



# **Regional Development through the lens of New Economic Geography**

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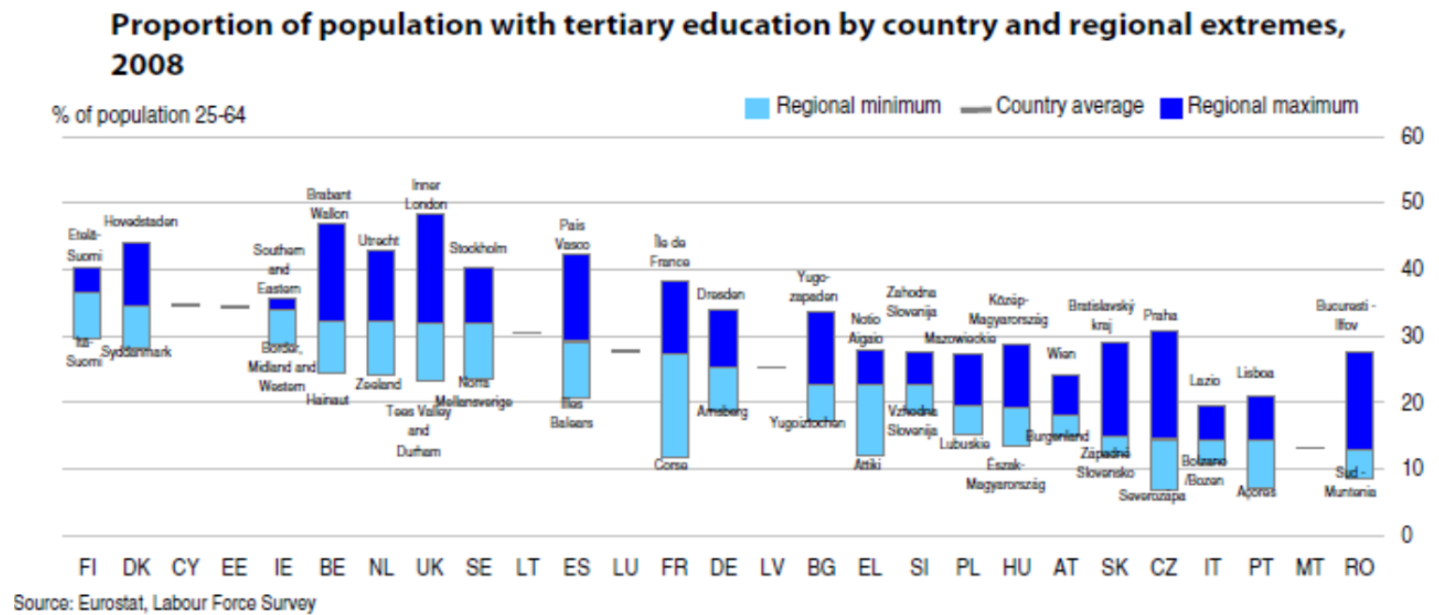
**Universidad de A Coruña  
C+D Research Group on Competition and Development**

## Outline of Presentation

1. Introduction
2. The Model
3. Model Implementation
4. Empirical Results
5. Concluding Remarks and Policy Implications

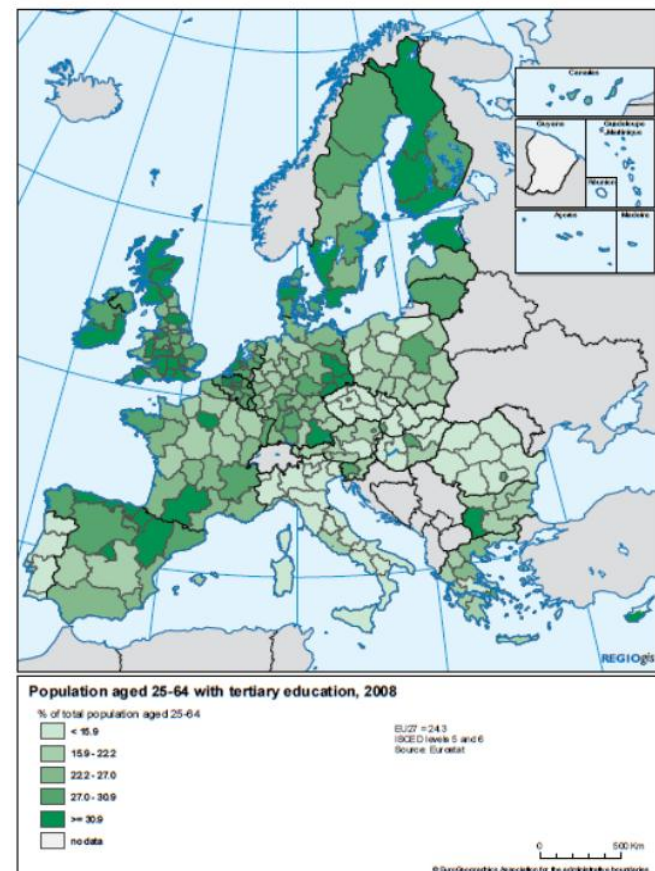
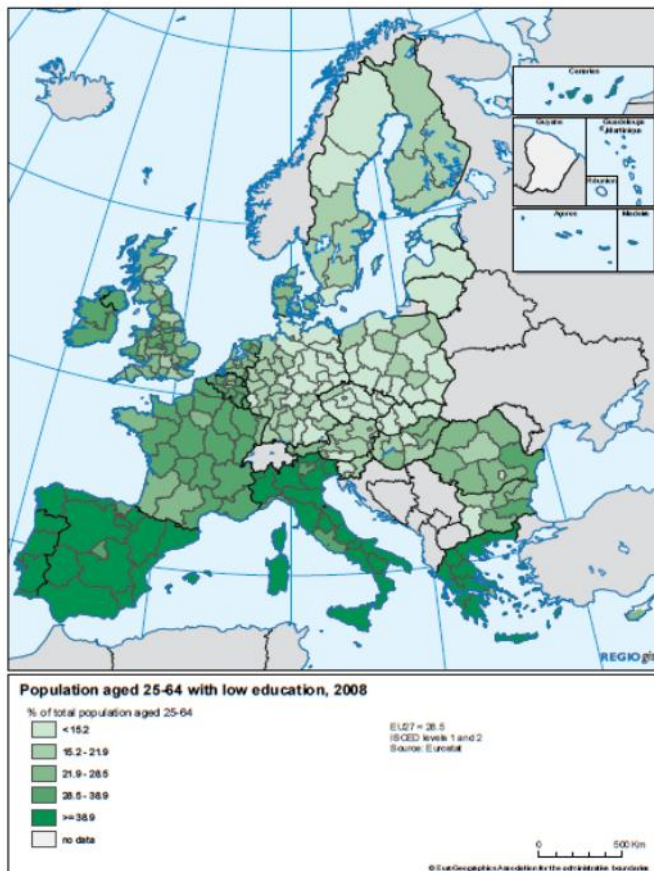
# 1. Introduction (I)

