocation of top talents should reflect institutions and respond to institutional change. However, there are general reasons to expect the same from all of human capital deployment (see, e.g., Murphy et al., 1993; Acemoglu, 1995) across the full range of abilities — from mediocre to outstanding, and it is unclear how the elasticity of such response varies across the ability range. We are unaware of any concise theoretical and especially empirical evidence on this matter, and the present paper aims to fill this gap.

To this end, we present a stylized model that predicts that the elasticity of response of the allocation of talent to incremental improvement of institutional quality does *not* rise monotonically in the ability level, as one might expect,[1] but rather depends on the ability in an inverted-U fashion. This result is based on two assumptions commonly made in the literature: (i) that ability is an effort (and hence payoff) multiplier, and (ii) that occupational choices reflect both material rewards and idiosyncratic preferences (personal aptitudes, predispositions, associated costs, etc.) for particular occupations and activities.

Since ability is a multiplier of payoff differentials between socially productive activities and rent seeking, for lower-ability individuals differences in material rewards in these activities will be small in relation to idiosyncratic considerations, and hence the changes in material rewards brought about by improved institutions will have a mild effect on occupational choice within the lower ability group. For stronger talents, the importance of payoff differentials relative to idiosyncratic preferences rises, and so does the intensity of this group's response to an institutional change. However, this is no longer true in the top talents cohort, where exceptional abilities increase reward differentials multifold, putting them far in excess of the monetary equivalents of idiosyncratic considerations (save those few individuals who have especially strong innate preferences for a given activity). This effect makes most of the top talent stick with the occupation with the highest material reward, and disregard institutional changes as long as they remain incremental and do not reverse the relative order of payoffs available in socially productive activities and rent seeking. A similar logic generates another important prediction (implied, but never clearly stated in the earlier literature), i.e. that in the case of strong (resp., weak) institutions, which deliver higher rates of return in socially productive activities (resp., rent seeking), the popularity of such activities will be rising in abilities. Overall, by explicitly treating institutions and abilities as interacting factors in the allocation of talent, we obtain a more nuanced and richer picture of the choices between socially productive and unproductive activities.

Testing such predictions empirically is a challenging task, as it would require a sample with two-dimensional variations of consistently measured institutions and abilities, and some proxies of occupational choices made in favor of either socially productive activities or rent seeking. Murphy et al. (1991) proposed to gauge such choices by college enrollment in, respectively, engineering and law in various countries, and this empirical strategy was implemented in a few subsequent studies (Natkhov and Polishchuk, 2019; Ebeke et al., 2015). However, such strategy would not be suitable for our purposes, since it operates with graduation totals for particular countries, without individual information on graduates' abilities. Even if such information were available, it would be of limited value, since the systems of higher education and national talent measures of university students are country-specific, and hence not directly applicable in a cross-country analysis. Agarwal and Gaule (2020) use globally comparable measures of talent (performance at International Mathematical Olympiad) and observe that younger people from developing countries who did well in such contests are less likely to engage in knowledge production; however, the authors do not ascribe such misallocation of talent to poor institutions.[2]

To address these difficulties, we conduct a cross-regional, rather than cross-national, analysis, following the recent practice of studying institutions and human capital at the subnational level (Gennaioli et al., 2013; Acemoglu et al., 2014; Chen, 2022). To this end, we select Russia — a vast country with profound interregional diversity, including substantial variations in the regional institutional environment. We employ a unique dataset on enrollment of Russian college and university students over the 2011–2014 period. The dataset includes about 1.3 million individual entries with information on higher education institution chosen by a student, selected field of study, and the student's aptitude, measured by the results of Russia's SAT-type national tests — Unified State Examination (USE), taken prior to the enrollment. We employ the scores from this test as an ability measure. The inclusion of such measure in an allocation of talent analysis based on college enrollment or graduation data is essential at a time when a post-secondary degree in and of itself is no longer a reliable evidence of higher abilities.

We follow Murphy et al. (1991) in using enrollment in engineering, or more broadly in sciences, technology, engineering, and mathematics combined (STEM) as a proxy for the allocation of talent to productive activities, whereas excessive enrollment in law (which we combine in the empirical part of the paper with public administration) is viewed as evidence of stronger appeal of rent seeking (or, more broadly, redistribution). The choice of enrollment in law and STEM as proxies of attractiveness of unproductive and productive activities, while intuitively plausible and elaborated in the previous literature, warrants some explanations.

[1] Intuitively, individuals endowed with higher abilities have valuable assets on their hands and invest those judiciously, closely monitoring and following changes in institution-induced payoffs available in various activities.

[2] The authors hypothesize that in developing countries "invisible geniuses" could be diverted from knowledge production to other, better paying, careers, but provide no evidence to support such causality.

Education in STEM is a major activity-specific investment, and enabling institutions provide the necessary confidence that such investment would earn appropriate returns in the value-adding activities. Furthermore, strong institutions support more complex production processes that require greater intensity of skills. Nunn (2007) and Levchenko (2007) show that good institutions favor contract-intensive industries, nearly all of which are in machinery manufacturing and hi-tech, and hence STEM, areas.

The tradition to associate legal profession with redistribution and, in particular, with rent seeking, has a long pedigree (reviewed, for example, in Tollison (1982)), and finds some empirical support (Laband and Sophocleus, 1988; Brumm, 1999). At the same time law plays a key role in sustaining productive activities, and in particular in protecting property rights; lawyers are carriers of "legal human capital"(Hadfield (2006)) required to uphold and enforce the rule of law. Instead of engaging in the debates about the contribution of the legal profession to economic outcomes (see, e.g., Epp, 1992; Olson, 1992), we are interested in variation between subunits and across time of the popularity of education in law, and show that it is strongly negatively correlated with institutional quality. Although our results describe what happens "at the margin", one can infer that such marginal outcomes in the case of poor institutions are likely to lead to a lopsided allocation of talent well in excess of the "optimal number of lawyers" (Magee, 1992), and thus reflect institutional pathologies and failures.[3]

Using these data, we first confirm the impact of institutions on the allocation of talent predicted, but not demonstrated, in Murphy et al. (1991) – an improvement of regional institutions makes, ceteris paribus, more likely enrollment in STEM, and less likely – in law and public administration.[4] These findings are more reliable than similar conclusions obtained by Natkhov and Polishchuk (2019) at the cross-country level, since we explain individual choices by university students, rather than enrollment aggregates. Furthermore, dealing with sub-national units of the same country rather than with countries of the world, considerably alleviates an omitted variable bias. Importantly, independent variables in such regressions include individual abilities measured by the USE test scores, which are directly comparable across our sample.

Beyond a confirmation of the Murphy et al. (1991) conjecture, the paper's main and novel empirical contributions are in demonstrating the more nuanced than previously understood impact of abilities on the allocation of talent — either conditionally on the institutional quality, or as a factor interacting with institutions and amplifying or suppressing their influence on the allocation of talent. Across various specifications, we observe a consistent pattern: higher ability made a young Russian more likely to select law and public administration as fields of study, and less likely to choose a STEM program. This is precisely what our theory predicts, given the overall poor state of economic and political institutions across the Russian Federation (Polishchuk, 2013; Baranov et al., 2015).

We also show that, in agreement with the theory developed in the paper, the above described overall impact of institutional quality on the allocation of talent depends on the ability level in a non-monotonic fashion. This impact is particularly pronounced, both qualitatively and in terms of statistical significance, over a middle range of abilities, whereas for low and top talents it becomes small in magnitude and statistically insignificant. A lack of tangible response of top talents to the variations of regional institutions is once again due to Russia's overall poor institutional quality, so that institutional variations within our sample, substantial as they might be, are not drastic and remain within the domain of extractive, rather than development-enabling inclusive institutions.

We use an alternative measure of regional institutional quality, different estimation techniques and specifications, and instrumental variable regressions to demonstrate robustness of our results and deal with the endogeneity concerns. Finally, we address the issue of migration of university graduates, which could weaken the link between institutional quality in a region where a student is pursuing his/her degree, and the allocation of talent. We show that controlling for such migration does not undermine the validity of our findings although, consistently with our model, the possibility to migrate naturally lowers the sensitivity of talent allocation to the region's institutional quality. Migration of university graduates is thus another source of variation in our empirical analysis, which provides additional confirmation of the predicted impact of institutional quality on the allocation of talent.

The rest of the paper proceeds as follows. In the next section, we provide a brief review of the literature on the interplay between institutions and human resources. The theoretical model is presented next, followed by a description of data, empirical findings, and concluding comments.

[3] DeSoto (1989) argues that red tape inflates the demand for legal services, in which case lawyers are not just rent-seekers but also "pilots" helping their clients to navigate through excessively cumbersome regulatory requirements. When property rights are vulnerable, lawyers help to protect their clients' assets from expropriation by rent-seekers, both private and public, so more lawyers substitute for the weakness of the rule of law (Arruñada, 2007; Dezalay and Garth, 1997). Mendoza (2015) argues that private efforts to compensate for inadequate public protection of property rights make government a free rider on private investments in security.

[4] Since the earlier work by Tullock (1980), Baumol (1990), etc., productive activities were expected primarily in the private sector, whereas rent seeking was associated with government. Later scholarship (see, e.g., Shleifer and Vishny, 2002) expanded such perspective by pointing out that both types of activities could transcend the private–public divide. Accordingly, we use the enrollments in STEM programs and law as measures of relative attractiveness of, respectively, production and rent seeking, even if STEM graduates pursue their careers in public enterprises, whereas law school graduates could work for private clients. Value-adding application of STEM knowledge and skills is not limited to the private sector — it could occur in state-owned enterprises, nonprofit research institutes, etc. While productivity of such efforts could vary between different types of organizations, they all need good institutions, such as property rights protection, as a common enabler. At the same time, the appeal of rent seeking can draw law school graduates into both public and private sector. A lawyer working in the private sector may help in raiding somebody's business (or, for that matter, to protect a particular business from being raided — see the previous footnote), provide legal counsel to targets of antitrust litigation, and otherwise partake in rent seeking. We are grateful to an anonymous reviewer who recommended the above clarification.

2. (Mis)allocation of talent: causes and consequences

Institutions, conventionally defined as rules of the game in economy and society (North, 1990), matter for economic development in multiple ways. Earlier literature stressed the role of institutions in reducing transaction costs (Eggertsson, 1990); later the emphasis has shifted on the protection of property rights and the maintenance of level playing field as key factors of long-term economic growth (Acemoglu and Johnson, 2005).

The main purpose of property rights is to protect value-creating activities from expropriation, and thus reduce the appeal of rent seeking and other unproductive profit-seeking activities (Bhagwati, 1982). This perspective reveals a general pattern — institutions affect the allocation of resources in the economy between productive applications and rent seeking (Murphy et al., 1993; Grossman, 1994; Acemoglu, 1995; Mehlum et al., 2003). Both options could be individually rational, depending on institutional environment; however, good institutions increase *private* payoffs to socially productive activities in relation to rent seeking, whereby bad ones have the opposite effect (Acemoglu and Robinson, 2012). This mechanism makes the *social* rates of returns to the factors of production conditional on the institutional quality, and places institutions among other economic growth determinants, including human resources such as labor and human capital.

There are conflicting views in the literature on the primacy of institutions and human capital as growth factors, reflecting opposite perspectives of the causality between institutions and economic development. One, known as the institutional hypothesis (North, 1990), puts institutions first and treats other growth factors, including human capital, as endogenous to institutions. In contrast, the development hypothesis stresses a pivotal role of human capital accumulation, which is expected to eventually improve institutions (Glaeser et al., 2004). Both views find support in the data (Gennaioli et al., 2013; Acemoglu et al., 2014), but such findings are not robust to the selection of an identification strategy. One reason for such ambiguity is that both human capital and institutions are endogenous and could have overlapping origins and root causes (Glaeser et al., 2004; Gennaioli et al., 2013). A related explanation, central to this paper, is that these growth determinants interact with each other, and the role of institutions in the *allocation* of human capital suggests complementarity between the two.

The well-known metaphor for such complementarity is that human capital, including education and skills, is required both for piracy and for chemical manufacturing (North (1990); see also Pritchett (2001)). Depending on which of these activities provides a higher private payoff, the contribution of human capital to economic development could be very different, possibly negative. If institutions make rent-seeking the preferred option for individuals (Pritchett, 2006), greater human capital can impede economic growth (Hanushek and Woessmann, 2008).

More generally, good institutions reduce market distortions and frictions, and therefore prevent a gap between private and social rates of returns to factors of production, including human resources. Such gaps reduce the total factor productivity (TFP; according to Hsieh and Klenow (2009), distortions cut TFPs in Chinese and Indian manufacturing by 25%–40%), making it, in agreement with the institutional hypothesis, dependent on institutions. Inputs misallocation caused by market distortions adversely affects growth and welfare, financial development, and innovation activities (Chen, 2022). Since distortions generally involve (or produce) rent (Cahuc and Challe, 2012), the bare bones picture of institutions as discouraging or facilitating rent seeking captures the gist of a broader misallocation phenomenon.

Institutions therefore serve as a "sorting factor" affecting the social rate of return to human capital. This could explain the "micro–macro paradox", whereby education earns a significant private payoff, but does not make a similarly robust and universal contribution to economic growth. In many countries education does not produce positive externalities expected in the endogenous growth theories, but instead causes negative externalities when educated individuals are drawn by poor institutions into rent seeking harmful for growth (Pritchett, 2001; Murphy et al., 1993). This can be seen, with necessary caveats, in the excessive engagement of educated individuals in public administration, legal profession, and more recently in the financial sector (Arcand et al., 2015; Philippon and Reshef, 2013).

