Jurajda, Štepán; Terrell, Katherine

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Štepán Jurajda
Katherine Terrell

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of Labor

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Štěpán Jurajda
CERGE-EI,
CEPR and IZA

Katherine Terrell
University of Michigan,
CEPR and IZA

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IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

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ABSTRACT

Regional Unemployment and Human Capital in Transition Economies*

Differences in regional unemployment in post-communist economies are large and persistent. We show that inherited variation in human-capital endowment across the regions of four such economies explains the bulk of regional unemployment variation there and we explore potential explanations for this outcome through related capital and labor mobility patterns. The evidence suggests that regions with high inherited skill endowments attract skilled workers as well as FDI. This mobility pattern, which helps explain the lack of convergence in regional unemployment rates, is consistent with the presence of complementarities in skill and capital. Nevertheless, we find no supporting evidence of human capital wage spillovers implied by the complementarities story. Unemployment of the least-skilled workers appears lower in areas with a higher share of college-educated labor and future research is needed to see if this finding as well as the observed migration pattern arise from different adjustments to regional shocks by education level brought about in part by Central European labor-market institutions, such as guaranteed welfare income raising effective minimum wages.

JEL Classification: E24, J0, J61

Keywords: unemployment, human capital, regional labor markets, transition economies, labor mobility, complementarities, spillovers, Czech Republic, Hungary, Romania, Ukraine

Corresponding author:

Katherine Terrell
University of Michigan Business School
701 Tappan Street
Ann Arbor, MI 48109-1234
USA
E-mail: terrell@bus.umich.edu

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1. Introduction

The first stages of transition from central planning to market economy brought about a recession and massive reallocation of both labor and capital; it is therefore not surprising that the unemployment rates quickly increased from their artificial zero level to double digits in most post-communist economies. However, what is surprising to many economists is that unemployment rates failed to decline during the later stages of the transition process, since they were often characterized by rapid growth pulled by foreign direct investment (FDI) and increasing economic integration (Münich and Svejnar, 2007).

One explanation may lie in the fact that the transition process is occurring in an era of rapid globalization, which is demanding skill biased technological change (SBTC). A recent line of research asks about the explanatory power for national unemployment levels in post-communist economies of the global shifts in labor demand towards skilled labor and argues that the effective skill endowments among the less educated in transition countries are low in international comparison.[1]

Another explanation may lie in a key feature of unemployment in post-communist countries: its persistently high regional dispersion. One can hope that understanding this feature of unemployment may help us uncover the underpinnings of the persistently high national unemployment rates. A growing strand of research has therefore investigated the lack of convergence in regional unemployment rates in post-communist countries. This work typically depicts labor migration as a weak equilibration mechanism and blames this on institutional deficiencies, such as underdeveloped housing markets.[2] However, other factors may explain why labor migration does not equilibrate regional unemployment (and wage) rates. In particular, this literature so far failed to focus on skill-specific migration, capital inflow and regional skill endowments.

This omission is important in light of the recent work by, e.g., Devillanova (2004) and Gianetti (2002), which stresses the importance of the regional distribution of human capital in driving migration and capital flows. The essence of these models is that skill-skill and capital-skill complementarities induce skilled labor and capital flows to regions

[1] See Sabirianova (2003), Commander and Köllő (2004), Kezdi (2003) and Köllő (2006).
[2] See, e.g., Bornhorst and Commander (2004), Huber (2004), or Fidrmuc (2004).

where there is a high concentration of skilled labor, rather than where it is scarce. Such a mechanism reinforces regional differences in unemployment and can exacerbate them.

Another related potential explanation for lack of regional unemployment convergence is that skilled and unskilled individuals respond differently to regional labor demand shocks. When there is a collapse in local demand for labor, the low-skilled workers may be less likely to migrate and hence more likely to remain unemployed or drop of out of the labor force than highly skilled workers, whose opportunity cost of not working is higher. This would exacerbate the level of unemployment of unskilled in areas with a large share of unskilled workers, creating more dispersion in the unemployment rates of regions.

This paper aims to shed light on the puzzle of the persistently high unemployment in transition economies by connecting the various strands in the literature on skill biased nature of the transition process and persistent regional unemployment disparities. Specifically, we use regional (NUTS-3 level) and worker-level data from the Czech Republic, Hungary, Bulgaria and Ukraine to explore the explanatory power of regional skill endowments for regional unemployment, related capital and labor flows and potential skill complementarities to explain the lack of convergence of regional unemployment rates

Our analysis proceeds in two main steps. First, using regional data, we establish that regional variations in unemployment and skill endowments are similarly wide across these four countries; moreover, regional skill endowment disparities in transition economies are increasing over time and are wider than in developed European economies. We also show that the persistence of regional unemployment over time is especially strong among the low-skilled.

Next, we (are the first to) demonstrate that the lion's share of the variation in regional unemployment rates in transition economies is explained by the variation in regional human capital; regions with a higher share of highly skilled people have lower unemployment rates and *visa versa*. This result is not driven simply by the generally lower unemployment rate of skilled people as it is much stronger than suggested by

applying the national average skill-specific unemployment rates to the regional skill distribution.

In the second step of our analysis, we turn to individual-level as well as regional data to provide evidence on the underpinnings of these regional unemployment-skill patterns. Specifically, we test whether migration and capital flows are contributing to the non-convergence of regional unemployment and wage rates. For migration to lower the dispersion in unemployment rates, we would particularly want to see unskilled workers move out of the high unemployment regions to low unemployment regions. We check for this and find that low skilled workers migrate less often than high skilled workers, who actually tend to migrate to regions with relatively high concentration of skilled people and low unemployment. These findings on migration by skill are consistent with the fact that the variation in regional skill endowments is rising over time. Similarly, we ask if capital flows tend to lower the dispersion in unemployment rates by flowing to regions with high unemployment and low skills. We focus on the inflow of FDI – "high-end" capital, which represents a major source of new capital in transition countries.[3] We find that on average FDI tends to flow to regions with high skill levels.

Next, we ask what might explain such flows of FDI and skilled labor and note that they are consistent with a story of "complementarities" or "spillovers" based on a geographical concentration of skilled workers.[4] We search for supporting evidence, following an identification strategy used in the US literature, but find no evidence for wage spillovers. On the other hand, there is some evidence that unemployment rates of the less skilled are lower in areas well endowed in college-educated labor, consistent with the strong explanatory power of regional skill endowments for regional unemployment.

[3] The cumulated FDI inflows during 1993 to 2000 are large given that their value equals about 25% (40%) of the 2000 Bulgarian (Czech or Hungarian) GDP as documented in Smarzynska Javorcik (2004) who also shows that FDI in transition countries generates productivity spillovers to local companies. Using an alternative measure, FDI constituted on average about 20 (40) [15] {5} percent of gross fixed capital formation during 1990 to 2000 in Bulgaria (Hungary) [Czech Republic] {Ukraine} according to the UN's 2006 *World Investment Report*.

[4] There is a growing literature on the skill-skill and capital-skill complementarities. See Glaeser et al. (1995), Glaeser and Maré (2001), Glaeser and Saiz (2003), Berry and Glaeser (2005), Bound et al. (2004), Moretti (2004) or Shapiro (2006) for the US literature. There is also research on EU regional disparities, e.g., Puga (1998, 2002) or Overman and Puga (2002). We review some of this work in Section 2.

In the absence of human capital-regional spillovers, what could explain the mobility of the high skilled and the lack of mobility among the low skilled combined with lower unemployment of low skilled in areas relatively abundant in high-skilled workers? A simple potential explanation is that workers of different skill types respond differently to labor demand shocks because of differences in the costs and benefits of migration. The "opportunity cost of not working" is higher for the skilled; hence, they are more likely to migrate. Labor market institutions such as the social safety net with its minimum guaranteed income level (effective minimum wage) contribute to the cost-benefit calculus for less-skilled workers. By raising their wage floor they not only discourage work in regions affected by negative productivity shocks, but they also lower the variance of the wage of less skilled workers across regions, lowering the benefits from migration.

Skill-biased labor demand shocks at the beginning of transition – positive in skilled regions and negative in unskilled regions – would then result in skilled workers moving to high-skill regions and low-skilled workers being less likely to be unemployed in high-skill regions, consistent with our evidence. Such a distribution of initial shocks is consistent with our observed FDI flows and the skill-biased nature of the whole transition process. This skill-biased labor mobility adjustment, which works against regional unemployment convergence, would be stronger *ceteris paribus* in economies with stronger social safety nets. In support of this argument, we find that in Central Europe the regional variance of the wages of low skilled workers is much lower than the variance of the wages for high skilled workers while the opposite is true for unemployment. This comparison is less stark in Bulgaria and Ukraine, where social safety nets are less comprehensive.

We conclude that the persistent variance in unemployment rates across regions of transition economies is being driven by different migration responses of skilled and unskilled workers to regional shocks, which may be explained in part by national institutions and SBTC. Future research is needed to test whether high unemployment in transition countries is the consequence of welfare traps for the low skilled combined with skill-biased labor demand shocks.

2. Explaining Divergence in Regional Unemployment Rates: Literature

In the post-communist countries, the transition from planning to market led to a dramatic increase in regional variation of economic outcomes and the early-transition regional differences in unemployment rates proved to be very persistent. There is now a growing literature suggesting that this persistence is supported by weak equilibration mechanisms, including an insufficient wage and labor mobility adjustment. For example, Bornhorst and Commander (2004) study the behavior of labor mobility, employment creation, out-of-labor-force movements and wage adjustment in response to persistent unemployment regional disparities in six transition economies. Their evidence is "sobering" as none of the equilibrating mechanisms appears to play a significant role in reducing regional disparities. Similarly, Fidrmuc (2004) who analyzes labor mobility in four transition countries finds that "the efficacy of migration in reducing interregional unemployment and wage differentials is low."[5] None of the existing studies pays attention to the regional variation in educational endowment or the skill composition of migration flows, however.

A new literature based on EU and US research has oriented researchers away from thinking that mobility of labor and capital might equilibrate unemployment and wage rates across regions. The new economic geography literature stresses the possibility that spatial concentration of production factors may lead to self-enforcing spatial divergence (Fujita, Krugman and Venables, 1999). The regional production factor of interest here is the concentration of human capital and the question is whether there are fundamental consequences in terms of unemployment and wages stemming from regional differences in this factor's endowment. If wages of otherwise comparable workers are higher in regions with a higher initial concentration of human capital, this may lead to further spatial divergence in human capital concentration.