- Wide scholarly agreement on HC impact on economic growth and economic development
- Societies better endowed ....greater development potentials
- Europe is not an exception
  - Disparities across EU nations



# 1. Introduction (II)

## ➤ Disparities across EU regions



## 1. Introduction (III)

- ✓ Pioneering studies on the link between human capital and Economic performance (Barro, 1991; Mankiw et al., 1992) resorted to basic indicators of educational stock as proxies for the stock of human capital
- ✓ **The results of analyses using educational stocks are far from uncontroversial** (Levine and Renelt, 1992)
- ✓ Educational stock.....only one of the possible ways of assessing the impact of human capital on economic growth
- ✓ Educational stock (Informative about quantity and quality HR; less informative about usage HR)

## 1. Introduction (IV)

- ✓ Alternative measures of human capital in economic analyses (Benhabib and Spiegel, 1994; Krueger and Lindahl, 1998)
  - ✓ Indicators of the adjustment between educational supply and labour demand
  - ✓ the degree of employment of the best-qualified individuals
  - ✓ the level of migration, etc.
- ✓ These alternative measures are as important indicators of a society's capacity to transform human capital into economic growth, as is its educational stock
- ✓ The use of such indicators in growth models is far rarer (Haque and Kim (1994), Beine et al. (2001), Hanushek and Kim (1995), Murphy et al. (1991), Rodríguez-Pose, 1996, 1998, Rodríguez-Pose and Vilalta-Buffi, 2005)

# 1. Introduction (V)

**Table 1.** Human capital variables

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*Stock of human capital*

Ageduco*	Nat. logarithm of average age when the highest education level was completed
Hcsecon	% of respondents with secondary education completed
Hctert	% of respondents with tertiary education completed
Agefjob	Natural logarithm of the average age at which individuals began their first job
High-skill	% of individuals working in high skilled jobs
Proftec	% of professionals and technicians among employed people

*State of education*

Edutra	% of respondents who have been in education/training since January last year
Secondary	% of respondents currently in the second stage of secondary education
Tertiary	% of respondents currently in tertiary studies (not including vocational training)

*Matching education-labour market*

Training	% of workers that have had formal training related to present job skills
Provided <sup>Δ</sup>	% of workers with education or training provided by the employer
Postrain* <sup>Δ</sup>	% of workers who took training and who think that it was at least fairly useful
Yunemp	Youth unemployment on total unemployment (from Eurostat's Regio database)
Satisf*	% of respondents satisfied with work or main activity
Infraskill* <sup>Δ</sup>	% of workers who think they could do a more demanding job with their skills

*Migration*

Hcmigra	% of newcomers with high education
Jobmigr	% of respondents who moved recently for job-related reasons
Migra*	% of people who are now residents in a region but come from a foreign country

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(\*) data for Germany not available; (<sup>Δ</sup>) data for UK not available.