Rogers (2008) and Armellini (2012) established complementarity at the cross-country level between institutional quality and education as factors of economic growth. Hanushek and Woessmann (2008) arrived at a similar conclusion, when human capital was measured by cognitive skills, rather than by educational attainment (see also Rossi, 2020).

While institutions affect the allocation of the total stock of human resources, their impact on the allocation of talent, i.e., on the occupational choices of individuals with high and/or unique abilities, traits and aptitudes, could be of particular importance for economic outcomes. Hanushek and Woessmann (2008) show that higher talents make far greater contributions to growth than mediocre ones,[5] but also caution that the contribution of talent, as it was the case with human capital in general, depends on the institutions.

Murphy et al. (1991) famously contrasted engineering and law as proxies for, respectively, socially productive activities and rent seeking, and showed that at the cross-country level, college enrollment in engineering is positively correlated with growth, while for college enrollment in law such correlation is negative. This finding illustrates the impact of the allocation of talent on growth, assuming that post-secondary education is a signal of higher abilities (Spence, 1973).

Legal profession is not the only lure for talents that could be drawing them away from contributing more directly to economic development. Another "usual suspect" is finance (Tobin, 1984). (Cahuc and Challe, 2012) show that frictions in financial markets

[5] Recall that according to Lucas (1978), top talents assume leadership positions in the economy, whereas the rest of human resources becomes labor.

create massive rent which attracts highly skilled individuals into speculation instead of production.[6] Talent could also be misallocated to government service, in which case innovations and conventional entrepreneurship are supplanted by the engagement of high ability individuals into rent seeking, where they become "non-productive entrepreneurs" (Baumol, 1990). Thus, in Chinese regions, concentration of educated individuals in government bureaucracy at the expense of the private sector is negatively correlated with R&D expenditures and patenting activity (Chen, 2022).

Talent could be misallocated not only by free choices of high ability individuals responding to distorted signals, but also by restricting career choices due to discrimination, cultural reasons, and various labor market and human capital accumulation frictions. Such barriers, many of them also institutional, hold back economic development. According to Hsieh et al. (2019), 20%–40% of the growth of market output per capita in the US in the 1960–2010 period is attributed to the increased presence of women and racial minorities in high skilled occupations.[7] Finally, talent can be misallocated within productive activities, e.g., by revenue diversion to managers (Benhabib and Hager, 2021).

These papers demonstrate the importance of the allocation of talent for economic development. Most of them also imply that such allocation, in its turn, is affected by institutions. Talent could be diverted from the advancement of economic growth by various institutional failures and pathologies, such as insecure property rights, discrimination, weak corporate governance, insufficient oversight of financial markets, etc. Baumol (1990) presented a hypothesis that the choice by would-be entrepreneurs, endowed with necessary abilities and aptitudes, between productive and unproductive entrepreneurship is driven by relative payoffs shaped by institutions. He illustrated this hypothesis by several cases from history, but otherwise provided no systematic empirical evidence. In another influential paper, Murphy et al. (1991) discussed both the influence of institutions on the allocation of talent, and the impact of the allocation of talent on economic growth, but presented empirical evidence only of the latter effect.

The literature that ensued provided a firmer empirical evidence of the role of institutions in the allocation of talent. Natkhov and Polishchuk (2019) used a cross-sectional sample of about 100 countries and a panel of economies in transition to demonstrate a strong and robust positive correlation between institutional quality and the graduation of college and university students in sciences, and a negative one — between institutional quality and the graduation in law. They also showed that these effects underlie the complementarity between institutions and education as factors of economic growth. Ebeke et al. (2015) demonstrated that the quality of national institutions affects the impact of resource rent on the allocation of talent. Lin et al. (2021) treated the abolishment in 1905 of a millennium-long civil examination system in China that drew the best and brightest into government bureaucracy as a natural experiment to demonstrate an ensuing reallocation of talent to China's emerging financial sector. Florida (2002) argued that openness and low entry barriers increase diversity, which draws talents into high-tech occupations.

While the literature discussed above singles out higher ability individuals ("talents") in the overall response of human resources to the institutional environment, it does not distinguish top talents from others within the group, especially in the empirical part. Assuming that top talents take leadership positions in the economy e.g., become firm managers, as in Lucas (1978) and the following literature, including Murphy et al. (1991), choices of high ability individuals should be particularly significant for economic growth. However, it remains unclear whether such choices are more or perhaps less sensitive to institutional quality, than in lower ability cohorts.[8] The theory presented in the next section sheds light on this matter.

3. The model

The model presented below merges two strands of formal theories of the allocation of talent. In the first, stemming from Roy (1951), heterogeneous individuals select their occupations based on their abilities (which may or may not be occupation-specific), and idiosyncratic preferences over the available occupational choices reflecting personal dispositions, aptitudes, commitments ("callings"), attitude towards risk (if it varies across the occupations[9]), etc. (Lockwood et al. (2017), Hsieh et al. (2019)). We follow the main tenets of Roy's approach, i.e., that self-selection, conditional on talent, skills, etc., of various roles and positions in the economy reflects the anticipated payoffs, and the latter, in equilibrium, are affected by such self-selection.[10] In the second stream, otherwise identical agents choose between productive activities and rent seeking, with payoffs in these two sectors reflecting the quality of institutions (Murphy et al., 1993; Grossman, 1994; Acemoglu, 1995; Mehlum et al., 2006; Mariani, 2007). In our model,

[6] As clarified in the previous section, legal profession should not be construed as synonymous to rent seeking, and the same caveat obviously applies to finance. Both occupations are key to economic development, but their excessive popularity, especially in high ability groups, indicates that talent is misallocated. Similarly to exceeding the "optimal number of lawyers", when the depth of financial sector exceeds a certain threshold, it turns from a resource of growth into its impediment (Arcand et al., 2015).

[7] Notice, however, that if some groups of population face entry barriers in accessing lucrative rent seeking positions in government and other protected domains, talents from such discriminated groups would be allocated to less privately remunerative but still available productive activities, with possible benefits for economic development (Murphy et al., 1991).

[8] In the model sketched in Murphy et al. (1991), higher talents become managers of firms operating in the productive (value-creating) sector or in the sector dealing in rent seeking, while others join the labor force. Under a restrictive assumption that one of these two sectors exhibits a uniformly higher economy of scale than the other, the model predicts that changes in the degree of expropriation of the productive sector have no impact on top talents' occupational choices. Instead, these choices are determined in the model solely by the comparative industrial organization of productive activities vs. rent seeking, rather than by the degree of expropriation in the productive sector and similar fundamentals of institutional quality central to our analysis.

[9] E.g., an important advantage of government employment is higher job security, which draws in the public sector ceteris paribus more risk-averse individuals.

[10] The Roy model finds various applications in applied economic analysis. In addition to studying occupational choices in the above referenced papers, it is a popular tool in migration studies, starting from the seminal paper by Borjas (1987); in the analysis of selection of medical treatment options (Chandra and Staiger, 2007); in studies of attitude to redistribution (Abramitzky, 2009); etc.

heterogeneous agents (as in the first of the above streams of literature) choose between productive activities and rent seeking (as in the second stream). This combination enables an analysis of the impact of institutions on the allocation of talent conditional on the abilities.

We make the standard assumption that ability is a multiplier transforming labor supply into effective labor, which earns different rates of return in productive activities and rent seeking. For higher ability individuals, these material reward differences are amplified in comparison to less talented ones, and hence the quality of institutions rises in significance with ability levels, and increasingly prevails over idiosyncratic non-pecuniary considerations. The latter, however, play a much greater role in occupational choices of less talented individuals, who are thus less sensitive to the institutional quality. Finally, in the case of top talents, reward differentials are very large and trump idiosyncratic considerations (which are not affected by ability), and most of such individuals pick the activity that offers higher return per unit of effective labor, save those few whose innate preference for the other activity is extraordinarily strong. Such near-unanimity makes top talent cohorts less sensitive to incremental variations in the protection of property rights that do not reverse the order of payoffs to productive and non-productive activities. As a result, the model reproduces a non-monotonic (inverted U-shaped) relation between abilities and the elasticity of occupational choices to institutional change.

We also allow for the possibility of migration of agents specializing in production or rent seeking to other jurisdictions with different institutional quality and hence different reward structures. We show that mobility predictably weakens the impact of (local) institutions on occupational choice, but in general does not eliminate it altogether unless mobility is universal and costless.

3.1. Preferences, activities, technologies, and payoffs

Consider an economy with a unit continuum of individuals $\omega \in \Omega$. Individuals differ from each other in their abilities $\theta = \theta(\omega) \geqslant 0$ and aptitudes for two alternative occupations $i = 1, 2$ available in the economy, respectively production and rent seeking (only one of these occupations can be chosen by an individual). In either of these occupations, individual ω inelastically supplies one unit of effort, at personal cost (disutility) $c_i(\omega)$, which is inversely related to his/her aptitude for activity i (including risk tolerance) and represents the monetary equivalent of the idiosyncratic preference for this activity. Denote $a(\omega) \equiv c_1(\omega) - c_2(\omega)$ relative aptitude for rent seeking (in comparison to production). Ability and relative aptitude measures are distributed independently from each other with cumulative distributions and densities, respectively, $G(\theta)$ and $g(\theta)$ ($\theta \in \mathbb{R}^+$), and $H(a)$ and $h(a)$ ($a \in \mathbb{R}$).[11] The ability measure is normalized to unity: $\int_0^\infty \theta g(\theta) d\theta = 1$.

Ability is an effort multiplier: a unit of effort supplied by individual ω translates into $\theta(\omega)$ units of effective labor. A unit of effective labor in activity i earns a flat return r_i, so that individual's income in this activity is $x = r_i\theta(\omega)$. Individuals have utility functions (depending on income and occupational choice) $u(x, i; \omega) = x^\gamma - c_i(\omega)$, for some $\gamma > 0$.[12]

The technology of production exhibits constant returns to scale, and output measure is normalized so that aggregate effective labor Θ, supplied towards productive purposes, produces gross output $Y = \Theta$.

Institutional quality is represented in the model by property rights protection, which is measured by the share $\sigma \in [0, 1]$ of the output that a producer keeps, whereas the residual share $1-\sigma$ goes to rent seekers who prey on vulnerable property rights. Hence, the payoff to a unit of effective labor in production is σ. To calculate such payoff in rent seeking, assume, as in Tullock (1980), that the total output captured by rent seekers is shared among them in proportion to effective labor supplied to rent seeking. Economy-wide gross payoff to rent seeking equals $(1 - \sigma)\Theta$, and the total effective labor in rent seeking is $1 - \Theta$ (recall that the total supply of effective labor by all individuals is normalized to unity); therefore the payoff per unit of effective labor in rent seeking, denoted by μ, obtains as follows:

$$\mu = \frac{(1 - \sigma)\Theta}{1 - \Theta}. \tag{1}$$

3.2. Equilibrium

Each agent compares his/her utilities in production and rent seeking, i.e., $(\sigma\theta(\omega))^\gamma - c_1(\omega)$ and $(\mu\theta(\omega))^\gamma - c_2(\omega)$ respectively, and chooses the occupation with greater utility. Production is chosen whenever $a(\omega) \leqslant \theta(\omega)^\gamma[\sigma^\gamma - \mu^\gamma]$, and the share of individuals with talent θ that select production equals $H(\theta^\gamma[\sigma^\gamma - \mu^\gamma])$. Recall that each of these individuals will supply to production θ units of effective labor, and therefore the total supply of effective labor to production is as follows:

$$\Theta = \int_0^\infty H(\theta^\gamma[\sigma^\gamma - \mu^\gamma])\theta g(\theta) d\theta. \tag{2}$$

For a given level of property rights protection σ, Eqs. (1) and (2) can be solved simultaneously for equilibrium Θ, μ.

Proposition 1. *For any level $\sigma \in (0, 1)$ of institutional quality, there exists unique equilibrium $\Theta = \Theta(\sigma), \mu = \mu(\sigma)$, satisfying Eqs. (1), (2).*

[11] Hsieh et al. (2019) similarly combine idiosyncratic preferences and abilities, but allow variations among agents in only one of these two dimensions. In our model, similarly to Lockwood et al. (2017), both of these characteristics vary across the community of agents.

[12] To place this assumption into the general Roy model context, recall that Roy's key question was whether (potentially) best hunter will be hunting and best fisherman will be fishing. A similar question in the Roy model's application to international migration is how returns to skills in the country of origin and country of destination are correlated with each other (Borjas, 1987). In our model, *monetary* returns in both activities are perfectly correlated, but occupational choices are also affected by activity-specific idiosyncratic preferences.

Proof. For a given σ, Eq. (2) defines Θ as a monotonically decreasing function of μ. Similarly Eq. (1) defines μ as a monotonically increasing function of Θ, such that $\lim_{\Theta\to 0}\mu = 0$, $\lim_{\Theta\to 1}\mu = \infty$. Therefore, these two continuous curves in the axes μ, Θ have a unique intercept, which is the equilibrium. ■

Once $\mu(\sigma)$ is known, the number (share) $\Pi(\theta,\sigma)$ of individuals with talent θ participating in productive activities obtains as

$$\Pi(\theta,\sigma) = H(\theta^{\gamma}[\sigma^{\gamma} - \mu(\sigma)^{\gamma}]). \tag{3}$$

Total participation in production for all talents equals

$$\tilde{\Pi}(\sigma) \equiv \int_0^{\infty} \Pi(\theta,\sigma)g(\theta)d\theta. \tag{4}$$

3.3. Comparative statics

In this sub-section, we study the impact on equilibrium of the quality of property rights protection, σ.

