

Regional unemployment and human capital in transition economies¹

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Abstract

Differences in regional unemployment in post-communist economies are large and persistent. We show that within-country regional variation in inherited human capital in four such economies explains the bulk of regional variation in unemployment; we explore potential explanations. Our evidence suggests that internal skill-biased migration and the flow of foreign direct investment are not working as adjustment mechanisms but rather help explain the lack of convergence in regional unemployment rates. Although this capital and labour mobility pattern is consistent with the presence of regional skill spillovers, we find little support for this hypothesis. Instead, the observed migration pattern appears to arise from different skill-specific adjustments to regional shocks brought about in part by labour-market institutions such as guaranteed welfare income.

JEL classifications: E24, J0, J61.

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1. Introduction

The first stages of transition from central planning to a market economy brought about a recession and massive reallocation of both labour and capital; it is therefore not surprising that 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 labour demand towards skilled labour and argues that the effective skill endowments among the less educated in transition countries are low in international comparison.²

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 usually depicts labour migration as a weak equilibration mechanism and blames this on institutional deficiencies, such as underdeveloped housing markets.³ However, other factors may explain why labour migration does not equilibrate regional unemployment (and wage) rates. In particular, this literature has so far failed to focus on the nature of skill-specific migration, capital flows and regional skill endowments.

This omission is important in light of the new economic geography literature, 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 labour and capital flows to regions where there is a high concentration of skilled labour, rather than where it is scarce. Self-reinforcing spatial concentration of factors of production could reinforce regional differences in unemployment and exacerbate them.⁴

Another potential explanation for lack of regional unemployment convergence is that skilled and unskilled individuals respond differently to regional labour

² See Commander and Köllő (2004), Sabirianova (2003), Kézdi (2003) and Köllő (2006).

³ See, for example, Bornhorst and Commander (2006), Huber (2004), or Fidrmuc (2004).

⁴ This economic geography literature is reviewed in Section 2 of the paper.

demand shocks. When there is a collapse in local demand for labour, the low-skilled workers may be less likely to migrate and hence more likely to remain unemployed or drop out of the labour force than highly skilled workers, whose opportunity cost of not working is higher. In particular, the presence of high national wage floors may 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 the 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 (i) the explanatory power of regional skill endowments for regional unemployment and the related capital and labour flows, (ii) potential skill complementarities, and (iii) different migratory response to regional shocks by skill, to explain the lack of convergence of regional unemployment rates.

Our analysis proceeds as follows: First, we establish stylized facts that within-country regional variations in unemployment and skill endowments are wide across these four countries and that the persistence of regional unemployment over time is especially strong among the low-skilled. We are the first to demonstrate that the lion's share of the variation in within-country regional unemployment rates in transition economies is explained by the variation in regional human capital. We show that this result is not driven simply by the generally lower unemployment rate of skilled people since it is much stronger than suggested by applying the national average skill-specific unemployment rates to the regional skill distribution. We then test whether migration and capital flows are contributing to the non-convergence of within-country regional unemployment and find evidence that they are: there is little internal migration among unskilled workers, and skilled workers are moving to regions with low unemployment. Moreover, FDI tends to flow to regions with high skill levels. Next, we ask whether the patterns of migration and capital flows we find are driven by 'spillovers' based on a geographical concentration of skilled workers or by the asymmetric regional shocks hypothesis. We find no evidence for wage spillovers implied by the complementarities hypothesis, but unemployment of low-skilled appears lower in highly skilled areas, consistent with imperfect substitution between skill types in the production process.

Based on these findings as well as some indirect cross-country evidence, 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 labour demand shocks.

2. Explaining divergence in regional unemployment rates: Theoretical and empirical 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 labour mobility adjustment. For example, Bornhorst and Commander (2006) study the behaviour of labour mobility, employment creation, out-of-labour-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, several studies of migration during the first decade of transition (see, for example Fidrmuc, 2004, and the references therein) find that migration rates are lower than in developed countries (including the EU15) and that migration is not helping to reduce interregional unemployment and wage differentials. However, none of the existing studies pays attention to the regional variation in educational endowment or the skill composition of migration flows.⁵

A new literature based on EU and US research has oriented researchers away from thinking that mobility of labour 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 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 concentration of human capital, this may lead to spatial divergence in human capital concentration through skill-biased migration.

For example, skill-skill complementarities may exist such that regions with more skilled workers have higher productivity over and above the national-level skill-wage gradient. If skilled workers benefit more from such externalities compared to unskilled labour, they will migrate to initially more skilled regions, exacerbating spatial disparities in unemployment and wages (Giannetti, 2003). Capital-skill complementarities may also exist, in which case regions with higher human capital endowment attract more advanced higher-productivity investment, such as FDI, which again results in regional divergence and skill-biased migration (Devillanova, 2004).

⁵ A recent exception is the study of Paci *et al.* (2007), who ask about the effect of education on migration in EU-8 economies. We discuss their results in detail in Section 3.3 together with our evidence.

Another possible mechanism supporting such skill-biased migration can operate even in the absence of skill externalities in the production process. In an era of SBTC, regional productivity shocks are likely to be related to regional human capital concentration while responses of skilled vs. unskilled workers to these shocks may differ. A growing literature suggests that high-skilled workers migrate in response to a decline in regional labour demand, while the low-skilled workers remain in the region and either drop out of the labour force or stay unemployed (Kwon and Spilimbergo, 2005; Mauro and Spilimbergo, 1999; Topel, 1986). Differences in the size of the regional shocks and the level of the minimum wage or safety nets that affect the benefits from moving could explain labour mobility and hence the dispersion and persistence of regional unemployment.

