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Thomas K. Bauer and Matthias Vorell[1]

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Abstract

Using a matched employer-employee panel dataset for Germany, we analyze the external effects of education on individual wages. Following the basic framework of Moretti (2004), we allow spillover effects to occur both within a specific firm and a specific region rather than analyzing spillover effects only on a regional level. Controlling for individual- and firm-specific fixed effects and using an instrumental variable strategy, our results confirm the existence of positive but small external effects of human capital. Positive spillover effects within firms occur only for the group of high-skilled workers.

JEL Classification: C23, D62, J31

Keywords: External effects; human capital; employer-employee matched data

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1 Thomas K. Bauer, RWI, Ruhr-Universität Bochum, and IZA Bonn; Matthias Vorell, RWI. *– The authors would like to thank Stefan Bender, Steven Stillman and participants at the IAB NuKo 2006, the Annual Meeting of the Canadian Economic Association 2007, European Society of Population Economists Conference 2007 and European Association of Labor Economists Conference 2008-* *– All correspondence to Matthias Vorell, RWI, Hohenzollernstr. 1–3, 45128 Essen, Germany, e-mail: matthias.vorell@rwi-essen.de.*

1 Introduction

The Lisbon Agenda of the European Council aims at making the European Union the world's most dynamic and competitive economy by transforming the EU into a large knowledge-based economy. To achieve this goal, the member states agreed to modernize their education systems in order to cope with the necessities of a knowledge-based society. Concerning education, the Lisbon Agenda explicitly asks their member states to increase their investments in human capital substantially. The main idea behind this strategy is that human capital investments have positive externalities that foster economic growth. In Germany, for example, public spending for the educational system in 2004 reached almost 86 Million Euro or about 4% of GDP (RWI Essen and Stifterverband für die deutsche Wissenschaft, 2006).

While there exist a vast literature on the private returns of human capital (Card, 1999, 2001), the empirical evidence on the external effects of human capital is rather limited. Closely following the identification strategy of (Moretti, 2004a,c), we estimate augmented Mincer-type wage equations (Mincer, 1974) using a matched employer-employee data set for Germany. Different to the existing literature, however, we analyze both, external effects occurring at the firm- and the regional level, providing insights on whether positive external effects at the regional level are only the sum of firm-level spillover-effects, or whether regional spillover-effects exist over and above firm-level effects. In addition – to the best of our knowledge – this paper is the first to analyze the existence of human capital externalities using individual data for Germany.

Taking time-invariant unobserved heterogeneity into account by controlling for individual and firm fixed effects and instrumenting the regional share of high-skilled workers by historical regional shares of workers with an university degree, we could confirm the existence of positive external effects of human capital for high-skilled workers. Even though we also find a positive effect of the share of high-skilled in a region on the wages of low-skilled, this evidence is not a clear indication of positive externalities of human capital, since we are not able to separately identify positive spillover effects of human capital and wage effects of a change in labor supply for this group of workers. Significant positive intra-firm spillover effects of human capital appear only for the group of high-skilled workers.

The paper proceeds as follows. The next section describes the literature on external effects of education. Section 3 describes the econometric model and the data used for estimation. Section 4 presents the estimation results and Section 5 concludes.

2 External Effects of Education: Theory and Existing Evidence

Positive externalities have always been the major justification for governments to subsidize the educational system. This justification is mainly based on theoretical models, who suggest several different sources of human capital externalities. Recent contributions to growth theory, for example, emphasize human capital accumulation as a major determinant of economic growth, wherein the mechanism through which this effect occurs is modeled in different ways. The majority of models emphasize the interaction of workers with different skill levels, i.e. they assume that higher skilled individuals increase the productivity of others with whom they work together. Thus, human capital accumulation increases total factor productivity and hence results in economic growth towards a higher equilibrium output (Lucas, 1988). Endogenous growth theory claims that a higher level of education in an economy increases its innovative power and knowledge diffusion. The new technologies, products and production processes resulting from this innovative power and a better diffusion of knowledge in turn foster economic growth (Romer, 1990; Temple, 2001; Shapiro, 2006).

