Regional Labor Markets in Transition and Initial Human Capital

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Abstract

We explore the importance of inherited differences in human-capital endowment across NUTS-3 regions of four post-communist economies for regional unemployment, wages (productivity), FDI inflow, and worker territorial mobility. The evidence, based on both region-level comparisons and individual data analysis suggests that regional skill endowments explain the bulk of regional unemployment variation and affect migration of skilled workers as well as FDI inflow. Unemployment of the least skilled workers is lower in areas with a higher fraction of college labor, but there is little evidence of human capital wage spillovers.

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1. Introduction

The first stages of transition from central planning to market economy brought about a transition recession and massive reallocation of both labor and capital; it is therefore not surprising that unemployment quickly increased from its artificial zero level to double digits in most post-communist economies. What is more surprising to many economist is the lack of decline of unemployment during the later stages of the transition process that are often characterized by rapid growth pulled by foreign direct investment (FDI) and increasing economic integration (Blanchard, ???).

One of the key features of high unemployment in post-communist countries today, is its high regional dispersion, which is also surprisingly reluctant to melt. One can hope that understanding this feature of transition unemployment may help us understand its underpinnings. A growing strand of research has therefore investigated the lack of convergence in regional unemployment rates in post-communist countries. This work typically depicts weak equilibration mechanisms, such as labor mobility and blames this finding on institutional deficiencies, such as underdeveloped housing markets.¹

Another line of research recognizes the skill-biased nature of the transition process (at the national level) and asks about the explanatory power for unemployment levels of the global shifts in labor demand towards skilled labor and/or the low level of effective skill endowments among the less educated in transition countries.²

Yet, there is so far little research of the role of the uneven regional distribution of skills in post-communist economies in either literature. The starting point of this paper is to show that regional endowment of human capital differs dramatically within transition economies. Based on this premise, we aim to connect the two strands of work on transition unemployment outlined above. Specifically, we hope to improve our understanding of why regional unemployment rates in post-communist countries are disparate and not converging and relate regional skill endowments to the skill-biased nature of the transition process. This may be a first step towards asking whether regional unemployment variation contributes to aggregate unemployment.

Our approach is motivated by much recent research in both the U.S. and the E.U., which asks about the evolution and consequences of variation in regional human capital endowment. This work asks both simple questions about the explanatory power of regional skill endowments for regional unemployment and fundamental questions about the consequences of differences in human capital endowment for regional growth and productivity. The importance of human capital for regional economic development may be particularly strong in countries undergoing massive reallocation of resources on the background of rapidly increasing economic integration—the transition countries.

In this paper, we therefore use data from several transition economies to demonstrate the extensive variation in education endowment across regions of transition economies at the end of the central planning era. We provide an explanation for this variation based on the location of college education production, inherited from communism and then ask about the evolution of regional human-capital endowment during the first decade of transition. We argue that the end-of-communism location of college-degree production is likely to be exogenous to market-economy productivity and demand regional shocks. Next, we focus on the question of lack of convergence in regional unemployment rates and use our measures of regional skill endowment in four difference capacities.

First, we provide a simple skill-composition accounting for the current regional unemployment distribution. Quantifying the explanatory power of regional skill distribution for unemployment differences is an important check on the existing regional-divergence empirical literature. Given that current regional skill composition may be endogenous to locality-specific technology shocks, we also focus on the exogenous portion of the regional human-capital variation; specifically, we instrument for current education structure using the location of colleges under communism.

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Second, the regional unemployment inequality literature in post-communist economies notes that even though gross cross-regional migration flows are reasonably high, net flows are low and do not help in lowering regional unemployment differences (e.g., Fidrmuc, 2004). We note that to the extent that regional unemployment differences are driven by the presence of less educated workers, it is important to ask about the skill composition of migration flows. Indeed, recent theoretical work argues that migration may be skill-biased and related to human capital concentration at the regional level. If skilled workers are drawn into initially highly skilled (low unemployment) areas while unskilled workers leave highly educated regions, then the skill content of gross migration flows may be a force supporting high regional unemployment disparity; this hypothesis is consistent with the presence of low net migration flows. Our second step is therefore to ask about the skill composition of migration flows and relate them to area skill level and unemployment.