The underlying theoretical framework for these two mechanisms can be briefly described as follows: Assume there are two regions (A and B) and each produces a single good (y) with a Cobb–Douglas technology:

$$y_i = A_i S_i^\alpha L_i^{1-\alpha}, i \in \{A, B\}, \quad (1)$$

where S denotes skilled labour and L stands for unskilled labour. The regional level of total factor productivity depends positively on the share of skilled under the skill spillover hypothesis: $\log(A_i) = \beta + \gamma S_i / (S_i + L_i)$. Let us also assume that region A is more skilled (has a significantly higher share of skilled workers) compared to region B at the beginning of transition.⁶ Finally, assume that there is a national minimum wage level, which is binding (above the level of marginal product) for some of the unskilled workers (causing unemployment). Migration is spurred by a change in regional wage differentials in both the ‘externalities’ and ‘regional shocks’ stories, but the mechanisms driving these wage differentials differ.

Let us first focus on the regional shocks mechanism, where regional total factor productivity does not depend on the share of skilled, but is affected by exogenous shocks.

A negative shock to one region increases regional wage differentials. For example, a negative shock in the unskilled region B (in line with SBTC) lowers the marginal product of all workers, which effectively lowers the wages of skilled workers but increases unemployment of unskilled workers, since their wage

⁶ This assumption is in accord with stylized facts presented in Section 3. In a typical model describing stable market economies, such variation in skill endowments would correspond to regional skill-biased technology differences or differences in amenities, which are valued more by high-skilled workers. However, the initial differences in the share of high-skilled workers we study are inherited from central planning where wages were set by national wage grids (Münich, Svejnar and Terrell, 2005) and cultural amenity investments were distributed evenly. In Section 3, we show that initial skill gaps across regions correspond to different placement of schools of higher education during the communist era.

cannot fall below the minimum wage. The higher regional wage differential for skilled workers provides an incentive for them to migrate to region *A*. Unskilled wage differentials are not large enough to compensate migration costs as the wage floor is set at the national level. As skilled workers arrive in region *A*, imperfect substitution shifts up the marginal productivity curve (labour demand) for low-skilled workers there, reducing unemployment.⁷ In contrast the departure of skilled workers from region *B* makes them scarcer there, which raises their wage. As a consequence, regional unemployment differences grow. Migration continues until regional wage differences for skilled are eliminated.

Under the alternative mechanism based on skill–skill complementarities, the initial (inherited) disparity in skill shares directly raises wages in region *A* above that in region *B*, which has a lower share of skilled workers. The higher mobility of *S* workers then again leads to an increase in regional disparity in skill endowments as well as unemployment and wage differences. The unskilled in region *A* now benefit from the arrival of additional *S* workers not only because of imperfect substitution, but also because of the ‘spillover’ productivity effect. In contrast to the simpler regional-shock scenario, wages of skilled in region *A* also benefit from the arrival of additional skilled labour through the presence of skill externalities. In a richer model with capital mobility and land (Moretti, 2004), migration stops when regional wage differences are equalized controlling for differences in price of land (rents), which grows in the more productive region.

There is substantial empirical work testing these hypotheses of complementarities and spillovers in the United States, but there is less of such work in Europe, where regional disparities in unemployment are also of high policy concern.⁸ In the United States, Berry and Glaeser (2005) are among the 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 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 (Glaeser, Scheinkman and Shleifer, 1995; Moretti, 2004). An important source

⁷ Wages of the unskilled do not rise in region *A* until all unskilled unemployed are absorbed into the labour market. Hence, as long as there is low-skilled unemployment in the high-skilled region, skilled workers there are not subject to diminishing marginal returns and their wages are also not changing.

⁸ See Canova (2001) or Puga (2002) for analyses 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.

of exogenous variation in local skill level used in this literature is the historical presence of colleges.⁹

Human capital production externalities could represent an important component of not only city or regional, but also aggregate economic development (Lucas, 1988). Specifically, human capital may be a key determinant of advanced technology adoption in less-developed economies (Acemoglu and Zilibotti, 2004).¹⁰ This mechanism could be particularly important in post-communist economies, which underwent massive reallocation of production and increasing international integration.¹¹ 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 SBTCs. There are now several studies documenting the skill-biased nature of transition at the national level (Commander and Köllő, 2004; Sabirianova, 2003; or Kézdi, 2003),¹² but there is no investigation of the issue of regional human capital externalities.

While the theory of human capital spillovers as well as the simpler skill-biased regional adjustment hypothesis provide 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 (in other words the increasing the 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 labour demand shocks combined with regional distribution of human capital.

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.¹³ Given we find that it is very important, much beyond the simple 'accounting' identity

⁹ Lange and Topel (2006) criticize the instrumental-variable approach for not accounting for endogeneity implied by spatial equilibrium. In particular, a highly elastic supply of skills to a locale, consistent with high geographical worker mobility in the United States, 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.

¹⁰ 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, De Simone and Faini (2007) suggest that FDI is indeed attracted by existing endowments of human capital.

¹¹ 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.

¹² Kézdi (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.

implied by national skill-unemployment gradients and local skill endowments, the next step in our analysis is to examine the direction of capital and labour flows. Informed by the recent advances in the new economic geography literature, we focus on skill-specific migration flows and thus extend the existing evidence on labour 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 labour, could make the initial skill composition of the labour 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 labour mobility by testing for the presence of skill complementarities and exploring the role of labour market institutions in explaining regional wage differentials and lack of mobility among unskilled workers.