Another strand of the literature points towards possible non-monetary benefits of human capital, i.e. positive external effects that are not directly linked to higher productivity. This type of external benefits may, for example, arise from a negative relationship between education and criminal behavior, which is usually confirmed by empirical studies on the determinants of crime (Lochner and Moretti, 2004). Higher education may further increase the stability of a democracy and the efficiency of economic policy, because higher skilled individuals are more competent to participate in the political process (Friedman, 1962; Milligan, Moretti, and Oreopoulos, 2003). Finally, education may have direct consumption externalities, raising welfare without having any impact on productivity (Lange and Topel, 2006).

Signalling or screening models of education, however, claim that education may also be associated with negative externalities (Arrow, 1973; Spence, 1973). In its extreme version, the screening model suggests that education does not enhance the productivity of an individual at all. Rather it is solely used as a signal of the latent productivity of an individual for which employers are willing to pay. In this type of models, education only generates private returns. Since schooling does not increase the productivity of individuals, it reduces social welfare because of the resources used to obtain the signal, i.e. a schooling degree. Hence, to the extent that schooling is used as a signal rather than increasing productivity, education may be even associated with negative externalities.

The empirical evidence on the existence and size of external effects of education is rather scarce, especially when compared to the extensive literature on the private returns to education (Card, 1999, 2001, provides an overview of this literature). Existing evidence is further predominantly based on US data. Following Moretti (2004b), three major empirical strategies to evaluate the external effects of human capital can be differentiated: (i) studies of the effects of aggregate human capital in a city or a region on individual wages or land prices; (ii) studies that evaluate the effects of aggregated human capital indicators on productivity either using firm or regional data; and (iii) studies that evaluate the effect of education on other social outcomes such as crime rates or voting behavior.

Rauch (1993) uses cross-sectional regional data for the U.S. in 1980. He finds small, but significantly positive effects on wages, which can be seen as an upper boundary, as he does not take the endogeneity of location choices into account. Acemoglu and Angrist (2000) find significant positive effects of state level shares of college graduates on individual wages in the U.S. for the period from 1960 to 1980. This effect becomes insignificant once they implement an IV estimation strategy with changes in compulsory schooling laws as an instrument for the regional share of high-skilled. Adding data from 1990, however, the effect becomes significant even in the IV framework, indicating a rising importance of human capital.

Moretti (2004b,a) develops a theoretical model to capture external effects of education in land prices and wages. Employing individual data for the US and instrumenting the regional share of high-skilled by the existence of land-grant colleges in a region. to take the endogenous location choice into account, he finds a wage premium of 0.4% for college-educated workers, if the share of high-educated workers is increased by one-percentage point. For low-skilled workers, the point estimate is sizeably higher (1.6-1.9%), but imperfect substitution between the skill-groups[1] prevents the precise estimation of the magnitude of the spillover effect (Moretti, 2004b). In some specifications a regional spillover effect of up to 9% in certain regions is found (Moretti, 2004a). Using plant-level productivity data, he finds a spillover effect on productivity in the range of 0.5-0.7% for a one-percentage point increase in the college share by comparing firms in high- and low-skilled cities (Moretti, 2004c).

Ciccone and Peri (2006) also use aggregated data on the regional level, as they criticize the individual approach as being not feasible to identify externalities due to the non-inclusion of downward sloping aggregate demand for human capital. Using a decomposition approach to control for changes in the skill structure of the workforce, they cannot confirm the existence of positive externalities for US cities between 1970 and 1990.