There are at least two possible theoretical mechanisms behind such potential effects. First, skill complementarities may exist such that regions with more skilled

[5] There is now also a set of wage-curve studies, which typically find statistically significant, but economically weak wage adjustment to changing unemployment (see, Galuščák and Münich, 2003 for a study of the Czech Republic).

workers have higher productivity and lower unemployment over and above the aggregate skill-wage and skill-unemployment elasticities. If skilled workers benefit more from such externalities, the presence of these human capital spillovers attracts more skilled labor to migrate to initially more skilled regions and exacerbates the spatial dispersion in unemployment and wages (Giannetti, 2003). Second, capital-skill complementarities may exist, in which case regions with higher human capital endowment attract more advanced higher-productivity investment, e.g., foreign direct investment (FDI), which again results in regional divergence and skill-biased migration (e.g., Devillanova, 2004).

There is substantial empirical work testing these hypotheses of complementarities and spillovers in the US, but there is less of such work in Europe, where regional disparities in unemployment are also of high policy concern.[6] In the US, Berry and Glaeser (2005) are among the important studies that document the diverging trend across cities in their human-capital endowment. Specifically, they show that in the last three decades, the share of adult populations with college degrees increased faster in cities with higher initial schooling levels. There are actually several strong correlations between an area's human capital endowment and its economic outcomes, even after controlling for workers' own education effect. A number of recent US studies employ instrumental variable strategies to lend a causal interpretation to the city- and state-level relationships between an area's human-capital concentration and its population, employment growth, or wage level (e.g., Glaeser et al., 1995; Glaeser and Saiz, 2003; Morretti, 2004). An important source of exogenous variation in local skill level used in this literature is the historical presence of colleges.[7]

Human-capital production externalities could represent an important component of not only city or regional, but also aggregate economic development (Lucas, 1988).

[6] See Canova (2001) for a study of the EU's regional policies. Giannetti (2002) studies potential mechanisms behind the co-existence of convergence at the national level and divergence at regional level in the European integration process. Among recent studies, Uhlig (2006) considers the importance of migration networks for the stark regional differences between East and West Germany.

[7] Lange and Topel (2006) criticize the instrumental-variable approach for not accounting for endogeneity implied by spatial equilibrium. In particular, an imperfect but highly elastic supply of skills to a locale, consistent with high geographical worker mobility in the US, may result in a relationship between the valuation of local amenities by marginal workers and local human capital measures. This may be less of an issue in post-communist economies, where worker mobility is relatively low and housing markets underdeveloped.

Specifically, human capital may be a key determinant of advanced technology adoption in less-developed economies (Acemoglu and Zilibotti, 2001).[8] This mechanism could be particularly important in post-communist economies, which underwent massive reallocation of production and increasing international integration.[9] Extensive trade openness and large inflows of FDI are among the measures of success of the transition process, which has been to a large extent concentrated in a single decade and which coincided with global skill-biased technical changes. There are now several studies documenting the skill-biased nature of transition at the national level (Sabirianova, 2004; Commander and Kollo, 2003; or Kezdi, 2003),[10] but there is no investigation of the issue of regional human-capital externalities.

While the theory of human-capital spillovers provides an appealing explanation for persistent regional economic differences, it is clear that in the presence of spatial variation of initial human-capital concentration within the post-communist countries, skill upgrading, i.e., the increasing skill content of employment, will result in variation in regional unemployment. It is therefore important to first ask to what extent regional unemployment differences in transition countries are merely the "accounting" outcome of the national-level skill-biased labor demand shocks combined with initial regional distribution of human capital. Overman and Puga (2002), who document the increasing polarization of regional unemployment across NUTS-2 areas of the EU-15 economies, measure the explanatory power of regional human capital for regional unemployment rates.[11] However, they do not explore the extent to which this explanatory power exceeds that implied by national-level skill-unemployment gradients.

Finally, another strand in the literature on regional unemployment differences focuses on the size of the regional shocks and different responses of skilled and unskilled

[8] In a related study, Acemoglu (2003, section 5.3) presents an international trade analysis endogenizing skill-biased technological change to relative skill supplies. Based on cross-country comparisons, Checchi et al. (2007) suggest that FDI is indeed attracted by existing endowments of human capital.

[9] In the case of Hungary and the Czech Republic, this process culminated in the accession into the European Union (EU) in May 2004. Bulgaria joined the EU in January 2007.

[10] Kezdi (2003) shows that much of the increasing demand for skills in late-transition Hungary is occurring within industries and is likely related to global skill-biased changes of the 1990s.

[11] To this effect, they regress the change in regional unemployment between 1996 and 1986 on the region's share of low- and medium-skilled workers, its initial unemployment level and initial share of employment in major industry sectors. After adding neighboring regions' unemployment change and a set of country dummies, they are able to explain 84% of variation in regional unemployment.

workers to these shocks (e.g., Topel, 1986; Mauro and Spilimbergo, 1999; Kwon and Spilimbergo, 2005). This literature suggests that the highly skilled migrate promptly in response to a decline in regional labor demand, while the low-skilled workers drop out of the labor force or stay unemployed. Some of these studies emphasize that the adjustment mechanisms to labor demand shocks by workers of different educational levels depends on existing labor market institutions and policies. Differences in the size of the regional shocks and safety nets across countries could explain labor mobility and hence the dispersion and persistence of regional unemployment.

This brief survey of the existing work suggests that we start our analysis by extending the stylized facts of the literature on regional equilibration in transition. We measure not only the extent of regional dispersion in unemployment, but also the persistence of unemployment rates by skill level and the extent to which human capital is concentrated in certain regions and how persistent this dispersion is over time. The question that naturally follows is how important the inherited regional skill distribution is in explaining the variance in unemployment. Given we find that it very important, much beyond the simple "accounting" identify implied by national skill-unemployment gradients and local skill endowments, the next step in our analysis is to examine the direction of capital and labor flows. Informed by the recent advances in the new economic geography literature, we focus on skill-specific migration flows, which extends the existing evidence on labor mobility adjustment in transition. Next, we provide novel evidence on the location of a particular type of capital: FDI. Textbook trade models suggest that the high capital mobility observed in early transition should result in low-skill intensive firms locating more often in low-skill abundant regions, thereby reducing the influence of regional skill endowment variation. On the other hand, skill-biased transition where the location of human capital determines advanced capital (FDI) adoption or inflow of highly educated labor could make the initial skill composition of the labor force very important for regional unemployment outcomes. In the final step of our analysis, we attempt to provide an explanation for the observed patterns of capital and labor mobility. Specifically, we ask about the presence of skill complementarities and explore the role of labor market institutions.

3. Analysis

Our empirical analysis is based on two types of data. First, we rely on regional (aggregate) data at the NUTS-3 level coming mainly from population censuses. Second, we use individual data from recent (2001-2003) labor force surveys, wage surveys or (retrospective) labor-market monitoring surveys from the Czech Republic, Hungary, Bulgaria and Ukraine. Our key variables are (i) the shares of each region's population with different education degrees as of the early part of transition, (ii) the extent of college-degree production as of the end of communism in each region (measured as the number of college graduates per capita), (iii) FDI stock per capita as of about 2002, and (iv) individual wages and unemployment status as of about 2002. Detailed data description is provided in Appendix Table A1.

3.1 Stylized Facts: Regional Variation in Unemployment and in Human Capital

We begin by providing some stylized facts regarding different pieces of the puzzle: current regional variations in unemployment (total and by skill level) and the concentration of human capital, and their evolutions over time.

First, Figure 1 presents the main object of interest: the recent NUTS-3-level regional distribution of unemployment rates from four post-communist economies: two central European economies, about to become EU members, and two less developed transition countries. We begin by noting that the variation in regional unemployment is quite high and similar in these countries, where the coefficient of variation is around 0.35 in Bulgaria, the Czech Republic and Hungary and lower in Ukraine at 0.26.[12]

Second, we document the high extent of regional inequality in shares of college educated population of our four countries. In any country, one would expect to find a inordinately high share of college-educated individuals in the capital city (and perhaps the immediately surrounding area) given the concentration of universities, cultural

[12] These coefficients of variation are higher than those reported by Eurostat in 2002 for NUTS3 areas of, e.g., Sweden (0.20) or Greece (0.29), but are similar to those of the UK (0.37). See, e.g., Bornhorst and Commander (2004) for an international comparison of regional unemployment dispersion confirming that post-communist countries face higher regional unemployment disparity in comparison to developed ones.

amenities valued by the highly educated, and public institutions staffed with a highly educated labor force. However, we find there is extensive variation in the shares of the college educated population across NUTS-3 areas of post-communist economies even outside of the capital city. For example, in 2001 Bulgaria (Ukraine), the share of the adult population with a college education ranged between 7 and 17 (9 and 19) percent outside of the capital city. A similar degree of dispersion in the 2001 share of college educated is found in our four countries, as illustrated in Figure 2, which shows kernel density estimates of the share of college educated after dropping the capital city and the immediately surrounding area. The bottom row of Table 1 also suggests that the overall extent of regional variation in the share of college educated, is quite similar to the coefficient of variation of the unemployment rates (bottom row of Table 2).[13]

What was the evolution of regional unemployment and human-capital inequalities over the first transition decade? Huber (2004) shows that regional unemployment disparities are highly persistent in transition countries. In Figure 3, we supplement the available stylized facts by showing that the persistence in regional unemployment differences is mainly due to the less skilled. Using Labor Force Survey data from the Czech Republic and Hungary,[14] the figure shows the NUTS3 regional skill-specific unemployment rates in 1993 and 2003 together with a least-squares regression line for each education category summarizing the time change in unemployment. The evidence in Figure 3 suggests that (a) region-education groups that started the transition process with relatively higher unemployment rates are still facing higher unemployment ten years later, and (b) with the exception of Hungarian elementary educated, unemployment persistence is stronger among the less educated. The skill ordering of regional unemployment persistence is particularly strong in the Czech Republic.

Next, we turn attention to the evolution of regional skill-endowment disparities. The three graphs in Figure 4 document that the regional variation in college education

[13] As was the case with unemployment disparities, the extent of regional variation in college-education endowment in post-communist economies appears higher than that of EU-15 economies. The regional coefficient of variation in shares of college educated population is close to 0.34 for Bulgaria, the Czech Republic, and Hungary, but it is 0.15 for Sweden, 0.25 for Greece and 0.14 for the UK, according to central statistical agencies of each country.