Proposition 2. *In equilibrium, aggregate effective labor supply to production $\Theta(\sigma)$ increases in property rights protection.*

Proof. In the axes μ, Θ, the curves defined by Eqs. (1) and (2) shift upwards when σ rises, and hence so does their intercept. ■

According to the above proposition, better institutions attract more effective labor in production, increasing gross output in the economy. This in and of itself does not guarantee that occupational choices are tilted in favor of production across the ability range. Such choices respond to changes in relative payoffs to two activities, and while property rights protection increases the payoff in production σ, in a positive-sum game it could make rent seeking more rewarding as well. Indeed, according to Eq. (1), better institutions affect the payoff to rent seeking $\mu(\sigma) = \frac{(1-\sigma)\Theta(\sigma)}{1-\Theta(\sigma)}$ directly, by leaving a smaller share of the output for grab, but also indirectly, by increasing the output $\Theta(\sigma)$, and leaving less effective labor $1-\Theta(\sigma)$ in rent seeking. The direct and indirect effects work in opposite directions, and their joint impact remains unspecified. However, even if the payoff to rent seeking goes up as property rights protection improves, changes in payoff *differentials* increase participation in production for all ability levels (except $\theta = 0$, where occupational choices are not affected by institutional quality and are driven entirely by relative idiosyncratic preferences).

Proposition 3. *One has*

$$\frac{d}{d\sigma}[\sigma^{\gamma} - \mu(\sigma)^{\gamma}] > 0, \tag{5}$$

and hence shares $\Pi(\theta,\sigma)$ of individuals with ability $\theta > 0$ participating in productive activities and total participation in production for all abilities $\tilde{\Pi}(\sigma)$ are increasing in σ.

Proof. According to Proposition 2, $\Theta'(\sigma) \gtrless 0$; one can easily check that in fact the inequality is strict. Due to Eq. (2), $\Theta'(\sigma) = \frac{d}{d\sigma}[\sigma^{\gamma} - \mu(\sigma)^{\gamma}]\int_0^{\infty}\theta^{\gamma+1}h(\theta^{\gamma}[\sigma^{\gamma} - \mu(\sigma)^{\gamma}])g(\theta)d\theta > 0$, which yields inequality (5). The rest of Proposition 3 follows directly from the definitions (3) and (4) of $\Pi(\theta,\sigma)$ and $\tilde{\Pi}(\sigma)$. ■

The strength of the impact of property rights protection on participation in production depends on the level of ability and institutional quality. Indeed, the marginal effect of improved institutions for the participation in productive activities in ability cohort θ is as follows:

$$\frac{\partial\Pi(\theta,\sigma)}{\partial\sigma} = \theta^{\gamma}\frac{d}{d\sigma}[\sigma^{\gamma} - \mu(\sigma)^{\gamma}]h(\theta^{\gamma}[\sigma^{\gamma} - \mu(\sigma)^{\gamma}]). \tag{6}$$

According to (6), in the zero ability cohort institutions have no impact on the choice between productive activities and rent seeking, and, as noted above, such choice is driven entirely by idiosyncratic preferences. For positive levels of ability, the impact of property rights grows from zero to positive values (assuming positive density $h(\theta^{\gamma}[\sigma^{\gamma} - \mu(\sigma)^{\gamma}])$, and hence its magnitude increases in ability, at least if θ is not large, i.e., in the "low to medium" ability range. Intuitively, more talented individuals possess more valuable assets, which could earn higher payoff, and therefore pay greater attention to the institution-driven payoff differentials when allocating such assets.

The impact of improved property rights on the allocation of *top* talents depends on the level of institutional quality, σ. For the break-even institutional quality $\sigma_0 \in (0;1)$ such that $\sigma_0 = \mu(\sigma_0)$, when the payoffs to productive activities and rent seeking are equal to each other, the marginal effect of institutional quality for the allocation of talent according to (5), (6) goes to infinity for $\theta \to \infty$. However, for all other σ, such marginal effect in fact tends to zero as $\theta \to \infty$ (with the additional tail distribution assumption $\lim_{|a|\to\infty} ah(a) = 0$); furthermore one can easily check that $\frac{\partial^2\Pi(\theta,\sigma)}{\partial\theta\partial\sigma} < 0$ for sufficiently high θ, pointing to an inverted U-shaped relationship between ability and the marginal effect of institutions. Intuitively, since ability amplifies the payoff differentials between activities, for exceptionally talented individuals, the appeal of an activity that earns a higher payoff per unit of effective labor trumps other considerations that could have made incremental institutional change pivotal for lower abilities. Unless institutional variations are *drastic* (crossing the break-even threshold σ_0), they affect occupational choices within the top talent cohort only for those agents whose relative aptitude for a particular activity is exceptionally strong. Such agents, if they exist at all, are in the remote tails of the distribution $h(a)$, and since the share of these tails is small, so is the cohort's response to institutional change. Therefore, when

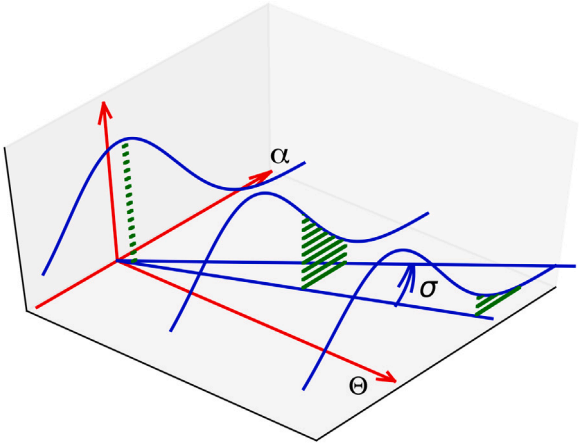


Fig. 1. Impact of institutions on the allocation of talent for various talent cohorts.

$\theta \to \infty$, the allocation of talent in cohort between production and rent seeking as a function of institutional quality approximates a step function.

The above observations summarize as follows.

Proposition 4. *For any given level of property rights protection σ, the marginal effect of institutions for occupational choices of individuals with ability θ increases from zero when θ rises from zero to a higher level. If $\sigma \neq \mu(\sigma)$ and $\lim_{|a|\to\infty} ah(a) = 0$, this effect decreases back to zero for sufficiently high θ.* ■

Fig. 1 illustrates the inverted U-shaped relationship between the ability and the elasticity of its allocation to the quality of institutions.[13]

Finally, when the variables σ and θ are considered in reverse order, the above theory sheds light on how the allocation of talent depends on the *ability* level, conditional on institutional quality. Two qualitatively different responses emerge depending on whether institutions are *strong*, when payoff to production is higher than in rent seeking ($\sigma > \mu(\sigma)$), or *weak* (vice versa).

Proposition 5. *When institutions are strong, higher ability individuals are more likely to select production over rent seeking ($\frac{\partial \Pi(\theta,\sigma)}{\partial \theta} > 0$). When institutions are weak, the opposite is true. For break-even institutions ability has no impact on the likelihood of selection of production or rent seeking.*

Proof. One has $\frac{\partial \Pi(\theta,\sigma)}{\partial \theta} = \gamma\theta^{\gamma-1}[\sigma^{\gamma} - \mu(\sigma)^{\gamma}]h(\theta^{\gamma}[\sigma^{\gamma} - \mu(\sigma)^{\gamma}])$. ■

According to the above proposition, in the case of strong institutions, productive activities are a magnet for talent, and the power of such magnet grows in ability. In the case of weak institutions, "gravity forces" of rent seeking are stronger for higher abilities.

3.4. Impact of mobility

Suppose that the economy described above is a part (subunit) of a bigger economic entity, e.g., a subnational unit in a federation, and that labor is partially mobile between a subunit and the rest of the encompassing entity. Assume that a mobile individual can move freely and costlessly to any other subunit in the entity, that the share of such individuals in the economy is $p \in [0,1]$ (which is a mobility measure), and that mobility is statistically independent from ability[14] and the relative aptitude for rent seeking. Finally, assume that the subunit is "non-pivotal", i.e., the payoffs to productive activities and rent seeking are not the highest across the encompassing entity.

[13] A sufficient condition for the function $\frac{\partial \Pi(\theta,\sigma)}{\partial \sigma}$ to be single-peaked in θ (assuming $\sigma > \mu(\sigma)$) is that the density elasticity $\epsilon(a) \equiv -\frac{ah'(a)}{h(a)}$ is an increasing function of $a \geq 0$ (if $\sigma > \mu(\sigma)$, the sufficient condition is that the function $-\frac{ah'(-a)}{h(-a)}$ increases in $a \geq 0$). These conditions are satisfied, e.g., when the distribution $h(a)$ is normal with a zero mean.

[14] This assumption is made for brevity's sake; the results reported below hold when mobility is correlated with ability — e.g., it is plausible that more talented individuals are ceteris paribus more mobile, as it would be easier for them to cover the mobility cost. In that case, mobility cost simply adds to other idiosyncratic components of the personal cost $c_i(\omega)$ of engaging in activity i (assuming that this activity is pursued in the subunit where it earns the highest return). Therefore, the main conclusions of the above presented theory stay when mobility and ability are correlated with each other. Mariani (2007) argues that agents with productive skills are more mobile, and their departure could reduce the attractiveness of rent seeking, which is an example of the beneficial brain drain (Mountford, 1997). This effect can also be incorporated in the activity cost in the baseline model, leaving its main findings intact.

For a given subunit, denote σ and μ local (i.e., within the subunit) payoffs to production and rent seeking. Furthermore, denote σ_0 and μ_0 the highest payoffs to, respectively, productive activities and rent seeking available in the encompassing economy. Since the subunit is non-pivotal, mobile individuals will always move outside the subunit and will be choosing between the payoffs $(\sigma_0\theta)^\gamma$ and $(\mu_0\theta)^\gamma$, whereas those who are immobile will choose between $(\sigma\theta)^\gamma$ and $(\mu\theta)^\gamma$. Therefore, the share of agents in the economy who will be engaged in productive activities is as follows:

$$\tilde{\Pi} \equiv p\int_0^\infty H(\theta^\gamma[\sigma_0^\gamma - \mu_0^\gamma])g(\theta)d\theta + (1-p)\int_0^\infty H(\theta^\gamma[\sigma^\gamma - \mu^\gamma])g(\theta)d\theta. \tag{7}$$

Local equilibrium μ, Θ satisfies the following equations:

$$\mu = \frac{\Theta(1-\sigma)}{1-p-\Theta}, \tag{1'}$$

$$\Theta = (1-p)\int_0^\infty H(\theta^\gamma[\sigma^\gamma - \mu^\gamma])\theta g(\theta)d\theta. \tag{2'}$$

Notice scale invariance of the model: substitution $\tilde{\Theta} = \Theta/(1-p)$ reduces Eqs. (1′) and (2′) to their original versions (1) and (2). Hence, in equilibrium, payoff to rent seeking $\mu = \mu(\sigma)$ does not depend on p and can be taken from the original model with $p = 0$. This observation leads to the conclusion that the allocation of effort between productive activities and rent seeking is less sensitive to the institutional quality in subunits with higher mobility. Indeed, for equilibrium enrollment in productive activities $\tilde{\Pi}(p,\sigma)$ one has $\frac{\partial^2\tilde{\Pi}(p,\sigma)}{\partial p\partial\sigma} = -\frac{d}{d\sigma}[\sigma^\gamma - \mu(\sigma)^\gamma]\int_0^\infty \theta^\gamma h(\theta^\gamma[\sigma^\gamma - \mu(\sigma)^\gamma])g(\theta)d\theta$, and Proposition 3 leads to the following

Proposition 6.

$$\frac{\partial^2\tilde{\Pi}(p,\sigma)}{\partial p\partial\sigma} < 0. \ \blacksquare$$

The above theory generates the following main testable hypotheses about the selection of fields of study by university students. First, in agreement with the earlier literature, improvement of property rights protection and other similar institutions should increase the enrollment in disciplines that equip students for productive activities and *de*crease enrollment in disciplines that could be useful in rent seeking (Hypothesis A). Second, such effect is more pronounced for more (but not exceptionally) gifted students, than for those with lower abilities and for the top talents (Hypothesis B). Third, in the case of weak institutions an increase in ability makes more likely participation in rent seeking, whereas in the case of strong institutions such increase improves the odds of participation in production (Hypothesis C). And fourth, mobility of students after graduation should weaken the above effects (Hypothesis D). In the remainder of the paper, we take these hypotheses to the Russian data.

4. Evidence from Russia

As explained in the Introduction, testing the predictions of the above theory requires a sample with variations of comparable measures of institutional quality and abilities, as well as of educational choices indicating preferences to productive activities or rent seeking. Cross-country data would not satisfy such requirements — differences in post-secondary education systems, definitions of programs, admission criteria, etc. produce significant noise and carry substantial risks of omitted variables. But even more crucially, it would be very hard to consistently measure abilities of university students from different countries. Even the basic assumption (underlying the earlier empirical analyses of the allocation of talent, as in Murphy et al. (1991)) that university students are endowed with markedly higher abilities than the general population, does not hold in the modern world, where post-secondary education is approaching a social norm (OECD, 2016).

In this paper, we follow an increasingly popular pattern to take comparative studies of institutions and development, initially carried out cross-nationally, to the subnational level. Using within-country variations in addition to or instead of those across countries could increase the sample size and, more importantly, alleviates the omitted variables bias (Snyder, 2001). Furthermore, subnational variations of development determinants could be broad and rooted in history, geography, etc., and as such could be with greater confidence treated as exogenous (Tabellini, 2010). This applies inter alia to analyses of institutions and human capital (Gennaioli et al., 2013; Acemoglu et al., 2014).

In using Russian regional data, we take advantage of substantial variations of institutional environments among Russian regions (Baranov et al., 2015). In addition to a host of regional variables, we also employ finer-grained individual-level data on the enrollment in post-secondary education in different regions of the Russian Federation. These data are available for several years and, most importantly, come with a chosen field of study and a measure of individual ability.