Outside the US, there exists evidence on human capital externalities for Sweden, Italy, Spain, China, and Russia. Isacsson (2005) supports the existence of

[1] Katz and Murphy (1992) provide evidence for imperfect substition in the US labor market.

significant positive external effects of education when applying cross-sectional models to Swedish matched employer-employee establishment data. These effects disappear when he controls for regional and individual fixed effects. Several studies confirm significant positive human capital externalities in Italy, both using individual-level data (Dalmazzo and de Blasio, 2007a,b) and firm-level data (Bratti and Leombruni, 2009). The same holds for Spain, where Ciccone, Garcia-Fontes, and Hidalgo (2008) also find positive educational spillover effects using different identification strategies. Liu (2008) finds wage increases in the magnitude of 6.3% for a one-percentage point increase in the regional college share in China using an IV estimation strategy with historic values of education levels as instruments. The results, however, are only significant at a 10-15% significance level. Based on individual data, Muravyev (2008) confirms positive regional spillover effects for Russia, using the transition process and the following movement of qualified individuals into cities as a natural experiment. He finds spillover effects on wages in cities in the magnitude of 1-2%.

In summary, the existing evidence for human capital externalities predominantly relies on estimates of the effects of aggregate human capital in regions on individual wages and on US data. The results indicates that these externalities are indeed positive and in most cases statistically significant, suggesting that potential negative externalities due to signalling are at least not dominating. The existing evidence, however, provides no clear indication on the size of these positive externalities.

3 Econometric Model and Data

To evaluate the external effects of education, we closely follow Moretti (2004b) by estimating augmented Mincer-type wage regressions of the following form:

$$\ln w_{ijt} = X_{ijt}\beta + Z_{jt}\delta + \gamma_0 A_{rt} + \gamma_1 A_{jt} + \xi T_t + \varepsilon_{ijt}, \quad (1)$$

where X_{ijt} is a vector of observable socioeconomic characteristics of person i in firm j at time t, Z_{jt} a vector of firm-specific characteristics at time t, and T_t a vector of year dummies to control for year specific effects. The residual ε_{ijt} is assumed to have the usual properties. The two main variables of interest are A_{rt} and A_{jt}. The former is an indicator of aggregated human capital in a region, calculated as the share of high-skilled individuals working in region r at time t. Correspondingly, A_{jt} is an indicator of the aggregated human capital in a firm, calculated as the share of high-skilled workers employed in firm j at time t. The estimated coefficients of these two variables, γ_0 and γ_1, provide evidence of the existence of regional and firm-level spillover effects of education, respectively.

Estimating equation (1) by OLS may lead to biased estimates of γ_0 and γ_1 because of unobserved variables that are correlated with individual wages and the share of high-skilled individuals in a region or firm. Regions and firms, for example, that demand a high-skilled workforce may also offer higher returns to unobserved abilities, leading to upward biased estimates of γ_0 and γ_1. The panel structure of our data, however, allows us to control for time-invariant unobserved individual and firm effects that may be correlated with A_{rt} and A_{jt}. Therefore, we subsequently added individual (α_i) and firm fixed effects (α_j) to equation (1). As it is not necessary for us to estimate the magnitude of the individual- and firm-specific effects itself to identify spillover effects, we follow Abowd, Kramarz, and Margolis (1999) when controlling for both individual and firm fixed effects by using spell-fixed effects to transform the regression function into:

$$\ln w_{ijt} = X_{ijt}\beta + Z_{jt}\delta + \gamma_0 A_{rt} + \gamma_1 A_{jt} + \xi T_t + \alpha_i \cdot \alpha_j + \varepsilon_{ijt}. \tag{2}$$

In our estimations we further use robust standard errors, clustered at the firm level, controlling for heteroskedasticity and possible serial correlation within firms.

The above regression models are estimated separately for three groups of workers: low-skilled, medium-skilled and high-skilled workers. If high- and low-skilled workers are imperfect substitutes, two different mechanisms are at work if the proportion of both types of workers is changing (Moretti, 2004b). The relative supply of low-skilled workers is declining if more high-educated workers enter the workforce. In this case, regional and firm-specific educational spillover effects, i.e. the signs of γ_0 and γ_1, are expected to be positive for low-skilled workers, (i) because of their increasing relative scarcity and (ii) because of productivity and learning effects (the actual spillover effect itself). Hence, for low-skilled workers a $\gamma_0 > 0$ and a $\gamma_1 > 0$ is not necessarily evidence for positive human capital externalities, since they may simply reflect a higher relative scarcity of low-skilled workers in the respective labor market. A different situation arises, if both kinds of workers are perfect substitutes. In that case, the sign of the coefficient is not clear a priori.[2]