[14] There are no household surveys available for early transition Bulgaria and Ukraine.

endowment is increasing over time: areas that started the transition process with a high share of college educated have increased their share of college educated more over the first transition decade than NUTS-3 areas with less favorable initial inherited college education endowment.[15] Berry and Glaeser (2005) document quite similar trends of diverging human-capital endowment across US cities. Clearly, such trends work against convergence of regional unemployment rates. In the bottom panel of Table 1, we ask about the sources of such disparities and find that in all four countries the share of college educated in a region today (in 2001) is largely predetermined by the location of colleges prior to the start of transition (in 1990). In other words, the extent of college-degree production in a region as of the end of communism (measured by the number of graduates from colleges in 1990 scaled by the regions' population size in a relevant age group), alone explains over half and as much as 91 percent of the 2001 share of college educated population in a region. This relationship is little affected by additionally controlling for initial-transition share of major industrial branches, which could itself be related to the presence of a college. Excluding the capital region (together with the immediately adjacent/surrounding area) does decrease the explanatory power, but the relationship remains strong and highly statistically significant.

The 1990 college production variable, which drives much of the current variation in regional college concentration, derives from the location of colleges, which was largely established under communism and may therefore be thought of as being exogenous to the skill demand and productivity shocks of the new post-communist economy.[16] For example, most of Czech colleges were established by the end of the 1960s and only a small subset was originally related to a local large firm.[17] Similarly, except for some of the Sofia universities and the Naval Academy in Varna, Bulgarian colleges were established between 1945 and 1975. Nevertheless, in areas where the

[15] We do not have initial transition education-group population share data available for Bulgaria. The autonomous republic of Crimea in Ukraine is an obvious outlier to the general pattern.
[16] A similar argument has been used by Moretti (2004) in US research on human-capital spillovers.
[17] Except for Prague and Olomouc, where universities were founded by 1348 and 1573, respectively, the other Czech colleges were typically established during the 1950s and 1960s. They often started as a pedagogical faculty (in, e.g., Ústí nad Labem, Hradec Kralové, or České Budějovice) or as engineering faculties tied to local manufacturing or chemical production (in, e.g., Plzeň, Zlín, Pardubice) and they all branched out into other fields by adding faculties over time.

original impetus for establishing a university was tied to strong manufacturing and to the extent that this manufacturing was important as of the start of transition, it is likely that overall labor demand dropped during transition. When relying on the exogeneity of the spatial distribution of tertiary education production, it is therefore important to control for end-of-communism industrial structure as we did in Table 1.

In sum, we find regional disparities in both unemployment and human-capital endowment to be extensive in transition economies. Regional skill disparities are clearly increasing over time and regional unemployment persistence appears to be stronger for less skilled workers.

3.2 Relationship between Regional Unemployment and Skill Distribution

Next, we ask how well the location of skilled and unskilled workers explains the regional variation in unemployment rates. Table 2 shows the explanatory power (least-squares regression coefficients and R^2 statistics) of the current regional human capital endowment for the current regional variation in unemployment. The first column of each country panel suggests that a higher concentration of college graduates is associated with significantly lower regional unemployment.[18] The next two columns within each panel imply that, with the exception of Ukraine, we can explain almost two-thirds of the within-country regional unemployment variation using simply the current shares of three education levels in the population (with the share of primary educated as the base). The explanatory power decreases after excluding the capital areas, but remains strong.

In the last panel of Table 2, we combine the unemployment regional data from our four countries to show that (without the use of country dummies), we can explain almost one-third of the regional (within- and cross-country) variation in unemployment using our four education shares (three explanatory variables). While this exercise assumes that the

[18] To some extent, the correlation between the current share of college-educated population and current regional unemployment can be due to college workers moving to regions hit by positive productivity shocks. We have therefore also re-estimated this specification using the pre-determined 1990 college degree production indicator to instrument for the current share of college. This exercise asks whether the exogenous part of the variation in college-degree regional endowment implies similar unemployment differences as the current-endowment variation. In Ukraine and Bulgaria, the un-instrumented and instrumented parameters are virtually identical. The Hungarian and Czech parameters decrease in their magnitude by about a third but remain statistically significant.

education content is comparable within an educational attainment group across these four economies, it is clear that regionally concentrated low educational endowment drives much of the high transition unemployment.[19]

To some extent, our regressions simply reflect the fact that higher skill level is always associated with lower incidence of unemployment, such that one would always expect higher unemployment in areas with a high share of low skilled individuals. In order to learn to what extent our regressions merely reflect this phenomenon v. a fundamental relationship between regional skill endowments and unemployment rates, we compare the rate of regional unemployment predicted on the basis of the regressions reported in Table 2 with the expected "shift-share" regional unemployment rate based on the weighted average of the national skill-specific unemployment rate, weighted by the regional shares of each skill group. The results of this exercise are plotted in Figure 5, together with a 45-degree line corresponding to perfect fit. The plots show that our simple regressions strongly out-predict the shift-share exercise. A prime explanation for this finding is that the unemployment rates of the low educated are lower in areas where there are more college educated (where unemployment rates are lower) than in areas with fewer college educated (where unemployment rates are higher) and *visa versa*.

To quantify this "excess" explanatory power, we compare for each country the sum of squared errors based on the shift share exercise with that from the regional regressions. In the case of the two Central European economies, the Czech Republic and Hungary, the shift-share prediction errors are about 140% higher than those of the regression analysis. The difference is smaller in Bulgaria at 107% and the explanatory-power gap is smallest in Ukraine at only 28%. We note that a similar pattern also exists in a more developed economy, the UK, where we find the sum of squared errors based on

[19] Where data are available, we also estimate an alternative specification (not shown in the table) that controls for conditions (i.e., unemployment, industrial and educational structure) at end of communism. In Hungary, regressing the recent unemployment rate of each NUTS3 on initial-transition regional shares of employment in industry and construction together with the 1990 share of college educated population and 1990 unemployment rate yields an R^2 of 62% after excluding the capital city area. In the Czech Republic, where we have the initial-transition shares of eight main industrial branches, initial-transition unemployment was negligible. Using the 8 industry employment shares together with the initial-transition share of college educated explains 77% of the 2001 Czech regional unemployment variation outside of the capital city. Clearly, initial conditions defined by industrial structure and college concentration are key to the current structure of unemployment in these two EU countries.

the shift-share analysis to be 90% higher than those based on a simple skill-unemployment regional regression, using the 2001 UK census.[20]

In sum, we have identified a number of regional patterns: a) over half of the regional variation in unemployment rates can be explained by regional skill endowments; b) the relationship between regional unemployment and the concentration of highly educated people in the region is much stronger than that based on simple shift-share accounting; c) initial conditions in terms of regional college-degree production at the end of communism explain much of the current variation in regional skill endowments as well as the change in college-degree regional concentration during transition. In the rest of the paper we search for evidence on the underpinnings of these patterns and their economic rationale.

3.3 Skill Composition of Migration

We first ask whether labor migration lessens regional unemployment disparities or whether it contributes towards the increasing difference in regional skill endowments, which we identified as the key explanatory factor behind regional unemployment.[21] The empirical literature on cross-region migration flows in transition economies, which relies mostly on administrative permanent-residency data and works with total flows (gross or net) across areas, finds that migration has at best a small effect on diminishing unemployment disparities across areas. However, as we noted in Section 2, migration could actually support regional disparities if workers of different levels of employability (skills) move in the opposite direction. Recent theoretical work provides a rationale based on human-capital complementarities for migration flows to be skill-biased and to vary by the level of human capital in a region (Giannetti, 2003; Devillanova, 2004). It is also

[20] We rely on the three census skill-level definitions ('no qualifications', 'lower level', 'higher level'). In order to make the UK exercise comparable to our transition analysis, we pool all London regions into one such that we compare unemployment and skill structure across 130 Local Authority County units available in the census – a level of regional classification similar to that of the 139 NUTS 3 regions of the UK.

[21] The faster increase in the share of college educated in areas that had (more) colleges as of 1990 must be supported by one of three possible factors: (i) students growing up near a college may be more likely to attend a college, (ii) students from non-college regions who attend a college are likely to stay in the college city area after graduating, (iii) during transition, workers who have attained education before the collapse of communism are moving in a skill-biased way.

possible that only highly skilled workers move and unemployed low skilled workers do not migrate because their welfare receipts (which are close to their market wage) are the same everywhere, while the cost of living is higher in low-unemployment high-skill areas.

Hence, in this subsection, we ask about the skill composition of migration flows across regions. We use the data from the 2001-2003 labor force surveys where respondents answer questions about their current area of residence as well as their residence in the previous year (Hungary) or as of any year since 1989 (Bulgaria) or 1986 (Ukraine).[22] While these migration definitions are not strictly comparable (such that we cannot compare the absolute size of migration flows, even conditional on skill), they allow us to shed light on the skill structure of worker territorial flows.

We first ask whether more educated individuals are more likely to move; next, we investigate whether the more educated are more likely to move to areas with a higher concentration of educated people, and conversely, whether the less educated are more likely to move to areas with the less educated people. Such mobility patterns would be consistent with the regional human-capital divergence depicted in Figure 4 and the "complementarities" story in the theoretical literature mentioned above.

In the first column of each country panel of Table 3, we present the results from estimating a linear probability model with the individual data, which predicts the probability of moving (v. not moving) for three levels of education relative to the primary level, controlling for gender and age (not shown in the table).[23] First, we focus on the case of Bulgaria, where cross-regional mobility is available only at a higher aggregation level of 8 regions.[24] We have 210 individuals who have moved across the borders of these regions between 1989 and 2001 and contrast them with a random sample of non-movers. We find college educated workers are 8 percent more likely to migrate

[22] No such data exists as of 2001 in the Czech Republic, where the labor force surveys cover a set of dwellings and not households (i.e., they do not identify when a new family moves to one of these dwellings).
[23] The estimated coefficients (probability derivates) are fully robust to alternatively using the probit model.
[24] The 28 Bulgarian NUTS-3 units are aggregated for the purpose of answering mobility-related questions into the following 8 areas: Sofia city, Sofia region, Plovdiv, Burgas, Varna, Haskovo, Montana, Lovech, and Russe.

compared to workers with elementary education and this difference is statistically significant, while there is no such difference for workers with lower education levels.

