INSTITUTIONS AND THE ALLOCATION OF TALENT*

Leonid Polishchuk†, Timur Natkhov‡,

Strong institutions attract talent to productive activities, whereas weak ones raise the appeal of redistribution. We propose a theoretical model that predicts that more talented individuals are particularly sensitive in their career choices to the quality of institutions, and test these predictions on a sample of 95 countries. We find a strong positive association between the quality of institutions and graduation of university students in science, and an even stronger negative correlation with graduation in law. The quality of human capital makes this distinction particularly sharp. We also show that the allocation of talent affects social returns to human capital.

JEL Codes: D02, I25, J24, O43

Key words: institutions, allocation of talent, rent-seeking, human capital, economic growth

* We thank Michael Alexeev, Gregory Androushchak, Anna Balsevich, Vladimir Gimpelson, Andrei Shleifer, Georgy Sunyaev and Ric Uslaner. Support of the Center for Basic Research at the National Research University Higher School of Economics is gratefully acknowledged.

† Professor, National Research University Higher School of Economics. E-mail: *leonid.polishchuk@gmail.com*

‡ Associate Professor, National Research University Higher School of Economics. E-mail: *timur.natkhov@gmail.com*

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I. Introduction

Poland and Ukraine are two Slavic countries of roughly equal sizes which share common border and history, have significant linguistic and cultural affinity, and are otherwise similar in many respects. These two nations proved to be compatible enough to jointly host the 2012 Euro Football Championship. Such proximities notwithstanding, Polish and Ukrainian university students have markedly different preferences over fields of study. In Poland the share of students pursuing degrees in science was recently close to 8%, while in Ukraine it was less than 4%. At the same time more than 8% of all Ukrainian students are studying law, whereas in Poland this share is mere 2.5%. Pre-existing educational capacities of the two countries would suggest the opposite: prior to the breakup of the Soviet Union Ukraine had cutting-edge research and educational facilities in science and engineering, including aviation and space technologies, whereas in Poland the tradition and culture of legal studies was stronger than in its Eastern neighbor. Evidently demand-side forces prevailed over those on the supply side.

We argue in this paper that such discrepancy reflects the uneven quality of institutions in the two countries. According to the Governance Matters dataset (Kaufmann, Kraay, and Mastruzzi 2010), Poland's percentile rank on the Rule of Law global scale in 2010 was around 70, whereas for Ukraine, despite the abundance of law degree holders, it was just 23. Control of Corruption percentile ranks for the two countries were respectively 70 and 15. Stronger institutions make young Poles confident in the ability to earn good rates of returns to their skills, knowledge, and innovations in modern technologies, whereas young Ukrainians believe that law degrees would better equip them for an institutional environment where the rule of law is feeble and corruption and rent-seeking reign supreme.

Institutions are "rules of the game" affecting incentives and resource allocation. The impact of institutions on growth and welfare depends on whether they reward productive activities that create wealth, or put a premium on rent-seeking and other directly unproductive activities (Bhagwati, 1982) that redistribute wealth away from its creators (North, 1990). Rent-seeking is harmful for growth since it consumes resources that could have been otherwise invested for productive purposes, and suppresses the incentives to engage in productive activities which are made less profitable by rent-seekers. A large literature points out to a strong association between the quality of institutions and governance (including the security of property rights) and economic growth (see e.g. Glaeser et al. 2004; Rodrik, Subramanian, and Trebbi 2004; Besley and Persson 2011).[1]

The link between institutions and economic outcomes involves the allocation of human resources (Murphy, Shleifer, and Vishny 1993; Acemoglu 1995), including such key drivers of economic growth as entrepreneurship and talent. Murphy, Shleifer, and Vishny (1991) argue that growth rates are higher in economies with better protected property rights and lower corruption, because in such economies talented individuals are more likely to be engaged in productive activities than in rent-seeking. Baumol (1990) emphasizes the allocation of entrepreneurial energy: good institutions offer generous rewards to

[1] In what follows, including the empirical part of the paper, we treat institutions as actual "outcomes" (Glaeser et al., 2004), or "equilibria", rather than formal rules which might or might not be properly enforced (Greif, Kingston, 2011).

productive Schumpeterian entrepreneurs and thereby generate innovations, whereas poor institutions drag daring and creative individuals into rent-seeking and other forms or redistribution, and hence stifle productivity growth (see also Mehlum, Moene, and Torvik 2003).

Institutions have a strong impact on investments, including investments in human capital (Pecorino 1992). In the case of conventional investments in physical capital sound institutions serve as a credible commitment to secured property rights, and investors' response drives economic growth (Keefer and Knack 1995). The effect of institutions on the investments in human capital is more qualitative than quantitative. Although Hall and Jones (1999) found a positive association between institutional quality and human capital measured by educational attainment, bad institutions did not impede the rapid growth of education in developing countries observed after World War II.

The impact of education on economic outcomes is actively debated in the literature. On the one hand, in cross-country and, subsequently, cross-regional analyses education is shown to be a major contributing factor to productivity and income (Mankiw, Romer, and Weil 1992; Acemoglu and Dell 2010; Gennaioli et al., 2012); furthermore initial educational endowments have a strong association with the ensuing growth rates. At the same time *accumulation* of "educational capital" in and of itself appears to be unrelated to the rates of economic growth. According to Pritchett (2001) education produces substantial private payoffs by conferring wage premiums, but its impact on growth rates on the top of what should be expected from rising individual incomes of better-educated individuals is *negative.* This means that private gains accruing to increased education come at least in part at the expense of the rest of society, and such "negative externality" indicates the presence of rent-seeking. Indeed, Pritchett suggests rent-seeking as a possible explanation of this "micro-macro paradox", when "… the demand for educated labor comes … from individually remunerative yet socially wasteful or counterproductive activities" (ibid, p. 368).

When human capital accumulation is diverted from production, especially at the managerial level, the economy is lacking a major production input, whereas an inflow of human capital into unproductive activities exacerbates such losses by making rent-seeking more efficient and hence more damaging to

growth. Preference to directly unproductive over productive activities, in its turn, reflects the quality of institutions, and hence institutions and educational capital complement each other as factors of economic development.[2] Recent literature presents evidence of the relevance of economic and political institutions for social returns to schooling and cognitive skills (Hanushek and Woessmann 2008; Rogers 2008; Armelini 2012), pointing out to the institutional quality as an "omitted variable" explaining the divergence between private and social returns to increase in education (Pritchett, 2006).[3]

The complementarity between institutions and human capital accumulation reveals itself in the choice of subject areas of study in tertiary education. It could be expected that good institutions strengthen the appeal of professions and careers in productive activities, whereas bad institutions raise interest in occupations associated with rent-seeking and other forms of redistribution. While such conjecture is present in the literature, to the best of our knowledge it has not been yet properly explored and rigorously tested using cross-country data. This paper fills the gap.

We draw our hypotheses from an equilibrium model, in which an individual can choose between productive activities and redistribution (the latter involves both attempts of rent-seekers on producers' property rights, and offering protection from such attempts). The individual characteristics affecting the choice are talent, which is a payoff multiplier (irrespective of the chosen activity), and an idiosyncratic preference for redistribution over productive activities shaped by disposition, background, and perception of prestige and non-pecuniary rewards (Baumol 1990; Acemoglu 1995), which could be positive or negative and is unrelated to talent. The selection between productive activities and redistribution is thus determined by a combination of tastes and anticipated material payoffs.

[2] Education is thus analogous to natural resources which can be turned by poor institutions into a "resource curse" (Brunnschweiler 2008).

[3] The effect of human capital for economic performance depends not only on formal institutions, but also on social norms such as morality, as demonstrated by Balan and Knack (2012).

The model shows that improved protection of property rights causes more individuals to choose productive activities over redistribution – stronger property rights increase the payoff to productive activities and reduce the appeal of rent-seeking and the demand from protection services. Such a response, however, is uneven across the range of abilities: in their career choices, less talented individuals are not as sensitive to changes in institutional environment as those with higher general abilities. Therefore the impact of institutions on the allocation of talent is more pronounced in the group with abilities in the intermediate range and higher. Those pursuing post-secondary education by and large fall in this category, which justifies our focus in the empirical part of the paper on graduates of colleges and universities. Furthermore the model predicts that when institutions are poor, the relative appeal of redistribution over productive activities rises with talent due to the increasing returns to ability (Murphy, Shleifer, and Vishny 1991), whereas for good institutions the opposite is true.

We treat graduation in sciences as a proxy for the selection of productive activities. Theoretical and empirical evidence indicates that better institutions create a strong demand for such knowledge and skills. Thus, Levchenko (2007) observes that good institutions support more complex production processes that require a greater intensity of skills. Similarly Nunn (2007) shows that good institutions favour contract-intensive industries, nearly all of which are in hi-tech and (broadly defined) science and engineering areas. According to Aghion and Howitt (2009), institutions that support openness and innovations maintain economic growth in the proximity of technological frontier, and at the same time research university-type education is a significant contributor to growth near the frontier.

Pursuing a degree in law is viewed in this paper, as in Murphy, Shleifer, and Vishny (1991), as a possible pass into rent-seeking and other forms of redistribution, including protection from rent-seekers. The tradition to associate legal profession with rent-seeking has a long pedigree (reviewed in e.g. Tollison, 1982) and is firmly grounded in both empirical (Laband and Sophocleus, 1988; Brumm, 1999) and theoretical (Varian, 1989) research. At the same time law obviously plays a critically important role in sustaining productive activities and in particular in protecting property rights, and lawyers are the carriers of "legal human capital" (Hadfield, 2007) required to operate and improve the

legal system. However, a markedly lopsided talent allocation across subject areas with a higher preference for law that cannot be attributed to other plausible factors such as the type of legal system[4] could be a reflection of an institutional abnormality (e.g. De Soto (1989) argues that red tape inflates the demand for legal services). In other words, using cross-country *variations* of the share of law students could, with appropriate controls, be a way to capture the relative appeal of redistribution over productive activities.

Poor institutions could draw more people in the legal profession not only by the lure of rent-seeking, but also by the increased demand for private protection against rent-seekers and other risks and perils of bad institutions. Indeed, according to Arruñada (2007), entrepreneurs respond to deficiencies of legal and regulatory frameworks by engaging more lawyers to perform "due diligence". Dezalay and Garth (1997) observe that in "relational capitalism" without firm rule of law institutional weakness raises the value and significance for the private sector of personal relations with legal practitioners, and lawyers invest in state power on behalf of their clients. The use of customized investment covenants which could substitute for legal protection which is not available otherwise is positively correlated with the number of legally trained investment fund managers (Cumming, Johan, 2006). Such evidence indicates that indeed both motives – "offensive" and "defensive" – could be at work in linking the appeal of legal profession to the institutional quality.

We also follow Murphy, Shleifer, and Vishny (1991) in using UNESCO data on graduation from post-secondary educational institutions across subject areas and countries around the world, but we do

[4] Legal origins could affect the demand for lawyers not just directly, but also via the quality of institutions. According to Tullock (1975) trials under the common law system are more lawyer-intensive than under the civil law, whereas the institutional quality under the civil law is on a number of important counts generally weaker than under the common law (La Porta, Lopez-de-Silanes, and Shliefer 2008), so these two effects work in opposite directions. Our data presented later in the paper indicate that the share of law graduates is ceteris paribus significantly *higher* in civil law countries, which suggests that the indirect effect operating via institutions is stronger than the direct one. Further work is required to fully clarify this matter.

it for a different purpose – instead of using such data to explain cross-country variations in economic performance, we relate the variations in the popularity of different disciplines to the quality of national institutions. In other words, while in the quoted source the allocation of talent data was used to explain economic growth, we treat the allocation of talent mainly as an outcome and explain it by institutional quality. Our empirical analysis shows that the link between institutions and the allocation of talent indeed exists and has the expected sign. We perform various robustness checks and show that the established link is stable and highly significant over various specifications of the model.

Several tests are conducted to deal with the endogeneity problem. First, we use instruments for institutions proposed in earlier literature, such as the share of English-speaking population (Hall and Jones 1999) and, for the sub-sample of former colonies, the mortality of European settlers (Acemoglu, Johnson, and Robinson 2001); in both instances these are valid instrumental variables for our purposes. Second, we reduce our full sample of 95 nations to transition countries of Central and Eastern Europe and the former Soviet Union. Under command economies, institutions and educational systems in these countries exhibited significant uniformity, but subsequently a profound institutional divergence has occurred in the group, and we show that talent allocation patterns closely match institutional variations, as illustrated by the above comparison between Poland and Ukraine.

Our data also corroborate the "economy-of-scale" prediction of the model: with weak institutions the preference for unproductive activities increases with abilities; when institutions improve, such effect disappears. Finally we present direct confirmation of Pritchett's conjecture that the wedge between private and public returns to increase in education is driven by the (mis)allocation of talent. Instead of entering various measures of institutional performance in empirical models relating education to economic outcomes, as in the earlier literature (Hanushek and Woessmann, 2008; Rogers, 2008; and Armelini, 2012), we incorporate allocation of talent indexes in such models and show their high significance for the public returns to schooling and cognitive skills.

The rest of the paper proceeds as follows. In Section II we present the theoretical model and in Section III describe the data. Our empirical evidence, including baseline estimations of econometric

models relating the allocation of talent to the quality of institutions, and various robustness and endogeneity tests are presented in Section IV. In section V we investigate how the allocation of talent, conditional on the quality of institutions, depends on the talent level. Section VI gives evidence that the allocation of talent affects the social rate of returns to "educational capital". Section VII concludes.

II. The Model

We use an equilibrium model in which individuals choose between directly productive and unproductive activities based on anticipated payoffs, which in their turn are affected by the quality of institutions such as property rights protection (see also e.g. Murphy, Shleifer, and Vishny 1993; Grossman 1994; Acemoglu 1995; Mehlum, Moene, and Torvik 2006.)

Consider an economy with a unit continuum of individuals. Individuals are characterized by talent $\theta \geq 0$ and (relative) preference for redistribution over productive activities w. The above parameters are distributed independently from each other; talent's cumulative distribution function is $G(\theta)$, with probability density function $g(\theta)$, whereas the preference for rent-seeking is distributed according to, respectively, $H(w)$ and $h(w)$ (later in this section we will consider an extension of the model where this distribution depends on institutional quality, reflecting a feedback from institutions to culture). For simplicity talent measurement is normalized to unity: $\int_0^\infty \theta g(\theta) d\theta = 1$.