3. Analysis

Our empirical analysis is based on two types of data. First, we rely on regional data at the NUTS-3 level coming mainly from the 2001 population censuses. Second, we use individual data from about 2001 from labour force surveys, wage surveys or (retrospective) labour-market monitoring surveys from the Czech Republic, Hungary, Bulgaria and Ukraine: two Central European economies, about to become EU members, and two less developed transition countries, one of which has joined the EU later. Our key variables are (i) the shares of each region's population with different education degrees, (ii) the extent of college-degree production at the end of communism in each region (measured as the number of college graduates per capita), (iii) FDI stock per capita in about 2001, and (iv) individual wage and unemployment status in about 2001. A 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, the variation

¹³ Overman and Puga (2002) also measure the explanatory power of regional human capital for regional unemployment rates for NUTS-2 areas of EU-15 economies. However, they do not explore the extent to which this explanatory power exceeds that implied by national-level skill-unemployment gradients.

in NUTS-3-level regional unemployment is quite high and similar in our four countries, where the coefficient of variation is around 0.35 in Bulgaria, the Czech Republic and Hungary and lower in Ukraine at 0.26.¹⁴

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 an inordinately high share of college-educated individuals in the capital city (and perhaps the immediately surrounding area) given the concentration of universities, cultural amenities valued by the highly educated, and public institutions staffed with a highly educated labour 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, the share of the adult population with a college education outside of the capital city ranged between 7 and 17 percent in Bulgaria and between 9 and 19 percent in Ukraine. We find a similar degree of dispersion in the 2001 share of college educated in our four countries, as attested by the coefficients of variation reported in the bottom row of Table 1. Moreover, the regional variation in the share of college educated is quite similar to the variation in the unemployment rates, reported in the bottom row of Table 2.¹⁵

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 1, we supplement the available stylized facts by showing that the persistence in regional unemployment differences is mainly due to the unemployment rates among the less skilled rather than the unemployment among the more skilled. Using Labour Force Survey data from the Czech Republic and Hungary,¹⁶ the figure shows plots of the NUTS-3 regional skill-specific unemployment rates in 1993 against those in 2003 for four education (skill) groups. The least-squares regression line in each graph summarizes the correlation between these rates over the two years. The evidence in Figure 1 suggests that (i) region-education groups that started the transition process with relatively higher unemployment rates are still facing higher unemployment 10 years later, and (ii) with the exception of Hungarian elementary educated, unemployment persistence is stronger among the less educated. The skill

¹⁴ These coefficients of variation are higher than those reported by Eurostat in 2002 for NUTS-3 areas of, for example, Sweden (0.20) or Greece (0.29), but are similar to those of the United Kingdom (0.37). See, Bornhorst and Commander (2006) and Paci *et al.* (2007) for an international comparison of regional unemployment disparities confirming that post-communist countries have much higher regional unemployment disparity in comparison to developed ones.

¹⁵ 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 United Kingdom, according to central statistical agencies of each country.

¹⁶ There are no household surveys available for early transition Bulgaria and Ukraine.

Table 1. Explaining current regional college-education endowment

Country	Bulgaria			Czech Republic			Hungary			Ukraine		
1990 college production	1.1	0.765	0.532	0.766	0.580	0.599	1.210	1.280	0.558	1.817	1.309	1.238
	(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	0.65	0.77	0.47	0.91	0.93	0.78	0.54	0.56	0.42	0.85	0.94	0.85
Initial industry shares		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes
Excluding capital city			Yes			Yes			Yes			Yes
Number of NUTS-3	28	26	14	12	20	18	26	24				
Coefficient 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) 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 are in parentheses. Bolded coefficients are 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	0.29		0.29	0.31	
Share upper secondary	-0.19	-0.066		-2.73	-3.32		-0.47	-0.42		-0.13	-0.16		0.38	0.41	
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	-0.48	-0.5	-0.74
R ²	0.37	0.59	0.51	0.14	0.71	0.64	0.23	0.66	0.61	0.23	0.3	0.18	0.12	0.42	0.41
Excluding capital			Yes			Yes			Yes			Yes			Yes
Number of NUTS-3	28	26	14	12	20	18	26	24	88	80					
Coefficient of variation of regional unemployment 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 are in parentheses. Bolded coefficients statistically significant at the 5% level.