# 1. Introduction (VI)

$$\Delta GDP_{t-0} = \alpha + \beta_1 GDP_0 + \beta_2 stock_0 + \beta_3 state_0 + \beta_4 match_0 + \beta_5 migrat_0 + \varepsilon$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
<i>Constant</i>	-1.721** (0.830)	-1.348 (0.887)	-1.280 (0.902)	-1.824** (0.844)	-1.645* (0.823)	-1.226 (0.819)	-1.217 (0.846)	-1.670* (0.904)	-1.238 (0.810)	-1.150 (0.912)	-0.934 (0.841)	-0.413 (0.982)	-0.555 (0.887)
<i>GDP94</i>	2.698*** (0.835)	2.185** (0.942)	2.184** (0.942)	2.743*** (0.841)	2.457*** (0.843)	1.890** (0.866)	1.965** (0.892)	2.641*** (0.923)	2.068** (0.830)	1.787* (0.982)	1.541* (0.909)	0.899 (1.099)	1.083 (0.989)
<i>HCSecon</i>		0.136 (0.117)								0.049 (0.125)	-0.004 (0.119)	0.178 (0.117)	0.123 (0.118)
<i>HCTert</i>			0.071 (0.058)										
<i>Secondary</i>				0.058 (0.072)									
<i>Tertiary</i>					0.164 (0.114)								
<i>Training</i>						0.310** (0.130)				0.290** (0.142)	0.249* (0.138)		
<i>Satisf</i>							0.221* (0.112)					0.278** (0.118)	0.207* (0.114)
<i>Migra</i>								0.006 (0.039)		-0.003 (0.039)		0.022 (0.040)	
<i>HCMigra</i>									0.143** (0.057)		0.119** (0.058)		0.106* (0.060)
<i>R-sq.</i>	18.2%	20.5%	20.7%	19.3%	21.7%	27.1%	24.5%	18.2%	28.1%	27.4%	33.6%	29.4%	33.6%
<i>Adj. R-sq.</i>	16.4%	17.0%	17.3%	15.8%	18.3%	23.9%	21.2%	14.6%	25.0%	20.8%	27.5%	23.0%	27.6%

Dependent variable is Growth. Standard Errors in parenthesis. (\*\*\*) 1% significance level, (\*\*) 5% significance level, (\*) 10% significance level.



## 1. Introduction (VII)

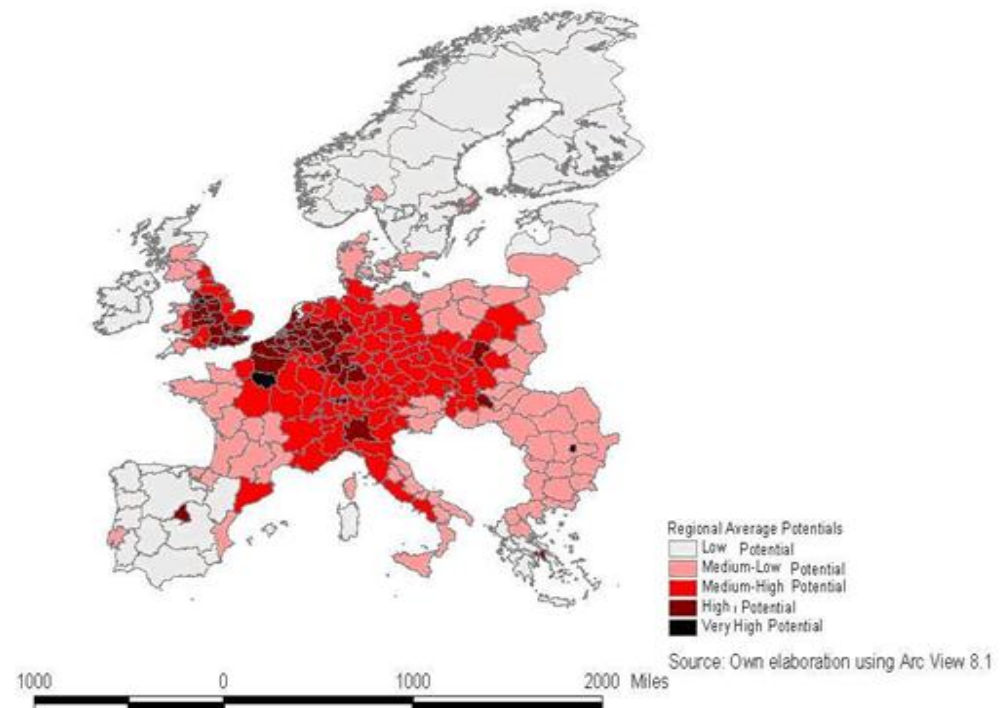
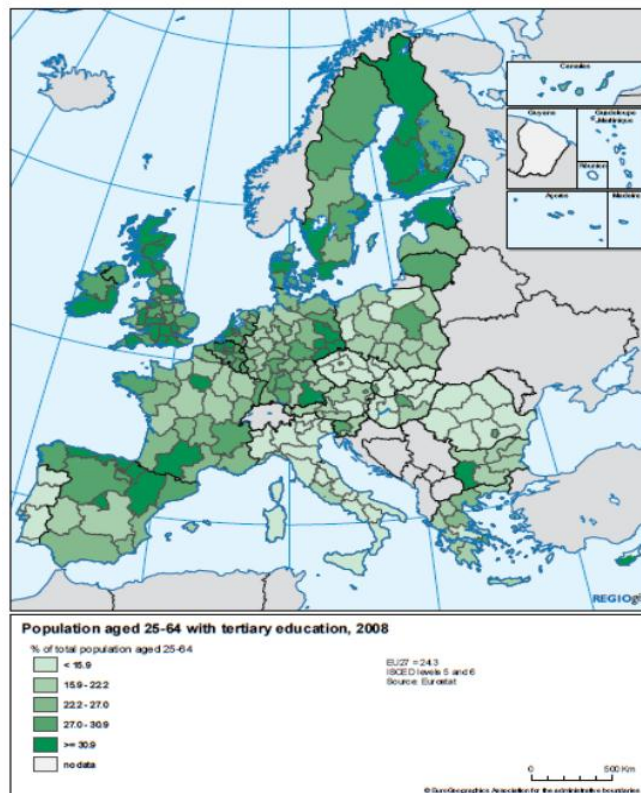
✓ **(C2) Controversy between stocks and attainment measures of HC when they are used to explain EU regional growth**