Individuals specialize in either production or redistribution, and each individual inelastically supplies a unit of effort towards the chosen activity.[5] A unit of effort translates into θ units of effective labor (Solow 1956) (abilities are untied to particular activities); the total stock of effective labor to be divided between production and redistribution thus equals 1. The technology of production exhibits constant returns to scale and is normalized such that the total Θ of effective labor supplied towards production purposes produces gross output $Y = \Theta$.

[5] The assumption that efforts are supplied inelastically is made for simplicity. A more general model with elastic effort supply derived from utility maximization leads to nearly identical conclusions.

Property rights of producers can be protected publicly and privately. The quality of public property rights protection is measured by the share σ of the output that a producer securely owns irrespective of his or her private protection efforts. The rest of the output is contested by re-distributors; however as in Grossman and Kim (1995) we assume that a producer can partially offset attempts on the publicly unprotected portion of her output by means of private protection. To this end, a producer has to retain protective services of re-distributors. If x units of effective labor of re-distributors is hired for protection per unit of output, then the share of output that the producer keeps goes up from σ to $\sigma + (1-\sigma)f(x)$, where $f(x)$ is a smooth monotonically increasing concave function such that $f(0) = 0, f'(0) = \infty, \lim_{x\to\infty} f(x) = 1$. Services of re-distributors are available at the market rate c per unit of their effective labor, and producers' demand for such services is determined from the following profit-maximization problem:

$$\max_{x\geq 0}[(1-\sigma)f(x) - cx] \qquad (1)$$

which gives $x = x^*(c,\sigma) = (f')^{-1}(\frac{c}{1-\sigma})$.

The portion of the gross output that lacks public protection and that the producers have failed to protect privately is $\Theta(1-\sigma)(1-f(x^*(c,\sigma)))$, and is available for grab by re-distributors who are not engaged in private protection and become rent-seeking predators. We assume, as in Tullock (1980), that the above share of the output is divided among the rent-seekers in proportion to their effective labor supplied towards predation.[6] This labor is the balance of the total effective labor supply which is equal 1 net of the producers' labor Θ and the labor of re-distributors hired for private protection $\Theta x^*(c,\sigma)$. In equilibrium re-distributors should be earning the same rate of returns per unit of their effective labor in private protection and predation, and hence

$$c = \frac{\Theta(1-\sigma)(1-f(x^*(c,\sigma)))}{1-\Theta-\Theta x^*(c,\sigma)}. \qquad (2)$$

[6] For micro-foundations of this assumption see Polishchuk and Tonis (2011).

The net return per unit of effective labor in production is equal $\sigma + (1-\sigma)f\big(x^*(c,\sigma)\big) - cx^*(c,\sigma)$, and the difference Δ between the rates of returns to effective labor in production and redistribution is as follows:

$$\Delta = \sigma + (1-\sigma)f\big(x^*(c,\sigma)\big) - cx^*(c,\sigma) - c. \qquad (3)$$

An individual with characteristics (w,θ) chooses production as an area of activity whenever $\Delta\theta \geq w$.[7] Hence the share of those in the cohort with talent θ who are engaged in production is $H(\Delta\theta)$, and therefore

$$\Theta = \int_0^\infty H(\Delta\theta)\theta g(\theta)d\theta. \qquad (4)$$

In equilibrium c, Θ and Δ are jointly determined from equations (2)-(4). Once Δ is known, the number (share) Π of agents participating in productive activities obtains as

$$\Pi = \int_0^\infty H(\Delta\theta)g(\theta)d\theta. \qquad (5)$$

Proposition 1. For any level $\sigma \in (0,1)$ of institutional quality there exists unique equilibrium $c = c(\sigma), \Theta = \Theta(\sigma), \Delta = \Delta(\sigma)$, satisfying equations (2)-(4), where functions $\Theta(\sigma)$ and $\Delta(\sigma)$ are monotonically increasing in σ. The share of agents participating in productive activities $\Pi = \Pi(\sigma)$ is also an increasing function of σ.

Proof. Equation (2) implicitly defines Θ as an increasing function of c. Indeed,

$$\Theta = c/[c + cx^*(c,\sigma) + (1-\sigma)\big(1 - f\big(x^*(c,\sigma)\big)\big)], \qquad (6)$$

and by differentiating the above expression by c and making use of the envelope theorem for the maximization problem (1) one can show that $\Theta_c > 0$. Vice versa, equations (3) and (4) define Θ as a *de*creasing function of c; to see this, observe that Θ is an increasing function of Δ, while according to

[7] The assumption that an individual's choice is driven by a combination of expected material reward and idiosyncratic preferences is similar to probabilistic voting models where voters choose between political parties based on economic considerations and ideological leanings (Persson and Tabellini 2000).

(3) $\Delta_c = -\big(1 + x^*(c,\sigma)\big) < 0$. Furthermore along the curve defined by equation (2) one has $\lim_{c\to 0}\Theta = 0$, and $\lim_{c\to\infty}\Theta = 1$. On the other hand according to (3), (4) there is $\Delta^0 > 0$ such that $\Delta > \Delta^0$ for all sufficiently small c, and hence for such c one has $\Theta > \int_0^\infty H(\Delta^0\theta)\theta g(\theta)d\theta > 0$. At the same time $\lim_{c\to\infty}\Delta = -\infty$, and therefore $\lim_{c\to\infty}\int_0^\infty H(\Delta\theta)\theta g(\theta)d\theta = 0$. This proves the existence and uniqueness of equilibrium.

To obtain the comparative statics results notice that an increase in σ shifts the curves (2) and (3), (4) upwards on (c,Θ) plane, and therefore pushes up the equilibrium value of Θ. According to (4), if Θ goes up, so does Δ, which in its turn implies that Π increases as well. ■

The proposition shows that, indeed, an improvement in the protection of property rights increases the ranks of those who are engaged in productive activities and reduces the number of re-distributors. While this effect is plausible, it is not obvious a priori since greater participation in production triggers a counter-effect by increasing the gross output and hence its share available for rent-seeking, which could in its turn strengthen the appeal of redistribution (Murphy, Shleifer, and Vishny 1991; Polishchuk and Savvateev 2004). However, the direct effect prevails, prompting the expected reaction of the equilibrium level of productive efforts to improved property rights.

On the (w,θ) plane representing the continuum of agents, the ray $w = \Delta\theta, \theta \geq 0$ separates those engaged in production from re-distributors, located respectively to the left and right of the separation line (Figure 1). As the quality of institutions rises, this line rotates around the origin clock-wise (recall that according to Proposition 1 the function $\Delta(\sigma)$ is monotonically increasing), and becomes vertical in the intermediate position when $\Delta = 0$ (i.e. production and redistribution offer the same returns per unit of effective labor.

This simple observation leads to two interesting corollaries. First, when institutions are strong, i.e., when production earns higher returns than redistribution and therefore $\Delta > 0$, the share $H(\Delta\theta)$ of those engaged in productive activities in the cohort with talent θ increases as θ rises, and hence only a small percentage among exceptionally gifted individuals with strong idiosyncratic preference for

redistribution are still engaged in such activities despite the huge opportunity cost of such choice. This is evidence of increasing returns to scale in the allocation of talent,[8] which progressively drives redistributors out of the cohorts with greater abilities. Vice versa, when institutions are weak ($\Delta < 0$), due to the same increasing returns to scale, redistribution crowds out productive activities from more talented cohorts and only those few who have strong innate aversion to redistribution can resist the temptation of growing material payoffs associated with unproductive activities. These observations summarize as follows.

Proposition 2: Let

$$\Pi(\sigma, \theta_0) = \frac{\int_{\theta_0}^{\infty} H(\Delta(\sigma)\theta) g(\theta) d\theta}{1 - G(\theta_0)} \qquad (7)$$

be the share of those engaged in productive activities among all agents with $\theta \geq \theta_0$ when the quality of institutions equals σ. Then in the case of strong institutions ($\Delta(\sigma) > 0$) the function $\Pi(\sigma, \theta_0)$ monotonically increases in θ_0 and $\lim_{\theta_0 \to \infty} \Pi(\sigma, \theta_0) = 1$, whereas in the case of weak institutions ($\Delta(\sigma) < 0$) this function is monotonically decreasing in $\theta_0$and $\lim_{\theta_0 \to \infty} \Pi(\sigma, \theta_0) = 0$. ■

Second, individuals with a low level of talent are less sensitive to the quality of institutions than those with a greater level of talent, which is illustrated by Figure I. At the limit with $\theta \to 0$, institutions become irrelevant and the choice between production and redistribution is determined solely by non-material idiosyncratic preferences. This means that if individuals with abilities below a modest cutoff level $\theta_0 > 0$ are excluded from consideration, the response to institutional change of those with $\theta \geq \theta_0$ is more elastic than such a response for the full continuum of agents. More precisely, the following statement holds.

Proposition 3: For a sufficiently small $\theta_0 > 0$ one has

$$\Pi_\sigma(\sigma, \theta_0) \geq \Pi'(\sigma). \qquad (8)$$

[8] For other versions and interpretations of this phenomenon, see Murphy, Shleifer, and Vishny (1991).

Proof. Due to Proposition 1, $\Delta'(\sigma) \geq 0$, and hence inequality (8) is equivalent to

$$\frac{\int_{\theta_0}^{\infty} h(\Delta(\sigma)\theta)\theta g(\theta)d\theta}{1-G(\theta_0)} \geq \int_0^{\infty} h(\Delta\theta)\theta g(\theta)d\theta.$$

The left hand side of the above inequality has a positive derivative by θ_0 at θ_0=0 (assuming positive density function h). ■

Notice however that not only the least, but also the most talented cohorts exhibit low sensitivity in their occupational choices to changes in the quality of institutions, assuming that the institutions before and after the change remain either both weak or both strong. Indeed, due to the economy of scale, nearly all agents among those with exceptionally high talents are engaged in productive activities (when institutions are strong) or redistribution (if institutions are weak). Yet when institutions turn from weak to strong, the elasticity of response of highly talented agents rises sharply, and, at the limit, such response can be described by a step function that is equal zero for weak institutions and one for strong ones.

Notice finally that institutions affect not just payoffs to productive activities and redistribution, but, in longer term, the relative attractiveness of these activities per se, irrespective of their payoffs. Entrenched institutions shape the perception in the society of the acceptance, legitimacy, and prestige of certain activities and walks of life (see e.g. Baumol, 1990). Acemoglu (1995) argues that a prevalence of rent-seeking leads to a social consensus that gives greater respect to rent-seeking and hence increases net "non-pecuniary rewards" associated with such activities. Similarly Tabellini (2008) relates "endogenous values" to the quality of institutions; in particular weak institutions condone traits and attitudes that would have been considered questionable by societies accustomed to stronger institutions.

Such feedback from institutions to values can be captured in our model by making the distribution of preference for redistribution depending on the institutional quality, so that the cumulative distribution function $H(w,\sigma)$ monotonically increases in institutional quality σ. In other

words, the distribution of w for better institutions stochastically (first-degree) dominates such distribution when institutions are worse.

It easy to see that if such influence of institutions on idiosyncratic preferences for redistribution is included in the above model, then the impact of the institutional quality on the supply Θ of effective labor towards production grows even stronger, because in such case *both* curves (2) and (3),(4) shift upwards in the (c, Θ) axes when σ increases, giving an additional push to the equilibrium level of Θ. However the impact of institutions operating through value change on the *allocation* of individuals between production and rent-seeking, described by the function $\Pi(\sigma)$ is less straightforward because there are two counteracting forces at play – first, idiosyncratic preferences for redistribution become weaker when institutions strengthen, drawing additional effective labor into production, but second, due to the increase in production the difference between the returns to production and redistribution gets narrower, making the relative appeal of production over redistribution somewhat weaker in economic terms. However under realistic assumptions about the impact of institutions on values the first effect dominates the second one, and hence the impact of institutions on values reinforces the overall effect of institutions on the allocation of talent.

To demonstrate this, assume that an improvement in institutions causes a change in the relative prestige of redistribution vs. production, which leads to a "parallel shift" of the distribution of w from $H(w)$ to $H(w + t)$ for some $t > 0$. For simplicity we ignore through the rest of the section the direct impact of institutional quality on the payoffs to production and redistribution and keep σ constant in equations (2), (3), in which case one has

$$\Theta(t) = \int_0^\infty H(\Delta(t)\theta + t)\theta g(\theta) d\theta, \qquad (9')$$

$$\Pi(t) = \int_0^\infty H(\Delta(t)\theta + t) g(\theta) d\theta, \qquad (10)$$

where (2)-(4) still hold for $\Delta(t)$ and $\Theta(t)$.

Proposition 4: Functions $\Theta(t)$ and $\Pi(t)$ are monotonically increasing.

Proof. Show that $\Theta'(0) > 0, \Pi'(0) > 0$; the case $t > 0$ is treated similarly. Assume without loss of generality $\Delta(0) = 1$. Let $k \equiv -\Delta'(0)/\Theta'(0)$; due to (2), (3) k is positive. Differentiating (9), one has

$$\Theta'(0) = -k\Theta'(0)\left(\int_0^\infty h(\theta)\theta^2 g(\theta)d\theta\right) + \int_0^\infty h(\theta)\theta g(\theta)d\theta,$$

and hence

$$\Theta'(0) = \frac{\int_0^\infty h(\theta)\theta g(\theta)d\theta}{1 + k\int_0^\infty h(\theta)\theta^2 g(\theta)d\theta} > 0$$

Furthermore

$$\Pi'(0) = -k\Theta'(0)\left(\int_0^\infty h(\theta)\theta g(\theta)d\theta\right) + \int_0^\infty h(\theta)g(\theta)d\theta =$$

$$\frac{\int_0^\infty h(\theta)g(\theta)d\theta\left[1 + k\int_0^\infty h(\theta)\theta^2 g(\theta)d\theta\right] - k[\int_0^\infty h(\theta)\theta g(\theta)d\theta]^2}{1 + k\int_0^\infty h(\theta)\theta^2 g(\theta)d\theta}.$$

That latter expression is also positive, since due to the Cauchy–Schwarz inequality one has

$$[\int_0^\infty h(\theta)\theta g(\theta)d\theta]^2 \leq \left[\int_0^\infty h(\theta)g(\theta)d\theta\right]\left[\int_0^\infty h(\theta)\theta^2 g(\theta)d\theta\right] \quad \blacksquare$$

III. Data

Our theory implies that in countries with a firmly established rule of law and adequate protection of property rights, we should observe stronger interest in education that prepares students for productive activities, whereas poor institutions raise the attractiveness among younger people of subject areas that could equip for redistribution. Furthermore, such institution-related discrepancy should be more pronounced for an upper part of the talent distribution where one should expect to find those pursuing post-secondary education.[9] Hence we gauge the allocation of talent in response to the quality of institutions by the graduation of college and university students in different fields of study.