For high-skilled workers, however, a $\gamma_0 > 0$ and a $\gamma_1 > 0$ could be interpreted as evidence for positive human capital externalities, since they are influenced by two contradictory effects. On the one hand, they will have the same or even higher learning effects compared to low-skilled workers. On the other hand, the relative shift in the workforce is directed against them, as the supply of more educated workers is likely to lower the wages offered to them following standard supply and demand analysis. Hence, positive estimates of the two coefficients of interest indicate that the spillover effects of human capital for high-skilled workers are big enough to compensate for potential negative wage effects due to an increased supply of high-skilled workers.

Overall, one can expect that the coefficients γ_0 and γ_1 for low-skilled workers exceed the respective coefficients for high-skilled workers, because in the situation of imperfect substitution the former benefit both from an increased share of high-skilled workers and additionally from potential human capital externalities, while the spillover effects of human capital for high-skilled workers must be big enough to compensate for potential negative wage effects due to an increased supply of high-skilled workers.

Further problems arise, because the human capital share in a region A_{rt} is likely to be endogenous, as workers may move between regions to live in areas with a higher or lower share of educated people and corresponding amenities (Moretti,

[2] Bauer, Kluve, Schaffner, and Schmidt (2009) provide recent evidence for Germany that workers of different skill-levels are imperfect substitutes.

2004b). To deal with this endogeneity problem, we instrument the respective covariates using the regional share of workers with an university degree 20 years before (1975-1981) our observation period, as 1975 is the first year where such process-generated data from the federal employment agency becomes available to us. This instrument should be orthogonal to current individual wages while still giving us exogenous variation in the share of high-skilled individuals in a region.

To perform our estimations, we use the LIAB, a linked employer-employee dataset that is provided by the Institut für Arbeitsmarkt- und Berufsforschung (IAB) in Nuremberg and maintained and accessible through the associated research data center (FDZ). The LIAB is created by matching official, process-generated data from the social security system (i.e. the German Federal Employment Services) to data from the IAB Establishment Panel.[3] We use the LIAB Version 2 to be able to follow persons over time and track firm changers, which is crucial to our identification strategy. From the LIAB, we create an unbalanced panel for the years 1996 to 2001 including firms and workers in West-Germany. The sample of workers is restricted to full-time employed persons in regular employment. Apprentices and part-time workers are excluded from the analysis.

One major drawback of using the LIAB is the quality of the information on the highest education level achieved by an individual. This information may be poorly measured as it is filled by the employer and not linked to any payments to or benefits from the social security system. Furthermore, the number of obviously wrongly measured, inconsistent and missing observations increases over time (Fitzenberger, Osikominu, and Völter, 2006). To solve this problem, the distinction between qualification groups in our analysis is accomplished using a classification scheme proposed by Blossfeld (1985). This scheme is based on the three-digit occupational definition of an individual as it was specified by the employer in their notification to the social security agencies. We differentiate three qualification groups: (i) low-skilled workers (*low*), (ii) medium-skilled workers (*medium*) and (iii) high-skilled workers (*high*). Following Blossfeld (1985), all

[3]For further information about the LIAB see Alda, Bender, and Gartner (2005).

blue-collar workers who work in a position that is characterized by simple manual tasks and white-collar workers performing simple services are considered to belong to the low-skilled group. Blue-collar workers performing complicated tasks and white-collar workers associated with qualified tasks, as well as semi-professionals are considered to be medium-skilled workers. The group of high-skilled workers consists of engineers, technicians, professionals and managers. The resulting classification is highly correlated with the completed occupational education of individual.[4] Based on this grouping, we observe 91,965 low-skilled workers, resulting in 349,666 person-year observations, 130,188 individuals with medium qualification (521,288 person-year observations) and 89,129 high-skilled workers (360,021 person-year observations), working in 2,042 firms which are spread over 66 regions, with the latter being defined as the districts of the responsible local unemployment office ("Arbeitsamtsbezirke").