4.1. *"Where has all the education gone?"*

Russian institutions are overall notoriously weak (see, e.g., Polishchuk (2013)). Over the last decade, the Worldwide Governance Indicators project placed the country in the bottom 20%–25% of its annual global rankings of the key institutional indexes, such as Voice and Accountability, Rule of Law and Control of Corruption. At the same time, Russia is second only to Canada among the OECD and OECD's partner countries in the popularity of post-secondary education, with 54% of tertiary educated in the 25–64 years old cohort (58% among the 25–34 years old). The respective OECD averages are 35 and 42% (OECD, 2016). A post-secondary degree

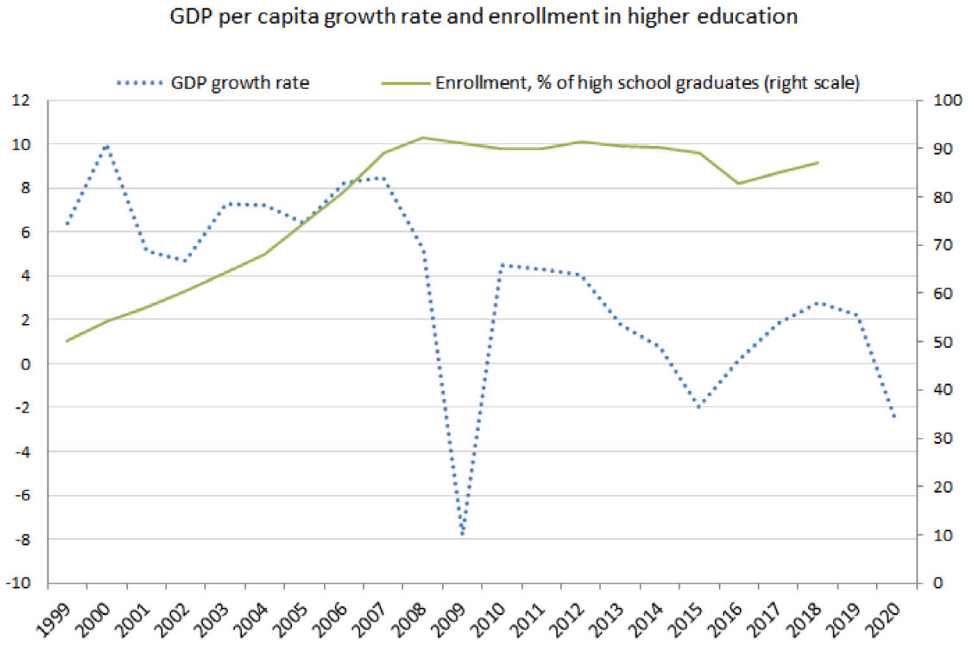


Fig. 2. Enrollment in tertiary education and economic growth in Russia (1999–2020).
Source: Indicators of Education 2020, HSE University and Ministry of Higher Education.

earns a sizeable educational premium in securing employment and increasing life satisfaction and income (Belskaya et al., 2020), which explains strong demand for tertiary education. However, despite such massive investments in human capital, the Russian economy has been mostly stagnating since the 2008 Great Recession (Fig. 2), and bad institutions are the prime suspect in answering Pritchett's question "Where has all the education gone?" (Pritchett, 2001).

As argued earlier in the paper, economic growth could be decoupled from human capital accumulation due to misallocation of talent. Hence, in accordance with our theory one should expect crowding out of science and engineering by law and public administration among more talented Russian youth. This is clearly illustrated by the distributions of the scores of Unified State Examinations (USE) of all applicants admitted to Russian post-secondary institutions in 2011–2014, and of those enrolled in, respectively, STEM and law programs (Fig. 3).[15]

Strong preference of Russian university applicants with high USE scores for law and public administration over STEM disciplines, including those representing cutting-edge technologies, persisted over time. In 2016, the average USE score for those enrolled, tuition-free, in law school was 80.73 out of 100 (fifth highest among all disciplines), in comparison to 71.07 for nuclear physics and technology and only 66.52 for aviation and space technology. In 2017, the average USE score for those newly enrolled in law departments with tuition waved, was 82.3, versus 69.6 for IT programs, which had the highest average score across STEM disciplines. Apparently, the proverbial perception of "rocket science" as a highly talent-intensive area is at odds with the actual allocation of top talents in modern Russia.

This illustration, however, does not provide direct evidence that the allocation of talent follows *variations* in institutional quality in a predicted manner, and does not reveal how younger Russian talents reacted to such variations depending on their abilities. To obtain such evidence, we need multiple subunits with substantial changes of institutional quality from one subunit to another and data on the allocation of (variable) talent within each subunit. Russian regions (over 80 subnational units of the Russian Federation) serve this purpose well.

Institutional disparities among Russian regions are far in excess of what can be expected from a country, even as vast and diverse as Russia, with a single polity, legal system, and economic space. Russian regions exhibit profound variations in their investment climate and business environment (Zubarevich, 2010) due to highly uneven red tape, corruption, entry barriers, share of the informal economy, and risks of doing business. These disparities go back to the early years of the Russian transition when a weak central government offered the regions to "take as much power as they could handle" (Polishchuk, 2001). The subsequent consolidation of the central government did not bring about greater institutional uniformity due to a chronically weak oversight and enforcement capacity (Yakovlev and Zhuravskaya, 2013), and the regime's willingness to tolerate local irregularities as long as certain political targets had been met (Reuter and Robertson, 2012). There has been also a lack of essential ingredients of "market-preserving federalism" that would create incentives to establish more uniformly investor-friendly institutions (Montinola et al., 1995).

[15] As explained later in the paper, we use the average of USE scores for two mandatory subjects — Russian language and mathematics.

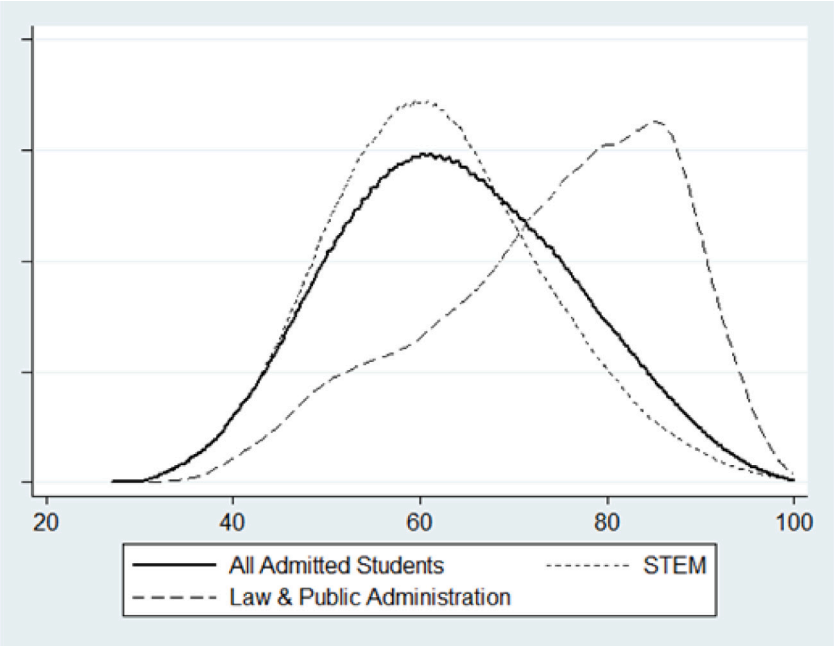


Fig. 3. Distribution of 2011–2014 Unified State Examination test scores for admitted university applicants in Russia.

Cross-regional institutional variations in Russia are sufficiently profound to allow a comparative analysis of the impact of institutions on the allocation of talent.[16] And yet, relative institutional advantages of some regions over the others fall short of making up for systemic deficiencies in the national institutions (Polishchuk, 2001, 2013; Baranov et al., 2015), such as a general lack of the rule of law, vulnerable property rights and ubiquitous corruption.

4.2. Post-secondary education in Russia: Basic facts

Strong demand for tertiary education in Russia was matched by the country's vast system of higher learning, available in 2014 (the final year of our observation period) from 969 universities, institutes, and academies, 578 of them public and the remainder private.[17]

The subject structure of education has undergone dramatic transformation since the Soviet time, when the emphasis was on engineering, sciences, medicine, and teacher training. Free market economy demanded specialists in management, law, and economics, which were not heretofore trained in sufficient numbers and with required skills. This resulted in a surge in the 1990s of programs in these disciplines offered by old schools branching out into the new fields, and especially by de novo educational institutions.[18] At the same time, education in science and engineering went into a decline, leaving much of the pre-existing capacity idled and depreciating. This pattern was observed throughout the former Eastern Bloc, but in more successful transition nations, such as Poland and the Czech Republic, education in law and management subsequently ebbed to normal levels, whereas engineering, and especially information technologies, rebounded. However, in Russia and some of its post-Soviet neighbors, the abnormal popularity of higher education in law, and later also in public administration, has continued until the present time, reflecting, as we argue in this paper, poor quality of the country's economic institutions.

Although higher education in Russia is formally under increasingly tight government regulation, in reality, Russian universities enjoyed broad discretion and de facto autonomy in choosing and implementing educational programs while showing compliance with some formal easy-to-meet requirements. Therefore, the supply of higher education in Russia remained sufficiently flexible and responsive to market demand. Capacity constraints did not restrict such flexibility since much of the expansion has been in less capital-intensive non-technical fields, whereas the pre-existing Soviet-time capacity in much more capital-intensive fields of engineering and sciences remained underutilized (see also Section 4.6).

[16] While Russia stands out from other countries in its institutional diversity, other nations also feature cross-regional institutional variations which have significant impact at within-country level in the interplay between institutions, human capital and economic development (Gennaioli et al., 2013; Acemoglu et al., 2014).

[17] Also many universities operate in several cities through their affiliate campuses (Education in the Russian Federation, 2014).

[18] In Russia, a postsecondary degree is not a prerequisite for admission into a law program. Typically, in order to obtain a law degree, one enrolls in a Faculty of Jurisprudence without any additional education beyond high school. This is an important advantage of our approach based on subnational jurisdictions in a single country, where both STEM and law occupations require similar level of training at the entry level.

Russian educational system underwent a number of reforms, including the adoption in 2007 of the Bologna educational standards prevailing in Europe,[19] and in particular the transition to a two-tier Bachelor's and Master's degree system. A major reform was the introduction of the Unified State Examination (USE), which since 2009 has served as the main admission criterion for Russian universities. Similarly to SAT, USE is administered nation-wide using standardized tests graded by independent committees. Every graduating high school student is required to take USE in mathematics and the Russian language. In addition, two more tests must be selected from a list of other disciplines. One of the main rationales for the introduction of the USE was to streamline the university admission procedure by making it more equitable and corruption-proof.

Initially, the new system was criticized for massive irregularities and suspected fraud, but improved oversight and control have addressed such concerns and over the 2011–2014 observation period used in the paper, USE indeed was a reliable ability measure for university applicants. A number of studies have shown that the USE score is a strong predictor, numerically and statistically, of the subsequent academic performance of enrolled students.[20] For example, Peresetskiy and Davtyan (2011) find that USE scores in the Russian language and in mathematics had significant and about equal effect on student performance during the first two years of study at the Economics Department of the Moscow Institute of Economics and Finance that had a joint program with the London School of Economics. Havenson and Solov'eva (2014) addressed a similar issue but using observations on about 19,000 students at five universities in different Russian regions. The authors show that the correlation between the student's average USE scores and his or her performance in the five universities averages 0.44. Moreover, the coefficients of the separate regressions of students' first year grades in different disciplines on USE scores in Russian and in mathematics are statistically indistinguishable. More specifically, the effects of USE scores in mathematics and in Russian are similar at mathematics and informatics departments, physics departments, economics departments, and marketing and management departments. The authors do not present the results for public policy and law departments.

Unfortunately, we are not able to conduct reliable analysis based on separate USE scores for mathematics and the Russian language.[21] However, given the results from the above cited literature, we do not view the lack of sufficient data for individual subjects as a significant obstacle. Also, the correlation between each of the subjects and the combined score in our data is over 0.8. On other effects of the introduction of USE, including students' mobility, see Francesconi et al. (2019).

A notable feature of the Russian higher education system is the co-existence of the tuition-free or "budget" (*budzhetniki*) track and the "paying" track where students are charged tuition. The students in the latter category typically have significantly weaker USE scores than the "budget" students, since the USE score and some related indicators are the qualifying criteria for tuition-free enrollment. Students with lower USE who are paying for their education choose law and public administration much more often than STEM programs, and as a result, the overall averages in our sample, shown in Table 1 below, are not as starkly different as in Fig. 3. However, if we limit our regressions reported below to tuition-free students only, the results (available upon request) remain qualitatively the same as those for the entire sample.

Available evidence, while not sufficiently comprehensive, indicates that the choice of a university program, especially in such knowledge-specific fields as STEM and law, is a sufficiently strong predictor of the future career, which is essential for our empirical strategy. Gimpelson et al. (2009) estimate that depending on the specific discipline, from 36% to 67% of STEM graduates with Bachelor's degree stay in the chosen fields of study holding jobs which require a Bachelor's degree, while from 8% to 12% do not work in those fields. In addition, 16%–29% of STEM graduates end up working in jobs that do not require Bachelor's degree and 10%–25% have positions that require an advanced degree. As for holders of law degrees, 59% end up working in law-related occupations and 5% do not, 23% work in jobs not requiring a Bachelor's degree while 12% obtain more advanced degrees. Also, according to Gimpelson et al. (2009), Gimpelson and Zinchenko (2021) most of interdisciplinary career changes after graduation, and of "downshifting" (taking jobs where a Bachelor's degree is not required) occur at a lower range of abilities, where our theory predicts low sensitivity of occupational choices to the institutional quality.

