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Returns to Education across the Urban-Rural Hierarchy

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Abstract: Returns to education are mainly influenced by the characteristics of the individual. However, returns also depend on location characteristics, suggesting location premia can exist for educational attainment. This paper analyzes regional variations to returns from education using Swedish municipalities. The political geography of Sweden assists the analysis since it can be divided into four categories based on size and commuting patterns. Based on the obtained results, the often-assumed hypothesis of equal returns to education for all regions in a country can be rejected. The highest returns to education are found in municipalities at the top of the urban-rural hierarchy (dense and large municipalities), and the lowest are in the most peripheral municipalities.

Keywords: returns to education, regional attributes, fixed-effects model

JEL Codes: H52, I21, I22, J61, R11

1. INTRODUCTION

Returns to education have been extensively analyzed since the 1960s, providing insights into how societies reward education. These returns have been viewed from several perspectives—social, individual, regional, and national. Most studies have focused on international variations. This paper adds to the existing literature that focuses on variation across regions within a country, following, for example, Black, Kolesnikova, and Taylor (2009). The purpose is to provide a detailed description of how returns to education in Sweden vary by location. Dealing with regional differences in wage structures and returns to education, Sweden positions itself at the lower end of the scale with its history of strong unions and wage equalization. Hence, if returns to education differ by region in this context, it is most likely that other countries show the same phenomenon. The results in this paper can be used as a lower threshold compared to other countries and thereby provide important insights in the human capital literature. The mobility pattern of educated and skilled individuals is an ongoing concern and focus for (local) politicians. As such, returns to education provide insights about the geographical spread of human capital. Educated individuals are associated with productivity externalities, consumption externalities, and economic growth. Thus, the paper enhances our understanding of how spatial patterns determine labor market outcomes and also how returns to education shape the attractiveness of a location.

Returns to education are expected to vary across geography due to location-specific factors such as market potential and labor market structure, and access to amenities. In other words, workers with similar jobs and educational levels have different returns to education due to different location premia (Hanushek, 1973; Farber and Newman, 1987; Asplund and Pereira, 1999; Black, Kolesnikova, and Taylor, 2009). Differences in returns to education can exist in

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general equilibrium because firm and household amenities vary over space and therefore create differences in wage and rent compensation (Roback, 1982). The findings in this paper are those of a partial equilibrium because only wages are considered.

I make a distinction here between metropolitan municipalities, central municipalities, peripheral municipalities in larger functional regions, and peripheral municipalities in small functional regions. Using this approach, the marginal effects can be identified in a Mincer-type wage equation through a fixed-effects model controlling for unobserved individual ability and observable individual, firm, and locational characteristics. Further, this paper adds to the existing literature by thoroughly estimating wage premiums for various levels of education for different location categories. The results show heterogeneous returns across space in Sweden, confirming previous findings of the importance of location for the returns to education. The results in this paper conclusively highlight the importance of controlling for the location when measuring the returns to education. Individuals living in municipalities in metropolitan functional regions have the highest returns to education. These regions have a more diversified labor market, yielding more career opportunities and a larger share of highly educated individuals, which may increase knowledge spillovers and overall productivity, thus highlighting the importance of agglomeration effects for the returns to education (Fuchs, 1967; Glaeser and Maré, 2001; Yankow, 2006). Individuals living in peripheral municipalities in small functional regions have the lowest returns to education. The difference is statistically significant and has a magnitude of 2percentage points. The size of the variation to the returns to education could be due to the special characteristics of the Swedish labor market, such as high union membership rates and high levels of collective bargaining coverage, which can lead to reduced wage differentials. Hence, despite the institutional framework, there are significant differences in regional returns to education in Sweden. In regards to the different educational levels, higher educational degrees (research degrees) are rewarded to a larger extent in urban locations compared to individuals that finished upper secondary high school. On the other hand, lower levels of university studies had higher returns in more rural places. Hence, even if the return to education is highest overall in urban settings there are monetary gains to be earned in rural locations if the individual chooses to continue into higher education or if an individual with these qualifications decides to move to these locations.

The remainder of this paper is organized as follows. Section 2 presents the conceptual framework and a discussion on the link between geographical location and returns to education differentials. Section 2 also presents the location categories used in the empirical model. Section 3 describes the data, variables, and method. The empirical results are presented in Section 4, and Section 5 concludes the paper.

2. SPATIAL VARIATIONS IN RETURNS TO EDUCATION

The foundation of human capital theory suggests that individuals invest in human capital such as education not based on present gains but on future pecuniary and nonpecuniary returns. The pecuniary gains consist of an increased labor income, i.e., returns to education. The returns to education are not only determined by individual characteristics, such as experience level, skills, and inherited abilities, but also by the economic environment, because the investments are recouped in a local labor market (Combes, Duranton, and Gobillon, 2008). Black, Kolesnikova, and Taylor (2009) show that returns to education are constant across space if and only if preferences are homothetic. In this case, the proportional returns to education between the

educated and less-educated are the same across locations. This strong assumption of homothetic preferences is in most cases rejected, leaving us with location-specific returns to education.

To test the claim that returns to education differ across locations, Sweden's municipalities have been divided into four categories based on their size and commuting patterns. The categories are chosen to capture specific regional characteristics affecting returns from education and are defined using the concepts of functional regions. A functional region is normally formed by grouping together several municipalities among which the intermunicipal commuting intensity is mutually high. The functional regions form a common market for labor, housing, and household and company services, and provide the home market for most firms. A functional region is built up by one central municipality and several surrounding, peripheral municipalities.

The first regional category is *Metropolitan functional regions* and contains those municipalities that belong to the functional regions with the three largest cities in Sweden, which are Stockholm, Gothenburg, and Malmö. Over 40 percent of the Swedish population lives in these three regions, and the regions account for 50 percent of the total gross regional product in Sweden. *Central municipalities* contain all central municipalities except the three largest cities in Sweden. A central municipality has the largest number of residents in a functional region and the highest inward commuting in absolute terms. Hence, these two types of regions are dense and large both in terms of economic activity and population, and they should yield agglomeration benefits. The central municipalities also work as growth engines for the rest of the region as they are the largest labor markets and provide the arena for knowledge transfers and diffusion.

Duranton and Puga (2004) classify the associated agglomeration benefits as sharing, matching, and learning mechanisms. The sharing mechanism involves the sharing of indivisible goods and facilities, the gains of input suppliers, the gains from narrow specialization, and sharing risks, also known as urbanization and localization economies. The matching mechanism captures the quality of the matching between employers and employees and the probability of a match (Gibbs, 1994). The probability of receiving a suitable job offer is enhanced in a larger market because the number of job openings in a given period is higher (Burdett, 1978). The quality of each of these matches is also enhanced as the quality is a function of the size of a location, in terms of number of individuals (Helsley and Strange, 1990). An improved matching process between jobs and workers enables individuals to be more productive given similar technological set-ups (Pissarides, 1979, 1984, 2011). The learning mechanism involves the accumulation, diffusion and generation of knowledge. Larger agglomerations facilitate the learning process by enabling more frequent face-to-face interaction and by generally having a larger pool of skilled individuals. Skilled individuals are abundant in urban location both through the sorting mechanism (the most talented individuals choose these locations as their returns are higher) and through the selection mechanism (only the most talented and skilled individuals succeed in these locations) (Behrens, Duranton, and Robert-Nicoud, 2013). Both factors foster the learning process and knowledge spillovers (Jacobs, 1969; Lucas, 1988; Rauch, 1993; Glaeser, 1998; Moretti, 2004; Glaeser and Resseger, 2010; Abel and Gabe, 2011). Other sources of production externalities in urban locations are more frequent job turnover that further fosters knowledge spillovers and labor pooling (Andersson and Thulin, 2008; Finney and Kohlhase, 2008).