Third, we note that FDI is an important determinant of regional as well as national unemployment and ask about the importance of human-capital distribution for the adoption of advanced technologies, as manifested in FDI accumulation across regional labor markets. Skill-biased migration may increase the human capital of regions that have already received FDI inflow; therefore, our empirical question here is whether initial-transition end-of-communism regional human capital has predictive power for regional FDI stock as of the end of the first transition decade (after controlling for initial-transition industry regional distribution). While there is evidence on cross-country FDI determinants in transition (Bevan and Estrin, 2004) there is little work on the regional distribution of FDI to date.

Fourth, the potential presence of human capital spillovers (increasing returns, skill-capital complementarities) represents another important link between regional human

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4 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). More specifically, see, e.g., Giannetti (2003) or Devillanova (2004) for theory of skill-biased migration based on human-capital spillovers and skill-capital complementarity, respectively.

5 For theories of FDI adoption driven by human-capital endowment see Acemoglu (2003) or Acemoglu and Zilibotti (2001).
capital concentration and economic outcomes. We therefore ask whether there are fundamental regional consequences in terms of productivity (as reflected in wages and unemployment changes) of the initial-transition endowment of human capital. Specifically, we follow Moretti (2004) and ask whether regional wages of college-educated workers, adjusted for the national-level wage effect of their individual education, are higher in regions that have a higher share of college educated. The current college-education endowment level is instrumented with the location of college-education production as of the end of communism. This exercise is also performed for the lower-skill groups and using unemployment instead of wages. The empirical relationship between the regional share of college educated and the productivity of less skilled reflects both the consequences of imperfect substitution between different types of labor and the potential presence of spillovers.

Finally, we are interested in the potential importance of centralized labor market institutions such as high (effective) wage floors in the presence of uneven regional distribution of demand shocks. The interaction of skill-biased regional shocks with centralized labor market institutions could help explain the observed persistence in regional unemployment rates and could also generate a link between the regional unemployment dispersion and aggregate unemployment. 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. Such scenario is likely if centralized institutions prevent sufficient downward wage adjustment in the areas hit by a negative shock. To get a first-approach look at this problem, we compare the relevant features of the regional distribution of unemployment across our sample countries and describe the regional variation in education-specific wages and unemployment.

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7 See Jurajda (2005) for such an exercise based on Czech districts (NUTS-4 territorial units).
8 Wage floors could be the consequence of national unemployment and social benefits or minimum wages; alternatively, there may be centralized bargaining setting minimum national wage increases.
9 See, e.g., Pench et. al (1999) or Albaek et al. (1999). The reasoning outlined above holds if workers are not sufficiently mobile across regions, which is likely to be the case for transition economies given the recent evidence on migration flows in Fidrmuc (2004) and Bornhorst and Commander (2004).
Our empirical analysis is based on regional (NUTS-3 level) and worker data from the Czech Republic, Hungary, Bulgaria and Ukraine. Some of the information we use is only available in a subset of these countries, but we continue trying to acquire the missing information.

2. Background

2.1 Regional Unemployment

Regional disparities in unemployment are of high policy concern in the European Union. (See Canova, 2001, for a study of the EU’s regional policies). Overman and Puga (2002) investigate, among other effects, the importance of regional human-capital endowment for regional unemployment. They study NUTS-2 areas of the EU-15 economies and document increasing polarization of regional unemployment. They also 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 thus able to explain 84% of variation in regional unemployment.

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 (e.g., Bornhorst and Commander, 2004; Fidrmuc, 2004; or Huber, 2004).

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.”¹⁰ None of the existing studies pays attention to the regional variation in educational endowment, however.

2.2 Regional Human Capital Evolution and Externalities

Berry and Glaser (2005) are among the studies that document the diverging trend across U.S. cities in their human-capital endowment. Specifically, they show that in the last 3 decades, the share of adult populations with college degrees increased faster in cities with higher initial schooling levels. They interpret this tendency as being driven by shifts in labor demand. 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 studies employs instrumental variable strategies to lend a causal interpretation to the city- and state-level relationships between area human-capital concentration and area population or 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.¹¹

Human-capital production externalities could represent an important component of economic development (Lucas, 1988). Specifically, human capital may be a key determinant of advanced technology adoption in less-developed economies (Acemoglu and Zilibotti, 2001). This mechanism could be particularly important in post-communist economies, which underwent massive reallocation of production and increasing international integration.¹² Extensive trade openness and large inflows of foreign direct investment (FDI) are among the measures of success of the transition process, which has been to a large extent concentrated in a single decade.