Next we estimate linear probability models relating individual mobility of a worker with a given age and gender to the share of college educated in the region of current residence (after moving). We do so separately for our each of our four main education groups (elementary, lower secondary, upper secondary and tertiary education). Such a descriptive regression is asking whether workers who move across regional borders are likely to reside now in NUTS-3 areas with higher share of college educated population compared to the majority of workers who have not moved. Specifically, we estimate the following equation for each of the four skill groups, *s*:

$$P_{irs} = \alpha_{os} + a_{1s} College_r + a_{2s} Gender_{irs} + a_{3s} Age_{irs} + \mu_{irs}, \quad (1)$$

where $P_{irs} = 1$ if an individual *i* of skill group *s* currently residing in region *r* recently moved across regional borders and 0 if he/she did not move; $College_r$ is the 1990 extent of college-degree production (measured as the number of college graduates as a share of the population) of the region *r*, and *Gender* and *Age* are controls. We report the estimates of a_{1s} for each education-specific regression in the second column of each country panel of Table 3. The results for Bulgaria suggest that more educated movers are more likely to have moved to areas with more educated people as of the start of the transition process.

We next estimate equation (1) replacing the $College_r$ variable with the current unemployment rate in each region as of 2001 ($Unemp_r$). The estimates of a_{1s} from this set of education-specific regressions are reported in the third column of each country panel in Table 3. The results for Bulgaria suggest that more educated movers are more likely to have moved to areas that are today facing lower unemployment rates. This is not the case for the low (elementary) educated movers.

The Hungarian analysis in the second panel of Table 3 focuses on recent migration patterns as we observe 754 workers who have moved between 2002 and 2001 across NUTS-3 borders.[25] Again, similar to Bulgaria, we find that more educated workers are more likely to have moved. Contrary to Bulgaria, in Hungary we find no relationship

[25] We drop the capital-city region with the immediately surrounding area because the suburbanization of Budapest represents a major migration flow that, however, falls outside of the focus of our analysis.

between the location of movers and an area's level of college production as of 1990 in any of the education categories. The difference in findings vis-à-vis Bulgaria could be caused by only focusing on very recent moves, i.e., they might have moved earlier. When we alternatively control for an area's unemployment rate, we find that college-educated and high-school educated movers are significantly less likely to have moved to an area with a high level of unemployment, while no significant relationship is detected for those with elementary and vocational educational attainment.[26]

The corresponding coefficients from Ukraine are estimated with 271 within-Ukraine cross-NUTS-3 movers.[27] The results indicate that in Ukraine more educated workers are more likely to move and there is also a tendency for secondary educated workers to move to areas with more educated workers as of the start of transition. However, we detect no relationship between migration of workers with different skill levels and regional unemployment rates.

Overall, our evidence is consistent with more mobility among the highly educated workers, who, based on the statistically significant coefficients, are more likely to move to areas with high levels of education and low unemployment areas.[28] On the other hand, we find no support for the notion that less educated workers move to areas with less education or higher unemployment.

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[26] We find similar signs of coefficients when regressing the population-normalized regional education-specific total inflow of individuals on the area unemployment rate. However, the regional-level regression parameters do not reach conventional levels of statistical significance.

[27] Whereas 543 individuals moved across NUTS-3 borders between 1986 and 2003, 274 moved in from another country (the USSR) so we work only with 271 within-Ukraine cross-NUTS-3 movers. The basic mobility regression with pooled education groups is highly similar when we do include those moving into Ukraine from the other Soviet Republics.

[28] As a robustness check, we have also estimated the specifications shown in columns (2) of each country panel controlling for the 2001 share of college educated as opposed to the 1990 extent of college-degree production. The college-share coefficients are highly similar to those presented in Table 3; the only exception is the positive coefficient for the college-educated Ukrainians, which is now somewhat larger and statistically significant. Next, we checked the interpretation of the estimates in columns (3). To some extent, these estimates could merely correspond to regional unemployment differences implied by differences in education structure of the population. Hence, we have re-estimated these specifications using a regional unemployment rate adjusted for regional education endowments. The adjusted unemployment rate is the residual from a regression of regional unemployment on the shares of 3 major education categories corresponding to estimates presented in columns (2) of each country panel in Table 2. Using education-adjusted unemployment rates, as opposed to raw regional unemployment, results in a loss of statistical significance as well as a reduction in the size of all of the Bulgarian coefficients. The results for the other two countries are little affected.

3.4 FDI and Initial Skill Endowment

Given the skill-biased nature of labor mobility, when skilled workers move to skilled regions, it is important to ask whether capital flows help lessen regional unemployment disparities or whether they are aligned with the diverging trend in regional human-capital endowments. In particular, we focus on the inflow of FDI – "high-end" capital – and ask whether initial conditions in terms of regional college-degree concentration at the end of communism are related to the regional structure of FDI stock as of the end of the first transition decade.[29]

In Table 4 we display a series of simple descriptive regional regressions where we ask about the explanatory power of initial-transition (1990/1991) college share in the population for 2001/2003 FDI stock per capita.[30] In all three countries where data are available the correlation is positive and significant, indicating FDI flows to regions with a high college share at the end of the communist period, which as we saw is highly and positively correlated with the current share of college educated. This relationship holds even after controlling for the industrial employment structure at the beginning of transition. However, with the exception of Ukraine, we find that this relationship does not exist once the capital city is excluded from the analysis.[31] In the large country of Ukraine, and after excluding the capital city region, moving from the minimum to the maximum regional share of college educated population results in an increase of FDI per capita level of almost two times the standard deviation of the FDI regional distribution. This is a large effect.

3.5 Human-Capital Spillovers and Imperfect Substitution

The finding that both highly skilled people and "high-end" physical capital (FDI) tend to move to regions with high concentration of highly skilled people as of early

[29] The literature on FDI focuses on country-level FDI determinants (e.g., Boeri and Brucker, 2001, Bevan and Estrin, 2004, or Checchi et al., 2007), but there appears to be no work on regional location of FDI.
[30] We use initial transition college share rather than current college share to obviate the problem of reverse causality (i.e., high-skilled labor flows to regions with high levels of FDI).
[31] We note that there is little FDI variation outside of the capital city in the Czech Republic. It may be that a tendency of FDI to locate in high-education areas is offset by the Czech government's policy to generously support FDI in high unemployment (low education) regions (see www.czechinvest.cz).

transition is consistent with the human-capital complementarity hypothesis. Hence, in this section we search for evidence of skill complementarities. Specifically, we ask whether wages of otherwise identical workers are higher in regions with a higher concentration of college education. Next, we repeat the same question for the probability of unemployment among otherwise identical workers.

A fundamental problem with identifying the wage spillover effect is the potential presence of locality-specific unobservable characteristics that may affect both wages and the share of highly educated workers. We follow Moretti (2004) and rely on the regional variation in the location of college-degree production under communism, which, given the communist misallocation of resources, can plausibly be thought of as being historically predetermined and orthogonal to current district-specific shocks. This argument is more likely to hold outside of the capital cities, which typically differ from the rest of the country in terms of cultural amenities, and is also more likely to be valid after we control for initial-transition industry shares in our analysis (as explained in Section 3.1).

Another difficulty with identifying the causal impact of local human capital concentration on wage levels is that wages of less educated workers may increase in regions experiencing a rise in their share of highly educated workers because of imperfect substitution across skill types — in a fashion reflecting imperfect substitutability of input factors in a straightforward perfect-competition neoclassical model.[32] Moretti (2004) therefore seeks qualitative evidence on the existence of spillovers by relating the wages of highly educated workers to the share of these workers in local labor force. We follow his approach.

Specifically, we use a two-step procedure. First, for all individuals in a given education group *s*, we regress their current log wages (*W*) on demographic characteristics (*Age* and *Gender*) and a set of regional fixed effects (β_{rs}):

$$W_{irs} = \alpha_o + \alpha_1 Age_{irs} + \alpha_2 Gender_{irs} + \beta_{rs} + \mu_{irs}, \qquad (2)$$

[32] See, e.g., Katz and Murphy (1992) for evidence on imperfect substitution and Moretti (2004) for an underlying model of local labor markets with human capital externalities.

The set of coefficients β_{rs} captures the average wage for an education group in a region net of age and gender compositional differences. We then regress the estimated regional fixed effects (β_{rs}) on the current share of college educated ($College_{tr}$) and the industrial structure at the beginning of transition (IND_r):

$$\beta_{rs} = \delta_o + \delta_1 College_r + \lambda' IND_r + \mu_{rs}, \quad (3)$$

These second stage regional-level regressions are weighted by the population size of each region.[33] Finally, equation (3) is re-estimated by instrumenting the current share of college educated with local college-degree production as of 1990 to control for endogeneity.

Hence the coefficients δ_1 presented in each cell of Table 5 indicate the relationship between averages wages in a region (controlling for demographic characteristics) and the share of college educated in that region for workers in each of the four levels of education. To focus on the exogenous portion of variation in regional college endowment, we present the IV coefficient in the third column of each country panel.

The findings for Bulgaria, in columns 1 and 2, suggest that the wages of high-school graduates are higher in areas with a higher share of college educated workers. This is consistent both with the presence of human-capital spillovers and the presence of imperfect substitution across worker types. We find no support for the existence of spillovers in the most important group of college-educated workers. These findings are little affected by dropping the capital city; instrumenting for current college education endowment using the end-of-transition college-degree production (i.e., focusing on the exogenous initial-transition variation in college endowment) results in imprecise estimates. The case for the existence of spillovers is stronger in Hungary, in the third panel of Table 5, where wages of all workers, but particularly wages of highly educated ones, are higher in areas with a higher share of college educated. However, dropping the capital city area results in a loss of statistical significance and instrumenting makes the parameters much smaller, even negative, and insignificant.

[33] An alternative procedure would be to include both individual- and region-specific variables in the original individual-level regression and cluster standard errors at the regional level. See Wooldridge (2003) for the potential pitfalls of clustering when the number of clusters (regions) is small.

A starkly different set of findings is presented in Table 5 for the Czech Republic and Ukraine. Here, wages of college educated are significantly lower in areas with a higher share of college educated and the negative coefficient is confirmed by instrumenting. This finding hinges on controlling for initial-transition industry shares on employment; the Czech coefficient would be 2.25 in the first column for the college educated if we were not to control for the extent of industrial employment in the regions in 1991 while the Hungarian coefficient would be similarly large even in the IV specification. What could explain these negative coefficients? One possible explanation is that college-educated workers living in areas where college education is sparse need to be compensated for the lack of amenities that derive from a higher concentration of college education.[34]

Finally, combining the data from our four economies, results in positive estimates of the association between an area's college education endowment and the residual wages of all education groups, with especially large estimates for the highly educated. This finding is robust to including country fixed effects (not shown in table), but hinges on the inclusion of the capital city areas. The OLS coefficient of 1.36 in the first column of the last panel, which is based on both capital and non-capital areas, suggests that wages of college educated workers increase by over 1 percent for each 1 percentage point increase in the area share of college-educated. When we instrument for the current area college endowment in data containing capital-city regions, we obtain a very similar coefficient (not reported in table). As Table 5 shows, however, excluding capital cities leads to negative coefficient estimates. Overall, we find little evidence for the presence of human capital spillovers outside of the capital cities. In two of our four economies we actually find a strong negative association between college wages and college endowment.