[9] Notice however that most able individuals could refrain from obtaining post-secondary education if the latter serves purely signaling purposes (Feitovich, Harbaugh, and To 2002).

As in Murphy, Shleifer, and Vishny (1991), we use, with appropriate caveats, the share of law school graduates as a proxy for the allocation of talent to redistribution. The share of those majoring in sciences (broadly defined to include life and physical sciences, mathematics, and computing) is our measure of talent allocation towards directly productive activities.

Our source of data on student graduation is the UNESCO Institute of Statistics,[10] which stores information on the number of graduates in tertiary education for 23 educational programs in 102 countries over the period from 1999 to 2009. Unfortunately, the database has quite a few gaps: for example, data on law school graduates are available for 26 countries in 2009, 47 countries in 2008, but for only 9 countries in 2007. In order to maximize the number of observations, we treat available data as a cross section and take the latest available graduation data for a given field in a country. We believe that this should not significantly bias our results for two reasons. First, the cross-discipline structure of post-secondary education could be "sticky" due to supply-side constraints and multi-year lengths of academic programs. Second, most of the data are available for more recent years close to 2009: for instance, 80% of our data on law and science graduates are from the 2005-2009 period, so that the coverage of this period is fairly accurate and complete.

To measure the quality of institutions, we use the well-known World Bank's Governance Matters database (Kaufmann, Kraay, and Mastruzzi 2010) and select the following measures of institutional quality: rule of law (including the quality of contract enforcement, property rights, and courts); government effectiveness (quality of public service, policies, and independence from political pressure); and control of corruption and state capture. In addition, given the centrality of property rights protection for our analysis, we add the Heritage Foundation's property rights index to the list (Miller and Holmes 2010). We average these indexes for the 2000-2005 period and use the results as explanatory variables. Such choice of timing is essential for two reasons. First, it provides some initial

[10] We are grateful to UNESCO's Chiao-Ling Chien and Albert Motivans who kindly provided detailed data not available from UNESCO's open-access sources.

assurance that the causality we seek to establish indeed runs from institutions to the allocation of talent (measured primarily for the 2005-2009 period), and, second, it reflects the fact that the choice of subject area is made several years prior to the graduation.

We also add various controls, such as GDP per capita, structure of the economy (share of services, manufacturing and agriculture, exports of manufacturing goods), level of post-secondary education, public sector size, natural resources, and emigration of post-secondary degree holders (all from the World Development Indicators database), oil reserves (CIA World Factbook), economic inequality measured by the Gini index (United Nations Statistical Database), and ethno-linguistic heterogeneity measured by Alesina's (2003) ethnic fractionalization index. Altogether the sample includes 95 countries for which all of the above dependent, independent, and control variables are available.

Table 1 contains descriptive statistics for the main variables. The table shows such statistics for all countries in the sample and also for the sub-samples with stronger and weaker institutions above and below the median Rule of Law Index. In each case, we report means and standard deviations (in parenthesis), and the total number of countries for which data are available.

A comparison of enrollment levels for sub-samples reveals stark differences between countries with strong and weak institutions. Thus, the average share of law school graduates in the countries with a weaker rule of law is almost twice as high as in countries where the rule of law is stronger. Conversely, the average share of science graduates for countries with above the median Rule of Law Index is more than 40% higher than the same share for countries below the median. These differences are statistically significant at the 1% level.

The discrepancy in enrollment between the two groups of countries is even more striking if we use differences between the shares of law and science graduates, which measure relative attractiveness of different fields of study. For countries with weaker institutions, the average of such differences is positive and equals 1.43 percentage points, whereas for countries with stronger institutions it is negative and equals 5.52 percentage points. We treat this difference as a yet another dependent variable

whose distribution is closer to the normal than the distributions of separate enrollment data for law and science.

IV. Empirical Analysis

IV.A. OLS Regressions

We start with estimating the following cross-country regressions relating the allocation of talent to indexes of institutional quality:

$$(Un)productive\ Activities_{\ i} = \beta_0 + \beta_1\, Institutional\ Quality_i + \beta_2\, X_i + \varepsilon_i, \quad (11)$$

where $(Un)productive\ Activities$ measures reflect the allocation of talent between subject areas of post-secondary education, $Institutional\ Quality$ is one of the indexes listed in the previous section, X_i is the vector of additional covariates serving as control variables, and ε_i is the error term. The coefficient of interest is β_1 capturing the impact of institutions on the allocation of talent.

The set of control variables reflects factors other than institutions that could possibly influence the allocation of talent and which are commonly used in similar cross-country analyses.[11] Thus, we control for GDP per capita since it is plausible that wealthier and poorer countries have different reward structures which are not directly related to the quality of institutions. Furthermore, it is conceivable that more economically advanced countries are able to afford more "capital-intensive" education in the sciences, and this supply-side effect could have an impact on the allocation of talent. In the same vein we control for country-level R&D expenditures, as this affects the demand for those trained in sciences. We also control for GDP structure measured by the share of services and manufacturing in GDP (and manufacturing exports), which could be correlated with the demand for respectively lawyers and scientists. Finally, there could be a link between the size and structure of the student body, and we add to the controls the aggregate enrollment in tertiary education.

[11] See e.g. Barro 1991; Knack and Keefer 1995; Hall and Jones 1999; La Porta et al. 1999; Acemoglu, Johnson, and Robinson 2001; Rodrik, Subramanian, and Trebbi 2004.

Allocation of talent could be affected by natural resources in what is known as the "resource-curse syndrome" (Gylafson 2001; Alexeev and Conrad 2011), when a massive resource sector could suppress investments in human capital and increase the relative attractiveness of rent-seeking over productive activities. To account for such link, we use oil reserves as a control variable. Our controls also include population (as a proxy for market size) and general government expenditure (% of GDP) as a proxy for government size – the latter, according to Pritchett (2001), could affect the allocation of talent. Economic and ethnic polarizations are controlled for by using the Gini and ethnic fractionalization indexes. The trade-to-GDP ratio reflects the openness of national economies which can also be relevant for the allocation of talent (Hanushek and Woessmann 2008). We also control for the percentage of post-secondary degree holders who immigrate to other countries, since emigration could disconnect educational choices from the quality of national institutions. Finally, we take into account legal origins of the country which could also affect the demand for legal profession.

In the first specification, we estimate model (11) with the share of law graduates as a dependent variable and report these results in Table 2. In the first column with no control variables, the coefficient of the Rule of Law Index is, as expected, negative and highly significant. When we add one after another our control variables (columns (2) to (8)), the negative association between institutional quality and law school graduation remains highly significant and grows in magnitude. These estimations show that, ironically, an increase in lawlessness is associated with growing graduation in law. This paradox is further illustrated by a large and *positive* correlation of 0.48 (statistically significant at the 1% level) between the graduation in law and the size of the unofficial economy, which is by definition outside of the legal domain.[12] This observation however is fully consistent with our theory, since the informal sector is enlarged by excessive regulatory barriers, which are hallmarks of poor institutions (De Soto 1989; Djankov et al., 2002).

[12] We use the unofficial economy measures as the percentage of GDP from Djankov et al., 2002.

Among the control variables, oil reserves have a positive and mildly significant coefficient, which agrees with the expected impact of the "resource curse" on the allocation of talent. The coefficient of the openness index is also significant and negative, perhaps reflecting the well-established contribution of international trade to the global competitiveness of the national economy (Frenkel and Romer 1999), which reduces opportunities for rent-seeking.[13] The coefficient of emigration of university graduates is negative and significant at the 10% level – the possibility to seek employment abroad reduces the appeal of studying law. One explanation is that such education is country-specific,[14] but another possible reason is that the option to seek employment in countries with better institutions increases the incentive to obtain directly productive skills. The coefficient of government expenditure is positive, as suggested by Pritchett (2001), although statistically insignificant. The share of services in GDP has a positive but statistically insignificant effect; shares of manufacturing and agriculture (not reported in the table) turn out to be insignificant either. Finally, countries with French legal origin have ceteris paribus more law graduates than common law countries.

An inspection of post-estimation residuals reveals several outliers – Angola, Cameroon, Colombia, Madagascar, Mauritania, Mozambique, Swaziland and Malta, which represent mostly low- and lower middle-income countries with weak institutions. To ensure that our results are not driven by the outliers, we exclude them from the sample and report this estimation in column (9). The Rule of Law Index remains statistically significant at the 1% level with a slightly lower coefficient: an increase by one standard deviation in the rule of law is associated with a decrease of 0.47 standard deviations in the share of law graduates. The scatter plot for this estimation is presented in Figure 2.

[13] Hanushek and Woessmann (2008) use openness to international trade as a yet another measure of institutional quality and show that it enhances the contribution of cognitive skills to economic growth. Our regression results reported in Table II indicate that the impact of openness on public returns to human capital involves the allocation of talent, as predicted by Pritchett (2001). More on this in section VI.

[14] We owe this observation to Michael Alexeev.

In the next regression (Table 3) the dependent variable is the share of science graduates, while the procedure otherwise remains the same. This time the coefficient of interest is positive, as expected, and in most specifications significant at the 1% or 5% levels. It is noteworthy that no field of study from the UNESCO dataset other than law and sciences exhibits a statistically significant association between the share of graduates and the rule of law or any other commonly used measure of institutional quality.

On average across specifications, an improvement of one standard deviation in the rule of law, holding other factors constant, is associated with an increase by 0.25 standard deviations of the share of science graduates. Figure 3 shows the scatter plot for column (9) with outliers eliminated.

Since the quality of institutions is negatively associated with the share of law students and positively – with the share of those majoring in sciences, the difference between these two shares should be particularly sensitive to the institutional quality. We test this for all four measures of institutional performance listed in the previous section and present in Table 4 the estimation results with main control variables included.

All four indexes of institutional performance are strongly negatively associated with the dependent variable, which is consistent with our hypothesis. The strength of this connection can be seen from the fact that a one standard deviation increase in the Rule of Law Index is associated with a 0.55 standard deviations decrease in the difference between the shares of law and science graduates. The scatter plot for the estimation with the Rule of Law Index as the dependent variable further illustrates this clear-cut link (Figure 4).

IV.B Sub-Samples of Nations

We use various modifications of our empirical model to check the robustness of the above findings, particularly to address the concern that our control variables do not fully eliminate an omitted variable bias that could be expected for an extremely diverse group of countries. To do so we reduce the sample to various more homogeneous sub-groups and estimate model (11) for such sub-groups with the Rule of Law Index as a measure of institutional quality and the difference between law and science

graduates as the dependent variable. First, we restrict our estimation to poorer countries by excluding OECD and high-income non-OECD countries (according to the World Bank's classifications). Next, we perform the opposite exercise by retaining only the wealthier part of the sample. The two other estimations are confined to former colonies of European powers and to post-communist transition countries in Central and Eastern Europe and the former Soviet Union. Finally, in the full sample we include dummies for Asia and Africa.

The coefficient of the Rule of Law Index is negative and significant at the 1% level across all of the above specifications (Table 5). The value of this coefficient is higher for poorer countries, former colonies, and transition nations, than for the sample at large.

The allocation of talent is especially sensitive to the quality of institutions for transition countries: the regression coefficient of the Rule of Law index in Table 5, Column 3 is more than 60% higher than such coefficient for the full sample (Table 4, Column 1).

This sub-sample is of particular interest for our analysis due to its quasi "natural experiment" features. Moscow's domination ensured high uniformity of institutions and post-secondary educational systems across the region. Command economies gave strong priorities to higher education in engineering and sciences, whereas law schools were rare and far less prestigious and appealing to younger talents.[15] Similarity of former command economies at the outset of their transition to the free market and the availability of formidable educational potential in sciences and engineering alleviates the concern that the allocation of students across fields of studies is at least in part a "supply-side" phenomenon reflecting the capacities of national university systems to offer education in particular

[15] This appears to be at odds with our theory, since the institutions of the command economy were obviously quite poor from the market economy's perspective. In fact our logic assumes a market economy, no matter how distorted, with a degree of economic freedoms and at least a modicum of private property rights. Rigid command economies did not meet such assumptions and are thus exceptions from our rule. However after the collapse of central planning they confirm the rule with exceptional clarity.

disciplines. The divergence in allocation of talent that ensued could be with greater confidence linked to "demand-side" forces, which in their turn reflected the quality of post-communist institutions.

In Table 6 we report the results of OLS estimations of model (11) for the sub-sample of transition economies for all three measures of the allocation of talent – graduation in law; in sciences; and the difference thereof as dependent variable, and the Rule of Law Index as a measure of institutional quality. For all three measures their coefficients are substantially – 25 % and up – higher than for the full sample of nations. The scatter plot presented in Figure 5 illustrates the strong association between the quality of institutions and allocation of talent in the former Soviet Union and Central and Eastern Europe.

Further illustrations of the "natural experiment" within the group are provided by comparisons of different countries that are neighbors and otherwise comparable and similar to each other. A case in point is the divergence between Ukraine and Poland described at the outset at the paper. Both countries experienced an explosive growth of interest in the legal profession in the early 1990s to fill the voids left by their pre-transition educational systems, and at that time education in science and engineering suffered a precipitous decline. However, over time the enrollment in law schools in Poland subsided and enrolment in science and engineering recovered, whereas no such adjustment has occurred in Ukraine (Figure 6). A stark difference between the two countries can be seen in the numbers of law schools: law degrees are conferred by 16 universities in Poland, whereas in Ukraine the number of such institutions runs into the hundreds.