Metropolitan and central municipalities also benefit from a higher level of urban amenities, especially in relation to their surrounding environment. Black, Kolesnikova, and

Taylor (2009) indicate theoretically how differences in local price levels across space that arise from differences in productivity levels and/or differences in urban amenities influence the returns from education. In equilibrium, individuals with different educational levels are indifferent to location if they are free to choose where to live and are paid according to their marginal productivity. Locations with different attributes (e.g., higher productivity levels and more higher-quality amenities) influence wage rates and housing prices until individuals are indifferent to where they live. Black, Kolesnikova, and Taylor (2009) demonstrate that returns from education are lower in high-productivity locations if the income elasticity of housing is less than one, i.e., as income increases, the income share assigned to housing decreases. They also find that returns from education are lower in amenity-rich locations under the assumption that amenities are luxury goods. Hence, the two types of regions *Metropolitan functional regions* and *Central municipalities* should experience a low return from education.

Less-urban municipalities are classified into two groups based on the size of the region to which they belong. *Peripheral municipalities in larger functional regions* contains the noncentral municipalities in functional regions with a population larger than 100,000. The functional regions with the three largest cities are excluded as they are part of the category *Metropolitan functional regions*. *Peripheral municipalities in small functional regions* constitute the non-central municipalities in functional regions with a population of less than 100,000. Although the last two categories both comprise peripheral municipalities, there is a clear difference between the two. The separation between large and small functional regions is a consequence of the development conditions of the two types of regions. Larger functional regions have a large central municipality that works as a driving force both for the central and the surrounding municipalities. Small functional regions often lack this shared growth factor (Johansson and Klaesson, 2007; Karlsson and Backman, 2011). Additionally, the access to urban amenities differs as individuals in a functional region with a larger central municipality have the possibility to commute to this location to benefit from these types of services. This is not the case for individuals in smaller functional regions because there is no large economic engine within commuting range. As these locations have very few urban amenities and agglomeration benefits, individuals should experience a relatively higher return to education following Black, Kolesnikova, and Taylor (2009). An additional reason is the labor supply factors that increase the returns from education in more sparsely populated areas (Adamson, Clark, and Partridge, 2004; Corcoran, Faggian, and McCann, 2010). In sum, this paper examines if the returns from education depend on location-specific factors, as defined in Hypothesis 1.

Hypothesis 1: Returns from education differ along the urban-rural hierarchy, whereby high-productivity and amenity-rich locations have a relatively lower return to education.

3. DATA, METHOD AND VARIABLES

The dataset used in this paper is provided by Statistics Sweden and covers all individuals employed by a firm in Sweden for the period 1998 to 2008.¹ All industries are incorporated, i.e., there is no distinction between public and private firms. For each individual, the information on age, occupation, residence and work municipality, labor income, and years of schooling is available. All employees can be matched with their employer. For the purpose of this paper, only individuals within the working age (ages 16 to 65) are selected. The same employee can be

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¹ This includes firm proprietors if they extract wage from their firm.

traced over the entire period. Consequently, the final number of individuals included in the dataset is slightly more than 600,000. The individuals dropped from the dataset are those that are missing information for some of the variables and constitute a random sample.² The gross labor income of an individual is registered in the municipality in which the individual lives. No other sources of income (such as income from capital) are reported.³ Labor income includes the wages earned during a year plus other monetary rewards; rather than the income from wages alone, these are chosen because they reflect all monetary rewards acquired from work. This should better reflect the return to education as not only wages are part of the return, although this approach is not as inclusive as Becker's (1964). It is not possible to distinguish if the individual works part- or full-time. Hence, the labor income cannot be measured per hour. Individuals with a yearly income below 156,000 Swedish kronor (SEK) (\$23,705) are therefore removed. This value corresponds to the minimum income required for a work permit according to the Swedish Migration Board. The vast majority (96 percent) of the individuals is born in Sweden, and 52 percent of the individuals in the dataset are men.

3.1 Variable Definitions and Descriptive Statistics

The gross income, in thousands of SEK, that individual g receives at time t , either from labor income or from an active business during the year, is used as the dependent variable. Hence, we use a definition of earnings from labor that is more restrictive compared to, for example, Becker (1964), who had a broader definition of the returns to education. The human capital of individuals is mainly measured by the years of schooling (*Education*) and experience for individual g at time t . *Experience* is measured by the age minus years of schooling minus six and defines a proxy for the general experience or informal training of the individual. This measure is, however, not optimal because it does not take into account any participation breaks from the labor force. The function of experience is expected to be concave, so a squared term of the experience is included to allow for decreasing returns (Mincer, 1974).⁴ Immutable individual characteristics such as gender and country of origin cannot by definition be included in the fixed-effects model but are instead tested with a pooled OLS and a random effects model, presented in Table A2 in the Appendix.

The tendency that individuals live and work in different locations, i.e., commuters, is controlled for. In this paper “commuting” refers to commuting across municipal borders, i.e. rather long-distance commuters, and not within the same city, i.e. urban land use. A dummy variable (*Commuting*) controls for whether an individual lives and works in different municipalities: 1 for “commutes” and 0 for “does not commute.” This variable partly accounts for the fact that if an individual lives in the periphery and works in the center, the income in the periphery will overstate the benefits of living there. It might also be the case that an individual chooses to commute after obtaining a higher income, i.e., the variable is endogenous. The estimations have therefore been tested without this variable, with similar results. An additional factor that influences wages is the *Industry* in which the individual works. Ten groups of

² A test of means shows that the dropped observations do not differ from the data used in the estimations. The variables tested were sex, age, and years of schooling.

³ Studies of this kind rely on data on wages and other sources of labor income so this paper follows previous literature. The reason why I mention that income from capital is not included is the hypothesis that more educated individuals are also likely to earn more income from this type of capital. Hence, it should be considered a part of the returns from education. This limit the alternatives in which individuals can invest, if, for example, the returns from education are too low, as suggested by Becker (1964).

⁴ Whether years of schooling experiences decreasing returns has been tested, but the squared term turned out to be insignificant.

industries are distinguished: (1) agriculture and fishery, (2) manufacturing, (3) public utilities, (4) wholesale and retail, (5) transportation, (6) hotels, restaurants and communication, (7) finance, insurance, real estate and law, (8) business services, (9) advanced public health sector, (10) recreation and other public services. The size of the firm in which the individual works might also influence wages and is therefore controlled for; the size of firm i is measured by the number of employees (*Firm Size*).

Location attributes are measured at the municipal level to capture the variation among the municipalities in the different categories. In this paper, firm-specific amenities include the proportion of human capital and the firm density assigned to the municipality in which the individual works because these variables influence the work environment and the individual's productivity. Consumer services amenities address the presence of restaurants, culture, and entertainment and are measured at the municipality of residence.