Figure 1. Regional unemployment persistence by education level

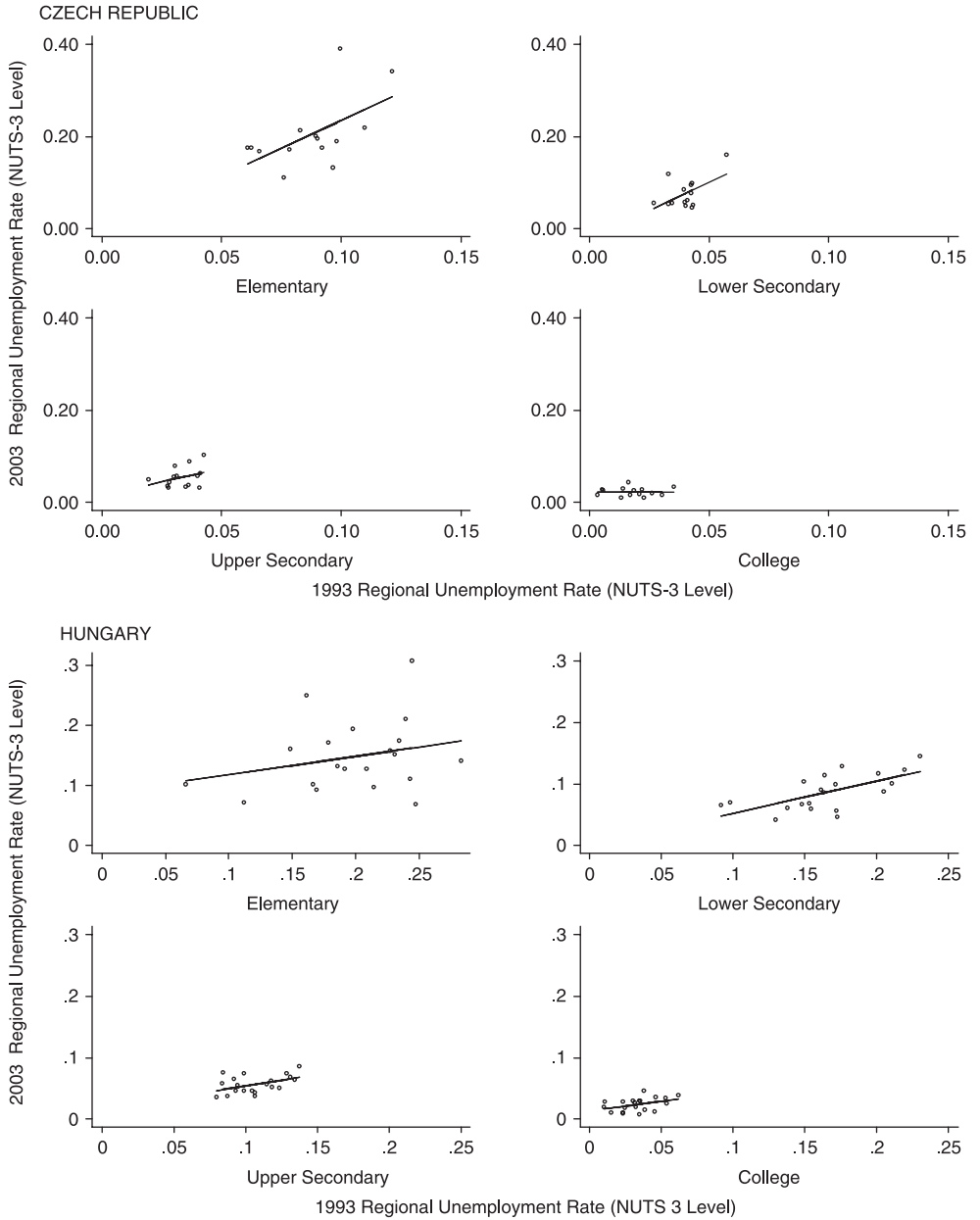
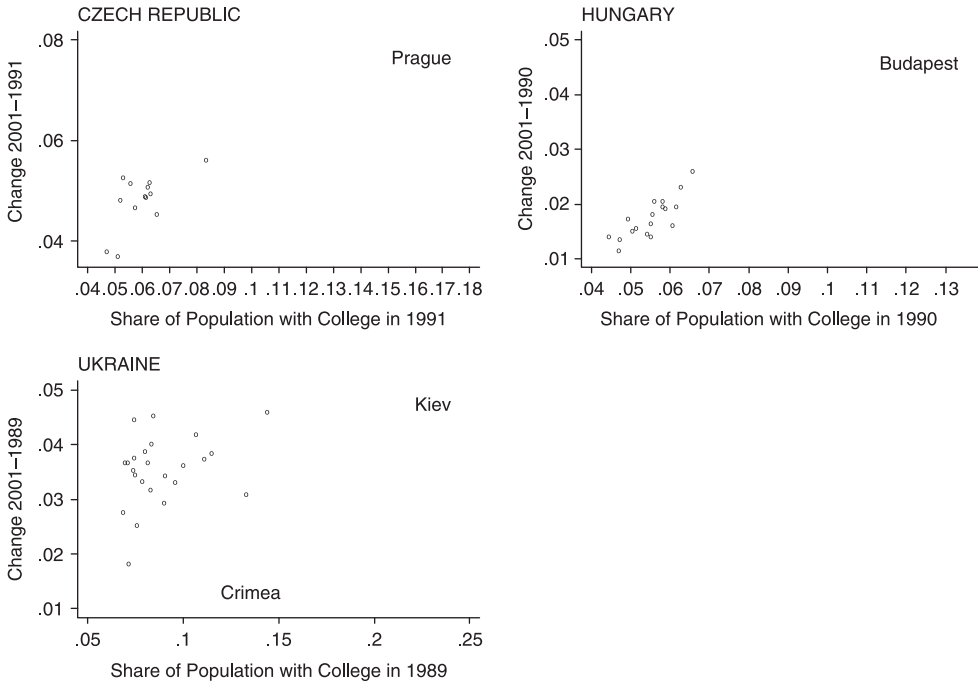


Figure 2. Persistence in NUTS-3 regional shares of college educated



ordering of regional unemployment persistence is particularly strong in the Czech Republic.

Next, we turn our attention to the evolution of regional skill-endowment disparities. The three graphs in Figure 2 document that the regional variation in college education 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 areas with less favourable initial inherited college education endowment.¹⁷ Berry and Glaeser (2005) document quite similar trends of diverging human capital endowment across US cities.¹⁸ Clearly, such trends work against convergence of regional unemployment rates.

¹⁷ We do not have initial transition education-group population share data for Bulgaria. The autonomous republic of Crimea in Ukraine is an obvious outlier to the general pattern.

¹⁸ In contrast, Suedekum (2008) suggests there has been convergence in regional skill composition in Germany between 1977 and 2002. Whether these different patterns are related to differences in location of college-education expansion is an interesting topic of future research.

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). As we show in Table 1, the extent of college-degree production in a region at the end of communism (measured by the number of college graduates 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 (see first column of each country panel). 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 (second column of each panel). Excluding the capital city (together with the immediately adjacent/surrounding area) does decrease the explanatory power, but the relationship remains strong and highly statistically significant (third column).

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.¹⁹ For example, most Czech colleges were established by the end of the 1960s and only a small subset was originally related to a local large firm.²⁰ 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 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 labour 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 summary, 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

¹⁹ A similar argument has been used by Moretti (2004) in US research on human capital spillovers.

²⁰ 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 (e.g. Ústí nad Labem, Hradec Kralové, or České Budějovice) or as engineering faculties tied to local manufacturing or chemical production (e.g. Plzeň, Zlín, Pardubice) and they all branched out into other fields by adding faculties over time.