Throughout, we control for firm size, the state of the production technology used by the firm by defining a dummy-variable that takes the value one for firms that use technology that is above the mean state of technology in the industry, a dummy variable measuring whether organizational changes occurred in a firm in the previous year, the mean-age of the workforce in a firm, and a dummy variable, indicating whether the firm is covered by centralized wage bargaining. When estimating equation (1) by pooled OLS, we also control for time-invariant individual characteristics, i.e. gender, age, and age-squared. The share of highly-skilled workers in the firm and the region, i.e. A_{jt} and A_{rt}, are calculated for each person separately, without its own contribution to the mean. Table 1 provides summary statistics of the variables used in the empirical analysis.

4 Estimation Results

Results from estimating equation (1) by pooled OLS are reported in Table 2. When including only the share of high-skilled workers in the region in the speci-

[4] For further information about this classification scheme see Bauer and Bender (2004).

fication (column 1), the point estimates of γ_0 appear to be positive for all three skill groups. As expected, $\hat{\gamma}_0$ is highest for the low-skilled group and lowest for high-skilled workers. However, only the estimated coefficient for the high-skilled workers appears to be statistical significant on conventional levels. Controlling only for the share of high-skilled workers in the firm (column 2), we obtain positive and significant coefficients for this variable for the low- and high-skilled, with the latter being statistically significant at the 10%-level, whereas the respective coefficient for medium-skilled workers is negative, albeit insignificant. The results do not change significantly when considering both aggregated human capital measures jointly (column 3).

These results provide evidence for the existence of positive human capital externalities for high-skilled workers. For this group of workers the spillover effects of human capital appears to be big enough to compensate for potential wage losses due to a higher supply of workers in the same skill group. Furthermore, the results indicate that human capital externalities exist on the regional level over and above positive educational spillovers on the firm-level.

The estimates obtained by pooled OLS may be biased by unobserved time-invariant individual and firm fixed effects that are correlated with the share of high-skilled in the region and the firm. Therefore, columns (1) to (3) of Table 3 reports estimation results when controlling for individual fixed effects, and columns (4) to (6) when controlling for both, individual and firm fixed effects. The estimation results indicate that pooled OLS delivers upward-biased effects of the regional share of high-skilled workers on individual wages, while the estimated effects of the share of high-skilled workers in a firm appears not to be biased by unobserved time-invariant effects. Furthermore, the biased estimates of pooled OLS seem to be driven by time-invariant individual fixed effects, since the estimation results do not change significantly when controlling for both individual and firm fixed effects if compared to those we obtain, when controlling only for individual fixed effects.

When controlling for unobserved individual and firm fixed effect, the estimated effect of the regional share of high-skilled workers on wages becomes statistically significant for the low-skilled, while the significant positive effect obtained in pooled OLS for high-skilled workers becomes insignificant. Evaluated at the respective means of the share of high-skilled in a region (see Table 1), the estimated coefficients imply that the wage of low-skilled rise by about 0.6% when the share of high-skilled in a region increases by one percentage point. As noted, this effect subsumes both, educational spillovers and the effects of a imperfect substitution between high- and low-skilled workers, and, hence, does not provide clear evidence on the existence of positive human capital externalities. However, the results still provide evidence on the existence of positive spillover effects for high-skilled within firms. The estimated coefficient for γ_1 reported in column (6) of Table (3) indicates that an increase of the share of high-skilled in a firm of one percentage point increases the wages of high-skilled in this firm by 2.8%.