¹⁰ There is now also a set of wage-curve studies, which typically find statistically significant, but economically weak wage adjustment to changing unemployment (see, e.g., Münich and Galuščák, 2003, for a study of the Czech Republic).
¹¹ Lange and Topel (in press) criticize the instrumental-variable approach for not accounting for endogeneity implied by spatial equilibrium. In particular, imperfect but highly elastic supply of skills to a locale, consistent with high geographical worker mobility in the U.S., 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.
¹² In the case of Hungary and the Czech Republic, this process culminated in the accession into the European Union (EU) in May 2004.
Skill upgrading of employment is one of the key features of transition reallocation. 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). It is clear that in the presence of spatial variation of initial human-capital concentration within the post-communist countries, skill upgrading will result in unemployment regional variation. We measure the extent of this feature of the transition process. On the one hand, high capital mobility would 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 FDI adoption could make the skill composition of the labor force very important for regional unemployment outcomes.

Such tendency would be particularly pronounced in the presence of significant spillovers from the presence of highly educated workers to productivity of less educated workers; under this hypothesis, unemployment could be lower and wages higher in areas starting the transition process with a high fraction of college-educated workforce even after accounting for the national-level effects of workers’ own education. Such effects are hard to disentangle, however, from the consequences of imperfect substitution of workers with different skill level within an area. A high fraction of college-educated workers implies that less educated workers are relatively scarce in a given area, raising the less-educated workers’ wages (lowering their unemployment) even in absence of any spillovers. Hence, the wage spillover analysis of Moretti (2004) focuses on the effect of exogenous differences in the presence of college education on wages of college-educated workers, after controlling for their own education effect.

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13 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. A related meta study, Fleisher, et al. (2005), studies the many national-level estimates of returns to education.

14 Acemoglu (2003, section 5.3) presents international trade analysis endogenizing skill-biased technological change to relative skill supplies. If more skilled regions adopt more skill-biased technologies beyond the standard Heckscher-Ohlin effect, they may exhibit greater skill premia.

15 Assuming imperfectly mobile capital (imperfectly elastic relative labor demand).
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 from census reports (typically from 1991 and 2001). Second, we use individual data from recent (2000-2003) labor force surveys, wage surveys, and (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 1991 and 2001, (ii) the extent of college-degree production as of the end of communism in each region (measured by the size of colleges in the area, per capita), (iii) FDI stock per capital as of 2001, and (iv) individual wages and unemployment status as of about 2001. Detailed data description is provided in the Data Appendix.

3.1. Regional Variation in Human Capital

In any country, one would expect a very high share of college-educated population in the capital city (and perhaps in the immediately surrounding area) thanks to the concentration of education production, cultural amenities valued by the highly educated, and public institutions staffed with highly educated labor force. However, there is extensive variation in the share of 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 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 share of college educated is found in our two Central European economies, as illustrated in the upper right graph of Figure 1, which shows kernel density estimates of the share of college educated in our four countries after dropping the capital city and the immediately surrounding area.

The next three graphs 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 NUTS-3 areas with less favorable initial inherited college education endowment.\textsuperscript{16}

Table 1 suggests that the overall extent of regional variation in the share of college educated, measured by the coefficient of variation, is similar across our four transition economies. Further, in all countries we find that the extent of college-degree production in a region in 1990, 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. 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.\textsuperscript{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 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

\textsuperscript{16} We do not have initial transition data available for Bulgaria. The autonomous republic of Crimea in Ukraine is an obvious outlier to the general pattern.

\textsuperscript{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 Králové, 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.
education production, it is therefore important to control for end-of-communism industrial structure as we did in Table 1.

3.2. Skill Accounting for Regional Unemployment

Here, we ask how well the location of skilled and unskilled workers explains the regional variation in unemployment rates. First, Figure 2 presents the object of interest: the recent NUTS-3-level regional distribution of ILO-type unemployment rates from four post-communist economies: two central European current EU members and two less developed transition countries. Clearly, Bulgaria is the country in our data suffering from some of the highest levels of regional unemployment. Almost one third of NUTS-3 regions in Bulgaria faced unemployment rates in the excess of 20 percent in 2003, while none of the regions of the other 3 countries gets close to the 20-percent mark.

Next, Table 2 asks about the explanatory power of the current regional human capital endowment for the current regional variation in unemployment. With the exception of Ukraine, we can explain almost two thirds of the within-country regional unemployment variation using the current shares of 4 education levels in the population. The explanatory power decreases after excluding the capital areas, but remains strong.