Size is defined by the total access to the aggregated value of all individual wages (in SEK thousands) for municipality s and is assigned to the municipality in which the individual works.⁵ A detailed description of the accessibility measure can be found in Johansson, Klaesson, and Olsson (2002, 2003). The accessibility to wages is a proxy for market potential and captures interdependencies among municipalities and can also measure the density of economic activity in a location (Andersson and Noseleit, 2011). By using an accessibility measure, the effect of economic activity in neighboring municipalities and interdependencies among municipalities are captured. This has the attractive property of reducing spatial autocorrelation (Gråsjö, 2005; Andersson and Gråsjö, 2009). The size variable also captures the house price in a location, as these variables are highly correlated, with a bivariate correlation above 0.8. Hence, the local prices are captured in the empirical setting by using the accessibility measure (*Size*) following Black, Kolesnikova, and Taylor (2009). The size of a location can represent both firm-specific and household-specific amenities, e.g., consumer services as well as proximity to other firms. The estimations therefore include more measures of firm amenities and consumer services.

The second locational factor measures the *Human capital intensity*, defined as the proportion of all individuals in municipality s with at least three years of higher education. Three years is a natural threshold because it normally takes three years to obtain a bachelor's degree in Sweden. Human capital intensity is often associated with the number of years of formal education (Hanushek and Kim, 1995; Schwerdt and Turunen, 2007; Black, Kolesnikova, and Taylor, 2009). This variable is assigned to the municipality in which the individual works because it should influence the work environment of individuals. Proximity to other firms can increase the individual wage as a result of potential knowledge spillovers (Ciccone and Hall, 1996) as well as local competition, which can foster innovation and information spreading (Porter, 1990). In this paper, this is proxied by the number of establishments divided by the population in municipality s (*Firm density*). This variable is measured as the municipality in which the individual works. Individuals have been found to accept lower wages if they live in pleasant and attractive locations. To capture the consumption amenities that differ across locations, a variable measures the proportion of employment in residence municipality r for firms with activities in the restaurant and cultural sectors and the entertainment sector (two-digit SIC codes 55-56, 90-93) (*Proportion of employment in culture, restaurants, and entertainment*).

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⁵ The results do not change if the variable is assigned to the residence municipality.

Table 1: Descriptive Statistics

	Full sample		Municipalities in metropolitan functional regions		Central municipalities in functional regions	
	Mean	St. dev	Mean	St. dev	Mean	St. dev
<i>Labor income_{gt}*</i>	335.93	203.08	373.04	270.04	315.09	140.55
<i>Education_{gt}</i>	12.23	2.43	12.61	2.51	12.18	2.40
<i>Proportion of employment in culture, restaurants, and entertainment</i>	0.041	0.022	0.044	0.016	0.048	0.029
Mean income by educational level						
<i>Senior high school</i>	294.57	122.30	315.40	155.98	283.28	99.59
<i>2 years of university education</i>	350.48	172.84	378.98	210.61	328.94	135.87
<i>Bachelor's degree</i>	397.00	332.64	447.97	440.68	351.09	162.76
<i>More than 3 years of university</i>	488.91	320.37	521.96	383.97	456.87	225.63
<i>Research (licentiate, Ph.D.)</i>	547.44	300.35	567.77	344.58	524.31	227.54
<i>N individuals (share of total)</i>	905,892 (100)		358,862 (43)		277,177 (33)	
<i>N municipalities (share of total)</i>	290 (100)		61 (21)		78 (27)	
	<i>Peripheral municipalities, large functional regions</i>			<i>Peripheral municipalities, small functional regions</i>		
	Mean		St. dev	Mean		St. dev
<i>Labor income_{gt}*</i>	298.41		115.18	291.24		104.59
<i>Education_{gt}</i>	11.57		2.14	11.37		2.08
<i>Proportion of employment in culture, restaurants, and entertainment</i>	0.035		0.018	0.037		0.021
Mean income by educational level						
<i>Senior high school</i>	280.23		86.01	276.85		83.55
<i>2 years of university education</i>	322.41		118.41	317.84		117.80
<i>Bachelor's degree</i>	338.49		149.42	328.02		139.52
<i>More than 3 years of university</i>	435.86		243.26	416.98		193.88
<i>Research (licentiate, Ph.D.)</i>	500.76		208.19	523.83		247.74
<i>N individuals (share of total)</i>	141,569 (17)			57,751 (7)		
<i>N municipalities (share of total)</i>	102 (35)			49 (17)		

*Yearly income in thousands of SEK. The median is below the mean for the labor income and education variables in all categories.

The tax level in the residence municipality r is measured as the total municipal tax rate as a percentage of the income that employees pay (*Tax level*). This tax rate is set by the local government in each municipality and influence the net income that individuals receive. Table 1 presents the descriptive statistics for the variables in focus: labor income and years of schooling, registered at the municipality of residence. It also indicates how the wage differs according to educational level and classification of locations and the level of amenities in each locational category.

The average for years of schooling in the full sample is approximately twelve years. Thus, a typical individual in the sample has completed senior high school. In Sweden, nine years of schooling are compulsory. In reality, over 99 percent enroll for twelve years of school, and approximately 84 percent complete high school. The average years of schooling and yearly income are highest in the municipalities in *metropolitan functional regions* and fall with declining metropolitan size. The same pattern can be found when looking at the average income level for the different educational levels; individuals living in municipalities in *metropolitan functional regions* have the highest overall income regardless of educational level. By region type, individuals do, however, tend to increase their income as their educational level increases. The income varies more at higher educational levels compared to lower levels. Hence, there is a broader income spread among highly educated individuals for all classifications of location, except for municipalities in *metropolitan functional regions*. The widest income range is in the metropolitan functional regions for individuals with a bachelor's degree. With regard to the level of urban amenities (*Proportion of employment in culture, restaurants, and entertainment*), as expected, the highest level is found in the metropolitan and central municipalities, and a significantly lower level is found among the more rural municipalities (the peripheral municipalities). The highest level is found in central municipalities, indicating that these municipalities function as a supplier of these goods to the surrounding environment.

Approximately 16 percent of the sample has changed location in terms of changing residence municipality one or several times during the period 1998 to 2008. There is a considerably smaller number of individuals that has changed regional category, approximately eight percent. Individuals who have changed location during the period investigated are not included in the different location categories to avoid wage premia arising from a change in location; for example, an individual moves from Stockholm and experiences a higher wage level in the new location (Glaeser and Maré, 2001). Hence, the returns to education in this paper are estimated for those individuals who do not move across regional categories, i.e., stayers.⁶ The estimated returns to education in this paper should therefore reflect the isolated effect from the gains of education in different regional contexts. The total number of individuals in the different locational categories therefore does not equal the total number of individuals in the full sample. The individuals that have changed regional category, i.e., movers, are on average younger, more educated and have a higher income. The difference in the returns to education for the movers compared to stayers is statistically different from zero, but still very small for all individuals, with movers having the higher return. Across the regional categories, there is no statistical difference in the returns to education for movers and stayers, respectively.

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⁶ The sample used in this paper is therefore biased as it only includes individuals that do not move across regional categories. The obtained results do however reflect the majority of the individuals as 92 percent of the individuals do not change regional category. They might move within the category but not across. Also, the results do not differ significantly for movers and stayers.