IV.C. 2SLS Regressions

Multi-country cross-sectional regressions are often suspected of an endogeneity bias that could be caused, apart from omitted variables, by measurement errors (which are likely to affect institutional performance indexes) and reverse causality. It could be argued that the allocation of talent is not only driven by institutions, but also affects those, e.g., through political pressure from organized interests seeking preferential conditions for certain trades and activities, or due to entrenched cultural attitudes

(Baumol 1990; Tabellini 2008). Endogeneity bias could render OLS estimations inconsistent, which calls for instrumental variables and 2SLS estimations. We perform such analysis using instruments suggested in earlier literature for former colonies and for the full global sample.

Acemoglu, Johnson, and Robinson (2001) observed that European powers had established vastly different institutional regimes in their former colonies, some of which protected private property rights while others facilitated the extraction and appropriation of rents. Such discrepancy has been remarkably resilient and sustained itself well into the present era. A plausible root cause of the divergence of institutional regimes was the mortality of European settlers: in some colonies, extreme climate and tropical diseases caused very high mortality among the settlers, making them consider such colonies as "remotely operated assets" and crafting institutions accordingly. Conditions in other colonies (most notably in "New Europe", consisting of North America, Australia, and New Zealand) with lower mortality rates proved to be more amenable to Europeans, and hence settlers established good institutions there to serve their own needs. To test the settler mortality as an instrument in our case, we restrict the full sample to former colonies and perform 2SLS estimations for all four measures of institutional quality. Estimation results are reported in Table 7.

The settler mortality instrument is weak for the Rule of Law and Control of Corruption indexes, but it is somewhat stronger for government effectiveness and especially for the protection of property rights index (which is similar to the institutional performance measure used by Acemoglu, Johnson, and Robison (2001)). In the latter case, the coefficient of the fitted explanatory variable still has the expected sign and is significant at the 5% level.

In our second IV test – this time for the full sample – we use as an instrument the share of English-speaking population, as suggested by Hall and Jones (1999). This measure characterizes a nation's exposure to more institutionally advanced part of the world influenced by Britain – a creator of the "modern institutional order" with strong rule of law and accountable government (Fukuyama, 2011). 2SLS estimation results presented in Table 8 show that this is a valid instrument for our

purposes and that the coefficients of the fitted institutional quality indexes have the predicted signs and are significant at the 10% level.

Therefore the association between institutions and the allocation of talent finds support in the test for endogeneity with the above instruments.

V. Institutions and the Allocation of Stronger Talent

We now turn to the testing of another prediction of our theory i.e. that under weak institutions law increasingly crowds out engineering and sciences among more talented individuals. A preliminary support to this hypothesis is provided by the case of Russia, which is notorious for low quality of its institutions (Polishchuk 2013). The distributions of the scores from the 2010 Unified State Examinations (the Russian version of a national SAT-like test) of applicants seeking education in various fields which is presented in Figure 7 reveals a clear preference of talented youth to law over even the most cutting-edge engineering 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.

We do not have similarly detailed abilities data for other countries in our sample, and instead in what follows keep treating countries as sample units and use available *national* measures of human capital as proxies for the talent of university students. Our source of data is an international database assembled by Altinok and Murseli (2007), who administred tests in mathemtics, sciences, and reading among junior high school students in 104, 79, and 88 countries, respectively, and aggregated the test results in an overall national human capital quality index which is available for 61 countries from our original sample.[16]

We divide this reduced sample in two parts at the median of the Rule of Law Index for the original sample (as we did in Table 1), and further divide both halves at their respective averages of the

[16] Other sources of similar indexes, e.g. Hanushek and Kimko (2000), cover much fewer countries.

national human capital quality measures. Next, we calculate average shares of law graduates for each of the four groups with stronger or weaker instituions and higher or lower human capital levels. The results are presented in Table 9.

The table confirms that, for countries with weaker institutions, the share of law graduates in the sub-sample with higher human capital quality is 2.5 times higher than in countries with the same quality of institutions but lower human capital quality. This difference is consistent with our theory and signifiant at the 1% level. We further observe that, for higher levels of human capital quality, the impact of the quality of institutitons is strong (the share of law graduates drops by more than 40%), and this difference is significant at the 5% level. For countries with lower human-capital quality, improvement of institutions leaves no statistically significant impact on talent allocation, which is also what the theory predicts. Finally, when we restict our attention to the subgroup with stronger institutions, we do not observe a statistically significant difference between the enrollment in law schools in countries with higher and lower human capital quality, which is in sharp contrast with the group of countries with poorer institutions. However we do not see a *decrease* in the graduation in law as we move from lower to higher human capital levels in the group of countries with stronger institutions.

The predicted impact of the quality of human capital on the allocation of talent is particulalry visible for the subsample of countries with weak instutions: Figure 8 clearly shows an increase of enrollment in law schools within this group when human capital quality rises from, respectively, the levels of Kenya and Tanzania at the lower, to Armenia's and Russia's at the higher end of the spectrum.

Additional evidence indicating that stronger talents are reluctant to pursue careers in science and engineering in countries with inferior institutions can be found in the locational choices of PhD holders who earned their degrees from US graduate schools. Grogger and Hanson (2013) used the National Science Foundation's Earned Doctorates Survey to conclude that stronger academimc abilities make science and engineering PhD holders more likely to stay in the US, as opposed to moving back to their

home countries. Apart from individual characteristics, home country conditions and in particular institutional quality affect locational choices of top talents. Thus the level of democracy in home countries, measured by the Polity IV score, is negatively associated with the likelihood of a foreign-born PhD holder staying in the US.[17] Symptomatically, and also in agreement with our theory and empirical findings, no statistically significant association between academic abilities and locational choices is observed for PhD graduates in fields other than science and engineering. The US economy is clearly benefitting from scientists and engineers' "voting with their feet" for the US as a locational choice. As for home countries, the prospect of seeking employment abroad could boost the domestic higher education, including science and engineering,[18] and in some cases produce net domestic gains of a "beneficial brain drain"; however countries with higher stocks of human capital and substantial emigration suffer net losses from skilled outmigration (Beine, Docquier and Rapoport, 2008).

VI. Allocation of Talent and Social Returns to Education

Pritchett (2001) invoked the famous metaphor of North (1990) that piracy and chemical manufacturing alike could benefit from education, to illustrate the hypothesis that social returns to education could be negligible or even negative, if the acquired knowledge and skills are applied for socially unproductive purposes. Allocation of investments in human capital is shaped by institutions, and the latter thus complement education as factors of economic growth. This hypothesis has been since tested and confirmed by several authors by entering various measures of institutional quality (corruption, black market premium, and brain drain (Rogers 2008)); trade openness and the protection

[17] Grogger and Hanson do not use in their analysis other measures of institutional quality, such as property rights protection; however there is significant correlation (0.63) between Polity IV score and the Rule of Law index. McAusland and Kuhn (2011) propose a model where countries use intellectual property rights in a "bidding war for global talent" (p. 77).

[18] In our estimation emigration of tertiary educated individuals has a positive, but statistically insignificant, effect for the graduation in science (Table 3).

against expropriation (Hanushek and Woessmann 2008); and democratic performance (Armellini, 2012) into empirical models relating economic growth to stock and/or flow of education-enhanced human capital.

In this section we put Pritchett's hypothesis to a direct test by controlling for the allocation of talent in regression models measuring social returns to an increase in education. Given the earlier established link between the quality of institutions and the allocation of talent, such test is expected to confirm that the complementarity between institutions and education indeed runs through students' preferences over directly socially productive vs. directly unproductive skills.

There are two main approaches in the literature to measuring the contribution of education to economic growth (see e.g. Bosworth and Collins 2003; Hanushek and Woessmann 2008) – first, education is considered as a proxy to human capital, and human capital accumulation affects growth rates, and second, education is measured at the beginning of the observation period and expected, in the spirit of the endogenous growth theory (Aghion and Howitt, 1998), to increase the total factor productivity. Since Barro and Sala-i-Martin (1995), initial level of education has been consistently shown to have a robust positive impact on subsequent economic growth. However an association between increments in education and economic growth appeared to be elusive (Pritchett, 2001), and misallocation of talent was suggested as a probable cause.

To verify if this is indeed the case, we estimate the following baseline model:

$$Growth\ GDP\ per\ Capita_{\ i} = \beta_0 + \beta_1\, Change\ in\ Schooling_i + \beta_2\, X_i + \varepsilon_i, \qquad (12)$$

where $Growth\ GDP\ pc_{\ i}$ is the average annual growth rate of GDP per capita in country i over the 1990-2010 period; $Change\ in\ Schooling_i$ is the increase over the same period of the average years of tertiary education;[19] X_i is the vector of control variables, and ε_i is the error term. The coefficient of

[19] We choose years of tertiary education, as opposed to total years of schooling, as in some other estimations of social payoff to education (see e.g. Pritchett, 2001; Rogers, 2008) to ensure consistency of our education measures with those of the allocation of talent.; see also Aghon, Howitt (2009).

interest is β_1. Estimation results are presented in Table 10, column (1). The coefficient of post-secondary education is positive, but statistically insignificant, which agrees with the earlier literature.

Next, we divide the sample at the median level of the allocation of talent index calculated as the difference between the shares of graduates in law and sciences, and estimate model (12) for the upper and lower halves. When increase in human capital is (mis)allocated towards redistribution, the rate of returns to tertiary education becomes negative and remains statistically insignificant (column 2). However for the other half with stronger preferences towards education in sciences this rate becomes positive, sharply rises in magnitude, and is significant at the 10% level. This gives evidence that the allocation of talent indeed complements post-secondary education from the perspective of economic growth.

To better visualize the contribution of the allocation of talent to the social payoff to education, we estimate rolling sample regressions (12) for a series of contiguous sub-samples containing 50% of observations and sliding those down step by step on our allocation of talent scale from the upper to the lower half.[20] Figure 9 demonstrates a gradual increase in the payoff to higher education in this rolling regression, with concurrent narrowing of the confidence intervals indicating growing significance of estimation.

Rogers (2008) conducted similar analyses for a number of institutional quality indexes and total and secondary schooling as measures of educational attainment. However he was unable to confirm the complementarity between institutions and increase in tertiary education – regression coefficients in such case turned out to be insignificant. Our approach which uses direct measures of the allocation of talent has higher precision and establishes the expected complementarity.

As a robustness check, we repeat the above analysis when human capital is measured by cognitive skills instead of the duration of tertiary schooling. Hanushek and Woessmann (2008, 2012) stress the role of cognitive skills as an educational outcome which is highly relevant for economic

[20] The idea is borrowed from Rogers (2008).

growth, and argue that such qualitative indexes are more suitable for measuring social returns to human capital than the duration of schooling per se.

We use cognitive skills measures from Hanushek and Woessmann (2012) which are based on the results of tests administered primarily at high schools level, and hence the purpose of our alternative estimation is to see how successfully the system of post-secondary education puts in use the social capital accumulated at lower levels of the education chain. As before, the answer depends on the allocation of talent. Estimations of model (12) for the full sample of countries for which the necessary data exist and the sub-samples above and below the median level of the allocation of talent are reported in columns (4)-(6) of Table 10. We observe the same pattern of growing magnitude and significance of the social payoff to human capital when the allocation of talent favors directly productive activities. When talent is misallocated (the part of the sample above the median) the coefficient of cognitive skills drops in magnitude and loses significance.[21]

VII. Concluding Remarks

Institutions affect economic behavior, and long-term investment decisions are particularly sensitive to the institutional quality. Insecure property rights, a weak rule of law, and excessive red-tape elevate investment risks and suppress physical capital accumulation. We show that institutions also strongly affect investments in human capital and hence 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, many of whom select engineering, sciences, medicine, and other similar disciplines. Poor institutions, on the other hand, make rent-seeking and other kinds of redistribution

[21] Hanushek and Woessmann (2008) controlled the impact of cognitive skills on institutional performance by introducing the interaction between institutions and cognitive skills in their regression model, and concluded that there is still "a significant positive growth effect of cognitive skills even in countries with a poor institutional environment" (p. 648). Our analysis which uses a direct measure of the allocation of talent leads to a more qualified conclusion.

more attractive than socially productive activities, and this causes hypertrophied enrollment in law, public administration, and similar educational programs.

We confirm these patterns by using data on the allocation of talent and institutional quality for approximately 100 countries of the world and demonstrate robustness of our findings. For smaller groups of countries, such as transition economies, which share a number of common features and have been exposed to "natural experiments" that set them on different institutional trajectories, the link between institutions and the allocation of talent is particularly strong. We also find that poor institutions cause deeper distortions of talent allocation among more talented individuals, which exacerbates damage to economic growth and welfare, since the best and the brightest are deflected from productive activities, including key entrepreneurial and managerial positions, and drawn instead into redistribution.

Our findings confirm the general dictum that enabling institutions and policies are essential for making proper use of factors of production, including investments in human capital. Human capital accumulation is driven by private returns and as such is much less sensitive to institutional quality than its allocation between productive and unproductive activities, which affects public returns to human capital. Education is usually expected to generate positive externalities ranging from increased productivity and adoption of new technologies to improved democratic participation. However inadequate institutions cause *negative* educational externalities with rent-seeking as the medium. This paper contributes to the debates in the literature over relative significance of human capital and institutions by providing direct evidence of the complementarity between institutions and education, based on the allocation of talent.

A discrepancy between private and public returns to education usually calls for public intervention. In the case of positive externalities such intervention could involve e.g. educational subsidies. If externalities are negative, they need to be corrected by public policies and reforms that repair faulty institutions and thus re-direct talents towards socially productive activities.

REFERENCIES

Acemoglu, Daron, "Reward Structures and the Allocation of Talent," *European Economic Review,* 39 (1995), 17–33.

Acemoglu, Daron, Simon Johnson and James Robinson, "The Colonial Origins of Comparative Development: An Empirical Investigation," *The American Economic Review,* 91 (2001), 1369–1401.

Acemoglu, Daron, and Melissa Dell, "Productivity Differences Between and Within Countries." *American Economic Journal: Macroeconomics*, 2 (2010),169-188.

Aghion, Philippe, and Peter Howitt, *The Economics of Growth.* Cambridge, MA: MIT Press, 2009.