Finally, in the last panel of Table 2, we combined the unemployment regional data from our four countries to show that (without the use of country dummies), we can explain almost a third of the regional (within- and cross-country) variation in unemployment using our 4 education population shares (3 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.

We have also re-estimated the simplest specification controlling for only the share of college educated in each area using the 1990 college degree production indicator to instrument for the current share of college. 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.

In Hungary we also estimated an alternative specification controlling for a set of initial-condition indicators. Specifically, 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 gives an R2 of 62% (after excluding the capital city area). In the Czech Republic, where we have available initial-transition shares of 8 main education branches, initial-transition unemployment was negligible. Using the 8 employment shares together with the initial-transition share of college educated explains 77% of the 2001 regional unemployment variation outside of the capital city. Clearly, initial conditions defined by industrial production and college concentration are key to the current structure of unemployment in these two EU countries.

In sum, by documenting the spatial variation in skill concentration, we are able to assign typically over half of the regional variation in unemployment rates to the regional skill endowments. Initial conditions, defined as college concentration and industrial structure of employment then explain about two thirds of regional unemployment variation in the two EU economies we focus upon.

3.4 Skill Composition of Migration

The growing empirical literature on cross-region migration flows in transition is mostly using administrative permanent-residency data and works with total flows (gross or net) across areas. It finds migration to have a little positive effect on diminishing unemployment disparities across areas. However, migration could actually support regional disparities if workers of different employability (skills) move in opposite direction. Indeed, recent theoretical work argues that migration may be skill-biased and related to human capital concentration at the regional level (Giannetti, 2003, or Devillanova, 2004). It is also possible that only highly skilled workers move (to highly skilled areas) while unemployed low skilled workers do not move at all because their welfare receipts are the same everywhere, but their costs of
living are higher in low unemployment high-skill areas where their unemployment rates are lower, but still very high.

Hence, in this subsection, we ask about the skill composition of migration flows. To do so we need to separate cross-region movers from those movers who change residency within an area. We have available individual data from recent worker surveys (from 2001 to 2003) where respondents answer questions about their current residency area as well as about their residency region as of the previous year (Hungary) or as of any year since 1989 (Bulgaria) or 1986 (Ukraine).\textsuperscript{18} While these mobility definitions are not directly comparable, they allow us to shed some light on the structure of worker territorial flows by skill. Using each data we first ask whether more educated individuals are more likely to move; next, we investigate whether the more educated move more likely to the more educated areas while the less educated move more likely to the less educated areas. Such mobility pattern would be consistent with the regional human-capital divergence depicted in Figure 1.\textsuperscript{19}

First, we focus on the case of Bulgaria, where cross-regional mobility is available only at a higher aggregation level of 8 regions.\textsuperscript{20} We have available 210 individuals who have moved across the borders of these regions between 2001 and 1989 and contrast them with a random sample of non-movers. Specifically, we estimate a linear probability model predicting the probability of moving. Controlling for gender and age, college educated workers are 8 percent more likely to move compared to workers with elementary education and this difference is statistically significant while there is no such difference for workers with lower education levels. The parameters from this regression are reported in the first column of Table 3.

\textsuperscript{18} No such data exists in the Czech Republic. The Labor Force Survey covers a set of dwellings and does not identify when a new family moves to one of these dwellings.

\textsuperscript{19} The faster increase in college population fraction 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, (iii) during transition, workers who have attained education before the collapse of communism are moving in a skill-biased way that supports the regional college-share divergence.

\textsuperscript{20} 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.
In the next step, we include in this regression selected regional characteristics (at the NUTS-3 level) and re-estimate the mobility linear probability model separately for our 4 main education groups (elementary, lower and upper secondary, and tertiary education). Such a descriptive regression is asking whether workers who have moved across regional borders are more likely to reside now in NUTS-3 areas with different characteristics, compared to the majority of the population, i.e. compared to workers who have not moved.

In the second column of Table 3 we report the parameters estimated from such a set of education-specific regressions when we control for the extent of college production as of 1990. The results suggest that more educated movers are more likely to have moved to areas more educated as of the start of the transition process. The third column of the Bulgarian panel of Table 3 then reports estimates from specifications controlling for the current area unemployment rate. We see 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 educated movers.