Next, we repeat this analysis for unemployment. Again, we follow a two-step procedure. As in equation (2), we first regress individual unemployment incidence on individual characteristics and regional fixed effects for each of the four education groups.

[34] Visualizing these findings in the Czech Republic shows that the negative coefficient is largely based on the comparison of a highly educated south Moravian region, with two areas in the North West of Bohemia that are close to East Germany and feature extremely low shares of college educated. All other areas feature similar average values of both residual wages and college share in population, while Prague is excluded from the analysis.

In the second stage, we regress these regional fixed effects (regional unemployment adjusted for demographic composition) on current college share in population, separately for each of the four major education groups (as in equation 3). The resulting coefficients from the second stage regressions are presented for each of the four countries and the pooled data in Table 6. With the exception of Ukraine, we find that a higher share of college educated is associated with lower unemployment chances for the less educated workers. This is true not only for the worker types that are likely to represent a potential substitute for college educated, i.e., for those with upper-level high-school diplomas, but also for those workers with only about 8-9 years of (elementary-level) education.[35] However, focusing on the variation in regional skill endowments driven by the location of colleges as of the end of central planning typically results in smaller and noisier estimates.

The results of the unemployment analysis, derived from individual-level data, are fully consistent with region-level evidence presented in Table 2 on the high explanatory power of regional skill structure for unemployment. The unemployment rates of less skilled workers are lower in more skilled areas, which we know benefit from the inflow of both skilled workers and FDI. Given that our wage analysis points to little support for the human-capital spillover hypothesis, we search for alternative explanations of the observed mobility and unemployment patterns in the next section.

3.6 Labor Market Institutions and Regional Adjustment

In the absence of regional human-capital wage spillovers, what could explain the flow of only skilled labor as well as FDI to skilled regions (Tables 3 and 4) together with the lower unemployment of less skilled workers in highly skilled areas (Tables 2 and 6)? A simple potential explanation is that (a) transition demand shocks were skill-biased (positive in skilled areas, negative in unskilled areas, even conditional on industrial structure) and that (b) different skill types respond differently to labor demand shocks

[35] We do not find any significant estimates for the association between college degree concentration and college-level unemployment, which may simply be due to the fact that the unemployment rates of the college-educated are very low (near zero) in all regions. With the exception of Bulgaria, the standard deviation of unemployment fixed effects (demographics-adjusted unemployment) for college-educated workers is below 0.02.

because of differences in the costs and benefits of migration implied by labor-market institutions. The presence of the skill-biased nature of regional demand shocks is supported by the finding that FDI is more likely to flow to more skilled regions and by the fact that less skilled workers face lower unemployment chances in highly skilled areas. It is also consistent with the mobility pattern among skilled workers. In the rest of this section, we provide indirect supportive evidence for the notion that centralized labor market institutions (such as the social safety net) affecting the "opportunity cost of not working" are behind the lower mobility of the less skilled workers.

By effectively raising the national wage floor, guaranteed income transfer schemes not only discourage work in regions affected by negative productivity shocks, they also lower the variance of the wage of less skilled workers across regions, lowering the benefits from migration for these workers. The "opportunity cost of not working" is clearly higher for high-skill workers. Under the institutional explanation, the skill differences in labor mobility adjustment, which we know work against regional unemployment convergence, would be stronger, *ceteris paribus*, in economies with stronger social safety nets. Given that the nature of our migration data does not allow for direct cross-country comparison of mobility rates, we compare regional differences in wages and unemployment by skill. If binding wage floors are important, then we would expect wages (unemployment) of less educated workers to be highly equalized (different) across locations, at least in comparison to highly skilled workers for whom effective minimum wages play a smaller role.

Such a comparison is offered in Table 7, which presents the ratio between the regional standard deviation of unemployment or wages of the college educated and the elementary educated.[36] We see that in the two Central European economies where binding national wage floors are more likely,[37] wages of college educated workers vary

[36] This is based on the regional fixed effects estimates used in Tables 5 and 6.

[37] Boeri and Terrell (2002) compare social support policies in Central Europe (CE) to those in post-soviet states and argue that in CE these policies upheld wages at the bottom of the distribution. The long run net replacement rates (NRRs) for the Czech Republic and Hungary are about 62% and 58% respectively (OECD, 2005) and whereas there are no systematic calculations of NRRs in Bulgaria and Ukraine, the available calculations suggest the NRR in Ukraine is approximately 41% (Mykhenko, 2005). Then NRR in the UK (49%) is closer to that in Ukraine than to those in the CE countries.

across areas substantially more than wages of unskilled workers. This is not true for Bulgaria and Ukraine, where the social safety net is lower. (It is also not the case in the US as Topel (1986) shows.) On the other hand, unemployment among the highly educated varies much less across regions than unemployment of the least skilled workers: this tendency is particularly pronounced in the more developed labor markets of Central Europe. Hence, this evidence is consistent with the idea that high wage floors in Central Europe lower the incentives for less skilled workers to migrate and support the high regional unemployment disparities.[38]

Furthermore, the interplay of centralized labor market institutions with regional disparities in skill levels may affect aggregate unemployment. In the presence of barriers to downward wage adjustment at the regional level, a mean-zero distribution of regional shocks, positive in skilled and negative in unskilled regions, may increase aggregate unemployment if the negative shock increases unemployment more in the low-productivity (uneducated) region than the positive shocks decreases unemployment in the highly educated region. To provide evidence on this issue, we contrast the dispersion in regional unemployment with the skewness of the regional unemployment distribution across our four economies. If high dispersion of unemployment is associated with right-skewness, this would be consistent with insufficient adjustment in areas experiencing the largest negative shocks as argued by, e.g., Pench et al. (1999). Figure 6 thus summarizes two moments of the regional unemployment distributions: dispersion and skewness. It shows that the Czech Republic is the only country in our sample featuring a strongly right-skewed unemployment distribution, where a few high-unemployment regions drive up the country's average unemployment rate. Overall, there may be some positive association between regional unemployment dispersion and (right-) skewness, but having four data points does not allow us to draw any strong conclusions.

[38] The evidence in Table 7 corroborates the finding of Section 3.2. that the explanatory power of regional skill composition for regional unemployment (relative to the benchmark of the shift-share analysis) is highest in the Czech Republic and Hungary, where the wage floor is highest, followed by UK, Bulgaria and Ukraine, where the wage floors are likely to be lower based on our comparison of the NRRs. One would expect the "excess" explanatory power of regional skill composition for regional unemployment stemming from mobility disincentives for low-skill workers to be higher the more important the disincentives. In Ukraine, less skilled workers must work (for low wages) even in areas affected by negative demand shocks.

Overall, we believe that our indirect evidence points towards the possibility that high wage floors may be contributing to higher overall unemployment, both directly through lack of regional wage adjustment in response to a negative shock but also indirectly by reducing the gains from migration for low-skilled workers. Future research is needed to explore this hypothesis further and to provide robust evidence for the implication that lowering the social safety nets and hence wage floor would have a significant impact of migration flows of unskilled people.

4. Conclusions

We hypothesized that the regional distribution of human capital endowment plays an important role in explaining both regional and national unemployment and presented a series of exploratory analyses to test this hypothesis.[39] We find powerful evidence of the importance of human capital in explaining the variance in regional unemployment rates, thanks in part to divergence in the regions' human capital endowments. We find evidence suggesting that the flows of both "high-end" labor and capital are contributing to the divergence of regional unemployment and wage rates across regions in the four transition economies. Both college educated people and FDI flow to regions with a higher concentration of college educated. Clearly, low-skill-intensive capital is not moving fast enough to post-soviet areas predominantly endowed with "low-end" human capital.

We then ask about two potential mechanisms which would explain these labor and/or capital flows and the patterns of regional unemployment by education groups: 1) the presence of complementarities and human-capital spillovers and 2) differences in the response of skilled and unskilled individuals to regional demand shocks which may be driven in part by centralized labor market institutions. We find little evidence for spillovers. On the other hand, we provide some evidence that is consistent with the idea that institutions in Central European countries contribute to the lack of migration of

[39] Our approach is similar to that of Köllő (2006) in that we also focus on unemployment by low education group as the main determinant of overall unemployment levels. While Köllő (2006) uses international comparisons and asks about the importance of the low endowment of effective skills of less-educated workers in post-communist economies, we use within-country regional dispersion of highly skilled labor as our starting point and search for economic mechanisms that would help us understand the nature of the regional variation in unemployment.

unskilled workers and lack of convergence of their unemployment rates across regions. We conclude that the variance in unemployment rates across regions is likely to correspond to national skill biased technical change and that more research is needed to explore the role of centralized labor market institutions for aggregate unemployment in transition. Ideally, such research would use comparable data on skill-specific cross-regional labor mobility and time-country variation in generosity of welfare systems.