Table 2: Educational Attainment in Different Regional Categories, Relative Shares

	Municipalities in metropolitan functional regions	Central municipalities in functional regions	Peripheral municipalities, larger functional regions	Peripheral municipalities, small functional regions
<i>Senior high school</i>	56 (36)	63 (35)	73 (21)	76 (8)
<i>2 years of university education</i>	18 (44)	18 (36)	14.7 (15)	14 (5)
<i>Bachelor's degree</i>	14 (50)	11 (34)	8 (12)	6.8 (4)
<i>More than 3 years of university</i>	10 (54)	7 (33)	4 (10)	3 (3)
<i>Research (licentiate, Ph.D.)</i>	2 (60)	1 (34)	0.3 (5)	0.2 (1)

Several studies have identified a self-selection of skilled and able individuals toward large urban locations and metropolitan regions (Marshall, 1890; Fuchs, 1967; Tabuchi and Yoshida, 2000). The same tendency can be found in Sweden and is examined using the relative shares of individuals in each educational category (rows) and location categories (columns), as presented in Table 2.

Table 2 indicates that highly educated individuals are better represented in municipalities within *metropolitan functional regions*, as 60 percent of all individuals who have a research degree are located in these regions. This occurs partly because these regions attract individuals by supplying urban amenities and a diverse and broad labor market. Individuals with a higher education are in particular attracted to these locations and have overall a higher mobility rate (Schwartz, 1973, 1976; Borjas, 2002). It could also be so that individuals who are born and/or raised in urban locations are more aware of the value of a higher education and are also socially pressured to become highly educated, compared to their counterparts in rural municipalities. Another obvious reason is the type of labor market where most occupations that require a research degree is metropolitan regions. Individuals in municipalities in the *metropolitan regions* are spread out across educational levels, i.e., there is large share of individuals with lower as well as higher levels of education. A completely different scenario is identified in the peripheral regions; nearly 90 percent of the individuals have below two years of university education. Thus, the supply of highly educated individuals is skewed toward metropolitan functional regions.

3.2 Mincer Wage Equation, Extended

The estimations in this paper are based on one of the wage equation specifications by Mincer (1974). The most common Mincer wage equation relates the logarithm of earnings to years of schooling, years of work experience, and years of work experience squared. Due to market frictions and market dynamics, there are good arguments to extend the Mincer wage

equation according to Equation 1 to also include the individual, firm and location-specific variables.

$$(1) \ln Laborincome_{gt} = \alpha + \beta_1 Education_{gt} + \beta_2 Experience_{gt} + \beta_3 Experience_{gt}^2 + x'_{gt}\delta + y_{it}\theta + z'_{st}\gamma + w'_{rt}\rho + D_T + \varepsilon_{gt}$$

where β_1 is the returns to education, the return to experience is measured by a combination of β_2 and β_3 , x'_{gt} represents a vector of control variables related to individual characteristics g , y_{it} is a firm variable for firm i for which individual g works, z'_{st} represents a vector of control variables related to the municipal characteristics where the individual works, and w'_{rt} represents a vector of control variables related to the municipal characteristics where the individual lives. D_T presents the year dummies, δ , γ , θ , and ρ are vectors of parameters, and ε_{gt} is the error term.

In this paper, a two-way fixed-effects model is used. The fixed-effects are applied at the individual level, and the model also controls for time effects by including year dummies to control for nominal increases in labor income due to inflation and to lessen the impact of business-cycle movements. Two issues need to be discussed and addressed: multicollinearity and endogeneity. When dealing with quadratic terms, multicollinearity is inevitably present. To reduce multicollinearity problems, experience has been centered on its mean. By centering, the relationship between high (low) original value and high (low) squared values is reduced and hence the multicollinearity as well (Smith and Sasaki, 1979).⁷

The second problem that needs to be discussed relates to endogeneity. There is an extensive debate regarding measurement errors and the failure to control for ability. Assuming that individual ability, which cannot be captured by education and experience, is time-invariant, its effect can be controlled by using an individual fixed-effects model. By using a fixed-effects model, only the within-effects from the independent variables are observed for each individual. Hence, the effect of education on wages without any ability bias can be identified. One possible limitation of the fixed-effects approach is that it cannot handle variables with no or few variations over time, and a consequence of this is the estimated parameters become inefficient. As it happens, education often has minor or no variations over time. The within-variation for the education variable in this paper constitutes approximately five percent of the total variance. This might at first seem low, but due to the large sample, there is substantial variation in the education variable. A robust Hausman test rejects a random-effects model, suggesting that a fixed-effects model should be used. Hence, by using a two-way fixed-effects model at the individual level, the endogeneity problem is reduced because the model captures and controls for (time-invariant) heterogeneity among individuals. In addition, the estimation also includes the characteristics of the individual that change over time such as the level of experience and commuting behavior. In sum, the model is able to isolate the effect of education on labor income to capture the returns to education.

In the estimations, the location choice is assumed to be exogenous. The estimations investigate different location categories, so this assumption needs some discussion. Combes, Duranton, and Gobillon (2008) argue that there is a bias if the location choice is driven by the exact wage that the employee can earn at a specific location in a given year but not if the location decision is driven by the average wage of the location. There are also other factors that reduce

⁷ The bivariate correlation before centering is approximately 0.98 for the experience variables. After centering, the bivariate correlation is -0.12.

the bias from this selection process. The migration decision taken by an individual is most likely driven by long-term decisions in which the future expected wage is more important than the wage for a particular year (Topel, 1986). Location decisions are also driven by features such as amenities that are separate from wage influence. The results in Dahl (2002) suggest that this selection bias has only minor effects on returns to education across the states in the United States. The value of the parameter changes but not the difference in returns to education across regional categories. As a robustness test, the same estimations have also been performed using fixed-effects at the municipal level to capture non-observable fixed-effects at the regional-level, with similar results.

4. ANALYSIS

A two-way fixed-effects model (in which the fixed-effect is at the individual level) is used to estimate the coefficients of Equation 1. The variables controlling for municipal size and human capital intensity have been separated into two specifications due to a high bivariate correlation. The estimation including the size of municipalities is presented in Table 3. The specification including the human capital intensity can be found in Table A1 in the Appendix.

Due to the large number of observations, it is practically impossible to correct for spatial correlation at the individual level. It is perhaps more likely that there is spatial correlation among groups of individuals, i.e., they are clustered in some sense. Because the focus in this paper is not on the spatial aspect of the data per se, standard errors are clustered at the municipal level to reduce spatial effects (Bertrand, Duflo, and Mullainathan, 2004; Kézdi, 2004). All industries are included in the estimations. It can be argued that there is less flexibility in the wage setting in the public sector. Therefore, this sector has been excluded in a robustness test to observe if the results change, which they do not. Because the wages are not fully fixed and there is some room for flexibility, this sector is included in the rest of the empirical setting.

4.1 Spatial Variation in Returns to Education

The intercept gives the average value of the individual fixed effects. The highest value is found for municipalities in *metropolitan functional regions*, and the lowest is for *peripheral municipalities in small functional regions*. The intercept ranking follows the same pattern of the income levels as the descriptive statistics in Table 1. The return to education, represented by β_1 in Equation 1, is positive and significant for all specifications. As expected, an additional year of schooling has a positive effect on income. The returns to education across the different categories are significantly different from each other. This is confirmed by looking at the confidence intervals and by a Chow test of equality of coefficients.