The next panel of Table 3 repeats this analysis using a sample of Hungarian movers and stayers. Here, we study the recent migration patterns as we work with 754 workers who have moved between 2002 and 2001 across NUTS-3 borders.21 Again, we contrast the movers with a random sample of non-movers. Again, similar to the other countries, we also 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. 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.22

21 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.  
22 We find a 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.
Finally, the last panel of Table 3 reports the corresponding coefficient from Ukraine, where we work with 543 individuals who moved across NUTS-3 borders between 1986 and 2003. However, of these individuals, 274 have moved in from another country (the U.S.S.R.) so we work only with 271 within-Ukraine cross-NUTS-3 movers. In Ukraine, more educated workers are more likely to move and we also find some tendency for secondary educated workers to be more likely to move to areas more educated as of the start of transition. However, we detect no relationship between mobility and unemployment.

Alternatively, we have also re-estimated columns (2) and (3) of each country panel controlling for the 2001 share of college educated and for the unemployment rate of an area adjusted for the region’s education endowment, respectively. 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. Using education-adjusted unemployment rates as opposed to raw regional unemployment results in loss of statistical significance as well as size for all of the Bulgarian coefficients. The other two countries are little affected.

Overall, our evidence is consistent with more mobility among the highly educated who are typically more likely to move to more educated, low unemployment areas. On the other hand, we find no support for the notion that less educated workers move to less educated areas.

3.5 FDI and Initial Skill Endowment

Next, we ask whether the initial-transition distribution of college education endowment is a significant predictor of the regional variation in FDI stock as of the end of the first transition decade. One possibility is that FDI is driven by low labor costs, but Boeri and Brucker (2001) argue that much of the FDI flow into transition

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23 The basic mobility regression with pooled education groups is highly similar when we do include those moving into Ukraine from the other soviet republics.

24 The adjusted unemployment rate is the residual from a regression of regional unemployment on shares of 3 major education categories (see columns 2 of each country panel in Table 2).
economies is motivated by market access. We are particularly interested in whether advanced technology adoption (FDI) is related to initial human capital concentration because, given the limited mobility of less skilled workers, a skill-biased inflow of FDI may have repercussions for today’s regional unemployment distribution as well as the overall unemployment level.

In Table 4 we therefore display a series of simple descriptive regional regressions where we ask about the explanatory power of initial-transition college share in population for 2001/2003 FDI stock per capita. With the exception of Ukraine, we find that such relationship does not exist once the capital city is excluded from the analysis.\(^{25}\) However, 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 2 times the standard deviation of the FDI regional distribution. This is a large effect.

### 3.6 Human-Capital Spillovers and Imperfect Substitution

In this section we follow, e.g. Moretti (2004), and rely on the regional variation in the location of college-degree production under communism to ask whether wages of otherwise identical college-educated workers are higher in regions with a higher concentration of college education. Next, we repeat the same question for unemployment chances as opposed to wage level.

A fundamental problem with identifying the wage spillover effect is the potential presence of locality-specific unobservable characteristics affecting both wages and the share of highly educated workers. However, given the communist miss-allocation of resources, one can plausibly think of the 1990/1 extent of college-degree production as being historically predetermined and orthogonal to current district-specific productivity shocks. Of course, 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

\(^{25}\) We do not have available the early transition share of college population share in Bulgaria. There is also particularly little FDI variation outside of the capital city in the Czech Republic. This may be caused by the government’s strategy to generously support FDI into high unemployment / low education regions.
amenities, and is also more likely to be valid after we control for initial-transition industry shares in our analysis.

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. 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 this approach.

Hence, we regress today’s individual wages on worker demographics separately for main education groups and a set of region fixed effects. We then take the fixed effects for each education group and regress them on the current share of college educated instrumented with local college production as of the end of communism. A first set of such estimates, for the case of Bulgaria, is presented in the first column of Table 5. Comparing residual wages of different demographic groups across regions differing in the share of college educated suggests that wages of high-school graduates are higher in areas that feature a higher share of college educated workers. This is consistent with both 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,

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26 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, no scale effects, and constant elasticity of substitution.

27 The second stage regional-level regressions are weighted by the population size of each region. An alternative procedure would be to include both individual- and region-specific in the original individual-level regression and cluster standard errors at the regional level. See Wooldridge (2005) for references on the potential pitfalls of clustering when the number of clusters (regions) is small.
dropping the capital city area results in a loss of statistical significance and instrumenting makes the now insignificant parameters negative.