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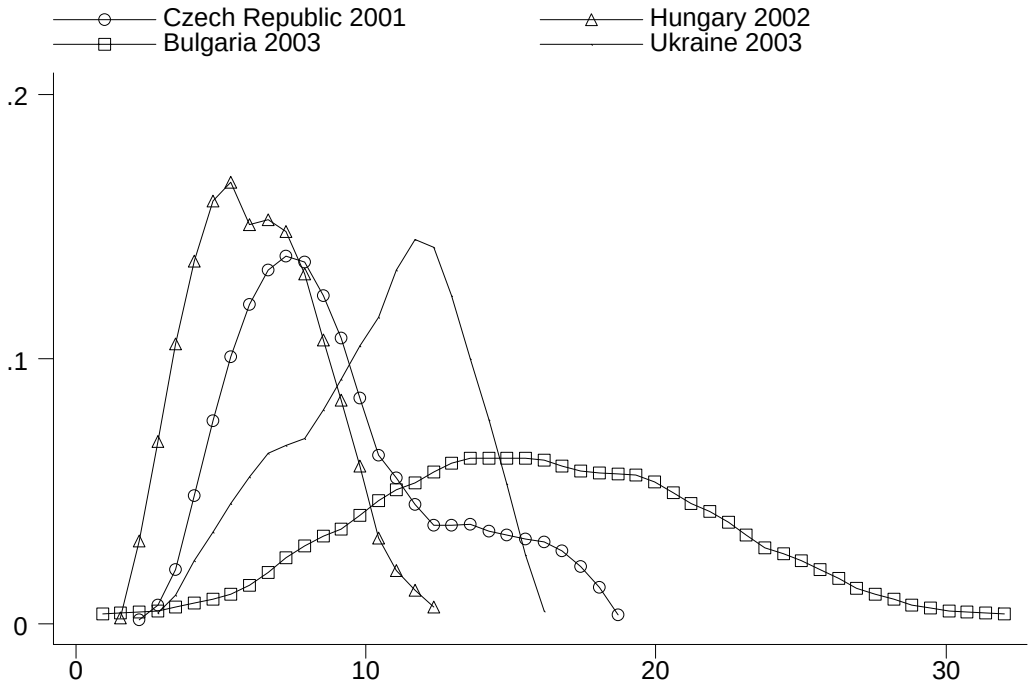

Fig. 1: Kernel Densities of Regional Unemployment Rates (NUTS3 level)