Alesina, Alberto, Arnaud Devleeschauwer, William Easterly, Sergio Kurlat, and RomainWacziarg "Fractionalization," *Journal of Economic Growth,* 8 (2003), 155–194.

Alexeev, Michael, and Robert Conrad, "The Natural Resource Curse and Economic Transition," *Economic Systems,* 35 (2011), 445–461.

Arruñada, Benito, "Pitfalls to Avoid when Measuring Institutions: Is 'Doing Business' Damaging Business?", *Journal of Comparative Economics,* 35 (2007), 729-747.

Altinok, Nadir and Hatidje Murseli, "International Database on Human Capital Quality," *Economics Letters,* 96 (2007), 237–244.

Armellini, Mauricio, "The Democratic Factor in the Education-Growth Relationship," *Kyklos,* 65 (2012), 285–312.

Balan, David J., and Stephen Knack, "The Correlation between Human Capital and Morality and Its Effect on Economic Performance: Theory and Evidence," *Journal of Comparative Economics*, (2012), 457–475.

Barro, Robert, "Economic Growth in a Cross-Section of Countries," *Quarterly Journal of Economics,* 106 (1991), 407–443.

Barro, Robert, and Xavier I. Sala-i-Martin, *Economic Growth*. (MIT Press., 1995)

Barro, Robert, and Jong-Wha Lee, "Schooling Quality in a Cross-Section of Countries," *Economica,* 38 (2001), 465–488.

Baumol, William, "Entrepreneurship: Productive, Unproductive, and Destructive," *Journal of Political Economy*, 98 (1990), 893-921.

Beine, Michel, Frédérique Docquier and Hillel Rapoport, "Brain Drain and Human Capital Formation in Developing Countries: Winners and Losers," Economic Journal, 118 (2008), 631-652.

Bhagwati, Jagdish, "Directly Unproductive, Profit-Seeking (DUP) Activities," *Journal of Political Economy,* 90 (1982), 988-1002.

Bosworth, Barry P. and Susan M. Collins, "The Empirics of Growth: An Update," *Brookings Papers on Economic Activity*, 2 (2003), 113–206.

Brumm, Harold, "Rent Seeking and Economic Growth: Evidence from the States," *Cato Journal,* 19 (1999), 7-16.

Brunnschweiler, Christa, "Cursing the Blessings? Natural Resource Abundance, Institutions, and Economic Growth," *World Development*, 36 (2008), 399–419.

Crogger, Jeffrey and Gordon Hanson, "Attracting Talent: Location Choices of Foreign-Born PhDs in the US, " NBER Working paper 18780 (2013).

Cumming, Douglas, and Sofia Johan. "Is it the Law or the Lawyers? Investment Covenenants around the World", *European Financial Management,* 12 (2006), 535-574.

De Soto, Hernando, *The Other Path.* New York, Harper and Row, 1989.

Dezalay, Yves and Brian Garth. "Law. Lawyers, and Social Capital: "Rule of Law Versus Relational Capitalism" *Social & Legal Studies,* 6 (1997), 109-141.

Djankov, Simeon, Rafael La Porta, Florencio Lopez-de-Silanes and Andrei Shleifer, "The Regulation of Entry," *Quarterly Journal of Economics,* 117 (2002), 1–37.

Feltovich, Nick, Richmond Harbaugh, and Ted To, "Too Cool for School? Signalling and Countersignalling," *RAND Journal of Economics,* 33 (2002), 630–649.

Frankel, Jeffrey and David Romer, "Does Trade Cause Growth?" *The American Economic Review*, 89 (1999), 379–399.

Fukuyama, Francis, *The Origins of Political Order.* New York, Farrar, Straus and Giroux, 2011.

Gennaioli, Nicola, Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer, "Human Capital and Regional Development", (2012), Mimeo.

Glaeser, Edward, Rafael La Porta, Florencio Lopez-de-Silanes and Andrei Shleifer "Do Institutions Cause Growth?" *Journal of Economic Growth*, 9 (2004), 271–303.

Greif, Avner, and Christopher Kingston, "Institutions: Rules or Equilibria?" in *Political Economy of Institutions, Democracy and Voting,* N. Schofield, and G. Caballero eds. (Springer-Verlag Berlin Heidelberg 2011).

Grossman, Herschel, "Production, Appropriation, and Land Reform," *The American Economic Review*, 84 (1994), 705–712.

Grossman, Herschel and Minseong Kim, "Swords or Plowshares? A Theory of the Security of Claims to Property", *Journal of Political Economy*, 103 (1995), 1275-1288.

Gylfason, Thorvaldur, "Natural Resources, Education, and Economic Development," *European Economic Review,* 45 (2001), 847–859.

Hadfield, Gillian. "Don't Forget the Lawyers: The Role of Lawyers in Promoting the Rule of Law in Emerging Market Democracies," *DePaul Law Review,* 56 (2007), 401-421.

Hall, Robert, and Chad Jones, "Why Do Some Countries Produce So Much More Output per Worker than Others," *Quarterly Journal of Economics*, 114 (1999), 83–116.

Hanushek, Eric, and Dennis Kimko, "Schooling, Labor-force Quality, and the Growth of Nations," *The American Economic Review,* 90 (2000), 1184–1208.

Hanushek, Eric, and Ludger Woesmann, "The Role of Cognitive Skills in Economic Development," *Journal of Economic Literature,* 46 (2008), 607–668.

Hanushek, Eric, and Ludger Woessmann, "Do Better Schools Lead to More Growth? Cognitive Skills, Economic Outcomes, and Causation," *Journal of Economic Growth,* 17 (2012), 267-321.

Kaufmann, Daniel, Aart Kraay and Massimo Mastruzzi, "The Worldwide Governance Indicators: A Summary of Methodology, Data and Analytical Issues," *World Bank Policy Research No.4978* (2010).

Knack, Stephen and Philipp Keefer, "Institutions and Economic Performance: Cross-Country Tests Using Alternative Institutional Measures," *Economics and Politics*, 7 (1995), 207–228.

Knack, Stephen and Philipp Keefer, "Does Social Capital Has an Economic Payoff? A Cross-Country Investigation," *Quarterly Journal of Economics,* 112 (1997), 1251-1288.

Laband, David, and John Sophocleus. "The Social Cost of rent-seeking: First Estimates." *Public Choice,* 58 (1988), 269-275.

La Porta, Rafael, Florencio Lopez-de-Silanes and Andrei Shelifer, "The Economic Consequences of Legal Origins," *Journal of Economic Literature,* 46 (2008), 285–332

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert W. Vishny, "Legal Determinants of External Finance," *Journal of Finance*, 52 (1997), 1131–1150.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert W. Vishny, "Law and Finance," *Journal of Political Economy*, 106 (1998), 1113–1155.

Levchenko, Andrei, "Institutional Quality and International Trade," *Review of Economic Studies,* 74 (2007), 791–819.

Mankiw, N. Gregory, Romer, David, and David N. Weil, "A Contribution to the Empirics of Economic Growth," *Quarterly Journal of Economics*, 107 (1992), 407–437.

McAusland, Carol and Peter Kuhn, "Bidding for Brains: Intellectual Property Rights and the International Migration of Knowledge Workers," *Journal of Development Economics,* 95 (2011), 77-87.

Mehlum, Halvor, Karl Moene, and Ragnar Torvik, "Predator or Prey? Parasitic Enterprises in Economic Development," *European Economic Review,* 47 (2003), 275–294

Mehlum, Halvor, Karl Moene, and Ragnar Torvik, "Institutions and the Resource Curse," *Economic Journal,* 116 (2006), 1–20.

Moretti, Enrico, "Estimating the Social Return to Higher Education: Evidence From Longitudinal and Repeated Cross-Sectional Data," *Journal of Econometrics,* 121 (2004), 175–212.

Miller, Terry and Kim Holmes, *Index of Economic Freedom,* (Washington DC: The Heritage Foundation and Dow Jones & Co., Inc., 2010)

Murphy, Kevin, Andrei Shleifer and Robert Vishny, "The Allocation of Talent: Implication for Growth," *Quarterly Journal of Economics*, 113 (1991), 503–531

Murphy, Kevin, Andrei Shleifer and Robert Vishny, "Why Is Rent Seeking So Costly to Growth?" *American Economic Review Papers and Proceedings,* 83 (1993), 409–414.

Nunn, Nathan, "Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade," *Quarterly Journal of Economics*, 122 (2007), 569–600.

North, Douglass, *Institutions, Institutional Change, and Economic Performance*, (Cambridge: Cambridge University Press, 1990).

Pecorino, Paul, "Rent Seeking and Growth: The Case of Growth Through Human Capital Accumulation," *The Canadian Journal of Economics*, 25 (1992), 944–956.

Persson, Torsten and Guido Tabellini, *Political Economics*, (Cambridge, MA: MIT Press, 2000).

Polishchuk, Leonid, "Institutional Performance," In: M. Alexeev, Sh. Weber (eds.) *Handbook of Russian Economy*, (Oxford: Oxford University Press, 2013), 189-220.

Polishchuk, Leonid, and Alexei Savvateev, "Spontaneous (Non)emergence of Property Rights," *Economics of Transition,* 12 (2004), 103–127

Polishchuk, Leonid, and Alexander Tonis, "Endogenous Contest Success Functions: a Mechanism Design Approach," *Economic Theory,* 4 (2011).

Pritchett, Lant, "Where Has All the Education Gone?" *The World Bank Economic Review,* 15 (2001), 367–391.

Pritchett, Lant, "Does Learning to Add Up Add Up? The Returns to Schooling in Aggregate Data," in *Handbook of the Economics of Education*, Eric Hanushek and Finis Welch, eds. (Elsevier, 2006).

Rodrik, Dani, Arvind Subramanian and Francesco Trebbi, "Institutions Rule: the Primacy of Institutions over Geography and Integration in Economic Development," *Journal of Economic Growth*, 9 (2004), 131–165.

Rogers, Mark, "Directly Unproductive Schooling: How Country Characteristics Affect the Impact of Schooling on Growth," *European Economic Review,* 52 (2008), 356–385.

Solow, Robert "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics*, 70 (1956), 65–94.

Tabellini, Guido, "The Scope of Cooperation: Values and Incentives," *Quarterly Journal of Economics*, 123 (2008), 905–950.

Tollison, Robert, "Rent Seeking: A Survey," *Kyklos,* 35 (1982), 575-602.

Tullock, Gordon, "On the Efficient Organization of Trials," *Kyklos*, 28 (1975), 745–762.

Tullock, Gordon, "Efficient Rent-Seeking," in *Toward a Theory of the Rent-Seeking Society,* J. Buchanan, J. Tollison, and G. Tullock eds. (College Station: Texas A&M University Press, 1980).

Varian, Hal. "Measuring the Deadweight Costs of DUP and Rent Seeking Activities," *Economics and Politics,* 1 (1989), 81-95.

Table 1. – Descriptive Statistics

	All countries	Strong institution countries	Weak institution countries
	(1)	(2)	(3)
A. Allocation of talent measures			
Share of Law graduates, %	6.22	4.21	8.2 7
	(4.90)	(2.90)	(5.66)
Share of Science graduates, %	8.30	9.72	6.84
	(4.63)	(4.92)	(3.85)
Difference between shares of law and science graduates, %	-2.08	-5.52	1.43
	(7.15)	(5.90)	(6.64)
B. Institutional quality indexes			
Rule of Law, average index for 2000-2005	0.13	1.00	-0.74
	(1.01)	(0.63)	(0.36)
Government Effectiveness, average index for 2000-2005	0.25	1.09	-0.59
	(1.02)	(0.71)	(0.39)
Control of Corruption, average index for 2000-2005	0.19	1.03	-0.68
	(1.05)	(0.79)	(0.37)
Private Property Protection, average index for 2000-2005	3.5	4.25	2.7
	(1.13)	(0.81)	(0.82)
C. Controls and instruments			
GDP per capita, PPP, in 2005 dollars	15064	24 597	5 329
	(13 873)	(13 378)	(4 337)
Average GDP growth rate per capita, 1990-2010, %	2.03	2.07	2.08
	(1.57)	(1.00)	(1.98)
Tertiary education, gross enrollment ratio, %	40.8	55.3	26.0
	(27.9)	(23.3)	(24.2)
Average Years of Tertiary Schooling (age 15 and more)	0.30	0.38	0.19
	(0.24)	(0.23)	(0.21)
Change in Average Years of Tertiary Schooling 1990-2010	0.19	0.24	0.13
	(0.18)	(0.17)	(0.18)
Cognitive Skills	4.60	4.74	4.12
	(0.52)	(0.48)	(0.37)
Services, value added, % GDP	59.0	66.4	51.6
	(14.0)	(11.3)	(12.5)
Government expenditure, % GDP	16.6	18.5	14.5
	(5.7)	(4.2)	(6.5)
Oil reserves,	10 346	9 983	10 716
	(38 457)	(45 281)	(30 445)

Ethnolinguistic fractionalization index	0.39	0.30	0.47
	(0.25)	(0.21)	(0.25)
Gini index	0.39	0.33	0.45
	(0.10)	(0.07)	(0.08)
Trade, ratio to GDP	0.90	1.03	0.76
	(0.54)	(0.64)	(0.37)
Emigration rate of tertiary educated, %	14.1	12.7	15.6
	(13.8)	(11.4)	(15.9)
Log Population	16.2	15.9	16.5
	(1.5)	(1.5)	(1.4)
French Legal Origin	0.43	0.31	0.57
	(0.49)	(0.47)	(0.49)
Observations	95	48	47

Notes: Mean values of main variables with standard deviations in parentheses. Values of GDP per capita, Tertiary Schooling, Services, Oil reserves, Gini, Government Expenditures, Trade and Population are for 2009. Emigration data are for 2000. Average GDP Growth data are from the last update of Penn World Tables 7.1. Tertiary education and change in tertiary education data are from the Barro-Lee dataset. Cognitive skills data are from Hanushek and Woessmann (2012).