- ☐ Stocks more related to wealth
- ☐ Matching, migration, etc. more related to economic performance

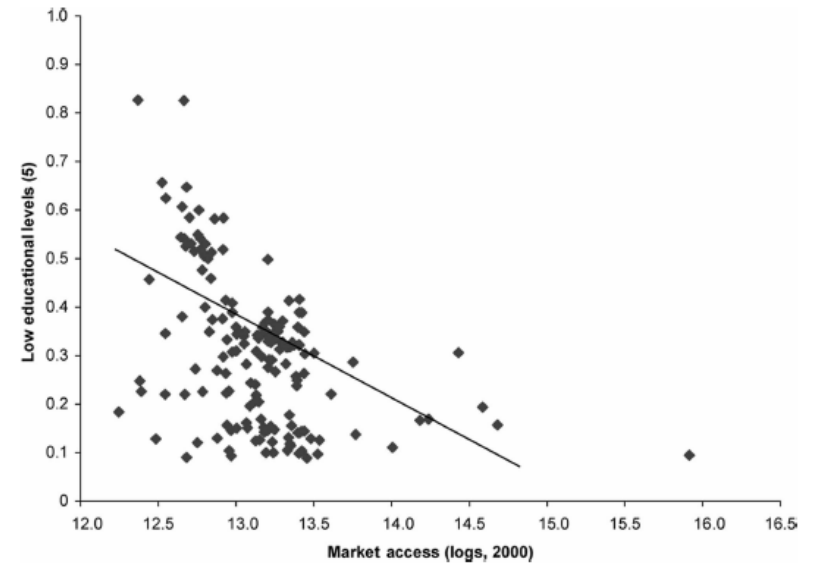
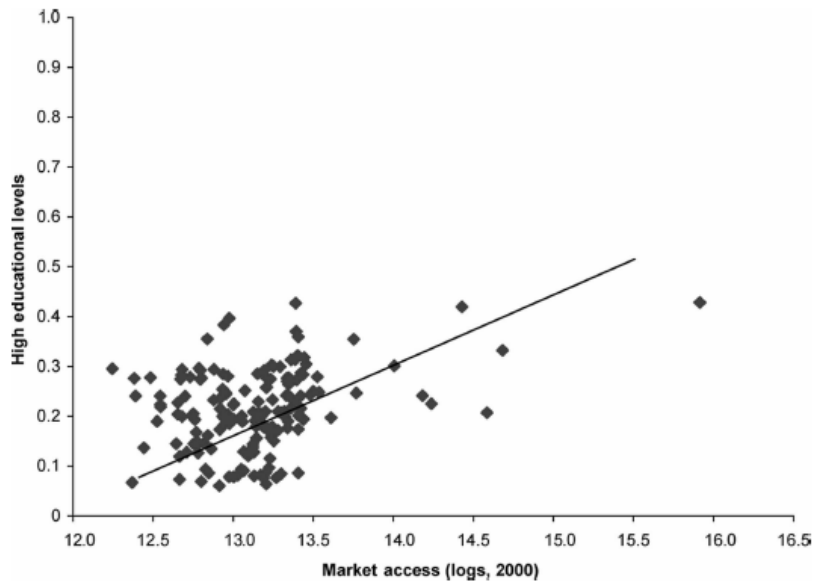
➤ **B. Geographical Economics and Human Capital**

# 1. Introduction (VIII)

## ➤ B. Geographical Economics and Human Capital 1. Europe



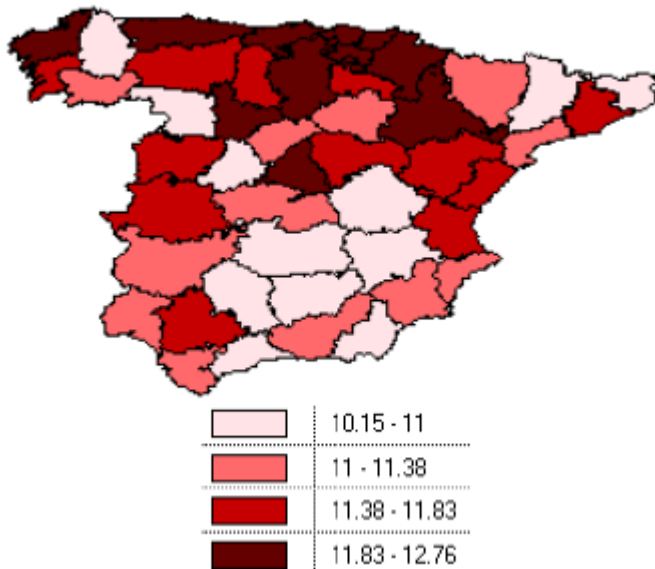
# 1. Introduction (IX)