A starkly different set of findings is presented in the second and fourth panel of 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. This finding, which is reinforces by instrumenting, 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 1991.²⁸ What could explain these findings? One possible explanation is that college-educated workers living in areas where college education in sparse need to be compensated for the lack of amenities that derive from a higher concentration of college education.²⁹

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, but hinges on the inclusion of the capital city areas. 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 regress individual unemployment incidence on individual characteristics and regional fixed effects. In a second stage regression, we then relate these fixed effects (adjusted unemployment) on area college endowment, separately for major education groups. The results are presented in Table 6. With the exception of Ukraine, where the definition of

²⁸ When we estimate the effects of individual- and region-specific variables in one stage, in one individual-level regression clustering residuals at the regional level, we obtain highly similar regional coefficients, both qualitatively and quantitatively.
²⁹ Visualizing these findings in the case of the Czech Republic shows that the negative coefficient is 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.
unemployment may not be sufficiently useful, 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 education. The latter finding is consistent with complementarities in the production process between highly skilled and highly unskilled workers. We do not find any significant estimates for the association between college degree concentration and college-level unemployment.\textsuperscript{30} The all-country estimates are relatively not stronger than the country-specific ones.

3.7 Labor Market Institutions and Regional Adjustment

Finally, we return to another potential channel linking the regional distribution of skills to aggregate unemployment. Specifically, we look for indirect evidence suggesting that centralized labor market institutions such as high (effective) wage floors may be important for the transition process and the resulting unemployment levels. 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 get a first look at 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. Figure 3 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

\textsuperscript{30} Using the one-stage method we find statistically significant negative estimates in the Czech Republic and positive coefficients in Bulgaria.
association between regional unemployment dispersion and (right-) skewness, but having 4 data points does not allow us to draw any strong conclusions.

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 comparison is offered in Table 7, which is based on the wage and unemployment fixed effects estimates for Tables 5 and 6 for each region and education category separately. Table 7 then presents the ration between the regional standard deviation of unemployment or wages between the college educated and those with elementary education. 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 wage of unskilled workers. This is not true for Bulgaria and Ukraine. On the other hand, unemployment of highly educated varies much less across regions than unemployment of the least skilled workers, and this tendency is particularly pronounced in the more developed labor markets of Central Europe. This evidence corroborates the cross-country comparison of Figure 3 which also highlighted the right-skewed nature of Czech unemployment distribution.

4. Conclusions

We hypothesized that regional distribution of human-capital endowment plays an important role in explaining both regional and national unemployment and presented a series of first-step exploratory descriptive analyses. Our approach is similar to that of Köllö (2006) in that we also focus on unemployment by (low) education group as the main determinant of overall unemployment levels. While Köllö (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. We start by simple skill-accounting of regional unemployment and then ask about two potential mechanisms, which could link the initial-transition regional skill endowment to the subsequent skill-biased nature of
transition reallocation, namely the presence of human-capital spillovers and the presence of centralized labor market institutions limiting regional adjustments. All our findings are preliminary at this point.

**Data Appendix - to be detailed**

Ukraine – 26 oblasts
(1) early transition regional info: graduates from universities / pop. size in 90 + empl. shares of major industry categories in 1996)
(2) current regional unemployment rates and education endowment
(3) current micro data with wages and unemployment and migration: ULMS

Bulgaria – 28 oblasts
(1) early transition regional info: graduates from universities 90 + population size 92 + employment shares of 2 industry categories 92
(2) current regional unemployment rates and education endowment
(3) current micro data with wages and unemployment and limited migration info (across 8 regions): LSMS

Hungary – 20 megye
(1) early transition regional info: graduates from universities 90 + population size 90 + employment shares of 2 industry categories 90
(2) current regional unemployment rates and education endowment
(3) current micro data with wages and unemployment: HLFS

Czech Republic – 14 kraje
(1) early transition regional info: graduates from universities 91 + population size 91 + employment shares of 2 industry categories 91
(2) current regional unemployment rates and education endowment from census
(3) current micro data with wages (ISAE) and unemployment (LFS)
Bibliography


Regional variation in college endowment
Fig. 2: Kernel Densities of ILO NUTS3 Unemployment Rates