4.3. Data

Our main source of data on the allocation of talent is the "Monitoring of Quality of Higher Education Enrollment" project administered since 2011 by the HSE University. Project database entries are newly enrolled university students; every entry includes year (from 2011 through 2014), the chosen university, discipline to be studied, and the student's USE scores. We use the average of USE scores for two mandatory subjects – Russian language and mathematics – as a proxy for ability. These average scores vary between 28 and 100, and its distribution across our sample is shown on Fig. 3. We also use the data collected by the Russian Ministry for Education and Science on relocation of university graduates out of the region of graduation in 2014.[22]

[19] Presently, the Bologna system is slated to be scrapped as part of the general isolationist trend in the country.

[20] See also Hanushek and Woessmann (2008) on generally high reliability of standardized test results in proxying cognitive skills and predicting individual outcomes.

[21] This is because we rely on the data reported by the universities and most of the schools report only the average scores for mathematics and Russian. Moreover, those universities that reported separate scores did it in a highly selective manner with law and public policy departments outside of Moscow and St. Petersburg reporting mostly scores for the Russian language (almost 3,000) rather than the scores for mathematics (fewer than 850). The STEM departments provided much more balanced reporting of these scores (approximately 75,500 for each subject). For comparison, we have the average scores for the two subjects for almost 95,000 students matriculated in law and public policy and over 478,000 students in STEM.

[22] University_graduates_monitoring_data

Table 1
Summary statistics.

Variable	Mean	Std. dev	Min	Max	*N*
Per capita GRP (thousand 2011 RR)	257.9	206.7	63.6	1576	308
Population (mid-year), thousands	1 541	1 099	149	5 429	308
Investment risk index	0.297	0.088	0.147	0.616	308
Average January temperature (Celsius)	−13.4	7.3	−36.5	−0.1	308
Share of graduates staying the region	0.70	0.10	0.32	0.92	308
Share of manufacturing in value added (%)	17.8	10.1	1.2	41.3	308
Share of mining in value added (%)	8.4	13.6	0	68.5	308
Share of state administration in value added (%)	8.5	4.5	1.7	28.5	308
Distance to Moscow (km)	2 274	2 534	168	10 004	308
Republic	0.26	0.44	0	1	308
Law school rating	0.58	0.99	0	5	308
STEM school rating	0.51	0.77	0	3	308
USE scores for STEM (all students)	59.7	11.1	28	100	464 050
USE scores for STEM (“budget” students, 89.6%)	60.5	11.0	28	100	415 737
USE scores for STEM (“paying” students, 10.4%)	52.6	9.2	28.4	98	48 313
USE scores for law and PA (all students)	61.9	12.1	28.1	100	90 710
USE scores for law and PA (“budget” students, 23.6%)	72.3	12.9	29	100	21 376
USE scores for law and PA (“paying” students, 76.4%)	58.7	9.8	28.2	100	69 334
Share of matriculants in STEM	0.33	0.09	0.05	0.60	308
Share of matriculants in law and PA	0.07	0.04	0	0.32	308

We combine enrollment in law and public administration to obtain a measure of the students’ inclination to be involved in rent seeking. Russia is a textbook case of a “grabbing-hand”-type state (Shleifer and Vishny, 2002), and joining government bureaucracy has become a popular career choice for the Russian youth (Natkhov and Polishchuk, 2012).

Our main measure of institutional quality of a Russian region is the investment risk index from the national rating agency Expert RA.[23] During the period covered by our data, this index varied between 0.147 and 0.616. A higher value of the index corresponds to lower institutional quality, and to make the results easier to interpret, we invert this index by subtracting its value for each region from unity. To check robustness, we use an alternative institutional quality measure specified below.

Other regional characteristics used as control variables include logarithm of per capita gross regional product (GRP) in the region in constant year 2011 prices; the shares of manufacturing, mining, and state administration in the value added in the region; the strength of regional STEM-oriented programs (measured by the number of regional universities included in the rating of the top technical schools according to the job search service SuperJob.ru) and the strength of regional law schools;[24] the distance from the regional capital to the national capital city of Moscow; the average temperature in January; and a dummy variable for the region’s status as an autonomous republic, reflecting, among other factors, a significant share of an ethnically non-Russian indigenous population.[25] These few controls generally suffice, since we are dealing with subnational units of the same country, and because we also include year fixed effects.

We drop Moscow, Moscow oblast (combined in our database with the city of Moscow), and St. Petersburg from our regressions, because Moscow and St. Petersburg attract a large number of students from the rest of the country, many of whom go back to their regions after graduation. Therefore, the choices of disciplines by matriculants in Moscow and St. Petersburg universities may not adequately reflect institutional environment in these cities. However, even when Moscow and St. Petersburg students are included in the sample, the results of such robustness checks remain qualitatively unchanged. We also drop sparsely populated autonomous districts (“okrugs” of Chukotka, Nenetstk, and Yamalo-Nenetsk) that have in total only fewer than 230 observations. The qualitative results are not affected by this exclusion. We leave in Khanty-Mansiisk okrug because it has over 10,000 data points. All variables and sources thereof are described in Table 9 in the Appendix. Table 1 shows descriptive statistics for our variables.

[23] This is the most popular and comprehensive measure of institutional quality of Russia’s regions available for all of our regions for all years (see Baranov et al., 2015 for a survey of the Russian regional institutional quality measures). The index aggregates several components of institutional environment, including the quality of regional legislation, management, finances, crime rates, and ecological and social situation. The data used to construct the index are obtained from the official statistics and from private experts. The weights used in the aggregation represent proprietary information of the agency. The details of the methodology are available at www.raex-a.ru (in Russian).

[24] SuperJob_Law_schools_ranking and SuperJob_STEM_schools_ranking

[25] Per capita GRP reflects the general level of development of the region, whereas the shares of manufacturing and mining reflect the structure of the region’s economy. Both of these sectors require engineers and scientists and thus are expected to increase the propensity of individuals to choose science and engineering professions, but mining industry also reflects resource rent availability in the region and may strengthen the incentives to acquire professions such as law and public administration. The share of state administration might be associated with greater demand for lawyers and public administration graduates. The region’s temperature in January and the region’s distance from Moscow are general characteristics of the region that may affect various aspects of the economy. The ratings of the region’s universities and law schools have an obvious bearing on the propensity of the local students to choose particular types of higher education in the region.

4.4. Baseline regressions

We now turn to our empirical analysis, using the above data to test the hypotheses drawn from the theory presented earlier in the paper. We begin with testing Hypotheses A and C about the overall response of the allocation of talent to institutional quality and talent level across our sample. To this end, we estimate the following Probit regression models.[26]

$$DISC_i = \beta_0 + \beta_1 USE_i + \beta_2 I_{jt} + \gamma X_{jt} + \tau_t + \varepsilon_i, \tag{8}$$

where $DISC_i$ is a dummy variable denoting student's i choice of discipline of study, I_{jt} is an institutional quality index for region j at time t (region and year of student i's enrollment), USE_i is the student's USE score, X_{jt} are regional controls specified in the previous section, and ε_i denotes errors clustered by region.

We use two different versions of $DISC_i$: $STEM_i$ and LAW_i which equal 1 (0) if individual i matriculates in sciences or engineering (law or public administration), and 0 (1) otherwise. We use the inverse investment risk index as a measure of institutional quality in most of our regressions, but later in the paper perform robustness checks for an alternative measure.

Estimation results are presented in Table 2. Coefficients of institutions have the expected signs — positive for STEM and negative for law and public administration, and are statistically significant at the 5% level (except for the Probit estimation for enrollment in law, where the significance is at 10%). Therefore, Hypothesis A finds support in our data. These results agree with those obtained earlier at the cross-country level (Natkhov and Polishchuk, 2019), but as argued in the Introduction are more straightforward in that they explain actual individual choices, rather than enrollment aggregates, and are less susceptible to an omitted variable bias. They also enrich the earlier literature by controlling for abilities in predicting the impact of institutions on the overall allocation of talent.[27] Notice that these baseline regressions pool various ability cohorts, where uneven response to institutional quality should be expected, as per Hypothesis B. Later in the paper, we show that this is indeed the case, and the impact of institutions is more strongly pronounced in the middle range of ability, and is weaker for low and top abilities, following an inverted U-shaped pattern. This explains why the statistical significance of institutions for the sample at large is not stronger than it is.

Baseline estimations also provide strong support for Hypothesis C — the coefficients of ability measures have the predicted signs, being negative for STEM and positive for law and public administration, and are significant at the 1% level. The impact of ability is also significant numerically. A one standard deviation increase in USE scores (11.8) reduces the probability of enrollment in STEM by almost 4% and increases the probability of enrollment in law and public administration by more than 1%. Given that about 35.6% of individuals in our data enroll in STEM and only 7.05% enroll in law and public administration, these impacts represent greater than ten percent changes in the relevant enrollment propensities for both subject areas. We conclude that a more talented young person in Russia is more likely, *ceteris paribus*, to pursue education in law and public administration, and less likely to become the proverbial "rocket scientist", or more generally to enlist in a STEM program. This is precisely what our theory predicts, given the overall poor institutional quality across the country. Such findings, plausible as they may be, were out of reach for the previous empirical analyses of the allocation of talent, which did not include individual ability measures.

4.5. Response conditional on talent

To demonstrate the non-uniform reaction of the allocation of talent to institutional quality depending on ability, in accordance with Hypothesis B, we estimate the following Probit and LPM models with time fixed effects and a battery of regional controls:

$$DISC_i = \beta_0 + \beta_1 USE_i + \beta_2 I_{jt} + \beta_3 USE_i \times I_{jt} + \beta_4 (USE_i)^2 + \beta_5 (USE_i)^2 \times I_{jt} + \gamma X_{jt} + \tau_t + \varepsilon_i, \tag{9}$$

where X_{jt} are regional level controls specified in the previous section, and τ_t denotes time fixed effects. As in all our regressions, we cluster errors by region. Quadratic terms and interactions thereof are included to enable us to capture the (inverted) U-shaped effects of response to institutional change across the range of abilities, predicted by our theory.

[26] Here and in the rest of the paper, Probit is our estimator of choice, unless explicitly stated otherwise. However, to ensure robustness, we replicate most of the estimations by running linear probability model (LPM) regressions and arrive at qualitatively identical results, including signs and significance of marginal effects.

[27] STEM and law and public administration stand out among other fields of post-secondary education in Russia in such sharply different responses to institutional quality. The only other major area of studies where enrollment exhibits significant sensitivity to institutions is medicine; estimation of regression (8) for such enrollment shows that as institutions get worse, students are more likely to choose medical schools (especially for the alternative measures of institutional quality introduced in Section 4.7 below; for the baseline investment risk index this effect is marginally significant with p-value 0.11). This finding can be explained as follows. Talents displaced by bad institutions from productive activities do not necessarily limit their next best choices to rent seeking, but may also move to other productive activities such as health care. Health care can serve in such absorbing capacity because it is less vulnerable to predation due to steady demand and high mobility of professionals with specialized skills and transferable client bases. Such built-in protection makes health care somewhat of an institutional "safe haven". The logic of this displacement effect is similar to Murphy et al. (1993), who consider a three-sector model — market production, rent seeking, and subsistence production. In that paper, subsistence is less rewarding than market production, but is insulated from bad institutions, and this is why engagement in subsistence increases when institutions get worse. A similar effect may be at work for medicine, and our model could be modified to a three-sector version that would generate such an effect. Of course, an obvious difference between medicine and subsistence is that the former is much more skill and talent-intensive. Therefore, for the effect we observe to occur, medicine should not only be better insulated from predation, but also highly rewarding for talents. Healthcare in Russia does provide sufficient material rewards to good doctors in part due to the large amounts of informal payments (a euphemism for corruption; see, e.g., Levin and Satarov, 2013), which is another mechanism explaining a negative correlation between institutional quality and enrollment in medical schools. This is a promising direction for future research (which is beyond the scope of the present paper), and we are grateful to an anonymous reviewer that brought this issue to our attention.

Table 2
Effects of institutions and talent on choice of education field.