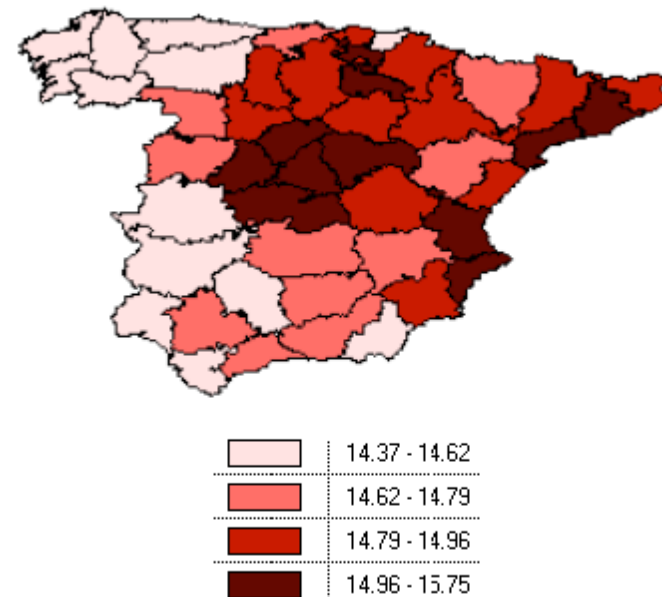
# 1. Introduction (X)

## 2. Spain

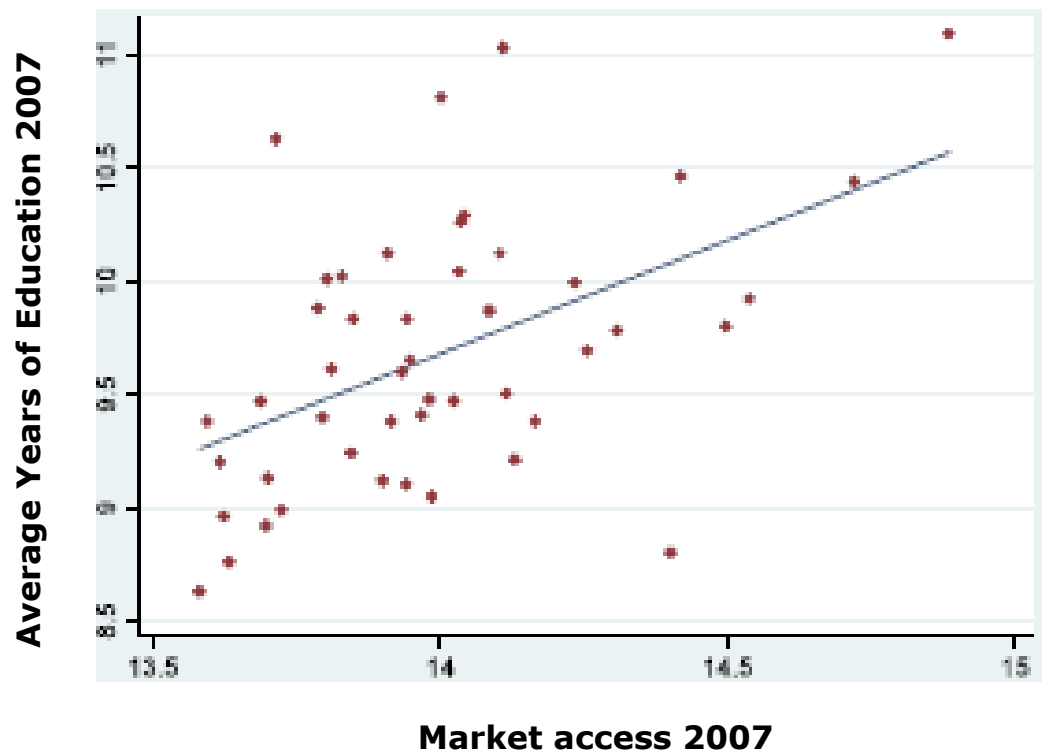
Average years of schooling – 2007



ln(Market access) - 2007



## 1. Introduction (XI)



## 2. The Model (I)

Extension of NEG model Fujita et al. (1999) (HC accumulation)

### ***2.1. Preferences and Endowments***

- World with  $j$  regions  $j \in \{1, \dots, R\}$
- Each region is endowed with a mass of  $L_j$  consumers
- Consumers have 1 unit of labour and choose endogenously to become or not educated
- Consumer preferences are identical and homothetic, and are defined over consumption of a homogenous agricultural good and a variety of differentiated manufacturing goods

## 2. The Model (II)

- Utility function  $U_j = A_j^\mu M_j^{1-\mu}$   $0 < \mu < 1$
- A agricultural good, M consumption index of differentiated manufacturing varieties

- $$M_j = \left[ \sum_{i=1}^R \int_0^{n_i} m_{ij}^C(z)^{\frac{\sigma-1}{\sigma}} dz \right]^{\sigma/\sigma-1} = \left[ \sum_{i=1}^R n_i (m_{ij}^C)^{\frac{\sigma-1}{\sigma}} \right]^{\sigma/\sigma-1}$$

- Elasticity of Substitution,  $\sigma > 1$
- Number of varieties,  $n_i$
- Amount of each variety produced in location i for final consumption in location j,  $m_{ij}^C$