Fig. 3: Skewness vs. Dispersion of Regional Unemployment Rates
<table>
<thead>
<tr>
<th>Country</th>
<th>Number of NUTS3</th>
<th>Dispersion of % college</th>
<th>1990 college production</th>
<th>R2</th>
<th>Initial industry shares</th>
<th>Excluding capital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bulgaria</td>
<td>Czech Republic</td>
<td>Hungary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>14</td>
<td>20</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dispersion of % college</td>
<td>0.35</td>
<td>0.19</td>
<td>0.33</td>
<td>0.13</td>
<td>0.34</td>
<td>0.16</td>
</tr>
<tr>
<td>1990 college production</td>
<td>1.1</td>
<td>0.765</td>
<td>0.532</td>
<td></td>
<td>1.21</td>
<td>1.28</td>
</tr>
<tr>
<td>(0.34)</td>
<td>(0.26)</td>
<td>(0.17)</td>
<td>(0.09)</td>
<td></td>
<td>(0.50)</td>
<td>(0.48)</td>
</tr>
<tr>
<td>R2</td>
<td>65</td>
<td>77</td>
<td>47</td>
<td></td>
<td>54</td>
<td>56</td>
</tr>
<tr>
<td>Initial industry shares</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Excluding capital</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Dispersion is regional coefficient of variation. Robust standard errors in parentheses. College production in 1990 is measured as the number of graduates in 1990 divided by the relevant population age group size in each region and normalized to equal average across countries. The share of regional population with college education comes from 2001. Industry shares are employment shares of construction and manufacturing in 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.

### Table 2: Explaining current regional unemployment rate

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of NUTS3</th>
<th>Dispersion of un. rates</th>
<th>% lower secondary</th>
<th>% upper secondary</th>
<th>% college</th>
<th>R2</th>
<th>Excluding capital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bulgaria</td>
<td>Czech Republic</td>
<td>Hungary</td>
<td>Ukraine</td>
<td>All</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>14</td>
<td>20</td>
<td>26</td>
<td>88</td>
<td></td>
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<tr>
<td>Dispersion of un. rates</td>
<td>0.35</td>
<td>0.31</td>
<td>0.37</td>
<td>0.35</td>
<td>0.32</td>
<td>0.26</td>
<td>0.24</td>
</tr>
<tr>
<td>% lower secondary</td>
<td>1.88</td>
<td>1.88</td>
<td>-0.66</td>
<td>-0.52</td>
<td>-0.85</td>
<td>-0.86</td>
<td>0.26</td>
</tr>
<tr>
<td>% upper secondary</td>
<td>-0.19</td>
<td>-0.066</td>
<td>-2.73</td>
<td>-3.32</td>
<td>-0.47</td>
<td>-0.423</td>
<td>-0.13</td>
</tr>
<tr>
<td>% college</td>
<td>-0.85</td>
<td>0.89</td>
<td>0.53</td>
<td>-0.32</td>
<td>1.01</td>
<td>0.73</td>
<td>-0.32</td>
</tr>
<tr>
<td>R2</td>
<td>37</td>
<td>59</td>
<td>51</td>
<td>14</td>
<td>71</td>
<td>64</td>
<td>23</td>
</tr>
<tr>
<td>Excluding capital</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Bolded coefficients statistically significant at the 5% level. Education endowment comes from 2001 census.
Table 3: Explaining individual cross-regional mobility

<table>
<thead>
<tr>
<th>Country</th>
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<th>Ukraine</th>
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<tr>
<td>Number of regions</td>
<td>28</td>
<td>18</td>
<td>26</td>
</tr>
<tr>
<td>Number of movers</td>
<td>210</td>
<td>754</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>elementary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--</td>
<td>0.13</td>
<td>0.02</td>
<td>--</td>
</tr>
<tr>
<td>(0.09)</td>
<td>(0.07)</td>
<td></td>
<td>(0.25)</td>
</tr>
<tr>
<td>lower secondary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.006</td>
<td>0.51</td>
<td>-0.25</td>
<td>0.005</td>
</tr>
<tr>
<td>(0.010)</td>
<td>(0.09)</td>
<td>(0.11)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>secondary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.036</td>
<td>0.89</td>
<td>-0.69</td>
<td>0.017</td>
</tr>
<tr>
<td>(0.027)</td>
<td>(0.30)</td>
<td>(0.19)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>college</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.081</td>
<td>0.66</td>
<td>-0.62</td>
<td>0.034</td>
</tr>
<tr>
<td>(0.024)</td>
<td>(0.26)</td>
<td>(0.17)</td>
<td>(0.006)</td>
</tr>
</tbody>
</table>