	Probit		LPM	
	STEM (1)	LAW (2)	STEM (3)	LAW (4)
Talent (USE_i score)	−0.008***	0.004***	−0.003***	0.001***
	(0.000)	(0.001)	(0.000)	(0.000)
Institutional quality (I_{jt})	0.940**	−0.580*	0.331**	−0.086**
	(0.011)	(0.052)	(0.015)	(0.043)
Manufacturing share	0.004	−0.004	0.002	−0.000
	(0.184)	(0.143)	(0.199)	(0.174)
Mining share	0.004	−0.003	0.001	−0.000
	(0.173)	(0.174)	(0.176)	(0.173)
State administration share	0.016	0.009	0.005	0.002
	(0.156)	(0.228)	(0.170)	(0.206)
Log of population	0.061	0.021	0.022	0.004
	(0.334)	(0.598)	(0.331)	(0.423)
Log of per capita GRP	−0.073	0.061	−0.027	0.011
	(0.516)	(0.490)	(0.518)	(0.347)
Mean January temperature	−0.010*	0.007	−0.004*	0.001
	(0.066)	(0.110)	(0.072)	(0.103)
Republic	0.112***	−0.111***	0.042***	−0.013***
	(0.004)	(0.003)	(0.005)	(0.005)
Log of distance to Moscow	−0.027	0.020	−0.010	0.003
	(0.482)	(0.574)	(0.488)	(0.542)
Law school rating	−0.005	0.057***	−0.002	0.008***
	(0.718)	(0.000)	(0.685)	(0.000)
STEM schools rating	0.101***	−0.033	0.038***	−0.005
	(0.004)	(0.193)	(0.006)	(0.144)
Constant	−0.735	−2.469**	0.229	−0.119
	(0.692)	(0.037)	(0.738)	(0.456)
Number of regions (clusters)	77	77	77	77
Observations	1 296 803	1 296 803	1 296 803	1 296 803

Notes: Robust p-values are in parentheses. Standard errors are clustered by region.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

The estimation results presented in Table 3, and the marginal effect graphs shown in Fig. 4, support the predictions of our model, and confirm Hypothesis B.[28] The coefficients of linear interaction terms (β_3) are positive (negative) in the STEM (LAW) regressions while the coefficients of the interaction terms with squared USE variables (β_5) are negative (positive). Marginal effects of institutional quality in these regressions equal $\beta_2 + \beta_3 USE + \beta_5 (USE)^2$, and we expect these marginal effects to exhibit an inverted U-shape for STEM and be U-shaped for LAW with the confidence intervals widening substantially at both ends of ability distribution.[29] This is indeed the case, as the graphs of marginal effects and 95% confidence intervals clearly demonstrate. The probability of choosing a STEM discipline is not affected by an improvement of institutions at the low level of talent (USE scores in the 50's), then it rises in ability both in magnitude and statistical significance, peaks at USE around 85, and afterwards declines as USE approaches its maximal level. For law and public administration, we obtain a mirror reflection of the STEM response: the likelihood of choosing these disciplines by prospective students with USE scores in the 50's is unaffected by institutional change, but in the middle range of ability (USE score between 60 and 85), the effect of improved institutions is negative and highly significant. For higher talents, this effect weakens and becomes insignificant.

The effects of institutional quality on the allocation of talent are significant in the mid-range of ability (as opposed to low and top abilities) not only statistically, but also quantitatively. For example, based on marginal effects from the $STEM_i$ regression, one standard deviation improvement of institutional quality (0.088) increases the probability that the individuals with USE score of 80 would choose STEM discipline rather than any other subject by 0.059. Given that about 28% of the matriculants with USE scores between 75 and 85 in our data choose to enroll in STEM disciplines, this represents a 21% increase in the probability of enrollment in STEM. One standard deviation decline of institutional quality raises the probability that a person with USE score around 80 would enroll in law or public administration by 0.011, which is a substantial change, given that in our data set the propensity of a person with such USE scores to take up law or public administration is 0.078. However, responses of mediocre and top ability individuals are much weaker — an effect that to the best of our knowledge was not observed in the earlier literature.[30]

Although the above approach produces clear evidence that occupational choices follow institutions, conditional on ability level, in accordance to Hypothesis B, it imposes a specific functional form on the interplay between institutional quality and abilities as joint determinants of occupational choice. Alternatively, we can test the main prediction of our model that the sensitivity of the allocation of talent to the quality of institutions is highest in a middle range of ability, by running separate regressions for different

[28] Given the parametric nature of Eq. (9), the estimates of this model might be driven by the largest cohorts in the talent distribution. To eliminate the potentially distorting effect of these cohorts, and as a robustness check, we also ran weighted regressions with weights equal to inverse frequencies of USE scores

Table 3
Interplay of institutions and talent. Regressions with investment climate index as a measure of institutional quality.

	Probit		LPM	
	STEM	LAW	STEM	LAW
	(1)	(2)	(3)	(4)
Talent (USE_i score)	−0.028	0.146***	−0.026	0.020**
	(0.690)	(0.003)	(0.182)	(0.010)
Institutional quality (I_{jt})	−3.895	6.341***	−1.903**	0.878***
	(0.134)	(0.003)	(0.014)	(0.007)
$USE_i \times I_{jt}$	0.101	−0.201***	0.057**	−0.028***
	(0.288)	(0.003)	(0.039)	(0.009)
$(USE_i)^2$	−0.000	−0.001**	0.000	−0.000**
	(0.743)	(0.012)	(0.591)	(0.035)
$(USE_i)^2 \times I_{jt}$	−0.000	0.001***	−0.000	0.000**
	(0.681)	(0.010)	(0.157)	(0.027)
Controls as in Table 2	✓	✓	✓	✓
Constant	1.440	−7.520***	1.399	−0.816**
	(0.599)	(0.000)	(0.119)	(0.010)
Number of regions (clusters)	77	77	77	77
Observations	1 296 803	1 296 803	1 296 803	1 296 803

Notes: Robust p-values are in parentheses. Standard errors are clustered by region.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

intervals of USE scores. Specifically, we estimate rolling regressions without any interaction terms, starting with matriculants whose USE scores are in the 50 to 60 points range, and shifting up the ten points range by one point at a time, until it reaches its top position from 90 to 100. For each position of the sliding range, we estimate the following models:

$$DISC_i = \alpha I_{jt} + \gamma X_{jt} + \tau_t + \varepsilon_i, \tag{10}$$

where variable names have the same meaning as in Eq. (8). Note that we do not include USE_i, because it exhibits little variation within a range.[31] The variable of interest in regression (10) is the coefficient of institutional quality; its values for the LPM sliding regressions are presented in Fig. 5.[32]

The estimation results agree with what the theory predicts: the coefficients in the STEM (LAW) regressions are close to zero and statistically insignificant when abilities are low, then rise in absolute values and have the expected signs, reaching the 1% significance level, and subsequently decline in magnitude and (for law and public administration enrollment) in significance for top ability ranges. Overall, these coefficients follow the predicted (inverted) U-shaped patterns.

The above analysis provides strong empirical support for our theory. These results are consistent across various estimation approaches, each with its own advantages and disadvantages, but all of them pointing to the same general patterns.

4.6. Endogeneity problem

Stark as they are, the reported results could be questioned due to the endogeneity bias. Two common causes of endogeneity are omitted variables and reverse causality. One potentially relevant omitted variable could be the uneven capacity in various regions to offer education in STEM disciplines. Education in STEM is highly capital intensive and requires specialized skills and equipment, and hence cannot adjust to the evolving demand as quickly as programs in law and public administration. Russia's present educational capacity in STEM has been largely inherited from the Soviet times, whereas, as explained in Section 4.2, in the post-Soviet period there has been a major expansion of law and public administration programs. In addition, we control for the quality of technical universities in the regions. If the pre-existing STEM capacity for some reasons is correlated with the regional investment climate, both the investment climate and the allocation of talent could be driven by the Soviet legacy.

However, the data show no systematic link between the STEM capacity, gauged both qualitatively and quantitatively, and regional investment climate. Quantitatively, the correlation between the pre-existing STEM capacity (measured by the number

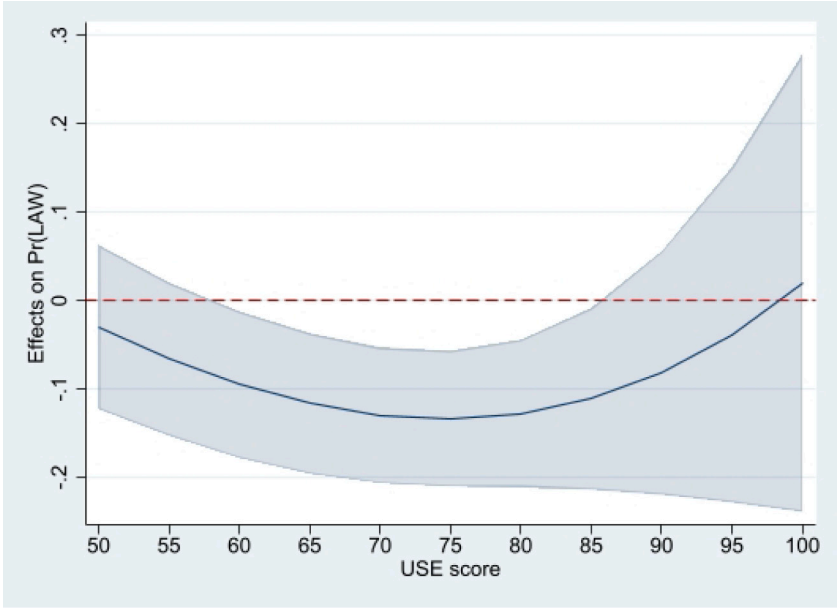
in every 5-point interval between scores of 30 and 100. The results of such weighted regressions are similar to the estimates of unweighted ones reported in Table 3.

[29] Marginal effects in these and all other regressions are obtained using "margins" command in Stata.

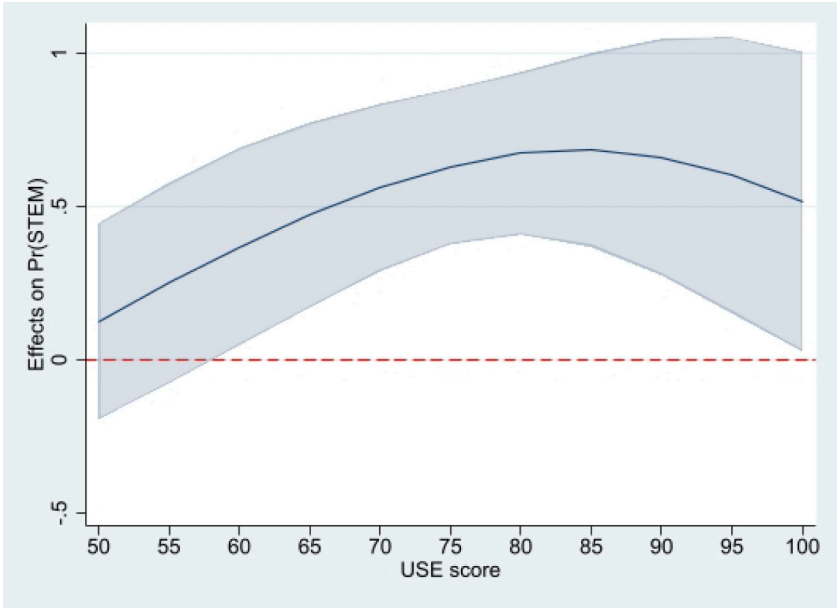
[30] Another way to explore the variable and potentially nonlinear impact of institutions on educational choices, conditional on ability level, is to estimate modified versions of regressions (8) and (9), where USE score is replaced by a categorical variable representing different USE intervals (quadratic terms in regression (9) become redundant in such modification). In such robustness test, we used four different dummy variables for USE scores (25th percentile, interval between 25th and 75th percentiles, interval between 75th and 95th percentile, and the top five percent of USE scores). The results of such estimations are consistent with those in Table 2 and the marginal effects shown in Table 3 and Fig. 4. Adding fixed effects for different 10-point ranges of USE does not change the results.

[31] Retaining this variable in the rolling regressions produces almost identical results.

[32] Marginal effects calculated for Probit estimations of models (10) exhibit similar trends.



(a) Effect for enrollment in Law and Public Administration

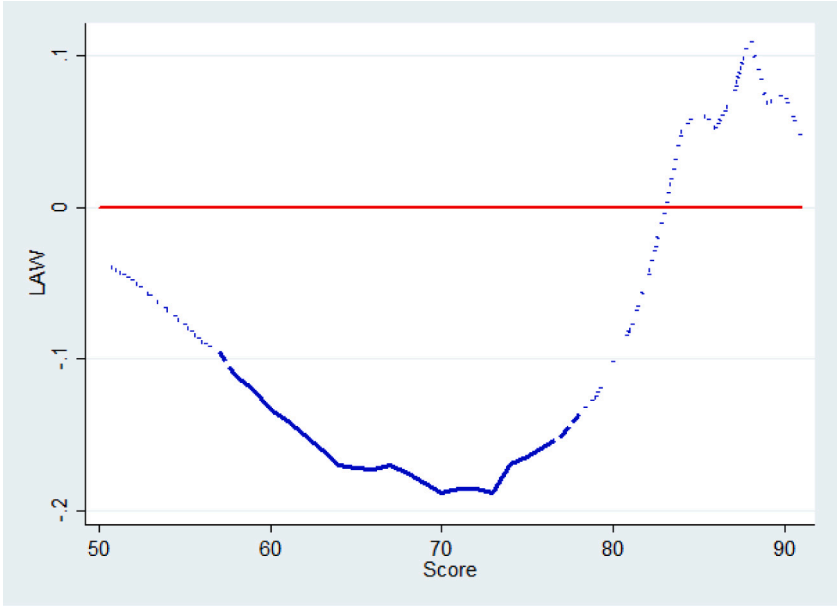


(b) Effect for enrollment in STEM disciplines

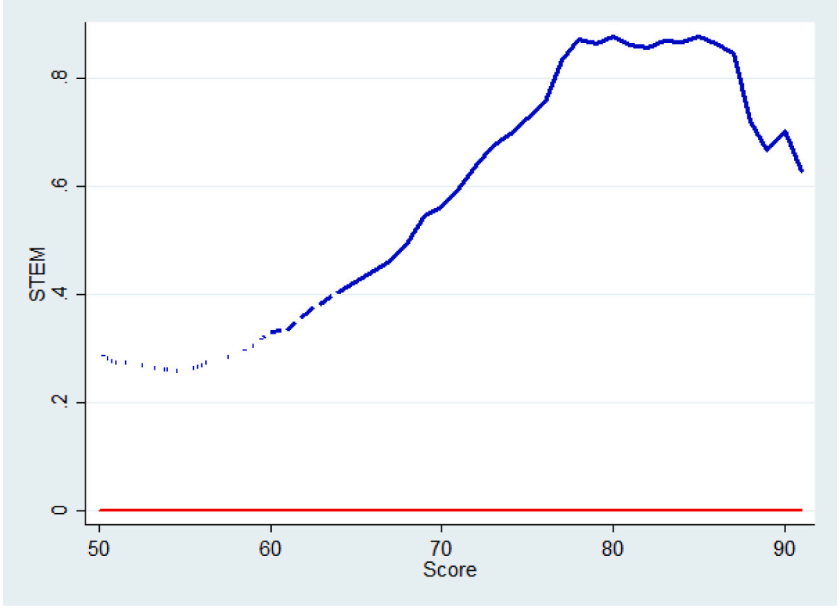
Fig. 4. Marginal effects of institutional change over the talent range and 95% confidence intervals: regressions with interaction terms.

of technical universities slots per capita in a region in 1991) and the present investment climate equals 0.2 and is statistically insignificant. Qualitatively, all of the regions (other than Moscow and St. Petersburg which are excluded from our analysis) with Russia's top STEM universities[33] have investment risks around or just above the median, and none of these regions is in the top 40% of the regional institutional quality distribution. Therefore, the pre-existing STEM capacity is hardly a cause of an omitted variable bias.