The highest value for returns to education appears for individuals living in municipalities in *metropolitan functional regions*. These municipalities are characterized by high levels of urban amenities such as entertainment, consumption opportunities, and culture that are valued by individuals and in particular those with a higher education level (Adamson, Clark, and Partridge, 2004). There is also a broader job variety, giving individuals access to a wider range of potential jobs in their field of expertise and better opportunities of making a career. These features are found to have a diminishing effect on the returns to education in other studies, as individuals “pay” with a lower wage to be able to live in these locations (Black, Kolesnikova, and Taylor, 2009). The results in this paper highlight, therefore, the advantages of being located in dense and large locations, despite controlling for size and urban amenities. Individuals in city regions tend

Table 3: Regression Results for Full Sample and Locational Categories, Two-way Fixed-Effects Estimation, 1998 to 2008. Dependent Variable: Labor Income (*ln*)

	<i>Full sample</i>	<i>Municipalities in metropolitan functional regions</i>	<i>Central municipalities in functional regions</i>	<i>Peripheral municipalities, larger functional regions</i>	<i>Peripheral municipalities, small functional regions</i>
Individual variables					
<i>Education_{gt}</i>	0.035** (0.0002)	0.045** (0.0004)	0.027** (0.0005)	0.031** (0.0005)	0.024** (0.001)
<i>Experience_{gt}</i>	0.035** (0.0001)	0.039** (0.0001)	0.031** (0.0002)	0.035** (0.0001)	0.028** (0.001)
<i>Experience_{gt}²</i>	-4.02e-4** (0.00001)	-4.97e-4** (0.001)	-3.58e-4** (0.00001)	-2.99e-4** (0.00001)	-2.90e-4** (0.00001)
<i>Commuting_{gt}</i>	0.016** (0.00001)	0.015** (0.001)	0.026** (0.001)	0.016** (0.001)	0.017** (0.001)
<i>Region dummy</i>	YES	NO	NO	NO	NO
<i>Industry dummy</i>	YES	YES	YES	YES	YES
<i>Firm size_{it} (ln)</i>	0.009** (0.0001)	0.009** (0.0002)	0.009** (0.0002)	0.010** (0.0003)	0.009** (0.0004)
Municipal variables					
<i>Size_{st} (ln)</i>	0.065** (0.002)	0.014** (0.002)	0.134** (0.007)	0.021** (0.003)	0.182** (0.016)
<i>Firm density_{st}</i>	0.064** (0.005)	0.733** (0.135)	0.105** (0.017)	0.045** (0.006)	-0.010 (0.032)
<i>Culture, restaurants, and entertainment employment proportion_{rt}</i>	-0.034** (0.015)	-0.036 (0.024)	0.014 (0.028)	0.074* (0.032)	0.231** (0.041)
<i>Municipal tax level_{rt}</i>	0.002** (0.0001)	2.99e-4 (0.0003)	-1.36e-4 (0.0001)	0.003** (0.001)	2.23e-4 (0.001)
<i>Intercept</i>	2.936** (0.025)	5.052** (0.033)	3.240** (0.106)	4.878** (0.044)	2.510** (0.248)
<i>R² (overall)</i>	0.06	0.04	0.07	0.05	0.09
<i>R² (within)</i>	0.45	0.42	0.49	0.50	0.52
<i>F-probability</i>	0.000	0.000	0.000	0.000	0.000
<i>N</i>	8,621,004	2,609,679	2,685,553	1,401,027	581,718
<i>Individuals</i>	905,892	358,862	277,177	141,569	57,751

**Significant at one percent, * significant at five percent. Cluster standard errors at the municipal level in parentheses to control for heteroskedasticity. The estimations have also been performed for the period 1998-2007 to test if the crisis in 2008 had any effect on the estimations; the results are robust.

to be more productive than those in rural areas because the interaction possibilities are enhanced and because of knowledge spillovers and information transfers. The mechanism of agglomerations (sharing and matching) has been found to work in favor of individuals with a higher level of education, as they have a tendency to move to acquire a job and commute over longer distances compared to individuals with lower levels of education (Becker, 1964; McCann, 2001; Johansson, Klaesson, and Olsson, 2003). A utility-maximizing individual seeks a maximized lifetime utility in terms of earnings and job satisfaction, subject to the cost of acquired education. Individuals with higher levels of education also have higher reservation incomes, which can prolong any job search. These elements combined lead to higher returns to education in this type of region, as the elasticity of demand for educated individuals is less elastic. The learning mechanism also works in favor of more educated individuals compared to the less educated (and hence raises the returns to education), as they are more likely to benefit from the knowledge spillovers in large and dense locations. More highly educated individuals have the capacity to absorb the information and knowledge and then transform it and adapt it to their current task, making them more productive.

The argument by Black, Kolesnikova, and Taylor (2009) that the income elasticity is less than one has been questioned in several papers in which the elasticity of demand for housing has a broad range of values depending on the investigated sample and time period (Carliner, 1973; Polinsky, 1977; Harmon, 1988). Swedish studies find ambiguous results for the elasticity of demand for housing, as different studies find elasticities both below and above one (Paldam, 1970; Brownstone and Englund, 1991; Turner and Whitehead, 2002). This indicates that if the income elasticity of housing is above one, Black, Kolesnikova, and Taylor's (2009) rationale (i.e., high-productivity locations have lower returns to education) might not hold. Firm-amenity and consumer services are partly controlled for by including proxies as independent variables. Although there is a large supply of highly educated individuals in municipalities in metropolitan regions, which should dampen wages, the demand for these individuals by firms increases their wages. The positive effects from hiring educated individuals outweigh the higher wages they have to pay; if this were not the case, private firms would relocate. There are also other benefits for firms to be located in these locations such as the accessibility to market potential and to other firms.

The lowest returns to education are found for individuals living in *peripheral municipalities in small functional regions*. These municipalities are characterized by low levels of urban amenities and their labor markets are small and homogenous. These are factors that tend to repel workers. These regions also tend to lack firm-specific amenities such as proximity to customers and suppliers. Taken together, these factors lower the return to education. These regions do, however, often provide a greater number and broader range of natural amenities that are valuable for individuals.⁸

The difference in returns to education is approximately 2 percentage points between the highest and lowest value. The regional differences in the returns to education in a country with a low wage variance emphasize the robustness and strength of within-country variation in returns to education. The range of estimates suggests that although the location factor is important and produces statistically significantly different returns to education, there are other

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⁸ Average temperature, average rainfall, crime level, share of land used for recreational use, and share of land with lake or ocean access have been tested in a cross-sectional model for the year 2008 but were found not to be statistically significant.

effects that explain the observed wage difference between urban and rural areas. One explanation is the sorting effect, whereby skill-intensive and hardworking individuals tend to cluster in generally larger urban locations (Glaeser and Maré, 2001; Rosenthal and Strange, 2003; Combes, et al., 2008) based not on the returns to education but perhaps on other factors such as urban amenities. Further, regions with a large and diverse labor market offer better career opportunities in terms of the number of job opportunities and advancement opportunities rather than solely in terms of the prospect of initially higher wages as is the case for individuals with a lower level of education. This aspect is especially important for married couples in which both spouses have a higher education, i.e., “power couples.” The dual career opportunities play a significant role in their location decision (Costa and Kahn, 2000). Firms in locations with a homogenous and small labor market, e.g., peripheral municipalities, may therefore need to pay higher wages to compensate human capital-rich individuals for the lack of career opportunities, for both individuals and couples (Corcoran, Faggian, and McCann, 2010). Thus, firms need to reward skilled individuals with relatively high wages to attract them to a certain location. This might be particularly true in the case of highly educated individuals because these individuals tend to be more mobile and more attracted to large urban settings (Borjas, 2002). This might also explain the small difference in returns to education between the metropolitan functional regions and the peripheral municipalities in small functional regions.