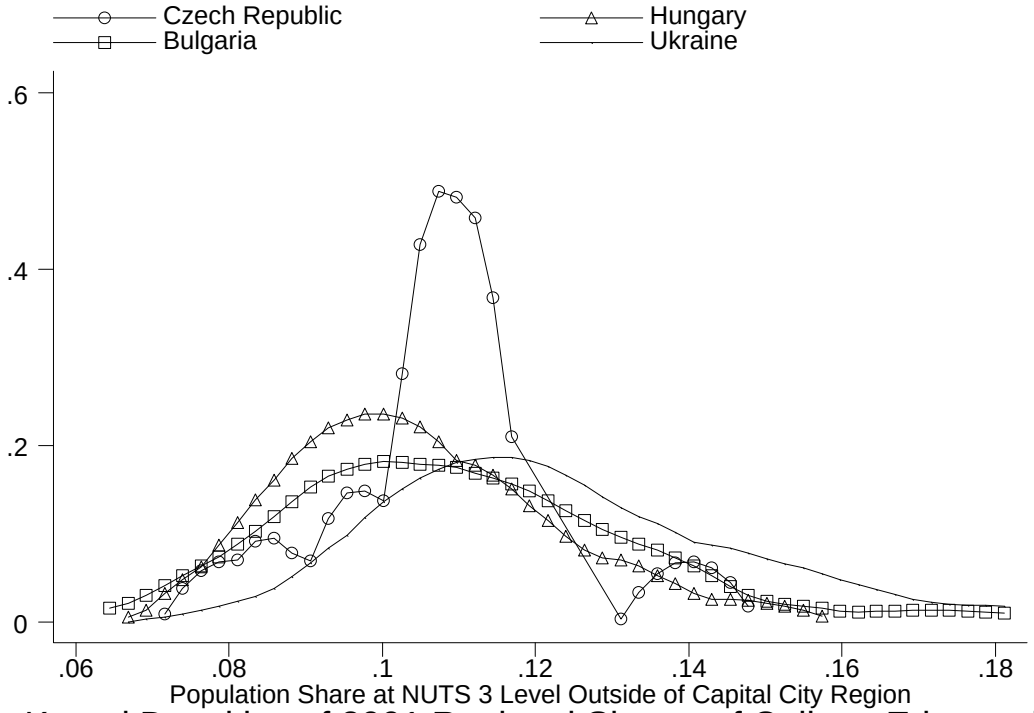

Fig. 2: Kernel Densities of 2001 Regional Shares of College Educated

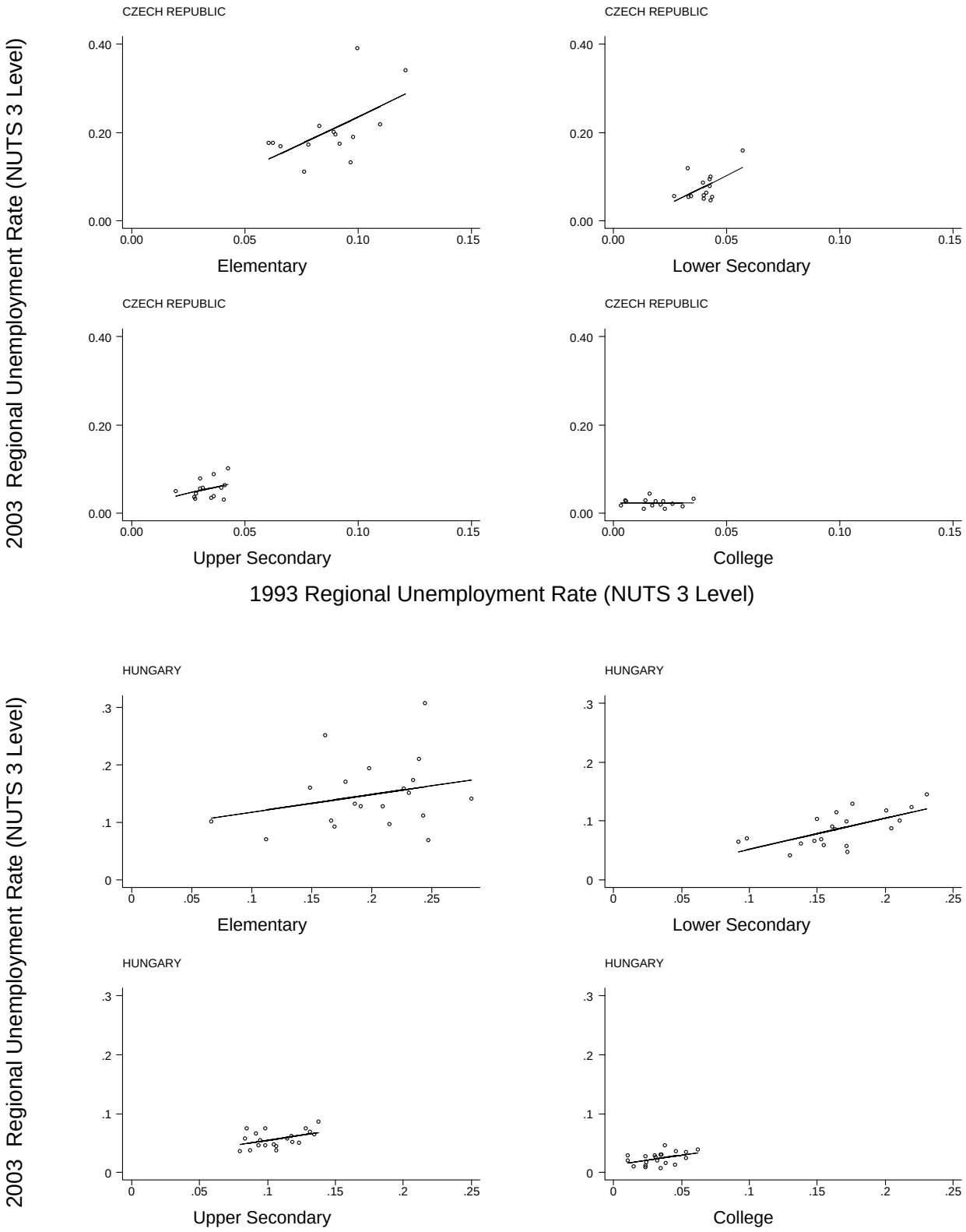

Fig. 3: Regional Unemployment Persistence by Education Level

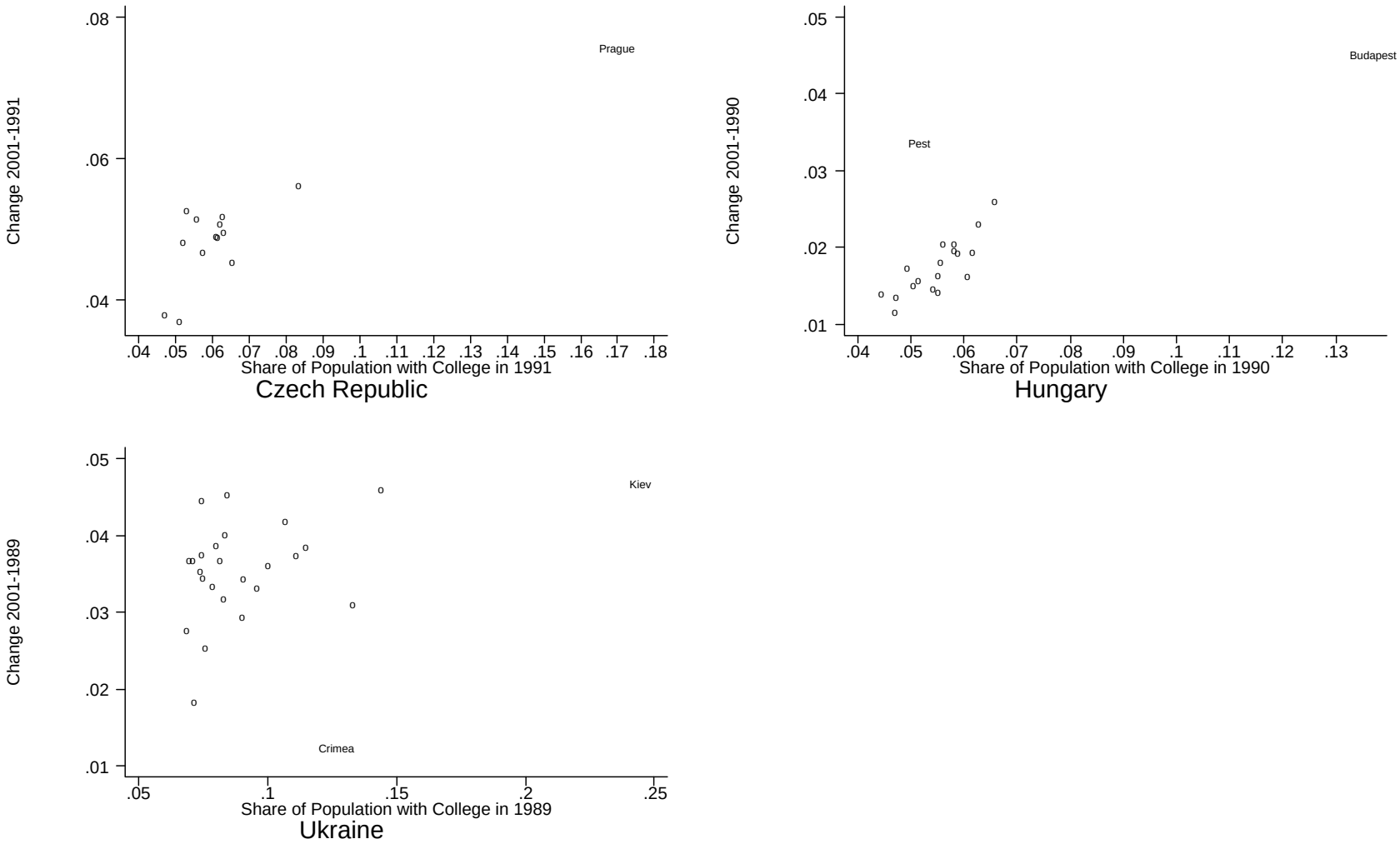

Fig. 4: Persistence in NUTS-3 Regional Shares of College Educated

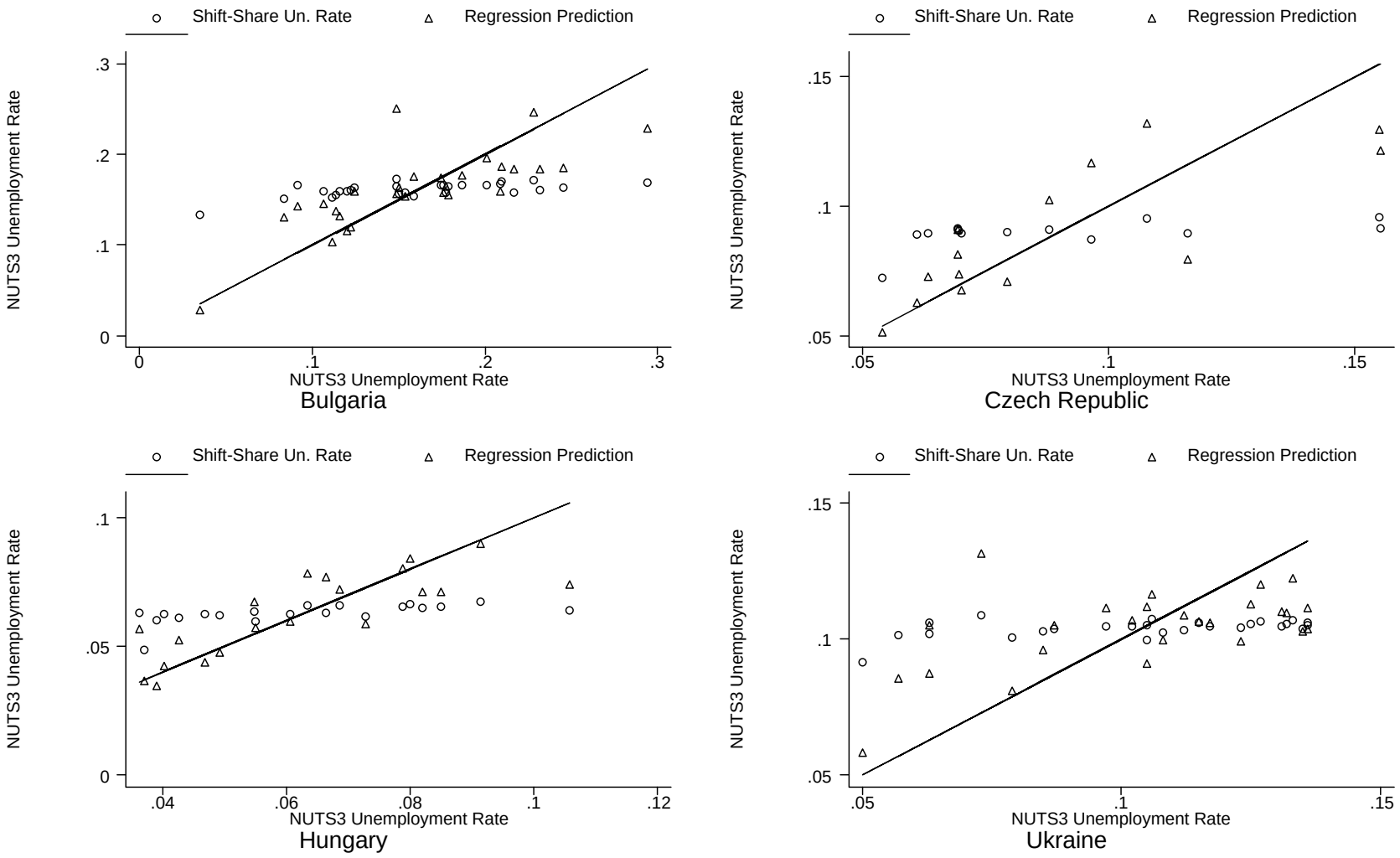

Fig. 5: Comparing Shift-Share and Regression Analyses

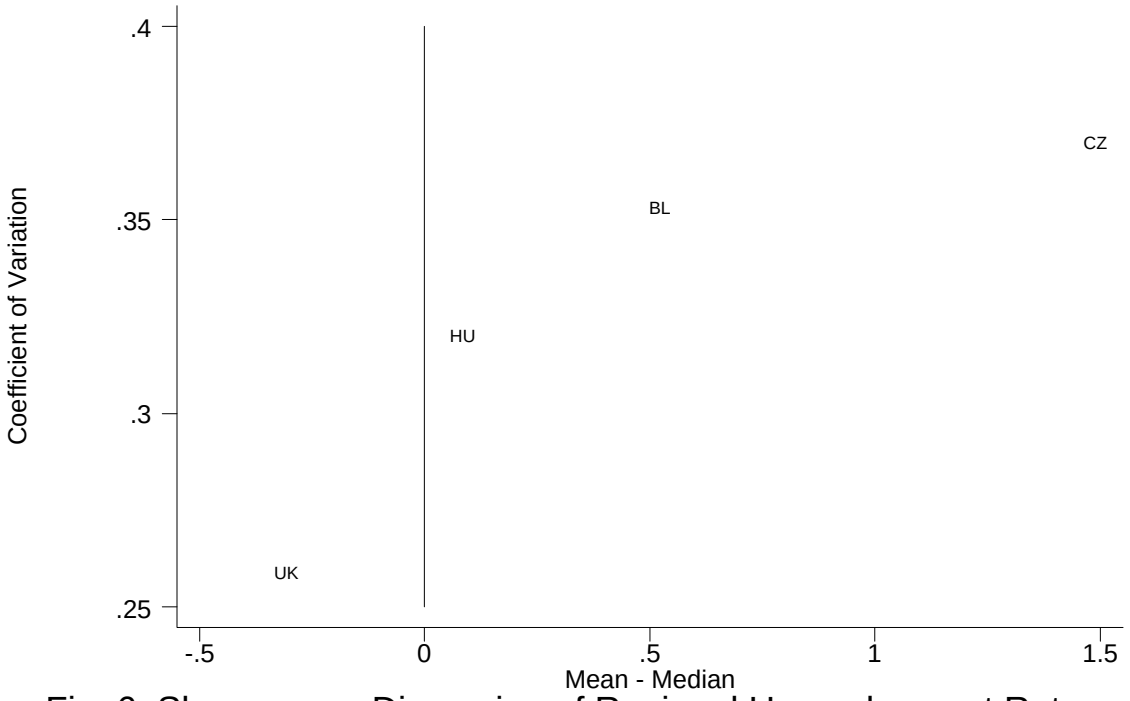

Fig. 6: Skewness v. Dispersion of Regional Unemployment Rates

Table 1: Explaining current regional college-education endowment

Country	Bulgaria			Czech Republic			Hungary			Ukraine		
1990 college production	**1.1**	**0.765**	**0.532**	**0.7655**	**0.5801**	**0.5991**	**1.21**	**1.28**	**0.558**	**1.8174**	**1.3094**	**1.2377**
	(0.34)	(0.26)	(0.17)	(0.09)	(0.15)	(0.12)	(0.50)	(0.48)	(0.20)	(0.24)	(0.13)	(0.14)
R^2	65	77	47	91	93	78	54	56	42	85	94	85
Initial industry shares		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes
Excluding capital city			Yes			Yes			Yes			Yes
Number of NUTS3	28		26	14		12	20		18	26		24
Coeff. of Variation of share of college educated	0.35		0.19	0.33		0.13	0.34		0.16	0.30		0.19

Notes: The dependent variable is the current (2001-2003) share of regional population with a college education. 'College production in 1990' is measured as the number of graduates in 1990 divided by the size of the relevant population age group in each region and normalized to equal average across countries. 'Industry shares' are employment shares in construction and manufacturing in each region as of 1990 (1996 in case of Ukraine, 1991 for the Czech Republic). Excluding capital city corresponds to excluding the region containing the capital city and the immediately surrounding region. Robust standard errors in parentheses. Bolded coefficients statistically significant at the 5% level.

Table 2: Explaining current regional unemployment rates

Country	Bulgaria			Czech Republic			Hungary			Ukraine			All		
Share lower secondary		**1.88**	**1.88**		-0.66	-0.52		**-0.85**	**-0.86**		0.26	0.289		**0.21**	**0.19**
Share upper secondary		-0.19	-0.066		**-2.73**	**-3.32**		**-0.47**	-0.423		-0.13	-0.16		**0.31**	**0.33**
Share college	**-0.85**	0.89	0.53	**-0.32**	1.01	0.73	**-0.28**	-0.33	-0.35	**-0.32**	**-0.21**	-0.06	**-0.285**	**-0.32**	-0.15
R^2	37	59	51	14	71	64	23	66	61	23	30	18	5	31	30
Excluding capital			Yes			Yes			Yes			Yes			Yes
Number of NUTS3	28		26	14		12	20		18	26		24	88		80
Coeff. of Var. of Regional Unemp. Rates	0.35		0.31	0.37		0.35	0.32		0.31	0.26		0.24	0.50		0.46

Notes: Education shares are from 2001 census. Excluding capital city corresponds to excluding the region containing the capital city and the immediately surrounding region. Robust standard errors in parentheses. Bolded coefficients statistically significant at the 5% level.