Table 2. – OLS Regressions for Share of Law School Graduates

	Dependent variable: *Share of Law graduates*								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rule of Law	-0.380***	-0.530***	-0.589***	-0.578***	-0.581***	-0.563***	-0.486***	-0.580***	-0.466***
	(0.100)	(0.161)	(0.172)	(0.168)	(0.171)	(0.170)	(0.168)	(0.207)	(0.119)
Log GDP per capita		0.218	0.218	0.207	0.232	0.0571	0.157	0.152	-0.0461
		(0.170)	(0.167)	(0.174)	(0.181)	(0.194)	(0.220)	(0.321)	(0.128)
School Tertiary		-0.335	-0.422	-0.433	-0.366	-0.0516	-0.581	-0.0209	0.609*
		(0.516)	(0.471)	(0.471)	(0.481)	(0.461)	(0.514)	(0.566)	(0.359)
Services, % of GDP			0.777	0.837	0.776	1.500	1.466	0.197	1.770**
			(1.014)	(1.040)	(1.053)	(1.060)	(1.046)	(1.392)	(0.832)
Log Oil reserves				0.00545	-2.57e-05	0.0626**	0.0542	0.0388	0.0575**
				(0.0259)	(0.0255)	(0.0307)	(0.0375)	(0.0450)	(0.0238)
Ethnic Fractionalization					0.285	0.327	0.286	0.352	-0.116
					(0.542)	(0.509)	(0.503)	(0.515)	(0.342)
Log Populaion						-0.219***	-0.357***	-0.335***	-0.178***
						(0.0779)	(0.0886)	(0.106)	(0.0596)
Gini coefficient							0.925	0.648	
							(0.0134)	(1.314)	
Trade to GDP ratio							-0.526**	-0.351	
							(0.00228)	(0.240)	
Emigration rate of tertiary educated, %								-0.00199	
								(0.0132)	
Government expenditure, % GDP								0.0285	
								(0.0254)	
French Legal Origin =1								0.522*	
								(0.295)	
R&D spending, % GDP								0.136	
								(0.142)	
Export of manufactured products, % total export								-0.152	
								(0.537)	
Constant	0.109	-1.707	-2.123	-2.072	-2.379	1.947	3.726	3.210	1.749
	(0.105)	(1.362)	(1.319)	(1.337)	(1.470)	(2.125)	(2.658)	(3.882)	(1.571)
Observations	95	95	95	95	95	95	81	72	87
R-squared	0.145	0.165	0.171	0.171	0.175	0.230	0.322	0.400	0.278

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0. Columns (1) to (8) report estimations of model (6) with different sets of control variables, and column (9) – with excluded outliers. The regression coefficients reported for Rule of Law index is standardized beta coefficients.

Table 3. – OLS Regressions for Share of Science Graduates

	Dependent variable: *Share of Science graduates*								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rule of Law	0.234***	0.257***	0.205*	0.258**	0.258**	0.252**	0.262**	0.353**	0.326***
	(0.0740)	(0.0970)	(0.106)	(0.120)	(0.120)	(0.118)	(0.117)	(0.143)	(0.0919)
Log GDP percapita		0.194	0.194	0.134	0.137	0.191	0.250	0.120	-0.000884
		(0.137)	(0.132)	(0.142)	(0.148)	(0.148)	(0.179)	(0.206)	(0.110)
School Tertiary		-1.261**	-1.339**	-1.395**	-1.386**	-1.482***	-1.179**	-0.966	-0.470
		(0.565)	(0.574)	(0.574)	(0.563)	(0.558)	(0.495)	(0.607)	(0.293)
Services, % GDP			0.700	1.020	1.012	0.789	0.235	0.577	-0.0459
			(0.744)	(0.714)	(0.707)	(0.746)	(0.736)	(1.148)	(0.599)
Log Oil reserves				0.0289	0.0281	0.00887	-0.0119	-0.00170	0.00421
				(0.0211)	(0.0226)	(0.0272)	(0.0286)	(0.0369)	(0.0214)
Ethnic Fractionalization					0.0378	0.0249	0.493	0.213	0.125
					(0.356)	(0.360)	(0.380)	(0.402)	(0.291)
Log Populaion						0.0674	0.114**	0.0915	0.0773*
						(0.0530)	(0.0509)	(0.0956)	(0.0425)
Gini coefficient							-0.0210	-0.0812	
							(0.845)	(0.985)	
Trade to GDP ratio							0.289	0.413	
							(0.248)	(0.337)	
Emigration rate of tertiary educated, %								0.00423	
								(0.00873)	
Government expenditure, % GDP								-0.0265	
								(0.0205)	
French Legal Origin =1								0.0979	
								(0.198)	
R&D spending, % GDP								0.0207	
								(0.138)	
Export of manufactured products, % total export								0.112	
								(0.492)	
Constant	-0.240***	-1.487	-1.861	-1.594	-1.635	-2.964*	-4.487**	-2.963	-1.453
	(0.0718)	(1.044)	(1.141)	(1.211)	(1.307)	(1.544)	(1.935)	(2.738)	(1.349)
Observations	95	95	95	95	95	95	81	72	90
R-squared	0.102	0.199	0.208	0.223	0.223	0.233	0.339	0.410	0.211

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0. Columns (1) to (8) report estimations of model (6) with different sets of control variables, and column (9) – with excluded outliers. The regression coefficients reported for Rule of Law index is standardized beta coefficients.

Table 4. – OLS Regressions for Difference between Shares of Law School and Science Graduates

	Dependent variable: *Difference between Shares of Law and Science graduates*			
	(1)	(2)	(3)	(4)
Rule of Law	-0.552***			
	(0.146)			
Government Effectiveness		-0.387**		
		(0.152)		
Control for Corruption			-0.383***	
			(0.117)	
Private Property Protection				-0.294**
				(0.133)
Log GDP percapita	-0.116	-0.188	-0.228	-0.339*
	(0.170)	(0.188)	(0.164)	(0.187)
School Tertiary	1.152**	1.153**	1.140**	1.013
	(0.561)	(0.575)	(0.569)	(0.696)
Services, % GDP	0.298	0.0628	0.218	0.101
	(0.873)	(0.941)	(0.890)	(0.971)
Log Oil reserves	0.0318	0.0440	0.0520*	0.0589**
	(0.0307)	(0.0306)	(0.0302)	(0.0295)
Ethnic Fractionalization	0.182	0.236	0.144	0.0169
	(0.421)	(0.432)	(0.435)	(0.518)
Log Populaion	-0.190***	-0.179**	-0.208***	-0.219***
	(0.0671)	(0.0682)	(0.0658)	(0.0739)
Constant	3.487*	4.060*	4.777**	7.135***
	(1.994)	(2.127)	(1.848)	(1.995)
Observations	95	95	95	83
R-squared	0.310	0.246	0.266	0.301

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Columns (1) to (4) report estimations of model (6) with different institutional quality indexes. The regression coefficients reported for Rule of Law index is standardized beta coefficients.

Table 5. – OLS Regressions for Sub-Samples of Nations

	Dependent variable: *Difference between Shares of Law and Science graduates*					
	Without OECD and High-Income Countries	Without Low-Income Countries	Post-Communist Countries	Former European Colonies	Full Sample with dummy for Asia	Full Sample with dummy for Africa
	(1)	(2)	(3)	(4)	(5)	(6)
Rule of Law	-0.697***	-0.488***	-0.912***	-0.737***	-0.636***	-0.631***
	(0.258)	(0.181)	(0.148)	(0.232)	(0.140)	(0.165)
Log GDP per capita	0.0930	-0.368	-0.432**	0.0665	0.00175	-0.0149
	(0.188)	(0.239)	(0.158)	(0.203)	(0.163)	(0.184)
School Tertiary	0.307	1.210**	1.421***	0.0892	0.995*	1.354**
	(0.575)	(0.557)	(0.398)	(0.989)	(0.545)	(0.567)
Services, % GDP	0.680	0.804	3.946***	1.095	-0.613	0.397
	(1.055)	(0.792)	(0.973)	(1.213)	(0.961)	(0.878)
Log Oil reserves	0.0577	0.0360	-0.0205	0.0654	0.0153	0.0301
	(0.0427)	(0.0330)	(0.0486)	(0.0440)	(0.0312)	(0.0310)
Ethnic Fractionalization	0.435	0.00826	-2.127***	0.264	-0.0105	0.115
	(0.460)	(0.556)	(0.607)	(0.529)	(0.369)	(0.417)
Log Populaion	-0.288***	-0.198**	-0.271*	-0.210**	-0.133*	-0.187***
	(0.0925)	(0.0787)	(0.130)	(0.0999)	(0.0733)	(0.0671)
Asia					-0.777***	
					(0.223)	
Africa						0.421
						(0.320)
Constant	3.129	5.729**	6.363**	1.945	2.408	2.330
	(2.554)	(2.655)	(2.404)	(2.583)	(1.988)	(2.201)
Observations	61	81	20	49	95	95
R-squared	0.29	0.36	0.833	0.33	0.41	0.32

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. The regression coefficients reported for Rule of Law index is standardized beta coefficients.

Table 6. – OLS Regressions for Post-Socialist Countries

	Share of Law Graduates	*Share of Science Graduates*	*Difference between Shares of Law and Science graduates*
	(1)	(2)	(3)
Rule of Law	-0.735**	0.571***	-0.912***
	(0.307)	(0.129)	(0.148)
Log of GDP per capita	-0.286	0.320**	-0.432**
	(0.313)	(0.146)	(0.158)
School Tertiary	0.399	-1.477***	1.421***
	(0.892)	(0.427)	(0.398)
Services, % of GDP	3.992*	-1.845**	3.946***
	(2.099)	(0.819)	(0.973)
Log of Oil reserves	0.0303	0.0490	-0.0205
	(0.0895)	(0.0504)	(0.0486)
Ethnic fractionalization	-0.554	2.224***	-2.127***
	(1.160)	(0.549)	(0.607)
Log of Populaion	-0.246	0.148	-0.271*
	(0.227)	(0.130)	(0.130)
Constant	4.181	-4.827*	6.363**
	(5.001)	(2.596)	(2.404)
Observations	20	20	20
R-squared	0.601	0.735	0.833

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. The regression coefficients reported for Rule of Law index is standardized beta coefficients.

Table 7. – Settler Mortality as an Instrumental Variable (The Case of Former Colonies)

	Panel A. Second Stage			
	Dependent variable: *Difference between Shares of Law and Science graduates*			
	(1)	(2)	(3)	(4)
Rule of Law	-1.533			
	(0.921)			
Government Effectiveness		-1.526**		
		(0.702)		
Control for Corruption			-1.413	
			(0.918)	
Private Property Protection				-0.931**
				(0.447)
Log of GDP per capita	0.471	0.627	0.495	0.828*
	(0.452)	(0.428)	(0.499)	(0.483)
School Tertiary	0.336	-0.0628	0.771	0.279
	(2.159)	(1.791)	(2.302)	(1.463)
Services, % of GDP	1.778	1.616	1.587	-0.604
	(2.034)	(1.849)	(2.202)	(1.487)
Log of Oil reserves	0.0395	0.0543	0.0361	0.0655
	(0.101)	(0.0873)	(0.108)	(0.0766)
Ethnic fractionalization	0.0448	0.284	0.358	0.967
	(0.833)	(0.698)	(0.971)	(0.932)
Log of Populaion	-0.263	-0.183	-0.223	0.0285
	(0.186)	(0.163)	(0.157)	(0.212)
Constant	-0.964	-3.409	-1.929	-1.709
	(6.398)	(5.792)	(6.446)	(4.921)
	Panel B. First Stage			
	Rule of Law	*Government Effectiveness*	*Control for Corruption*	*Private Property Protection*
Log of Settler Mortality	-0.245	-0.246*	-0.266	-0.403*
	(0.156)	(0.140)	(0.162)	(0.207)
Log of GDP per capita	0.285	0.389*	0.326	0.852**
	(0.234)	(0.222)	(0.244)	(0.313)
School Tertiary	0.639	0.381	1.002	0.992
	(0.915)	(0.785)	(0.907)	(0.967)
Services, % of GDP	1.144	1.043	1.107	-0.674
	(1.222)	(1.309)	(1.294)	(1.270)
Log of Oil reserves	-0.0553	-0.0458	-0.0624	-0.0631
	(0.0534)	(0.0532)	(0.0563)	(0.0656)
Ethnic fractionalization	0.297	0.455	0.545	1.480**
	(0.553)	(0.445)	(0.599)	(0.630)
Log of Populaion	0.00684	0.0595	0.0363	0.325***
	(0.0955)	(0.0865)	(0.0887)	(0.116)
Constant	-2.411	-4.025	-3.301	-4.772
	(3.001)	(2.613)	(3.008)	(3.765)
Observations	35	35	35	35
R-squared	0.615	0.707	0.675	0.775
First Stage F-statistics	6.15	9.30	8.02	13.26

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Columns (1) to (4), Panel A, report second stage estimations of model (6) with fitted institutional quality indexes instrumented by settler mortality at the first stage (Panel B). Source of settler mortality data: Acemoglu, Johnson, and Robison, 2001. The regression coefficients reported for Rule of Law index is standardized beta coefficients.