The returns to education for individuals in the different location categories imply that an additional year of schooling increases an average individual’s yearly income by approximately 16,500 SEK in municipalities in *metropolitan functional regions*, 8,500 SEK in *central municipalities in functional regions*, 9,300 SEK in *peripheral municipalities in large functional regions* and 7,000 SEK in *peripheral municipalities in small functional regions*. The calculations only consider the returns to education for an individual and not the discount rate or the precise shape of each individual’s earnings function (Hanushek, 1973). These figures should be viewed as an indication and not as absolute values. Still, they give a striking picture of the value of one additional year of schooling. The effect is more than twice as large in municipalities in *metropolitan functional regions* than in *peripheral municipalities in small functional regions*. The difference is likely driven by the industry structure in the respective category. A proportionally large share of individuals in the most rural parts of Sweden work within the public sector, that overall has a lower wage level and often a lower wage increase.

The industry structure in a region might also influence returns to education. The location decisions of private and public firms are not based on the same criterion. A private firm can choose the location most suitable for its core activities. Thus, the private sector is market driven in its location decisions. Wage differentials in the private sector are most likely driven by labor demand-side factors such as spillovers and agglomeration effects. The public sector is population driven and must be present everywhere in Sweden to provide services to the inhabitants. Wage differentials in the public sector may be driven by labor supply-side factors such as amenities appreciated by workers. To attract individuals to less attractive locations, the individuals must be compensated with a higher wage. One example of this is the value of the industry dummy representing the advanced public health sector. The value of the dummy is highest in the peripheral locations, indicating that individuals in these occupations in peripheral locations earn a relatively higher wage. The public sector has to supply services in all locations, and to attract individuals to remote locations, particularly those with a high level of human capital, they have to increase wages (Corcoran, Faggian, and McCann, 2010).

As a robustness check to observe if the results are driven by differences in gender distribution across locations, the estimations are also performed separately for men and women and are presented in Table A3 in the Appendix. Men and women both earn the highest return in large and dense locations, i.e., municipalities in *metropolitan functional regions*. The return that they earn in these municipalities is for men substantially larger compared to that of the other regional categories. Men living in *peripheral municipalities in small functional regions* have a slightly lower return to education compared to *central municipalities* and *peripheral municipalities in large functional regions*. For women, the difference across the regional categories is smaller, except for the returns gained in *metropolitan functional regions*. Overall, women experience a higher return but the effect is declining at a faster rate. The results indicate that the returns to education overall are larger for women, a result found in earlier studies (Butcher and Case, 1994; Blundell et al., 1997; 1999; Psacharopoulos and Patrinos, 2004); however, the difference is small. The small difference for Sweden is confirmed by other studies (Harmon, Oosterbeek, and Walker, 2003). There are, however, differences across the locational categories. Women have the highest returns in all regional categories with the exception of those who live in municipalities in *metropolitan functional regions*. The difference is, however, the smallest for this category. The largest difference between men and women is for the individuals in *peripheral municipalities in small functional regions*.

To further illustrate the differences between the levels of education and location categories, a comparison is made between five different educational levels: senior high school (base), two years of university education, three years of university education, more than three years of university education, and research degree (a licentiate or Ph.D.). This allows for a more complete picture of the differences in the returns to education. The same estimation as presented in Table 3 was performed; however, instead of the continuous number of years of schooling, dummy variables were used for different educational levels. This follows an approach similar to that of Goetz and Rupasingha (2003). The results for the dummy variables are presented in Table 4. The other variables have the same magnitude and significance level as reported in Table 3.

The results in Table 4 indicate that there are differences between educational levels and location categories. Differences in the educational level generate the expected effects, i.e., higher educational levels generate higher incomes. Naturally, incomes can also vary among occupations within a municipality, but this is the general picture. There are, however, some differences across locations. No single regional category has the overall highest premia across all educational levels. The lowest educational degree has the highest reward in *peripheral municipalities in large functional regions*. In these locations an individual with two years of higher education earns 4.6 percent more in income compared to a similar individual with a secondary high school education. This can be compared to individuals in metropolitan municipalities who earn only 2.5 percent more compared to those with a secondary high school education. Individuals living in *central municipalities* experience a high premium for university studies at or above three years but less than a research degree. The highest premium for a research degree is paid to individuals living in municipalities in *metropolitan functional regions*. Here, an individual with a research degree earns 36 percent more compared to having a secondary high school education. The premium is considerably smaller in peripheral municipalities, where a research degree gives you approximately a 22 percent wage rise compared to upper secondary high school. In the case of individuals living in *peripheral municipalities in small functional regions*, there is a relatively large premium for all educational levels below a research degree and in particular for the lower levels of education. The proportional impact for the research degree could be misleading

Table 4: Income Increases for Educational Degrees, Dummy Variables Representing Five Educational Degrees (Proportional Impacts), All Location Classifications.
[Dependent variable: $\ln(\text{Labor income})$]

	<i>Full sample</i>	<i>Municipalities in metropolitan functional regions</i>	<i>Central municipalities in functional regions</i>	<i>Peripheral municipalities, larger functional regions</i>	<i>Peripheral municipalities, small functional regions</i>
2 years of university education	0.0382** (0.002)	0.0254** (0.005)	0.0393** (0.004)	0.0464** (0.006)	0.0339** (0.009)
3 years of university education	0.1392** (0.003)	0.1201** (0.006)	0.1264** (0.005)	0.1002** (0.009)	0.1058** (0.014)
More than 3 years of university	0.2048** (0.003)	0.1730** (0.006)	0.1819** (0.006)	0.1436** (0.009)	0.1616** (0.015)
Research degree	0.3825** (0.007)	0.3576** (0.012)	0.2969** (0.015)	0.2210** (0.025)	0.2318** (0.062)

**Significant at one percent. Cluster standard errors at the municipal level in parentheses are to control for heteroskedasticity. The base is secondary high school education. The dummy variables have been recalculated to illustrate their proportional impact ($p_i = [\exp(\beta) - 1]$).

especially for peripheral (rural) municipalities due to the low number of observations. The overall picture is that lower levels of education, up to three years of higher education, is rewarded to a greater extent in peripheral municipalities. The highest level of education is, on the other hand, rewarded in urban locations.

The differences in monetary gains for different educational levels across regional categories are even more striking considering that the cost side of education in Sweden is relatively homogenous. Sweden has a policy of no tuition fees (for Swedish citizens and other members of the European Union) and a beneficial loan system for students. There is by this token less cost-variation across different regions. The same is true for lost earnings as Sweden with its long history of wage equalization still has less wage variation compared to other countries. The cost-of-living does on the other hand vary across regions. Using housing prices as a proxy, the cost-of-living in the most expensive region (metropolitan) is more than three times higher than the least expensive (peripheral municipalities in small functional regions). While comparing the return to education for the same regional categories, the return to education is less than twice as high in the metropolitan region compared to the most rural regional category. It is also among these regional categories that the largest difference between cost-of-living and returns to education can be found. For the other regional categories the difference is less pronounced.

4.2 Control Variables

Experience raises an individual's income, but at a decreasing rate. As individuals become more experienced and older, their wage growth might increase at a slower pace due to lower job turnover and/or due to a decrease in productivity growth (for a literature review see Skirbekk, 2004). The returns to experience follow the same pattern as the returns to education. An

individual gains the most from acquiring an extra year of experience if he/she lives in a municipality in *metropolitan functional regions*. The diminishing effect is largest in this regional category and lowest in *peripheral municipalities in small functional regions*. The effects of informal training or learning-by-doing are, hence, larger in urban municipalities. Individuals also have access to a larger labor market in which this experience is more valued, if they opt to change their job. Glaeser and Maré (2001) found that individuals working in urban locations learn more skills during their work. Thus, the returns to experience are higher at the upper end of the urban-rural scale, which is consistent with other findings in this paper. Similar findings are presented in Phimister (2005), Gould (2007), and Michaelsen and Haisken-DeNew (2011).