(least-squares regression coefficients and R^2 statistics) of the current regional educational structure 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.²¹ 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.²²

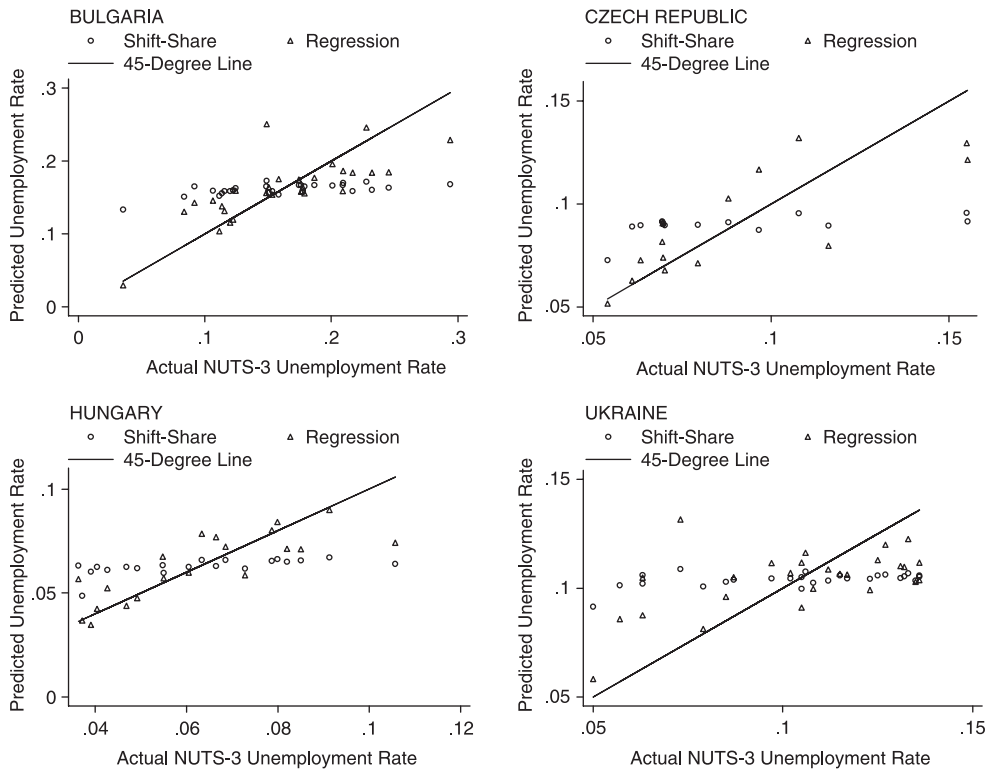
In the last panel of Table 2, we combine the regional unemployment data from our four countries to show that (without the use of country dummies), we can explain about 40 percent of the regional (within- and cross-country) variation in unemployment using our four education shares (three explanatory variables). While this exercise assumes that the 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.²³

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 rather than reveal 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

²¹ 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 to 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.

²² The coefficients estimates differ across countries, which may be due to strong multicollinearity of the three education shares. When we summarize the skill endowment of each region using a crude imputed number of years of schooling, we obtain similar negative significant coefficients in all countries.

²³ 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 the end of communism. In Hungary, regressing the recent unemployment rate of each NUTS-3 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 0.62 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 eight industry employment shares together with the initial-transition share of college educated explains 0.77 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.

Figure 3. Comparing two predicted unemployment rates: shift-share vs. regression

expected 'shift-share' regional unemployment rate. The latter is the regional unemployment rate that would prevail if the regional unemployment rates by skill were the same as the national unemployment rate by skill. It is imputed by applying the unemployment rate of each education group at the national level to each region using the regional education structure. In Figure 3, we plot for each observed regional unemployment rate (on the horizontal axis) the predicted unemployment rate from our regressions as well as the predicted unemployment rate implied by the shift-share exercise. The predictive power of each exercise corresponds to how close the predicted values are to the 45-degree line, which corresponds 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 aggregate unemployment rates are lower) than in areas with fewer college educated (where aggregate unemployment rates are higher).

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 percent higher than those of the regression analysis. The difference is smaller in Bulgaria at 107 percent and the explanatory-power gap is smallest in Ukraine at only 28 percent. 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 the shift-share analysis to be 90 percent higher than those based on a simple skill-unemployment regional regression, using the 2001 UK census.²⁴

In summary, we have identified a number of regional patterns: (i) over half of the regional variation in unemployment rates can be explained by regional skill endowments; (ii) 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; and (iii) 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 regional college-degree 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 labour 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.²⁵ 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. It is also possible that only highly skilled workers move and

²⁴ 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 so 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 United Kingdom.

²⁵ The faster increase in the share of college educated in regions that had (more) colleges in 1990 must be supported by one or more 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 region after graduating, (iii) during transition, workers who attained a college education before the collapse of communism are moving in a skill-biased way.

unemployed low skilled workers do not migrate because their welfare receipts (which are close to their market wage) are the same everywhere.

Hence, in this subsection, we ask about the skill composition of migration flows across regions. We use the data from the 2001–2003 labour force surveys where respondents answer questions about their current area of residence as well as their residence in the previous year (Hungary) or in any year since 1989 (Bulgaria) or 1986 (Ukraine).²⁶ While these migration definitions are not strictly comparable, they allow us to shed light on the skill composition of internal migration.²⁷ 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 a less educated population.

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 (as apposed to not moving) for workers within three levels of education relative to the primary level, controlling for gender and age.²⁸ First, we focus on the case of Bulgaria, where cross-regional mobility is available only at a higher aggregation level of eight regions.²⁹ We have 210 individuals who have moved across the borders of these regions between 1989 and 2001, and we contrast them with a random sample of non-movers. We find college educated workers are 8 percent more likely to migrate compared to workers with elementary education and this difference is statistically significant, while there is no such difference for workers with secondary education levels.