## 2. The Model (III)

- Manufacturing goods price index

$$G_j = \left[ \sum_{i=1}^R \int_0^{n_i} p_{ij}^M(z)^{1-\sigma} dz \right]^{1/(1-\sigma)} = \left[ \sum_{i=1}^R n_i (p_{ij}^M)^{1-\sigma} \right]^{1/(1-\sigma)}$$

- Prices of individual varieties produced in location i and sold in location j,  $p_{ij}^M = p_i T_{ij}$
- $T_{ij}$  Trade costs (iceberg)

### **2.2. Production technologies**

- Agricultural sector produces an homogeneous agricultural good under CRS and perfect competition
- Manufacturing sector produces a differentiated good under IRS and imperfect competition



## 2. The Model (IV)

- PF Agri. Sector  $Y_i = \theta_i^Y (S_i^Y)^\phi (L_i^Y)^{1-\phi} \quad 0 < \phi < 1$
- $L_i^Y$  unskilled labour,  $S_i^Y$  skilled labour,  $\theta_i^Y$  productivity index
- Manuf. Sector  $\Gamma_i = (w_i^S)^\alpha (w_i^U)^\beta G_i^{1-\alpha-\beta} c_i [F + x_i]$
- $c_i$  constant marginal input requirement,  $c_i F$  fixed input requirement,  $x_i = \sum_{j=1}^R x_{ij}$  total output produced for all markets
- $w_i^S$  wages of unskilled workers (input share  $\alpha$ ),  $w_i^U$  wages of skilled workers (input share  $\beta$ )

## 2. The Model (V)

### 2.3. Human capital investment

- Cost of education.....function of unskilled labour
- $\Omega_i(z)$  units of unskilled labour needed to transform unskilled labour into skilled labour

$$\Omega_i(z) = h_i / a(z)$$

- $h_i$  Institutional environment and government policies
- $a(z)$  Individuals' ability
- Decision rule to educate  $w_i^S - w_i^U \geq \Omega_i(z)w_i^U = h_i / a(z) w_i^U$

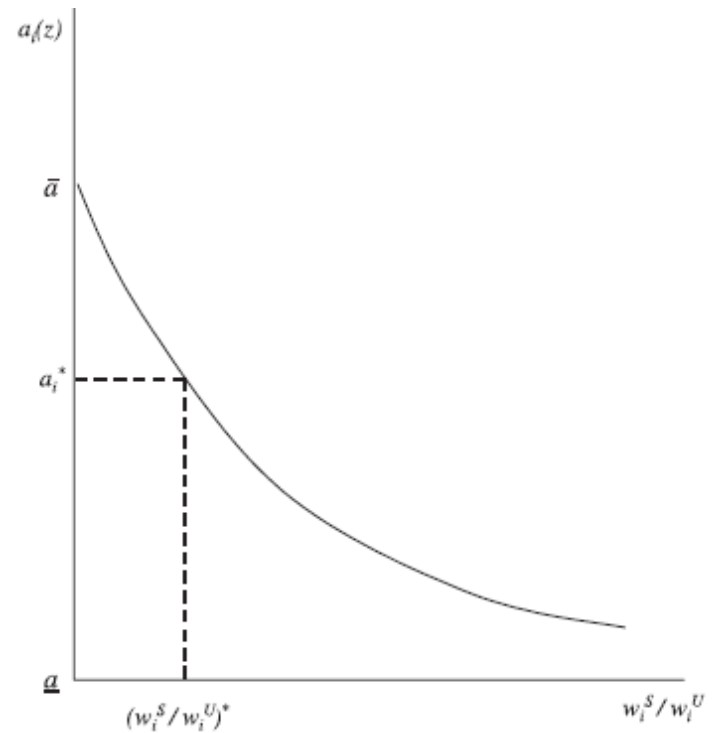
## 2. The Model (VI)

### 2.4 General Equilibrium

#### 2.4.1 Equilibrium supply of skills

- *Skill indifference condition*

$$a_i^* = \frac{h_i}{\left( \frac{w_i^S}{w_i^U} - 1 \right)}$$



## 2. The Model (VII)

### 2.4.2 Producer Equilibrium

- Agricultural Sector: Profit Maximization (Price=unit costs of production)

$$P_i^Y = 1 = \frac{1}{\theta_i^Y} (w_i^S)^\phi (w_i^U)^{1-\phi}$$

- Manufacturing Sector: Profit Maximization

$$\Pi_i = \sum_{j=1}^R \frac{P_{ij}^M x_{ij}}{T_{ij}^M} - (w_i^S)^\alpha (w_i^U)^\beta G_i^{1-\alpha-\beta} c_i (F + x_i)$$

- 1OC (Nominal Wage Equation)

$$(w_i^S)^\alpha (w_i^U)^\beta = \xi \frac{1}{c_i} (MA_i)^{\frac{1}{\sigma}}$$

$$\xi = \frac{\sigma - 1}{\sigma}$$

$$MA_i = \sum_{j=1}^R (T_{ij}^M)^{1-\sigma} E_j G_j^{\sigma-1}$$

## 2. The Model (VIII)

### 2.4.3 Equilibrium relationship between geographical location and endogenous human capital investment

- Differentiate zero profit conditions :

$$0 = \phi \frac{dw_i^S}{w_i^S} + (1 - \phi) \frac{dw_i^U}{w_i^U} \quad \alpha \frac{dw_i^S}{w_i^S} + \beta \frac{dw_i^U}{w_i^U} = \frac{1}{\sigma} \frac{dMA_i}{MA_i}$$