Commuting is positively associated with labor income for all estimations. Thus, by commuting, an individual gains access to a job with a higher income. If the individual did not receive a higher income by commuting, it is unlikely that the individual would choose to commute. By commuting in peripheral municipalities and in metropolitan functional regions, individuals reach a larger and more diversified labor market. The parameter is surprisingly large for those living in *central municipalities in functional regions*. The commuting variable cannot only be interpreted as a cost because it incorporates the benefits from working and living in different locations.

The gender dummy, in the random effects model and pooled OLS (Table A2 in the Appendix), is positive for all classifications. Men tend to receive higher incomes than do women, irrespective of location; this finding is consistent with earlier studies (Blau and Kahn, 1994; Albrecht, Björklund, and Vroman, 2003). This could be a consequence of women being more likely to work part-time, discrimination, or women segregating in occupations in which the wage level is commonly lower, such as in the public sector. The dummy variables controlling for country of origin have the same impact in all estimations. A country of origin other than Sweden has a negative impact. These discrepancies may be caused by the level of language proficiency, the lack of experience in the Swedish labor market, cultural barriers, or discrimination.

The effect of the size of firms is positive and of the same magnitude for individuals in all locations. The tendency that larger firms pay higher wages has several explanations: more qualified employees, higher productivity, a more stable workforce, market power allowing firms to share the profits among their workers, compensation of workers for bad working environments, and matching of high-skilled workers (Brown and Medoff, 1989; Idson and Oi, 1999; Lallemand, Plasman, and Rycx, 2005).

The size of a municipality has a positive influence in all estimations. There is a well-established connection between the size of locations and labor income, i.e., the urban wage premium (Glaeser and Maré, 2001; Yankow, 2006; Combes et al., 2010). The accessibility measure captures the interdependence across municipalities because it weights the market potential in all municipalities by a distance decay function. Accessibility to wages has a high correlation with density measures such as population density and has been used as a density measure in previous studies (Andersson and Noseleit, 2011).

An individual in a human capital-rich location earns a higher wage compared to a similar individual in a less human capital-rich location. To work in a municipality with a high proportion of highly educated individuals is positively related to an individual's income. Similar results are found in Rauch (1993), Acemoglu and Angrist (2004), and Moretti (2004). This effect may arise from the spillover effects from other educated individuals, which increase individual

productivity. Individuals also tend to learn more from each other in regions with a higher proportion of skilled individuals (Glaeser, 1998). Hence, there are productivity externalities arising from human capital. The increase in the wage due to a higher overall level of human capital comprises, in addition to spillovers, the complementarity effect across individuals with different levels of human capital (Moretti, 2004). The size of the effect is largest for *peripheral municipalities in small functional regions*. Because the municipalities are divided into four categories, the variance of the municipal variables is limited for some categories. For example, the size measure, access to wages, has a smaller variance across municipalities in metropolitan functional regions. This may be the reason why an increase in the size measure has a smaller impact on wages in metropolitan functional regions. The overall size is large, and an increase therefore has minor effects.

The firm density variable is positive and significant for all specifications except for individuals living in *peripheral municipalities in small functional regions*. The magnitude of this variable is largest for *municipalities in metropolitan functional regions* and falls with decreasing size. Thus, it follows a hierarchical structure. The proxy for household amenities, i.e., the proportion of culture, restaurants, and entertainment employment, has a significant negative influence on income for all individuals. This indicates that individuals “pay” to live in pleasant locations by accepting a lower wage, consistent with expectations and other studies (Roback, 1982; Blomquist, Berger, and Hoehn, 1988; Tabuchi and Yoshida, 2000). This variable is, however, positive for peripheral regions, indicating that this feature increases the wage within this regional category. This variable does not control for variation across categories. One potential problem regarding amenities is that they vary within locations (Cho, Poudyal, and Roberts, 2008; Nilsson, 2013). Thus, when aggregated to the municipal level, only the average effect from the variable is captured and there is less variation across municipalities. There might, however, be differences within the municipality. An additional aspect is that the variable is measured in the municipality of residence. Individuals tend to commute to access these consumption opportunities, and hence, amenities do not have to be in the municipality where they live but could instead be within the same functional region to which the individual has access. Hence, highly educated individuals do not have to live in high-amenity locations to benefit from them. This tendency is especially valid in larger regions where individuals tend to live outside the core of the city. In more remote regions, this is less of a problem, as individuals tend to live and consume amenity goods within the same municipality. Hence, there is a closer spatial match with the individual and locational features. The municipal tax level is positive and significant for *peripheral municipalities in large functional regions*. A positive effect was unexpected, but the magnitude is small and close to zero.

5. CONCLUSIONS

This paper concludes that there is significant variation in returns to education across locations in Sweden. Thus, rates of return depend on location-specific factors and differ across location categories. The analysis of returns to education becomes unreliable if the location is not considered or controlled for. The largest returns to education are found for individuals living in municipalities in *metropolitan functional regions*. These regions attract a large number of highly educated individuals, are characterized by a high level of human capital, have a dense economic environment and a more diversified labor market compared to other parts of the country, and offer a variety of urban amenities. These are all factors that increase the returns to education because these individuals tend to benefit more from the attributes in large and dense economic

milieus such as knowledge spillovers. Individuals living in *peripheral municipalities in small functional regions* have the lowest returns to education. Thus, the spatial patterns in returns to education is one of the factors that determine the observed labor market outcomes observed in Sweden as well as many other countries where rural areas experience a drastic brain drain. Returns to education are, thus, location-specific regional features that shape the attractiveness of a location. Since returns to education change slowly over time, they are also semi-fixed from a spatial perspective.

The difference in returns to education is statistically significant and at a magnitude of approximately 2 percentage points. The Swedish educational system, decentralization of higher educational institutions, and a long tradition of wage equalization may smooth regional differences in returns to education. Given the institutional setting in Sweden, the regional differences in the returns to education strengthen the finding that location premiums are important. The result is most likely applicable in other countries where the wage differentials are not as compressed as in Sweden.

An additional reason for the low difference in the returns to education is that skilled individuals with a higher education are often compensated in rural municipalities for the lack of career opportunities and urban amenities. To have positive in-migration of highly educated individuals, wages must be increased. Thus, the results emphasize the well-established importance of firm demand factors such as agglomeration and knowledge spillovers in metropolitan regions. In addition, this paper emphasizes that other factors, such as the labor supply conditions in small peripheral regions, increase the returns to education—a point often neglected in other studies.

From a policy perspective, it is important to understand what might drives individuals to invest in more years of schooling because the public benefits from having access to educated individuals are well documented. One of the factors that influences the people's location choice is the return to education that they can obtain from their work. The return to education is mainly determined by an individual's characteristics, but the economic environment is also important and should be highlighted. By analyzing the regional returns to education in other countries, a more detailed picture of location-specific factors could be formed. It would then be possible to find patterns that are region- and/or location-specific instead of country-specific aggregates. It is also interesting to investigate the wage premium individuals experience as they move to more urban or more rural locations.