Table 8. – Fraction of English Speaking Population as an Instrumental Variable

	Panel A. Second Stage			
	Dependent variable: *Difference between Shares of Law and Science graduates*			
	(1)	(2)	(3)	(4)
Rule of Law	-0.704*			
	(0.415)			
Government Effectiveness		-0.757*		
		(0.442)		
Control for Corruption			-0.543*	
			(0.309)	
Private Property Protection				-0.561*
				(0.332)
Log of GDP per capita	-0.0582	0.0193	-0.132	-0.118
	(0.302)	(0.338)	(0.264)	(0.283)
School Tertiary	1.067	1.069	1.004	0.665
	(0.906)	(0.952)	(0.933)	(1.054)
Services, % of GDP	0.516	0.625	0.285	0.0264
	(1.183)	(1.293)	(1.158)	(1.301)
Log of Oil reserves	0.0173	0.0151	0.0357	0.0338
	(0.0329)	(0.0363)	(0.0313)	(0.0313)
Ethnic fractionalization	0.256	0.417	0.250	0.0599
	(0.501)	(0.546)	(0.521)	(0.606)
Log of Populaion	-0.256***	-0.224**	-0.281***	-0.257***
	(0.0827)	(0.0864)	(0.0872)	(0.0825)
Emigration rate of tertiary educated, %	-0.0135	-0.0124	-0.0144*	-0.0166**
	(0.00816)	(0.00783)	(0.00744)	(0.00722)
Constant	4.253	2.988	5.431**	7.222***
	(2.755)	(3.465)	(2.275)	(2.131)
	Panel B. First Stage			
	Rule of Law	*Government Effectiveness*	*Control for Corruption*	*Private Property Protection*
Fraction of English Speaking Population	0.751***	0.699***	0.974***	0.980***
	(0.192)	(0.181)	(0.208)	(0.277)
Log of GDP per capita	0.462***	0.532***	0.463***	0.444***
	(0.0966)	(0.100)	(0.106)	(0.167)
School Tertiary	0.344	0.323	0.330	0.194
	(0.370)	(0.383)	(0.440)	(0.560)
Services, % of GDP	1.458*	1.501*	1.466*	0.893
	(0.736)	(0.785)	(0.835)	(1.313)
Log of Oil reserves	-0.0638**	-0.0623**	-0.0490	-0.0543
	(0.0254)	(0.0275)	(0.0306)	(0.0433)
Ethnic fractionalization	-0.00652	0.206	-0.0194	-0.0957
	(0.260)	(0.242)	(0.292)	(0.486)
Log of Populaion	-0.0410	0.00457	-0.0988	-0.0344
	(0.0520)	(0.0579)	(0.0639)	(0.0728)
Emigration rate of tertiary educated, %	-0.00789	-0.00596	-0.0120***	-0.0159*
	(0.00517)	(0.00382)	(0.00428)	(0.00864)
Constant	-4.537	-5.793	-3.846***	-1.203
	(1.276)	(1.206)	(1.384)	(2.117)
Observations	75	75	75	71
First Stage R-squared	0.78	0.81	0.78	0.58
First Stage F-statistics	30.38	35.88	29.50	10.66

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Columns (1) to (4), Panel A, report second stage estimations of model (6) with fitted institutional quality indexes instrumented by the fraction of English-speaking population at the first stage (Panel B). Source of English-speaking population data: Hall and Jones 1999.

Table 9. – Quality of Institutions and Strength of Talent

	Weak Institutions	Strong Institutions
High Human Capital Index	7.33%	4.24%
Low Human Capital Index	2.88%	3.20%
Difference	4.44%***	1.04%
t-statistics	3.76	1.2
Observations	17	44

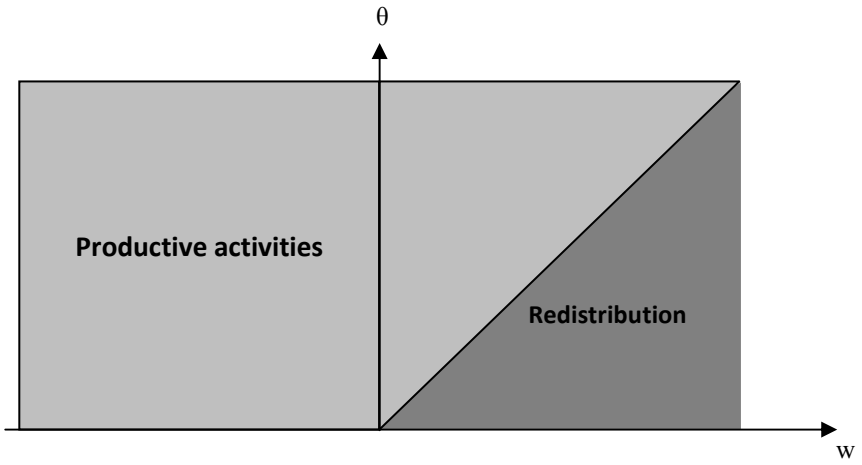
Note: *** p<0.01 Share of Law Graduates for different types of countries. Asterisks represent statistical significance of the difference. *t*-statistics for difference-in-means test.

Table 10. – Allocation of Talent and Returns to Education

	Dependent Variable: *Average growth Rates of GDP per Capita in 1990-2010*					
	Full Sample	Difference Above Median	Difference Below Median	Full Sample	Difference Above Median	Difference Below Median
	(1)	(2)	(3)	(4)	(5)	(6)
Change in Tertiary Schooling	0.569	-0.948	1.637*			
	(0.886)	(1.602)	(0.896)			
Cognitive Skills				1.069***	0.745	1.158***
				(0.371)	(0.584)	(0.346)
Log Initial GDP per Capita	-0.427**	-0.641*	-0.382*	-1.085***	-1.599***	-0.629**
	(0.171)	(0.320)	(0.199)	(0.317)	(0.470)	(0.247)
Log Initial Tertiary Schooling	1.110	3.670*	-0.234	0.522	2.258	-0.496
	(0.833)	(1.871)	(0.524)	(0.618)	(1.775)	(0.426)
Average Investment, % GDP	0.0432*	0.0600	0.0255	0.0191	0.0181	0.0192
	(0.0222)	(0.0403)	(0.0284)	(0.0255)	(0.103)	(0.0219)
Constant	4.294**	5.165*	4.698**	6.610***	12.09***	2.470*
	(1.646)	(2.717)	(2.127)	(1.969)	(2.094)	(1.315)
Observations	88	44	44	58	29	29
R-squared	0.105	0.150	0.221	0.321	0.502	0.422

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Columns (1) to (3) represent regressions of economic growth rates on the increase of average tertiary schooling for respectively the full sample and sub-smaples with the differences between law and science graduation above and below the sample median. Columns (4) to (6) represent similar regressions when increase in tertiary schooling is replaced by a cognitive skills measure from Hanushek and Woessmann, (2012).

a) Strong institutions



b) Weak institutions

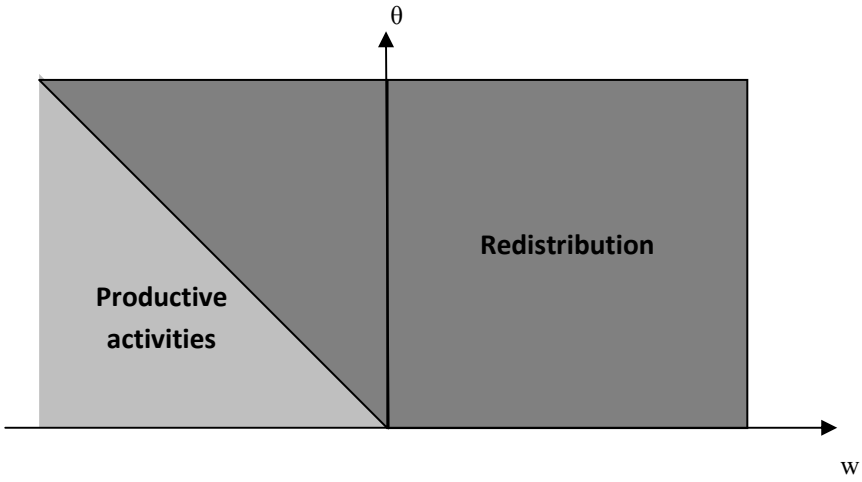


Figure 1.—Allocation of Talent Under Strong (a) and Weak (b) Institutions

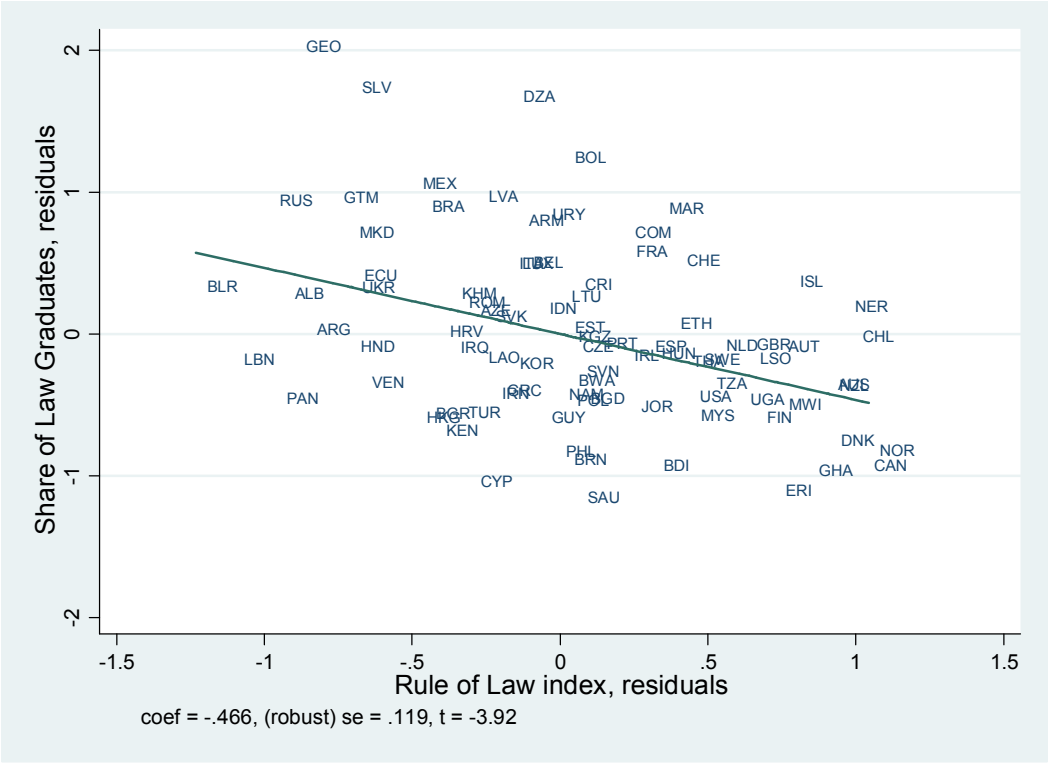


Figure 2. —Quality of Institutions and Graduation in Law

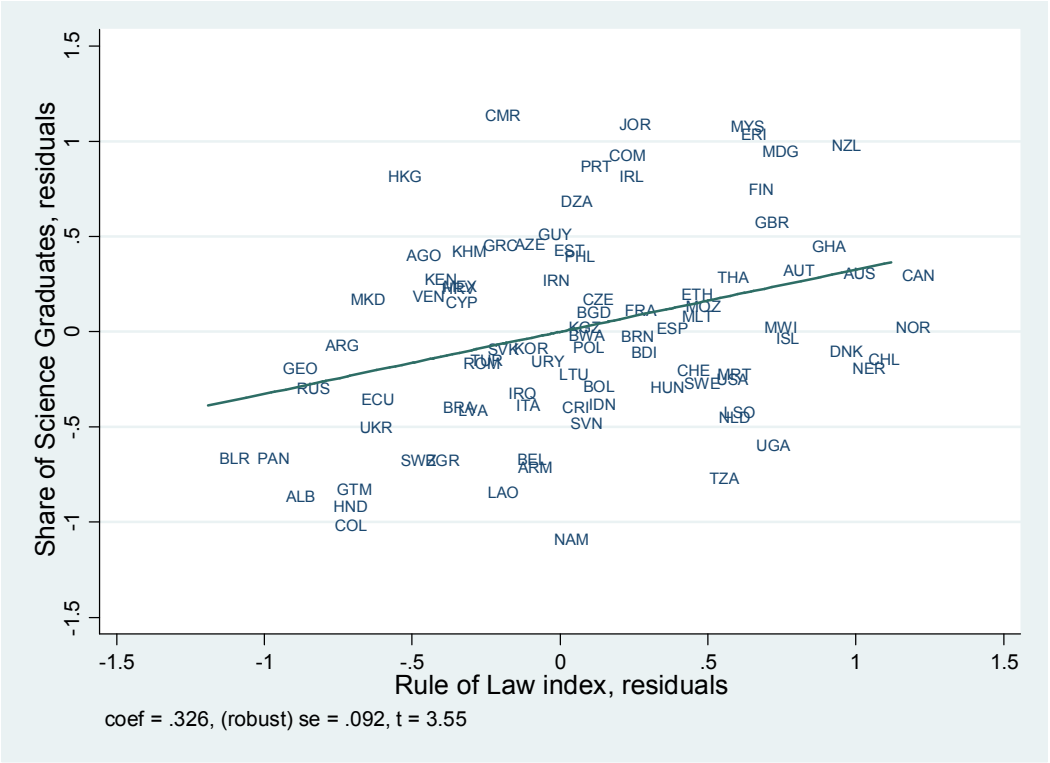


Figure 3. —Quality of Institutions and Graduation in Science

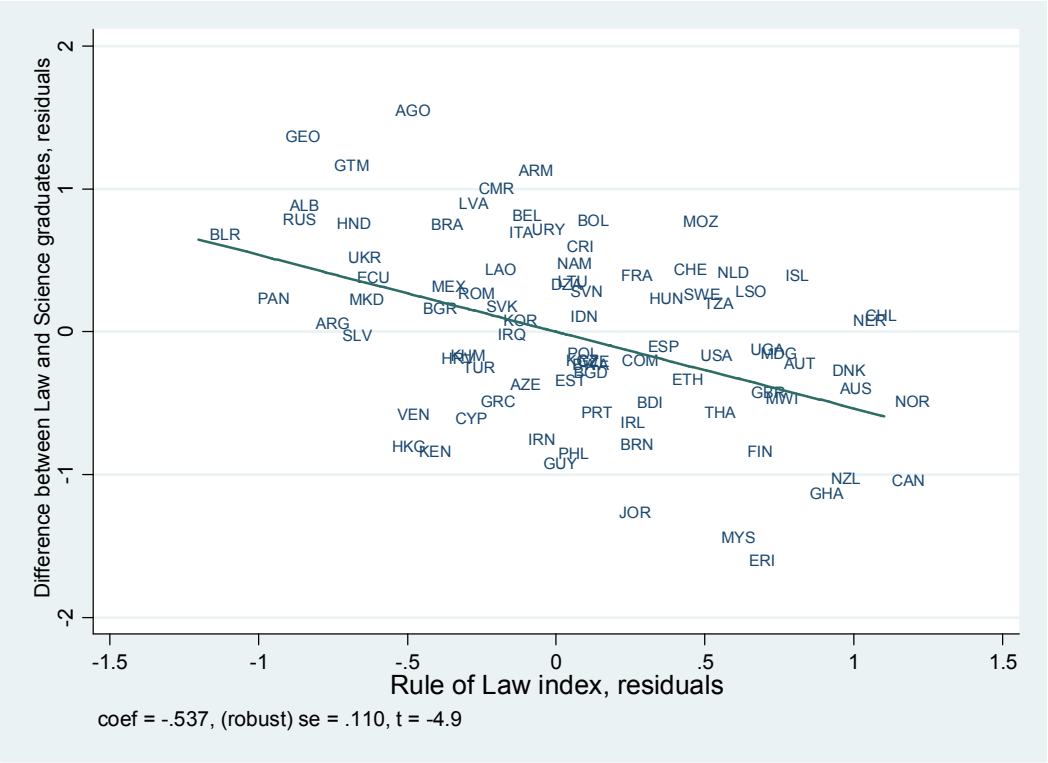


Figure 4. —Quality of Institutions and Difference between Graduation in Law and Science