[33] These universities have been designated by the Russian government as national leaders in STEM by granting them the official elite status of "National Research Universities".



(a) Effect for enrollment in Law and Public Administration



(b) Effect for enrollment in STEM disciplines

Fig. 5. Marginal effects of institutional change over the talent range: Rolling regressions.
Solid line — 1% significance;
Dashed line — 5% significance;
Dotted line — more than 10% significance.

In a more systematic and comprehensive approach to the omitted variable problem, we include in regression models the full set of region-year fixed effects which would account for all variables conceivably relevant for our analysis. Obviously, in such estimations we cannot retain measures of institutional quality (which are subsumed by the fixed effects), but could still study the impact of ability on the allocation of talent, and even draw some inferences about the impact of institutions by checking for correlations between region-year fixed effects and our institutional quality index. Such regressions, if turning out as expected, would provide additional evidence in support of Hypotheses A and C. Furthermore, in search of evidence of non-linear effect predicted by Hypothesis B, we could include in regression models with region-year fixed effects interactions of institutions and ability and ability square, similarly

Table 4
Estimations with region-year fixed effects (LPM).

	STEM (1)	LAW (2)	STEM (3)	LAW (4)
USE_i score	−0.003***	0.001***	−0.034***	0.024***
	(0.000)	(0.001)	(0.087)	(0.002)
$(USE_i)^2$			0.000	−0.000***
			(0.042)	(0.010)
$USE_i \times I_{jt}$			0.067**	−0.033***
			(0.016)	(0.002)
$(USE_i)^2 \times I_{jt}$			−0.0004*	0.0002***
			(0.097)	(0.007)
Region-year fixed effects	✓	✓	✓	✓
Average marginal effects of USE_i	−0.003***	0.001***	−0.003***	0.001***
	(0.000)	(0.001)	(0.001)	(0.000)
Adjusted R^2	0.037	0.017	0.040	0.017
Number of regions (clusters)	77	77	77	77
Observations	1 296 803	1 296 803	1 296 803	1 296 803

Notes: Robust *p*-values are in parentheses. Standard errors are clustered by region. All regressions include fixed effects for region-year pairs.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

to the regression models (9). To these ends, we estimate the following LPM regressions:

$$DISC_i = \beta_1 USE_i + \mu_{jt} + \varepsilon_{it}, \tag{11}$$

$$DISC_i = \beta_1 USE_i + \beta_2 USE_i \times I_{jt} + \beta_3 (USE_i)^2 + \beta_4 (USE_i)^2 \times I_{jt} + \mu_{jt} + \varepsilon_{it}, \tag{12}$$

where μ_{jt} are region-year fixed effects.[34] Estimation results presented in Table 4.

Estimations of model (11) reported in columns (1) and (2), confirm Hypothesis C even with the most stringent set of controls — the propensity for education in STEM among Russian youth declines in ability, whereas for education in law and public administration ability has the opposite impact.[35] It is noteworthy that coefficients of the ability measure in estimations (11) are essentially the same as in the LPM regressions reported earlier in Table 2 (columns (3) and (4)) with the initial set of regional controls; such similarity further alleviates concerns about an omitted variable bias. Notice further that the region-year fixed effects estimated in regression (11) for enrollment in STEM are *positively* correlated with our institutional quality index (correlation 0.25, statistical significance $p < 0.001$), whereas for the region-year fixed effects from the same model for enrollment in law and public administration such correlation is *negative* (−0.10; $p < 0.001$). These correlations reveal the predicted role of institutions in the allocation of talent even when institutions are "hidden" in the overall region-year fixed effects.[36]

Estimations of model (12) (columns (3) and (4)) also come out as expected: the coefficients β_2 and β_4 of the interaction terms are statistically significant and have the predicted signs, same as in the estimation of model (9) with the original controls, reported in Table 3. Notice that in the model with region-year fixed effects the coefficients of interactions between institutions, abilities and ability squares have higher statistical significance than in the baseline model (9), so that with the exhaustive set of controls confirmation of Hypothesis B gets even sharper. We conclude that our regressions show no evidence of an omitted variable bias (which was, to begin with, less likely at the subnational level).

Another possible source of endogeneity is reverse causality. Our key empirical findings – on the impact of abilities on the allocation of talent, and on how abilities affect the response of occupational choices to institutional variations – are less likely to be affected by reverse causality, inasmuch as abilities reflect innate cognitive skills and are more exogenous than other human capital measures such as educational attainments.[37]

However, reverse causality is still possible in the relationship between institutions and the allocation of talent. For example, regions that for some reason have been producing more lawyers in the recent past, could be experiencing the potentially negative effects of excess supply of lawyers on the investment climate. The standard way to deal with the possibility of such reverse causality is to find an appropriate instrument for the quality of institutions. Finding a good instrument for the regional institutional quality

[34] The presence of fixed effects could render Probit estimations problematic, but in our case LPM and Probit produce similar results.Ditto for extimators with frequency weights.

[35] We arrive at similar results by calculating marginal effects of USE scores in estimations of Eqs. (12), where such effects are negative and highly statistically significant for STEM and positive and highly statistically significant for law and public administration for the entire range of institutional quality of the Russian regions.

[36] For another example of using fixed effects to reveal underlying causes of observed phenomena see, e.g., Acemoglu et al. (2009).

[37] "Causation concerns are very different in the case of cognitive skills than with the quantity of schooling and are much less likely to be a significant issue in interpreting the results" (Hanushek and Woessmann, 2008, p. 636). To rule out a potential endogeneity mechanism (Hanushek and Kimko, 2000) investigated whether students' standardized test scores were systematically affected by their schools' resources prior to the tests, and found no such effect.

Table 5
2SLS estimations of the interplay between institutions and abilities (second stage).

	Probit		LPM	
	STEM (1)	LAW (2)	STEM (3)	LAW (4)
Talent (USE_i score)	−0.155*	0.272***	−0.073***	0.036***
	(0.071)	(0.000)	(0.003)	(0.000)
Institutional quality (I_{jt})	−8.585***	11.128***	−3.630***	1.459***
	(0.005)	(0.000)	(0.000)	(0.000)
$USE_i \times I_{jt}$	0.275**	−0.373***	0.120***	−0.050***
	(0.017)	(0.000)	(0.000)	(0.000)
$(USE_i)^2$	0.001	−0.002***	0.000**	−0.000***
	(0.258)	(0.000)	(0.022)	(0.000)
$(USE_i)^2 \times I_{jt}$	−0.002*	0.003***	−0.001***	0.000***
	(0.081)	(0.000)	(0.003)	(0.000)
Controls as in Table 2	✓	✓	✓	✓
Constant	4.994*	−10.992***	2.693***	−1.267***
	(0.088)	(0.000)	(0.007)	(0.000)
Under-id. test (p-value)			0.049	0.049
Kleibergen–Paap rk Wald F statistic			1.537	1.534
R^2			0.019	0.019
Number of regions (clusters)	77	77	77	77
Observations	1 296 803	1 296 803	1 296 803	1 296 803

Notes: Robust p-values are in parentheses. Standard errors are clustered by region.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 6
2SLS estimations with region-year fixed effects (LPM; second stage).

	STEM (1)	LAW (2)	STEM (3)	LAW (4)
Talent (USE_i score)	−0.017***	0.007***	−0.079***	0.041***
	(0.004)	(0.003)	(0.000)	(0.000)
$(USE_i)^2$			0.0005***	−0.0003***
			(0.008)	(0.000)
$USE_i \times I_{jt}$	0.018***	−0.008**	0.129***	−0.056***
	(0.006)	(0.004)	(0.030)	(0.000)
$(USE_i)^2 \times I_{jt}$			−0.001***	0.0004***
			(0.010)	(0.0001)
Under-id. test (p-val)			0.023	0.023
Kleibergen–Paap rk Wald F statistic			9.98	9.98
Stock–Yogo weak ID test (20% max IV size)		6.66	3.95	
Number of regions (clusters)	77	77	77	77
Observations	1 296 803	1 296 806	1 296 806	1 296 806

Notes: Robust p-values are in parentheses. Standard errors are clustered by region. All regressions include fixed effects for region-year pairs.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

is a difficult task. We propose using indexes of investment climate in 2005 (i.e., six years prior to the beginning of our data on enrollments) as such an instrument. This is a suitable choice, since it is highly unlikely that the excess supply of lawyers would be sufficient to influence regional institutional quality in 2005, a little over a decade since the start of the Russian transition. It takes significant time to open new law schools and educate new lawyers, and for those to have an impact on regional institutions.[38]

We report 2SLS estimations with the above instruments of regression models (9) and (12) in Tables 5 and 6.

The first stage results indicate that the instruments are sufficiently strong in the 2SLS version of Eq. (12), but are relatively weak in the 2SLS version of Eq. (9). However, all the interaction term coefficients in the second stage have the signs that support our theory and are statistically significant at least at the 5% level. The point estimates of the coefficients of interaction terms in the IV regressions are greater in absolute value than the coefficients of interaction terms in Tables 3 and 4, and have lower p-values. As before, to check robustness, we use Probit and frequency weights estimators, and arrive at essentially the same conclusions.

[38] We would have preferred to use even earlier indicator of institutional quality as an instrument, but ratings of investment climate began only in 2002 and ratings prior to 2005 are available for only 48–51 regions, depending on the year, out of 77 included in our sample.

4.7. Alternative measures of institutional quality

Our findings so far have been based on one particular measure of institutional quality — the regional investment risk index. As explained earlier, we chose this measure, by far the most popular and widely tested in Russian subnational institutional analyses (see, e.g., Baranov et al., 2015 and sources cited therein), because it is available for most regions and for all years in our sample, and because of its breadth, incorporating such institution-related features as government effectiveness and public safety and security. However, this measure might be too broad, because it also reflects economic trends and financial conditions of regional governments and private enterprises. Even though we control for regional per capita output, this might not entirely separate the effects of economic development from institutional quality *per se* within the index. Hence as a robustness check of our results, we use other measures of institutional quality, namely the inverse share of informal employment and regional corruption indexes, one of which produced by the Public Opinion Foundation (FOM; www.fom.ru),[39] and the other — by N. Petrov and A. Titkov under the auspice of Moscow Carnegie Center (Petrov and Titkov, 2013; see also Baranov et al., 2015). Using the first of these measures is based on the premise that the informal sector arises in response to dysfunctional or predatory formal institutions (La Porta and Shleifer, 2014), and the other two — that corruption comprises and signals systemic institutional failures.

The estimates of model (9) using inverse of the informal employment as institutional quality measures I_{jt} are very close to our benchmark results, but the marginal effects for LAW are not statistically significant although they exhibit the same sign pattern. Note, however, that the interaction terms coefficients in the LAW regressions have the expected signs and are statistically significant. Similar results obtain when we use regional corruption index from FOM. Lower significance of these estimates is not surprising, given that the variations of informal employment shares had to be interpolated for some of the years, and FOM corruption index is available only for one year (2011). We obtain a better fit for the other corruption measure — the Petrov–Titkov index, which is available for most of our observation period of 2011–2014.[40] General patterns of the marginal effects of institutional quality obtained for these measures are remarkably similar to each other and agree with the baseline estimations, proving their robustness to how Russian regional institutions are measured. We illustrate these findings by Fig. 6, where marginal effects for the Petrov–Titkov corruption measure are presented.

4.8. Accounting for mobility

As noted earlier, one could argue that a university graduate could be pursuing his/her trade in a region other than where the university is located, and the possibility of migration of university graduates to another Russian region (or perhaps abroad) is a source of noise in our data. As explained in Section 3.4 (Footnote 14), when mobility is correlated with ability, it will not alter the main hypotheses. However, if the relationship between graduates' mobility and regional institutions is systematic – in some regions graduates are in general more mobile than in the others – this could introduce biases in our estimates. To address such concerns and test the predicted impact of mobility on the link between the allocation of talent and institutional quality in the region of graduation, we use the above referenced data collected by the Russian Ministry of Education and Science on mobility of university graduates out of the region of graduation in 2014. According to the available data, for most of the regions such migration was in the range of 15%–35% of graduates.