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APPENDIX

Table A1: Regression Results for Full Sample and Location Categories, Fixed-effects Estimation, 1998 to 2008. Dependent Variable: Labor Income (*ln*)

	<i>Full sample</i>	<i>Municipalities in metropolitan functional regions</i>	<i>Central municipalities in functional regions</i>	<i>Peripheral municipalities, larger functional regions</i>	<i>Peripheral municipalities, small functional regions</i>
Individual level variables					
<i>Education_{gt}</i>	0.036** (0.0002)	0.045** (0.0004)	0.032** (0.0004)	0.031** (0.001)	0.030** (0.001)
<i>Experience_{gt}</i>	0.036** (0.0001)	0.039** (0.0001)	0.035** (0.0001)	0.034** (0.0001)	0.033** (0.0002)
<i>Experience_{gt}²</i>	-4.01e-4** (0.00001)	-4.97e-4** (0.00001)	-3.58e-4** (0.00003)	-2.98e-4** (0.00003)	-2.92e-4** (0.00001)
<i>Commuting_{gt}</i>	0.016** (0.0004)	0.015** (0.001)	0.026** (0.001)	0.015** (0.001)	0.016** (0.002)
<i>Region dummy</i>	YES	NO	NO	NO	NO
<i>Industry dummy</i>	YES	YES	YES	YES	YES
<i>Firm size_{it} (ln)</i>	0.009** (0.0001)	0.009** (0.0001)	0.009** (0.0001)	0.010** (0.0002)	0.009** (0.0003)
Municipal level variables					
<i>Human capital_{st}</i>	0.321** (0.006)	0.087** (0.008)	0.289** (0.017)	0.343** (0.023)	0.741** (0.051)
<i>Intercept</i>	5.318** (0.003)	5.334** (0.006)	5.323** (0.005)	5.302** (0.006)	5.275** (0.009)
<i>R² (overall)</i>	0.04	0.04	0.05	0.05	0.06
<i>R² (within)</i>	0.45	0.42	0.49	0.50	0.52
<i>F-probability</i>	0.000	0.000	0.000	0.000	0.000
<i>N</i>	8,621,004	2,609,679	2,685,553	1,401,027	581,718
<i>Individuals</i>	905,892	358,862	277,177	141,569	57,751

**significant at one percent, *significant at five percent. Cluster standard errors at the municipal level in parentheses are to control for heteroskedasticity

Table A2: Pooled OLS and Random-effects Model, Full Sample and Location Categories, 1998 to 2008. Dependent Variable: Labor Income (*ln*)

	<i>Full sample</i>	<i>Municipalities in metropolitan functional regions</i>	<i>Central municipalities in functional regions</i>	<i>Peripheral municipalities, larger functional regions</i>	<i>Peripheral municipalities, small functional regions</i>
Pooled OLS					
<i>Education_{gt}</i>	0.076** (0.0001)	0.077** (0.0001)	0.071** (0.0001)	0.063** (0.0002)	0.057** (0.0002)
<i>Experience_{gt}</i>	0.006** (0.00001)	0.006** (0.0001)	0.006** (0.0001)	0.005** (0.0002)	0.005** (0.0001)
<i>Experience_{gt}²</i>	-3.20e-4** (0.00001)	-4.11e-4** (0.00001)	-3.03e-4** (0.00001)	-2.64e-4** (0.00001)	-2.58e-4** (0.00001)
<i>Male</i>	0.153** (0.0002)	0.170** (0.001)	0.166** (0.0004)	0.158** (0.001)	0.153** (0.001)
<i>R²</i>	0.38	0.39	0.39	0.36	0.35
Random-effects model					
<i>Education_{gt}</i>	0.046** (0.0001)	0.051** (0.0003)	0.040** (0.0003)	0.035** (0.0004)	0.030** (0.001)
<i>Experience_{gt}</i>	0.004** (0.00004)	0.005** (0.0001)	0.005** (0.0001)	0.004** (0.0001)	0.004** (0.0001)
<i>Experience_{gt}²</i>	-4.03e-4** (0.0001)	-5.03e-4** (0.00003)	-3.71e-4** (0.0001)	-3.12e-4** (0.0001)	-2.95e-4** (0.00001)
<i>Male</i>	0.143** (0.001)	0.168** (0.001)	0.163** (0.001)	0.154** (0.002)	0.147** (0.003)
<i>R² (overall)</i>	0.33	0.36	0.35	0.33	0.32
<i>R² (within)</i>	0.47	0.43	0.48	0.49	0.51

**Significant at one percent, * significant at five percent. Cluster standard errors at the municipal level in parentheses are to control for heteroskedasticity. The dummy scores 1 if the individual is male and 0 if female. The estimations include all independent variables as in Table 3, plus dummies controlling for country of origin.

Table A3: Fixed Effects, Sample Split on Gender and Location Categories, 1998 to 2008.
Dependent Variable: Labor Income (*ln*)

	<i>Full sample</i>	<i>Municipalities in metropolitan functional regions</i>	<i>Central municipalities in functional regions</i>	<i>Peripheral municipalities, larger functional regions</i>	<i>Peripheral municipalities, small functional regions</i>
Men					
<i>Education_{gt}</i>	0.036** (0.0003)	0.045** (0.0005)	0.033** (0.0004)	0.033** (0.0006)	0.030** (0.0008)
<i>Experience_{gt}</i>	0.038** (0.00001)	0.041** (0.0001)	0.038** (0.0001)	0.036** (0.001)	0.036** (0.0001)
<i>Experience_{gt}²</i>	-3.82e-4** (0.00001)	-4.95e-4** (0.00004)	-3.48e-4** (0.00001)	-2.91e-4** (0.00004)	-2.78e-4** (0.00001)
<i>Intercept</i>	5.356** (0.004)	4.904 (2.738)	5.602* (2.274)	5.358* (2.641)	3.789 (2.393)
<i>R² (overall)</i>	0.06	0.07	0.06	0.07	0.07
<i>R² (within)</i>	0.47	0.43	0.48	0.49	0.50
<i>N</i>	5 403 744	1 971 285	1 970 724	1 132 065	462 484
<i>Individuals</i>	500 914	179 208	179 158	102 915	42 044
Women					
<i>Education_{gt}</i>	0.039** (0.001)	0.044** (0.001)	0.036** (0.001)	0.037** (0.001)	0.037** (0.002)
<i>Experience_{gt}</i>	0.043** (0.0002)	0.046** (0.0002)	0.041** (0.0002)	0.040** (0.0002)	0.039** (0.0003)
<i>Experience_{gt}²</i>	-5.04e-4** (0.0001)	-5.54e-4** (0.0001)	-4.66e-4** (0.0001)	-4.33e-4** (0.0001)	-3.61e-4** (0.00001)
<i>Intercept</i>	5.100** (0.047)	5.112** (0.018)	5.100** (0.047)	-19.478 (12.938)	-10.265 (8.975)
<i>R² (overall)</i>	0.01	0.01	0.01	0.01	0.01
<i>R² (within)</i>	0.50	0.47	0.53	0.53	0.55
<i>N</i>	1,132,103	548,900	357,533	182,930	72,149
<i>Individuals</i>	105,009	49,900	32,503	16,630	6,559

**Significant at one percent, *significant at five percent. Cluster standard errors at the municipal level in parentheses are to control for heteroskedasticity. Estimations control for industry and municipality fixed effects. The estimations have also been performed for the period 1998-2007 to test if the crisis in 2008 had any effect on the estimations; the results are robust.