Table 3: Explaining individual cross-regional migration

Country	Bulgaria			Hungary			Ukraine		
	Education	Regional % College	Regional Unemp.	Education	Regional % College	Regional Unemp.	Education	Regional % College	Regional Unemp.
Education:									
elementary	--	0.13	0.02	--	-0.32	-0.04	--	0.12	-0.2
		(0.09)	(0.07)		(0.25)	(0.17)		(0.24)	(0.18)
lower secondary	0.006	**0.51**	**-0.25**	0.005	-0.28	0.24	**0.023**	0.14	0.02
	(0.010)	(0.09)	(0.11)	(0.003)	(0.34)	(0.31)	(0.007)	(0.39)	(0.28)
secondary	0.036	**0.89**	**-0.69**	**0.017**	0.03	**-0.71**	**0.037**	**1.04**	-0.55
	(0.027)	(0.30)	(0.19)	(0.003)	(0.48)	(0.34)	(0.008)	(0.43)	(0.42)
college	**0.081**	**0.66**	**-0.62**	**0.034**	-0.34	**-0.88**	**0.063**	0.19	-0.18
	(0.024)	(0.26)	(0.17)	(0.006)	(0.51)	(0.30)	(0.010)	(0.30)	(0.25)
Moving between	1989 and 2001			2001 and 2002			1986 and 2003		
Number of movers	210			754			271		
Number of stayers	4488			25910			6334		

Notes: The first column of each country panel displays linear probability regression parameters from cross-regional migration binary equations controlling for gender and age. The parameters in the second and third columns come from *separate regressions on cross-regional migration for each education level* ; they represent the coefficients on the 1990 regional level of college-degree production (College) and current regional unemployment rate (Unemp), respectively, controllingfor age and gender, as described in equation (1) in the text. Standard errors are clusterd at the regional level. Bolded coefficients are statistically significant at the 5% level.

Table 4: Explaining current FDI stock using initial-transition college-education endowment

Country	Czech Republic			Hungary			Ukraine		
1990 college share	**0.0934**	**0.0637**	0.001	**0.0601**	**0.0561**	0.0396	**0.0045**	**0.0035**	**0.0016**
	(0.008)	(0.018)	(0.002)	(0.007)	(0.010)	(0.068)	(0.001)	(0.001)	(0.001)
R2	0.92	0.94	0.05	0.31	0.34	0.06	0.72	0.75	0.31
Initial industry shares		Yes	Yes		Yes	Yes		Yes	Yes
Excluding capital			Yes			Yes			Yes
Number of NUTS3	14		12	20		18	26		24
Coef. of Var. of FDI p.c.	2.72		0.26	1.25		1.22	1.32		0.62

Notes: Industry shares are employment shares of construction and manufacturing in the region as of 1990 (1996 in case of Ukraine, 1991 for the Czech Republic). Excluding capital corresponds to excluding the region containing the capital city and the immediately surrounding region. Bolded coefficients statistically significant at the 1% level based on robust standard errors.

Table 5: Explaining Wages by Education Using Regional Share of College Education

Country	Bulgaria			Czech Republic			Hungary			Ukraine			All		
for college educated	0.354	1.11	1.23	-0.29	**-2.92**	**-2.14**	**3.54**	2.45	0.25	**-3.48**	**-4.61**	**-4.51**	**1.36**	-0.93	-1.72
	(1.02)	(1.34)	(2.18)	(1.96)	(0.56)	(0.99)	(0.38)	(2.15)	(2.70)	(1.87)	(2.50)	(2.74)	(0.26)	(1.37)	(1.65)
for upper secondary				-0.64	**-2.33**	-0.81	**2.02**	1.25	-0.97	0.23	0.56	-0.63	**1.51**	0.88	-0.47
	2.36	**2.4**	0.68	(1.72)	(0.75)	(1.62)	(0.26)	(1.16)	(2.05)	(1.17)	(1.11)	(1.05)	(0.14)	(0.66)	(0.99)
for lower secondary	(0.51)	(0.74)	(2.05)	-0.41	**-2.01**	-0.69	**0.83**	1.97	-2.04	**3.01**	2.68	0.07	**1.01**	0.55	-0.71
				(1.42)	(0.48)	(1.54)	(0.38)	(1.79)	(2.43)	(1.43)	(2.03)	(2.01)	(0.36)	(0.67)	(1.12)
for elementary educated	0.24	1.21	-4.45	0.29	**-1.24**	0.18	**1.07**	1.23	-2.66	-0.51	-0.95	-2.37	**0.78**	0.45	-2.37
	(2.74)	(3.27)	(8.26)	(1.25)	(0.67)	(1.76)	(0.35)	(1.21)	(2.26)	(1.38)	(1.24)	(1.79)	(0.22)	(0.88)	(2.37)
Excluding capital city		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes
IV			Yes			Yes			Yes			Yes			Yes
Number of NUTS3	28	26		14	12		20	18		26	24		88	80	

Notes: Each cell shows the coefficient from a *separate education-specific regression* of the average regional wage (for an education group) on the regional share of college educated population in 2001, weighted by population and controlling for initial industry shares. The regional average wages correspond to the coefficient on the regional fixed effects estimated in log-wage regressions on the non-public sector of the economy, controlling for workers' age and gender and estimated separately for each education group. The two-step procedure is shown in equations (2) and (3) in the text. Excluding capital city corresponds to excluding the region containing the capital city and the immediately surrounding region. Instrumenting (IV) is based on the regional college-degree production per capita in 1990. Bolded coefficients are statistically significant at 10% level based on robust standard errros. The all-country estimates are fully robust to including country fixed effects.

Table 6: Explaining Unemployment by Education Using Regional Share of College Education

Country	Bulgaria			Czech Republic			Hungary			Ukraine			All		
for college educated	0.31	0.46	1.55	-0.14	-0.03	-0.14	-0.03	0.01	0.31	0.05	0.06	0.07	-0.08	0.07	0.42
	(0.59)	(0.86)	(1.32)	(0.16)	(0.19)	(0.23)	(0.07)	(0.25)	(0.41)	(0.05)	(0.07)	(0.10)	(0.06)	(0.31)	(0.39)
for upper secondary				-0.8	-0.48	-0.44	**-0.23**	-0.23	-0.15	0.02	0.01	-0.04	**-0.33**	**-0.62**	-0.48
	-1.95	**-2.25**	-2.45	(0.59)	(0.64)	(0.58)	(0.08)	(0.25)	(0.47)	(0.04)	(0.03)	(0.03)	(0.08)	(0.26)	(0.39)
for lower secondary	(0.58)	(0.74)	(1.63)	-1.08	0.21	1.14	**-0.28**	**-0.85**	**-1.22**	-0.01	-0.3	-0.03	**-0.27**	0.08	0.43
				(1.09)	(0.84)	(1.09)	(0.15)	(0.30)	(0.45)	(0.01)	(0.03)	(0.02)	(0.06)	(0.21)	(0.46)
for elementary educated	**-3.17**	-0.98	1.21	**-1.79**	**-1.96**	-0.56	**-0.82**	**-1.69**	0.02	-0.1	0.12	0.15	-0.31	-0.48	0.41
	(1.72)	(2.14)	(3.11)	(0.77)	(0.83)	(1.04)	(0.28)	(0.73)	(1.69)	(0.19)	(0.12)	(0.15)	(0.22)	(0.51)	(0.78)
Excluding capital city		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes
IV			Yes			Yes			Yes			Yes			Yes
Number of NUTS3	28	26		14	12		20	18		26	24		88	80	

Notes: Each cell shows the coefficient from a *separate education-specific regression* of the regional unemployment rate for an education group on the the regional share of college educated population in 2001, weighted by population and controlling for initial industry shares. The regional education-specific unemployment rates correspond to coefficients on the regional fixed effects estimated using a linear probability model of individual unemployment (conditional on being in the labor force) controlling for workers' age and gender and estimated separately for each education group. Excluding capital city corresponds to excluding the region containing the capital city and the immediately surrounding region. Instrumenting (IV) is based on the regional college-degree production per capita in 1990. Bolded coefficients are statistically significant at the 10% level based on robust standard errros. The all-country estimates are fully robust to including country fixed effects.

Table 7: Comparing Variation in Regional Outcomes between College and Elementary Educated

Country	Bulgaria		Czech Republic		Hungary		Ukraine	
unemploment	0.45	0.45	0.20	0.20	0.33	0.33	0.50	1.00
wages	0.70	0.73	1.57	1.00	2.00	1.75	0.84	0.92
Excluding capital		Yes		Yes		Yes		Yes
Number of NUTS3	28	26	14	12	20	18	26	24

Note: Each entry is the ratio of the regional standard deviation of unemployment (or wages) of the college educated to that of the elementary educated. The wage/unemployment data corresponds to regional fixed effects estimated in Tables 5 and 6.

Table A1: Description of Data Sources for Each Variable

	Bulgaria	Czech Republic	Hungary	Ukraine
Early Transition Regional Data				
Share of college-educated in adult population	n.a.	1991 population census	1990 population census	1989 population census
College-degree production:				
Number of graduates from universities	1990	1991	1990	1990
Population size	1992 regional data	1991 census	1990 census	1989
Employment shares of industries	1990	1990	1990	1996
Recent Regional Data				
Share of college-educated in adult population	2001 census	2001 census	2001 census	2001 census
Unemployment rate	2003 regional statistics	2001 census	2002 Labor Force Survey	2003 regional statistics
FDI stock p.c., USD million	2003 Central Bank	2001 Central Bank	2001 Central Bank	2003 Central Bank
Recent Individual-Level Data				
Wage	2001 Living Standards Measurement Survey (LSMS)	2001 Inf. System on Average Earnings (ISAE)	2002 Wage and Earnings Survey (WES)	2003 Ukrainian Longitudinal Monitoring Survey (ULMS)
Unemploment	2001 LSMS	2001 Labor Force Survey	2002 Labor Force Survey	2003 ULMS
Cross-region migration	2001 LSMS	n.a.	2002 Labor Force Survey	2003 ULMS
Time frame of migration question	Moved since 1989? 8 regions	n.a.	Moved since last year?	Moved since 1986?
Unit NUTS 3 Regions	28 oblasts	14 kraje	20 megye	26 oblasts

Notes:

(i) Regional information comes from population censuses or from regional statistics of central statistical agencies with the exception of some of the college-degree production data (ministries of schooling) and some of the FDI data (central banks).

(ii) See Jurajda (2003) for details on the ISAE data, Jolliffe and Campos (2005) for information on the WES data, Ganguli and Terrell (2006) for ULMS description and Jolliffe (2002) for information on the Bulgarian LSMS.