Uneven outward mobility of university graduates in Russian regions is another valuable source of variation in our analysis, suggesting an additional test of the impact of institutions on the allocation of talent. Higher mobility reduces the impact of local institutions on the reward structure, and hence on the career choice of university students who factor in the possibility to pursue their trade outside of the region of education. Our theory confirms this intuition, suggesting that the impact of local institutions on the allocation of talent should be more pronounced in regions with lower mobility of university graduates (Hypothesis D). In order to test this hypothesis for Russian regions, we estimate the marginal effects of institutional quality on the choice of discipline depending on the ability level *and* the scale of outmigration by using the following Probit regression model:

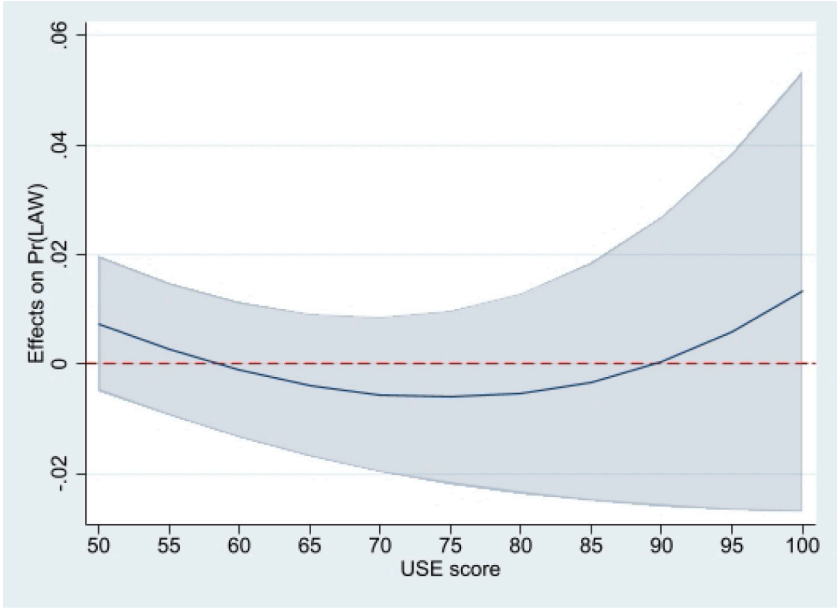
$$\begin{aligned} DISC_i = &\beta_0 + \beta_1 USE_i + \beta_2 I_j + \beta_3 STAY_j + \beta_4 (USE_i)^2 + \beta_5 USE_i \times I_j + \\ &+ \beta_6 (USE_i)^2 \times I_j + \beta_7 USE_i \cdot STAY_j + \beta_8 I_j \times STAY_j + \\ &+ \beta_9 USE_i \times I_j \times STAY_j + \beta_{10} (USE_i)^2 \times I_j \times STAY_j + \beta_{11} X_j + \varepsilon_j, \end{aligned} \tag{13}$$

where $STAY_j$ is the share of graduates staying in the region. Estimation results are reported in Tables 7 and 8 for, respectively, enrollments in STEM disciplines and in law and public administration.

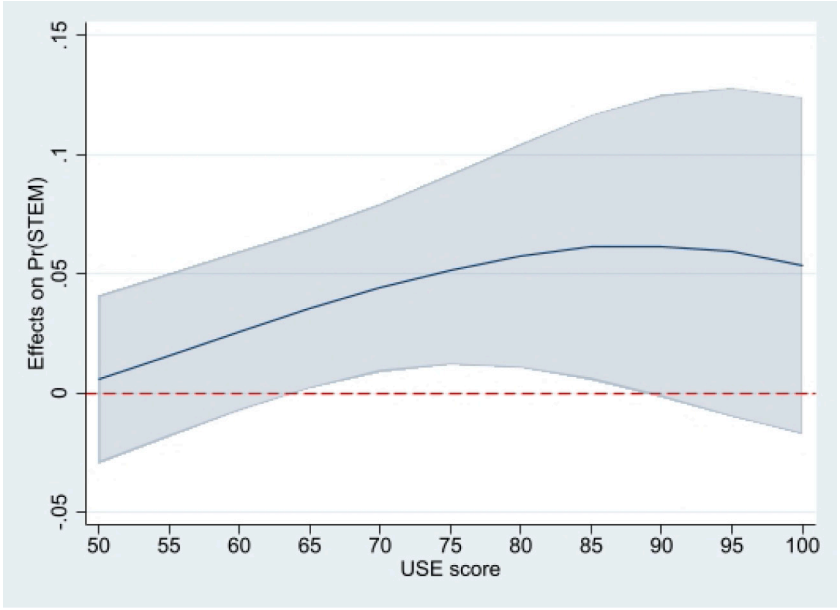
Given that now there are two variables of interest – ability and graduates' mobility – we present marginal effects for various combinations of both of these variables. These results agree with the theory's predictions and confirm Hypotheses B and D. For low levels of mobility (last columns of Tables 7 and 8), we observe the (inverted) U-shaped pattern in relation to talent, as per

[39] See Baranov et al. (2015) for a description of these and other institutional quality measures for Russian regions. The informal employment share is obtained from Rosstat with the data for missing years (2011 and 2013–2014) linearly interpolated from the data for 2009, 2012, and 2015. FOM measure is based on a survey of 54,400 respondents conducted in February 2011. The index reflects the percentage of respondents from the region who gave a positive answer to the question "Have you personally in the last year or two encountered a state official who asked or expected from you an unofficial side payment for his/her service?"

[40] The publicly available Petrov–Titkov measures of corruption end in 2010, i.e., just before our 2011–2014 observation period. We obtained the data for 2013–2014 privately from Aleksei Titkov. For the missing years 2011 and 2012, we assumed that 2011 numbers were similar to 2010, and estimated 2012 values as an average between 2011 and 2013.



(a) Effect for enrollment in Law and Public Administration



(b) Effect for enrollment in STEM disciplines

Fig. 6. Marginal effects of institutional change over the ability range and 95% confidence intervals based on Petrov-Titkov measure of corruption: regressions with interaction terms.

Hypothesis B. However, these patterns are flattening with higher mobility (first column). For the highest mobility level in the tables, the marginal effects of local institutions lose significance altogether in the case of law and public administration, and remain significant only at the peak of the U-shaped curve in the case of STEM.

Another way to visualize the joint impact of talent and mobility is to draw two-dimensional graphs of the marginal effects of institutions for the allocation of talent, conditional on the above variables, obtained from estimations of model (13). Such graphs, presented in Fig. 7, show (inverted) U-shaped patterns for lower mobility (higher values of STAY variables), which become "squeezed" closer to zero level when mobility rises. All of the above confirms Hypothesis D.

Table 7
Marginal effects of institutions for Probit model with migration measure (2014 data). Dependent variable: enrollment in STEM.

USE score	Share of graduates staying in region, %		
	65	75	85
50	0.345	0.404**	0.463*
	(0.302)	(0.039)	(0.088)
60	0.648*	0.726***	0.804**
	(0.067)	(0.001)	(0.013)
70	0.875***	0.858***	0.841**
	(0.009)	(0.000)	(0.015)
80	0.992***	0.800***	0.598*
	(0.001)	(0.000)	(0.081)
90	0.960	0.575**	0.112
	(0.014)	(0.048)	(0.774)
100	0.769	0.249	−0.533
	(0.137)	(0.534)	(0.324)

Notes: Marginal effects are based on Probit regressions that include our standard control variables; Robust standard errors clustered by region are in parentheses $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 8
Marginal effects of institutions for Probit model with migration measure (2014 data). Dependent variable: enrollment in law and public administration.

USE score	Share of graduates staying in region, %		
	65	75	85
50	−0.095	−0.113*	−0.130
	(0.315)	(0.063)	(0.169)
60	−0.105	−0.170**	−0.237**
	(0.305)	(0.017)	(0.034)
70	−0.073	−0.140*	−0.212**
	(0.443)	(0.077)	(0.049)
80	−0.010	−0.025	−0.043
	(0.917)	(0.782)	(0.741)
90	0.073	0.161	0.276
	(0.583)	(0.207)	(0.275)
100	0.163	0.412*	0.775
	(0.406)	(0.055)	(0.138)

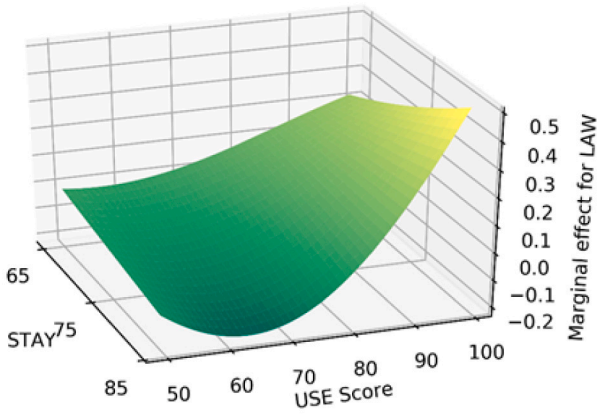
Notes: Marginal effects are based on Probit regressions that include our standard control variables. Robust standard errors clustered by region are in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

5. Concluding comments

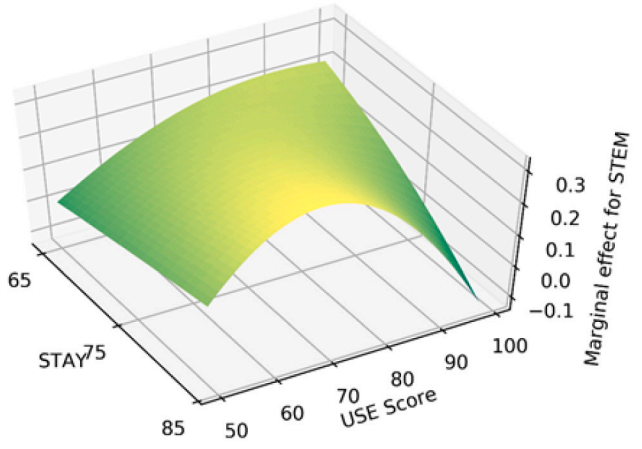
Institutions affect economic behavior, and long-term investment decisions are particularly sensitive to the institutional quality. Using Russian regional data, we show empirically that this conclusion extends onto the investments in human capital and hence on the allocation of talent. Market-supporting institutions attract talents to productive activities, and this is reflected in the choices of fields of study by university students, more of whom select STEM disciplines. Poor institutions, on the other hand, make rent seeking more attractive than directly productive activities, and this causes higher enrollment in law and public administration.

While such association between institutions and the allocation of talent was predicted in the earlier literature, where it also found some empirical support, our findings have a more solid foundation provided by a unique dataset comprising educational choices of 1.3 million Russian university students. The dataset includes information about students' abilities reflecting their cognitive skills. Treating abilities as a factor of its own in the allocation of talent, we obtain a more nuanced description of the link between institutions and human resource deployment. In particular, we show that as abilities rise from lower to medium and higher levels, individual occupational choices become more sensitive to the institutional environment. However, this pattern does not extend all the way to the top talents, where the rising sensitivity trend is reversed, and highest ability individuals displayed negligible sensitivity to institutional variations within our sample. The preference to activities associated with rent seeking clearly expressed in the upper tail of the talent distribution remained by and large unwavering and unaffected by interregional differences in institutional quality, since those differences, significant in and of themselves, were not radical enough to break out of the fold of poor institutions nationwide.

This finding, in agreement with the classical "second-best principle" (Lipsey and Lancaster, 1956), confirms a general dictum that to make a tangible impact for economic development, an institutional improvement should be sufficiently radical, changing the



(a) Effect for enrollment in Law and Public Administration



(b) Effect for enrollment in STEM disciplines

Fig. 7. Marginal effects of institutional change depending on talent and mobility.

nature of an institutional regime from largely extractive, as has been the case in Russia, to inclusive, supplying public production inputs for economic growth (Acemoglu and Robinson, 2012). Gradual institutional improvements at the margin, addressing "micro-market failures" and providing somewhat more amenable and predictable investment climate, fall short of what is required to supply an adequate institutional foundation for sustainable development. The theory and empirics presented in the paper confirm that without such foundation, incremental institutional change will not motivate top talents to invest their abilities in productive activities, denying economic growth of its key input.

Acknowledgments

We thank Gregory Androushchak, Vladimir Gimpelson, Aleksei Titkov, Alex Rubin, Andrei Shleifer, Maria Yudkevich, and two anonymous reviewers of the Journal for valuable comments and assistance. The usual caveat applies. Timur Natkhov gratefully acknowledges support from the Basic Research Program of the National Research University Higher School of Economics.

Appendix. Data sources

See Table 9.

Table 9
Variables descriptions and sources.

Variable	Description	Source
Unified State Examination (USE) score	Individual USE scores for students matriculating in various disciplines at almost all Russian universities. These data are combined with the discipline of the matriculants and the location of the university.	National Research University Higher School of Economics "Monitoring of quality of higher education enrollment"
Per capita GRP	Per capita GRP in thousands of year 2011 rubles (deflated by GDP deflator).	Regiony Rossii, various years and authors calculations
Share of manufacturing	Share (in percent) of manufacturing in value added in the region.	Regiony Rossii for 2014.
Share of mining	Share (in percent) of mining in value added in the region.	Regiony Rossii for 2014.
Share of administration	Share (in percent) of administration in value added in the region.	Regiony Rossii for 2014.
Investment risk index	Composite investment risk ratings of Russia's regions. Higher value of the index indicates higher investment risk. In the regressions, we invert this index by subtracting its value from unity.	Expert RA regional rating
Average January temperature	Average temperature (Celsius) in January.	Goskomstat (2012).
Share of STEM enrollees in total (STEM)	Share of students enrolled in science, technology, engineering and mathematics in total enrollments.	National Research University Higher School of Economics under the "Monitoring of quality of higher education enrollment" project and authors' calculations.
Share of law and public administration enrollees (LAW)	Share of students enrolled in law and public administration in total enrollments.	National Research University Higher School of Economics under the "Monitoring of quality of higher education enrollment" project and authors' calculations.
Autonomous republic	A dummy variable with a value of 1 if the region has a status of an autonomous republic and a value of 0 otherwise.	Regiony Rossii for 2014.
Mobility of graduates	Share of graduates staying in the region after graduation.	Russian Ministry of Education and Science.

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