As discussed in the last section, the estimates reported in Table (3) might still be biased due to the endogenous location choice of individuals. To address this problem, we instrumented the regional share of high-skilled workers with the historical regional share of workers with an university degree. Table 4 reports the results of the IV estimates[5], with columns (1) and (2) referring to the results of a pooled OLS-IV model, and the remaining columns to the results of a fixed effects-IV model, where we included only individual fixed effects in columns (3) and (4), and individual and firm fixed effects in columns (5) and (6). Compared to the results of the simple pooled OLS model shown in Table (2), the estimated effect of the share of high-skilled in a region on high-skilled is halved but still statistically significant at the 10%-level. The fixed-effects IV estimates, however, are similar to those reported in Table (3), despite that the coefficient on the regional share of high-skilled becomes statistically significant at the 10%-level for high-skilled

[5]All IV regressions were performed using the ivreg2-command from Baum, Schaffer, and Stillman (2010). Note that the standard errors of the IV estimates are slightly lower if compared to the OLS estimates. This unexpected result can entirely be traced back to the clustering of the standard errors at the firm level. When we do not adjust the standard errors for potential serial correlation at the firm level the IV standard errors are bigger than the respective OLS standard errors.

workers. Evaluated at the respective means of the regional share of high-skilled workers, the estimated coefficient implies, that an increase of the share of high-skilled in a region by one percentage point increase the wage of high-skilled workers by 0.2% and those of low-skilled workers by 0.6%. Note that these effects are at the lower end of those found by Moretti (2004b,a) for the US.

5 Conclusion

This paper investigates the existence of external effects of human capital using an employer-employee matched panel data set for Germany. Different to the existent literature on this issue, we are able to analyze both the effects of the regional share of high-skilled workers and the share of high-skilled workers in a firm on individual wages, allowing us to study whether regional spillover effects of human capital exist over and above firm-specific spillover effects.

We estimate Mincer-type wage equations, controlling for individual and firm level unobserved heterogeneity by using fixed effects as well as instrumenting the share of qualified workers in a region using historical share of workers with an university-degree. The results suggest that high-skilled workers experience positive regional and intra-firm spillover effects of education. We also find a positive effect of the regional share of high-skilled workers on the wages of low-skilled. This latter effect, however, is no clear indication of positive external effects of human capital, because an increase in the share of high-skilled reduces the relative supply of low-skilled, which in turn may have positive effects on their wages. The estimated spillover effects are, however, very small, indicating that an increase of the share of high-skilled in a region by one percentage point increase the wage of high-skilled workers by 0.2% and those of low-skilled workers by 0.6%. The estimates further indicate, that statistically significant intra-firm spillover effecs effects exist only for high-skilled workers. For them, a one percentage point increase of the share of high-skilled in the firm increases the wages by about 3%.

Even though our results confirm the existence of external effects of human capital, the size of this effect appears to be rather negligible, casting some doubts on the reasoning, that higher education should be subsidized because of the existence of positive external effects. Furthermore, the distribution of the positive spillover effects among the workforce appears not to be uniform. On top of receiving private returns to education, mostly high-skilled workers benefit from working together with high-skilled co-workers.

Table 1: Summary Statistics

	Low		Medium		High	
	Mean	Std. Dev.				
Daily Wage (EUR)	57.72	19.74	68.58	23.19	83.28	25.51
Age	38.16	11.08	38.28	11.09	39.69	11.01
Gender	0.685	0.464	0.445	0.497	0.412	0.492
Mean Age of Workforce	38.29	4.42	38.31	4.84	38.34	4.17
Firm Size	3243.41	4123.33	4212.91	4657.83	4174.75	4492.32
Technical Change	0.498	0.500	0.452	0.498	0.432	0.495
Organizational Change	0.276	0.447	0.301	0.459	0.304	0.460
General Wage Contract	0.843	0.367	0.884	0.320	0.895	0.306
Regional Share of HQ	0.047	0.017	0.048	0.020	0.051	0.022
Firm Share of HQ	0.035	0.037	0.040	0.040	0.093	0.054
Regional Share of HQ (overall)	0.0542	0.0520				
Firm Share of HQ (overall)	0.0483	0.0209				

Table 2: Estimation Results for OLS and Fixed Effects

		(1)	(2)	(3)
Low	Region	0.724	-	0.705
		(0.532)		(0.531)
	Firm	-	0.122	0.084
			(0.256)	(0.255)
	N	349,666	349,666	349,666
	R^2	0.50	0.50	0.50
Medium	Region	0.286	-	0.352
		(0.404)		(0.410)
	Firm	-	-0.213	-0.235
			(0.248)	(0.250)
	N	521,288	521,288	521,288
	R^2	0.59	0.59	0.59
High	Region	0.373^{**}	-	0.310^{*}
		(0.175)		(0.160)
	Firm	-	0.205^{*}	0.186^{*}
			(0.105)	(0.103)
	N	360,021	360,021	360,021
	R^2	0.42	0.42	0.42