Notes: The first column of each country panel of the table displays linear probability regression parameters from cross-regional mobility binary equations controlling for gender and age. In the second and third column, the same regression is estimated separately for each education level; either the current regional unemployment rate or the 1990 regional level of college production is controlled for. Standard errors are clustered 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

<table>
<thead>
<tr>
<th>Country</th>
<th>Czech Republic</th>
<th>Hungary</th>
<th>Ukraine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of NUTS3</td>
<td>14</td>
<td>20</td>
<td>26</td>
</tr>
<tr>
<td>Dispersion of FDI p.c.</td>
<td>2.72</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>1990 college share</td>
<td>0.0934</td>
<td>0.0637</td>
<td>0.001</td>
</tr>
<tr>
<td>(0.008)</td>
<td>(0.018)</td>
<td>(0.002)</td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>0.92</td>
<td>0.94</td>
<td>0.05</td>
</tr>
<tr>
<td>Initial industry shares</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Excluding capital</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Dispersion is regional coefficient of variation. Robust standard errors in parentheses. Industry shares are employment shares of construction and manufacturing in 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 are statistically significant at the 1% level.
### Table 5: Explaining Wages by Education Using Regional Share of College Education

| Country | Number of NUTS3 | Bulgaria 26 | 14 | 12 | Czech Republic | Hungary 18 | 20 | 14 | 12 | Ukraine 24 | 26 | 18 | All 88 | All 80 |
|---------|----------------|-------------|----|----|----------------|-------------|----|----|----|----|-------------|----|----|-------|------|
| for college educated | 28 | 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 | | -1.95 | -2.25 | -2.45 | -0.8 | -0.48 | -0.44 | -0.23 | -0.23 | -0.15 | -0.02 | 0.01 | -0.04 | -0.33 | -0.62 | -0.48 |
| | | (0.58) | (0.74) | (1.63) | (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 | | -3.17 | -0.98 | 1.21 | -1.08 | 0.21 | 1.14 | -0.28 | -0.85 | -1.22 | -0.01 | -0.3 | -0.03 | -0.27 | 0.08 | 0.43 |
| | | (1.72) | (2.14) | (3.11) | (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 | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Notes: Each estimate is based on a separate regional regression weighted by the population size and controlling for initial-transition industry shares on employment. The left-hand-side variable is the estimated regional fixed effect from a log-wage regression based on the non-public sector of the economy controlling for workers' age and gender and estimated separately for each education group. The right-hand-side variable is the share of college educated population in 2001. 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.

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

| Country | Number of NUTS3 | Bulgaria 26 | 14 | 12 | Czech Republic | Hungary 18 | 20 | 14 | 12 | Ukraine 24 | 26 | 18 | All 88 | All 80 |
|---------|----------------|-------------|----|----|----------------|-------------|----|----|----|----|-------------|----|----|-------|------|
| for college educated | 28 | 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 | | 2.36 | 2.4 | 0.68 | -0.64 | -2.33 | -0.81 | 2.02 | 1.25 | 0.97 | 0.23 | 0.56 | 0.63 | 1.51 | 0.88 | -0.47 |
| | | (0.51) | (0.74) | (2.05) | (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 | | 0.29 | -1.24 | 0.18 | 1.07 | 1.23 | -2.66 | -0.51 | -0.95 | -2.37 | 0.78 | 0.45 | -2.37 | 0.88 | (2.37) | 0.45 |
| | | (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 | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | IV Yes | Yes | Yes | Yes |

Notes: Each estimate is based on a separate regional regression weighted by the population size and controlling for regional initial-transition industry shares on employment. The left-hand-side variable is the estimated regional fixed effect from 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. The right-hand-side variable is the share of college educated population in 2001. 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.
## Table 7: Comparing Variation in Regional Outcomes between College and Elementary Educated

<table>
<thead>
<tr>
<th>Country</th>
<th>Bulgaria</th>
<th>Czech Republic</th>
<th>Hungary</th>
<th>Ukraine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of NUTS3</td>
<td>28  26</td>
<td>14  12</td>
<td>20  18</td>
<td>26  24</td>
</tr>
<tr>
<td>unemployment</td>
<td>0.45 0.45</td>
<td>0.20 0.20</td>
<td>0.33 0.33</td>
<td>0.50 1.00</td>
</tr>
<tr>
<td>wages</td>
<td>0.70 0.73</td>
<td>1.57 1.00</td>
<td>2.00 1.75</td>
<td>0.84 0.92</td>
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<tr>
<td>Excluding capital</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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