Next we estimate linear probability models relating cross-regional migration of a worker, with a given education level, age and gender, to the 1990 college-degree production in the region of current residence (after moving). Such a descriptive regression indicates whether workers who move across regional borders are more likely to reside now in NUTS-3 areas with a higher share of college educated compared to the workers the majority of whom do not move. Specifically, we estimate the following equation for each of the four skill groups, s (elementary, lower secondary, upper secondary and tertiary education):

$$P_{irs} = \alpha_{0s} + \alpha_{1s}College_r + \alpha_{2s}Gender_{irs} + \alpha_{3s}Age_{irs} + \mu_{irsr} \quad (2)$$

²⁶ No such data exist for 2001 in the Czech Republic, where the Labour Force Survey covers a set of dwellings and not households (i.e. there is no indicator of a new family moving to one of these dwellings).

²⁷ Paci *et al.* (2007) measure cross-NUTS-2 migration flows between 2003 and 2004 in several EU-8 economies and suggest that the level of migration there is about four times lower compared to France, Netherlands or the United Kingdom, but similar to that of Greece, Spain or Italy.

²⁸ The estimated coefficients (probability derivatives) are fully robust to alternatively using the probit model.

²⁹ The 28 Bulgarian NUTS-3 units are aggregated for the purpose of answering mobility-related questions into the following nine areas: Sofia city, Sofia region, Plovdiv, Burgas, Varna, Haskovo, Montana, Lovech and Russe.

Table 3. Explaining individual cross-regional migration

Country	Bulgaria			Hungary			Ukraine		
	Education	Regional % College	Regional Unemployment	Education	Regional % College	Regional Unemployment	Education	Regional % College	Regional Unemployment
Education:									
Elementary	–	0.13 (0.09)	0.02 (0.07)	–	–0.32 (0.25)	–0.04 (0.17)	–	0.12 (0.24)	–0.2 (0.18)
Lower secondary	0.006 (0.010)	0.51 (0.09)	–0.25 (0.11)	0.005 (0.003)	–0.28 (0.34)	0.24 (0.31)	0.023 (0.007)	0.14 (0.39)	0.02 (0.28)
Secondary	0.036 (0.027)	0.89 (0.30)	–0.69 (0.19)	0.017 (0.003)	0.03 (0.48)	–0.71 (0.34)	0.037 (0.008)	1.04 (0.43)	–0.55 (0.42)
College	0.081 (0.024)	0.66 (0.26)	–0.62 (0.17)	0.034 (0.006)	–0.34 (0.51)	–0.88 (0.30)	0.063 (0.010)	0.19 (0.30)	–0.18 (0.25)
Moving between		1989 and 2001			2001 and 2002			1986 and 2003	
Number of movers		210			754			271	
Number of stayers		4,488			25,910			6,334	

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* (described in the first column); they represent the coefficients on the 1990 regional level of college-degree production (Regional % College) and current regional unemployment rate (Regional Unemployment), respectively, controlling for age and gender, as described in Equation (2) in the text. Standard errors are clustered at the regional level. Bolded coefficients are statistically significant at the 5% level.

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 α_{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 at the start of the transition process. This is not the case for the low (elementary) educated movers. We next estimate Equation (1) replacing the $College_r$ variable with the current (2001) regional unemployment rate ($Unemp_r$). The estimates of α_{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 2001 and 2002 across NUTS-3 borders.³⁰ 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 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, that is, 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.³¹

The corresponding coefficients from Ukraine are estimated with 271 within-Ukraine cross-NUTS-3 movers.³² The results indicate that in Ukraine more educated workers are more likely to move than the less educated and there is also a tendency for secondary educated workers to move to areas with more educated workers at the start of transition. However, we detect no relationship between migration of workers with different skill levels and regional unemployment rates.

³⁰ 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.

³¹ 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.

³² 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.

Overall, our evidence is consistent with more mobility among the highly educated workers,³³ who, based on the statistically significant coefficients, are more likely to move to areas with high levels of education and low unemployment areas.³⁴ On the other hand, we find no support for the notion that less educated workers move to areas with less education or higher unemployment rates.

3.4 FDI and initial skill endowment

Given the skill-biased nature of labour 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.³⁵

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.³⁶ 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

³³ Paci *et al.* (2007) confirm the higher mobility rates among the skilled using 2004 data from several post-communist countries and conditioning on a wider set of individual characteristics.

³⁴ 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 2001 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 the 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 three 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.

³⁵ The cumulated FDI inflows during 1993–2000 are large given that their value equals about 25 percent (40 percent) of the 2000 Bulgarian (Czech or Hungarian) GDP as documented in Smarzynska-Javorcik (2004). Using an alternative measure, FDI constituted on average about 20 (40) [15] [5] percent of gross fixed capital formation during 1990–2000 in Bulgaria (Hungary) [Czech Republic] [Ukraine] according to the UN’s 2006 *World Investment Report*. The literature on FDI in transition economies focuses on the determinants of FDI location across countries (e.g. Boeri and Brücker, 2001, Bevan and Estrin, 2004, or Checchi, De Simone and Faini, 2007), but there appears to be no work on regional location of FDI.

³⁶ We use initial-transition college share rather than current college share to obviate the problem of reverse causality (i.e. high-skilled labour flows to regions with high levels of FDI).

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

Country	Czech Republic			Hungary			Ukraine		
1990 college share	0.0934 (0.008)	0.0637 (0.018)	0.001 (0.002)	0.0601 (0.007)	0.0561 (0.010)	0.0396 (0.068)	0.0045 (0.001)	0.0035 (0.001)	0.0016 (0.001)
R ²	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 NUTS-3	14	12		20	18		26		24
Coefficient of variation 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.

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.³⁷ 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 twice the standard deviation of the FDI regional distribution. This is a large effect. Overall, it appears that FDI flows do not help in reducing regional skill and thus unemployment disparities.³⁸

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 in the early transition period is consistent with the human capital complementarity hypothesis as well as with the skill-biased regional shocks hypothesis with barriers to mobility of the low-skilled. 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 ask whether the unemployment rates of otherwise identical workers are lower in regions with a higher concentration of college education. This is relevant in light of the simple model of Section 2, which suggests that if low-skilled workers are unemployed and immobile, they should leave unemployment in the presence of a higher share of skilled 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 usually 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

³⁷ 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).