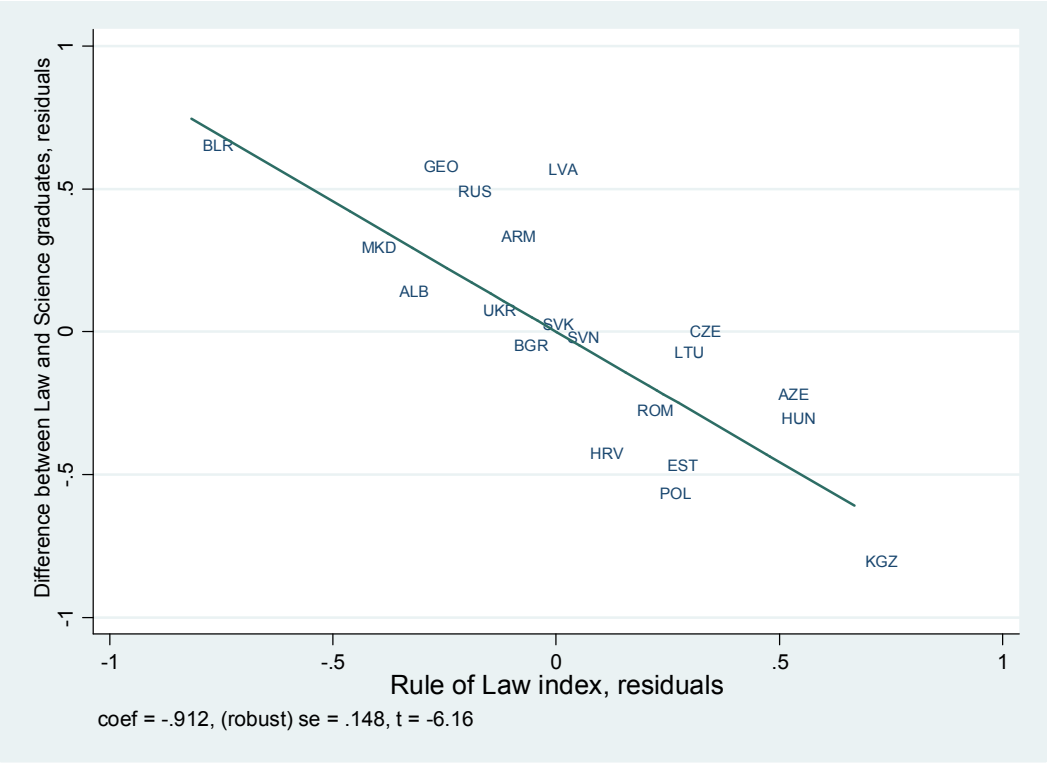


Figure 5. —Quality of Institutions and Difference between Law and Science Graduation rates in Post-Communist Countries

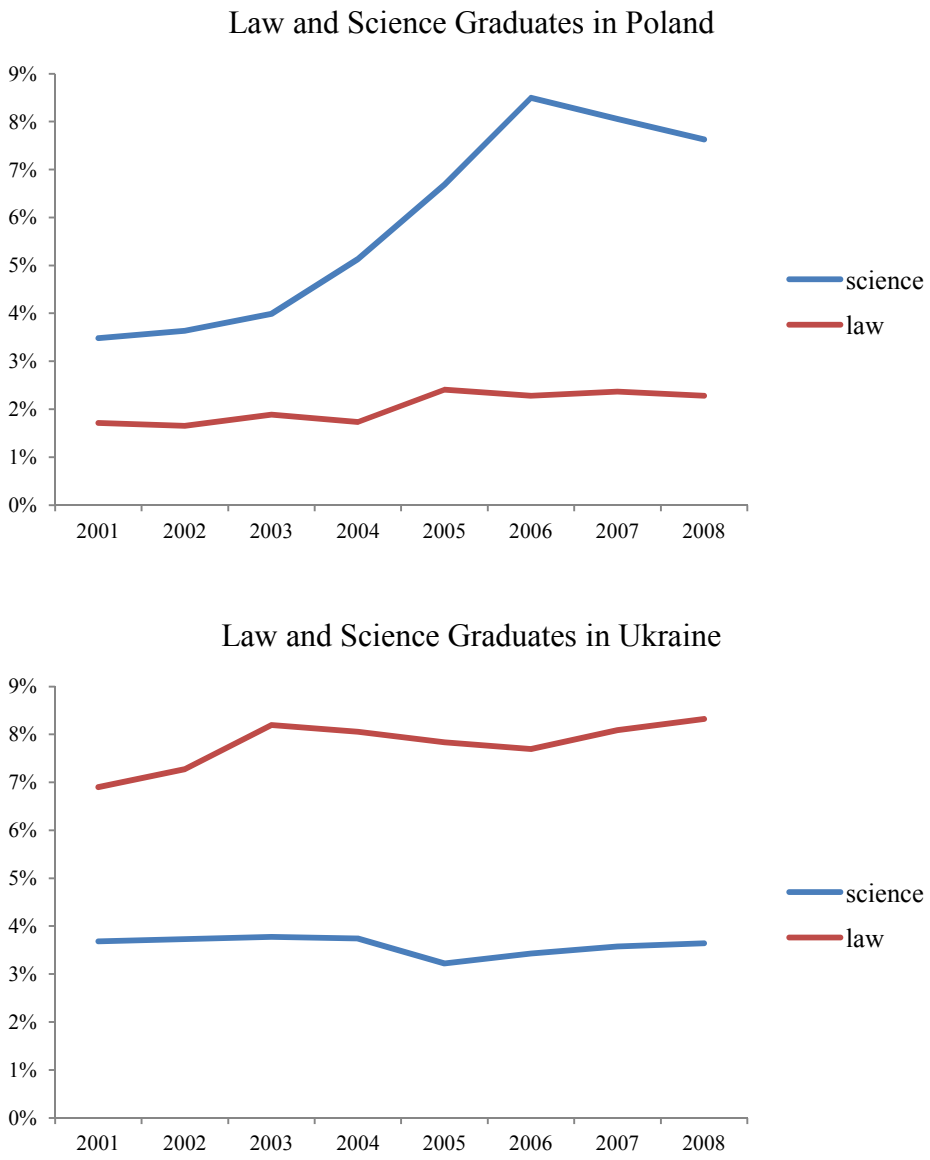


Figure 6. —Law and Science Graduation trends in Poland and Ukraine (Source: UNESCO Educational Statistics)

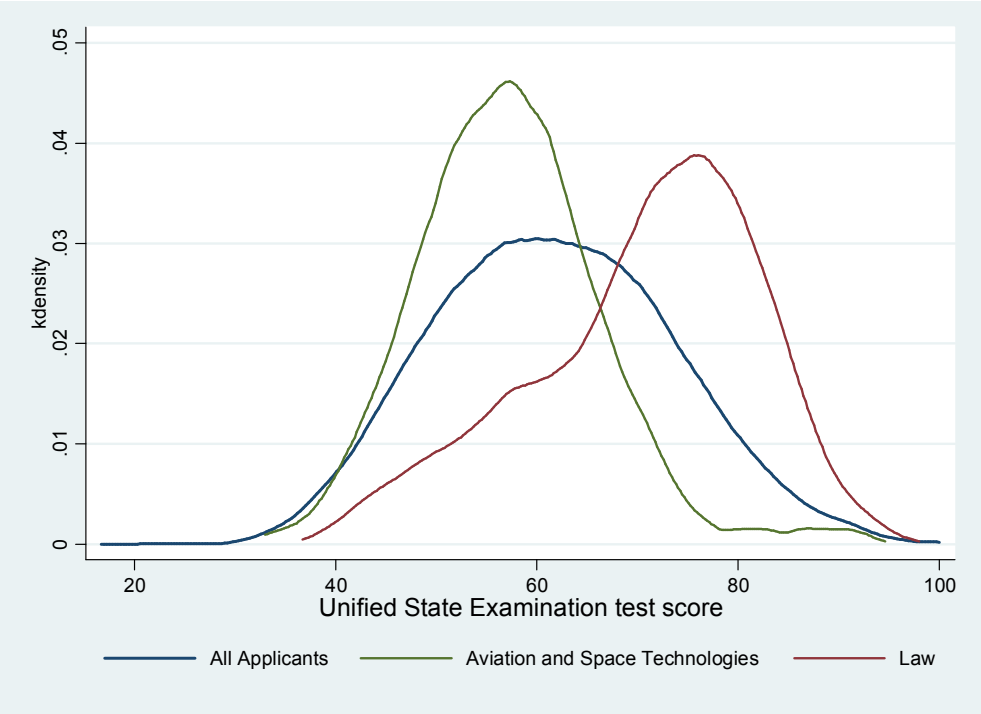


Figure 7. —Distribution of 2010 Unified State Examination Test Scores for all university applicants in Russia (Source: Russian Federal Education Web-portal (www.edu.ru))[25]

[25] We are grateful to Gregory Androushchak and Alexander Novikov (Center for Institutional Studies at the Higher School of Economics) who kindly provided detailed individual level data not available from open access sources.

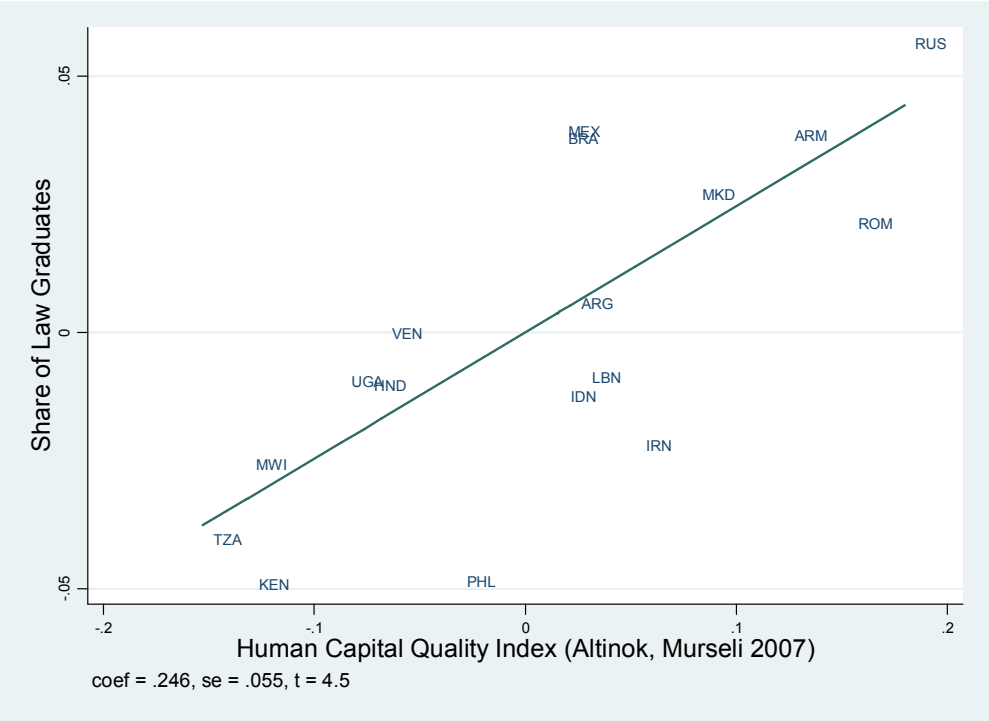


Figure 8. —Quality of Human Capital and Allocation of Talent in Countries with Weak Institutions

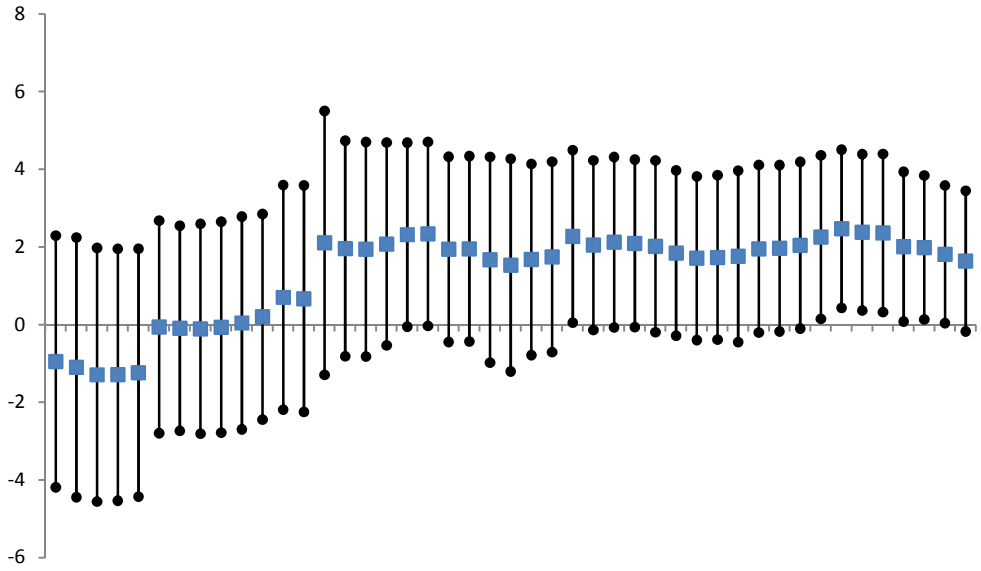


Figure 9. —Rolling Sample Regression of Economic Growth on Tertiary Education

Note: Dependence of the regression coefficient of the *Change in (tertiary) Schooling* variable from model (7) estimated for the rolling sub-sample. Vertical lines show 95% confidence intervals.