Note: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$
Standard errors are robust and clustered on firm level.
All models include time dummies and controls for technological state, organizational change and the coverage by centrally bargained wages on the firm level, as well as age, age-squared, gender and firm size on the individual level.

Table 3: Estimation Results for OLS and Fixed Effects

		(1)	(2)	(3)	(4)	(5)	(6)
Low	Region	0.133***	-	0.129***	0.130***	-	0.127***
		(0.044)		(0.044)	(0.044)		(0.044)
	Firm	-	0.142	0.136	-	0.146	0.140
			(0.110)	(0.110)		(0.110)	(0.110)
	R^2	0.14	0.14	0.14	0.14	0.14	0.14
Medium	Region	0.067	-	0.066	0.066	-	0.066
		(0.050)		(0.050)	(0.050)		(0.050)
	Firm	-	0.050	0.048	-	0.041	0.038
			(0.057)	(0.057)		(0.057)	(0.057)
	R^2	0.19	0.19	0.19	0.19	0.19	0.19
High	Region	0.031	-	0.023	0.031	-	0.023
		(0.023)		(0.023)	(0.023)		(0.023)
	Firm	-	0.325***	0.324***	-	0.307***	0.306***
			(0.061)	(0.061)		(0.059)	(0.059)
	R^2	0.15	0.15	0.15	0.15	0.15	0.15
Individual Fixed-Effects		Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed-Effects		No	No	No	Yes	Yes	Yes

See notes to Table 2

Observations: Low-skilled: 349,666; Medium-Skilled: 521,288; High-Skilled: 360,021.

Table 4: Estimation Results for IV Models

		(1)	(2)	(3)	(4)	(5)	(6)
Low	Region	0.536	0.537	0.118***	0.119***	0.118***	0.119***
		(0.424)	(0.424)	(0.043)	(0.043)	(0.043)	(0.043)
	Firm	-	0.093	-	0.139	-	0.140
			(0.256)		(0.109)		(0.110)
	N	349,666	349,666	349,666	349,666	349,666	349,666
	R^2	0.50	0.50	0.13	0.14	0.14	0.14
	F-Test (1^{st})	16.28	16.38	344.98	342.02	343.27	340.28
	Shea Partial R^2	0.31	0.32	0.83	0.83	0.83	0.83
Medium	Region	0.119	0.128	0.065	0.066	0.066	0.066
		(0.255)	(0.246)	(0.053)	(0.053)	(0.055)	(0.055)
	Firm	-	−0.221	-	0.056	-	0.038
			(0.248)		(0.057)		0.057
	N	521288	521,288	521,288	521,288	521,288	521,288
	R^2	0.59	0.59	0.19	0.19	0.19	0.19
	F-Test (1^{st})	272.83	271.49	1,095.73	1,088.00	1,043.55	1,035.87
	Shea Partial R^2	0.53	0.54	0.89	0.89	0.89	0.89
High	Region	0.190**	0.176*	0.034*	0.034*	0.033*	0.033*
		(0.095)	(0.100)	(0.020)	(0.019)	(0.020)	(0.018)
	Firm	-	0.194*	-	0.320***	-	0.305***
			(0.106)		(0.058)		(0.059)
	N	360021	360,021	360,021	360,021	360,021	360,021
	R^2	0.42	0.42	0.15	0.15	0.15	0.15
	F-Test (1^{st})	758.40	792.40	1,767.21	1,756.74	1,844.12	1,835.18
	Shea Partial R^2	0.73	0.73	0.92	0.92	0.93	0.93

See notes to Table 2: Columns (3) and (4) include individual fixed effects, columns (5) and (6) individual and firm fixed effects.

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