³⁸ Cieslik (2005) suggests that foreign firms are less likely to locate in high-unemployment areas of Poland.

substitutability of input factors in a straightforward perfect-competition neoclassical model (see Section 2). 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 labour 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 wage (W) on demographic characteristics (Age and $Gender$) and a set of NUTS-3 regional fixed effect dummies (β_{rs}):

$$W_{irs} = \beta_{rs} + \beta_1 Age_{irs} + \beta_2 Gender_{irs} + \mu_{irs}. \quad (3)$$

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 ($College_r$) and the industrial structure at the beginning of transition (IND_r) separately for each of the s education groups:

$$\beta_{rs} = \delta_{0s} + \delta_{1s} College_r + \lambda'_s IND_r + \mu_{rs}. \quad (4)$$

These second stage regional-level regressions are weighted by the population size of each region.³⁹ Finally, Equation (4) 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_{1s} presented in each cell of Table 5 indicates the relationship between average regional wages for workers in a given education level (controlling for demographic characteristics) and the current share of college educated in that region. 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, which is the mechanism supporting the regional skill-biased adjustment hypothesis. 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 (column 3).

³⁹ 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.

Table 5. Explaining wages by education using regional share of college education

Country	Bulgaria			Czech Republic			Hungary			Ukraine			All		
For college educated	0.354 (1.02)	1.11 (1.34)	1.23 (2.18)	-0.29 (1.96)	-2.92 (0.56)	-2.14 (0.99)	3.54 (0.38)	2.45 (2.15)	0.25 (2.70)	-3.48 (1.87)	-4.61 (2.50)	-4.51 (2.74)	1.36 (0.26)	-0.93 (1.37)	-1.72 (1.65)
For upper secondary				-0.64 (1.72)	-2.33 (0.75)	-0.81 (1.62)	2.02 (0.26)	1.25 (1.16)	-0.97 (2.05)	0.23 (1.17)	0.56 (1.11)	-0.63 (1.05)	1.51 (0.14)	0.88 (0.66)	-0.47 (0.99)
For lower secondary				-0.41 (1.42)	-2.01 (0.48)	-0.69 (1.54)	0.83 (0.38)	1.97 (1.79)	-2.04 (2.43)	3.01 (1.43)	2.68 (2.03)	0.07 (2.01)	1.01 (0.36)	0.55 (0.67)	-0.71 (1.12)
For elementary educated	0.24 (2.74)	1.21 (3.27)	-4.45 (8.26)	0.29 (1.25)	-1.24 (0.67)	0.18 (1.76)	1.07 (0.35)	1.23 (1.21)	-2.66 (2.26)	-0.51 (1.38)	-0.95 (1.24)	-2.37 (1.79)	0.78 (0.22)	0.45 (0.88)	-2.37 (2.37)
Excluding capital city		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes
IV			Yes			Yes			Yes			Yes			Yes
Number of NUTS-3	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 (3) and (4) 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 errors. The all-country estimates are fully robust to including country fixed effects.

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 statistically insignificant.

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. Given the small sample sizes, some of these findings are sensitive to controlling for initial-transition industry shares on employment. For example, 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 Ukrainian coefficient in the first column would be close to zero without the industry controls. 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.⁴⁰

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 the 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 the table). As Table 5 shows, however, excluding capital cities leads to negative and statistically insignificant coefficient estimates. These results are not sensitive to excluding the industry structure controls. Overall, we find little evidence for the presence of human capital spillovers outside of the capital cities.⁴¹ 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

⁴⁰ 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.

⁴¹ This conclusion is confirmed in a companion paper, Jurajda (2004), based on 74 Czech NUTS-4 areas.

on individual characteristics and regional fixed effects for each of the four education groups. 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 4). 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, that is, for those with upper-level high-school diplomas, but also for those workers with only about eight to nine years of (elementary-level) education.⁴² 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 presence of human capital spillovers and the findings from the unemployment analysis are consistent with the hypothesis outlined in Section 2 regarding regional adjustments to shocks, we explore additional evidence on this hypothesis in the next section.

3.6 Labour market institutions and regional adjustment

In the absence of regional human capital wage spillovers, the skill-biased regional shocks and adjustment hypothesis can explain the flow of skilled labour 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). The hypothesis is based on transition demand shocks being skill-biased (positive in skilled areas, negative in unskilled areas) and unskilled labour mobility being unresponsive to negative labour demand shocks. The presence of skill-biased regional demand shocks is supported by (i) existing evidence of SBTC at both country and industry level (see Section 2), (ii) our finding that FDI is more likely to flow to more skilled regions, (iii) the fact that less-skilled workers face lower unemployment chances in highly skilled areas, and (iv) the finding that these unemployment rates are highly

⁴² 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.

Table 6. Explaining unemployment by education using regional share of college education

Country	Bulgaria			Czech Republic			Hungary			Ukraine			All		
For college educated	0.31 (0.59)	0.46 (0.86)	1.55 (1.32)	-0.14 (0.16)	-0.03 (0.19)	-0.14 (0.23)	-0.03 (0.07)	0.01 (0.25)	0.31 (0.41)	0.05 (0.05)	0.06 (0.07)	0.07 (0.10)	-0.08 (0.06)	0.07 (0.31)	0.42 (0.39)
For upper secondary				-0.8 (0.59)	-0.48 (0.64)	-0.44 (0.58)	-0.23 (0.08)	-0.23 (0.25)	-0.15 (0.47)	0.02 (0.04)	0.01 (0.03)	-0.04 (0.03)	-0.33 (0.08)	-0.62 (0.26)	-0.48 (0.39)
For lower secondary				-1.08 (1.09)	0.21 (0.84)	1.14 (1.09)	-0.28 (0.15)	-0.85 (0.30)	-1.22 (0.45)	-0.01 (0.01)	-0.3 (0.03)	-0.03 (0.02)	-0.27 (0.06)	0.08 (0.21)	0.43 (0.46)
For elementary educated	-3.17 (1.72)	-0.98 (2.14)	1.21 (3.11)	-1.79 (0.77)	-1.96 (0.83)	-0.56 (1.04)	-0.82 (0.28)	-1.69 (0.73)	0.02 (1.69)	-0.1 (0.19)	0.12 (0.12)	0.15 (0.15)	-0.31 (0.22)	-0.48 (0.51)	0.41 (0.78)
Excluding capital city		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes
IV			Yes			Yes			Yes			Yes			Yes
Number of NUTS-3	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 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 labour 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 errors. The all-country estimates are fully robust to including country fixed effects.

persistent. Although we have shown differences in migration responses by skill, an open question remains as to the source of potential differences in the costs and benefits of migration implied by labour-market institutions across workers of different skill level. In the rest of this section, we provide indirect supportive evidence for the notion that centralized labour 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.

There are substantial differences in the generosity of social support across our four transition economies. Boeri and Terrell (2002) compare social support policies in Central Europe (CE) to those in the former Soviet Union (including Ukraine) 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 percent, 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 percent (Mykhenko, 2005). For comparison, the NRR in the UK (49 percent) is closer to that in Ukraine than to those in the CE countries.

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 wages of less skilled workers across regions, lowering the benefits from migration for these workers. Under this institutional explanation, the skill differences in labour 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 much smaller role.

Such a comparison is offered in Table 7, which presents the ratio between the regional standard deviation of unemployment (wages) of the college educated and the elementary educated.⁴³ We see that in the two Central European economies where binding national wage floors are more likely, wages of college educated workers vary 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 United States, 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 CE labour markets. Hence, this evidence is

⁴³ This is based on the regional fixed effects estimates used in Tables 5 and 6.

Table 7. Comparing variation in regional outcomes between college and elementary educated

Country	Bulgaria		Czech Republic		Hungary		Ukraine	
Unemployment	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 NUTS-3	28	26	14	12	20	18	26	24

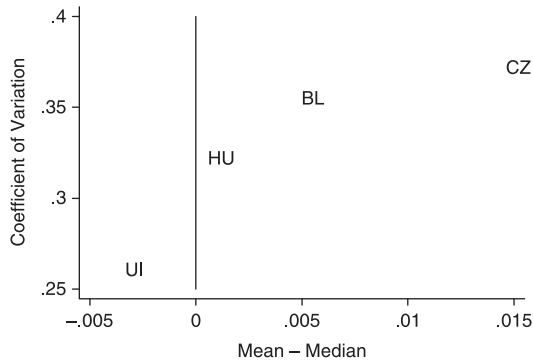
Notes: Each entry is the ratio of the regional standard deviation of unemployment (or wages) of the college educated to that of the elementary educated. The wage/unemployment data corresponds to regional fixed effects estimated in Tables 5 and 6.

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.

The evidence in Table 7 also 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 United Kingdom, Bulgaria and Ukraine, where the wage floors are likely to be lower. 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.

Furthermore, the interplay of centralized labour 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 Pench, Sestito and Frontini (1999), for example. Figure 4 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

Figure 4. Skewness vs. dispersion of regional unemployment rates



dispersion and (right-) skewness, but having four data points does not allow us to draw any strong conclusions.

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 on 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. The analysis is based on NUTS-3 regional units, using a combination of census and labour force survey data for four transition economies (Bulgaria, Czech Republic, Hungary and Ukraine). We find powerful evidence of the importance of differences in the concentration of human capital across regions in explaining the variance in regional unemployment rates and show that the dispersion of human capital across regions is largely explained by its distribution at the end of communism. We show that the migration patterns of workers by skill and the flow of foreign capital are both contributing to the divergence of regional unemployment and wage rates. That is, both more educated workers and FDI flow to regions with a higher concentration of college educated while the less educated are less likely to migrate.

We then ask about two potential mechanisms that could explain these labour and/or capital flows and the patterns of regional unemployment: (i) the presence

of complementarities and human capital spillovers, and (ii) differences in the response of skilled and unskilled individuals to regional demand shocks, which may be driven in part by centralized labour market institutions. We find little evidence for wage spillovers. On the other hand, we provide some evidence that is consistent with the idea that institutions in Central European countries contribute to the lower migration propensities of 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 SBTC and that more research is needed to explore the role of centralized labour market institutions for aggregate unemployment in transition. Ideally, such research would use comparable data on skill-specific cross-regional labour mobility and time-country variation in the generosity of welfare systems.

After more than 10 years of transition from central planning, it appears that post-communist labour markets resemble some of the EU-15 markets more closely than the US or other unregulated labour markets; regional differences in economic outcomes in transition economies are large and persistent and are not abated by labour migration. In part, European labour market institutions may be at fault.

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Table A1. Description of data sources for each variable

	Bulgaria	Czech Republic	Hungary	Ukraine
<i>Early Transition Regional Data</i>				
Share of college-educated in adult population	NA	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	1991	1990	1996
<i>Recent Regional Data</i>				
Share of college-educated in adult population	2001 census	2001 census	2001 census	2001 census
Unemployment rate	2003 regional statistics	2001 census	2002 Labour Force Survey	2003 regional statistics
FDI stock p.c., USD million	2003 Central Bank	2001 Central Bank	2001 Central Bank	2003 Central Bank
<i>Recent Individual-level Data</i>				
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)
Unemployment	2001 LSMS	2001 Labour Force Survey	2002 Labour Force Survey	2003 ULMS
Cross-region migration	2001 LSMS	NA	2002 Labour Force Survey	2003 ULMS
Time frame of migration question	Moved since 1989? 8 regions	NA	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.