- Manufacturing sector skill-intensive relative to agricultural sector the new equilibrium must be characterized by a lower relative wage of skilled workers

- Proof:

$$\frac{dw_i^U}{w_i^U} = \frac{\phi}{(1 - \phi)} \frac{dw_i^S}{w_i^S} \quad \left( \alpha - \frac{\beta\phi}{1 - \phi} \right) \frac{dw_i^S}{w_i^S} = - \left[ \frac{1}{\sigma} \right] \gamma$$

$$\left( \alpha - \frac{\beta\phi}{1 - \phi} \right) > 0 \quad \Longleftrightarrow \quad \frac{\alpha}{\beta} > \frac{\phi}{1 - \phi}$$

$$\frac{dw_i^U}{w_i^U} > 0 \quad \frac{dw_i^S}{w_i^S} < 0$$

$$\frac{d\left(\frac{w_i^S}{w_i^U}\right)}{\frac{w_i^S}{w_i^U}} < 0$$

## 2. The Model (IX)

### Summary of theoretical model

- i. If market access falls and the manufacturing sector is relative intense in skilled labor, the model features a relative lower wage for skilled labor
- ii. A relatively lower salary for skill workers reduces the incentives to become skilled and to invest in HC
- iii. The Equilibrium levels of HC and the share of skill workers is lower in peripheral locations
- iv. **Remoteness is a handicap for human capital investment**

### 3. Model implementation(I)

- In this section we check whether the human capital implications of the model are supported by the Romanian data.

$$Ln(EA_i) = \alpha_0 + \alpha_1 \ln(MA_i) + \varepsilon_i$$

{	$EA_{it}$	Educational attainment
	$MA_i$	Market Access
	$\varepsilon_i$	Error term

$$Ln(EA_i) = \alpha_0 + \alpha_1 \ln MA_i + \sum_{n=1}^N \gamma_n X_{i,n} + \varepsilon_i$$

{	$X_{in}$	Control variable
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We also report the results of one alternative estimation based on transformations in the definition of the dependent variable:

1. Dependent variable is average years of schooling

### 3. Model implementation(II)

**Regional System**  
Romanian Counties  
(42 counties)

$$\log(EA_i) = \alpha_0 + \alpha_1 \log[MA_i] + \varepsilon_i$$

**Educational Attainment**  
**Levels** <sub>2006</sub> (from INSSE)

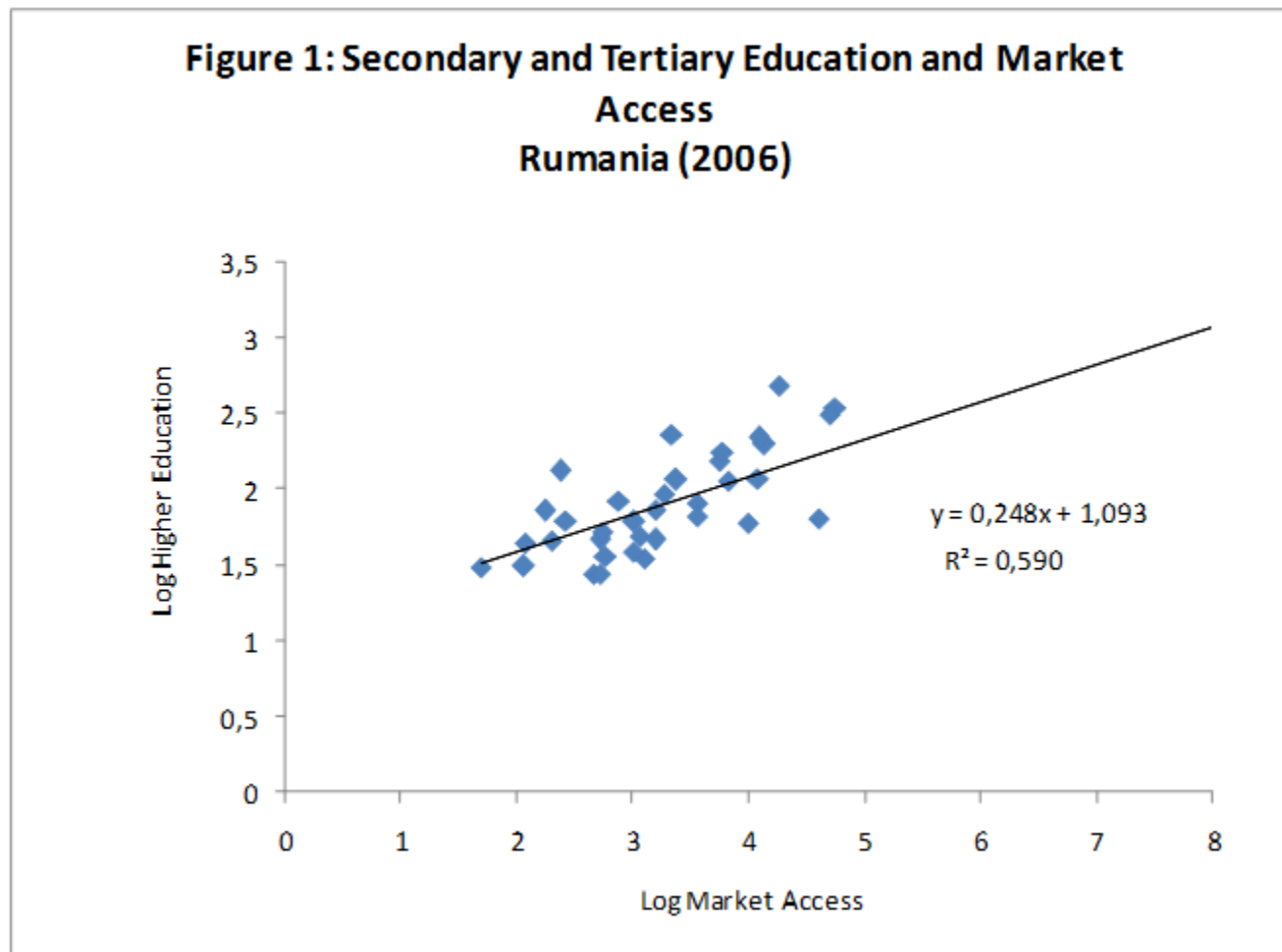
**Market Access (MA)**: proxy for access to sources of expenditure.  
Computed as a distance weighted sum of regional GDPs:

$$MA_i = \sum_{j=i}^n \frac{GDP_j}{d_{i,j}}$$

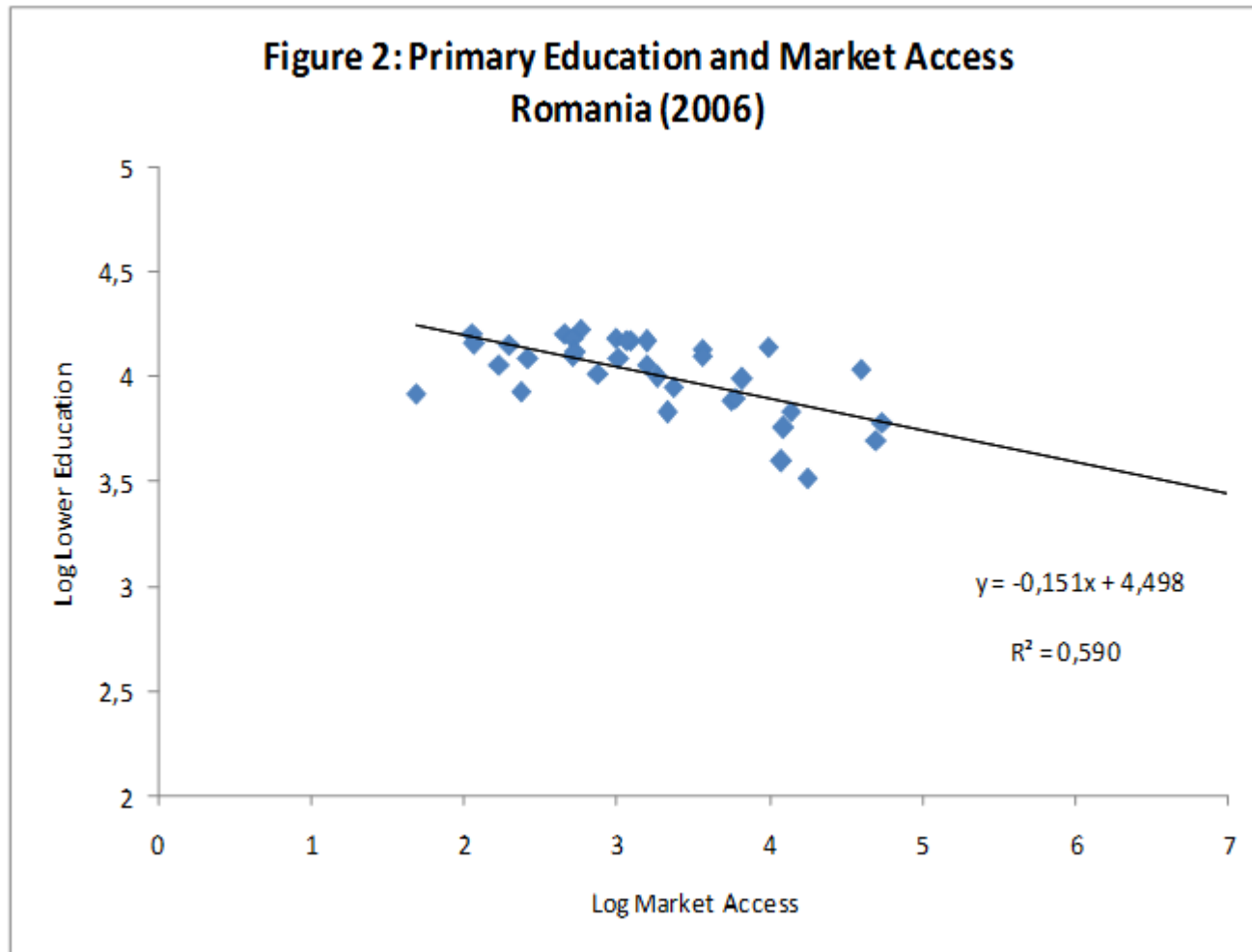
$GDP_j$  Gross Domestic Product of region j  
 $d_{ij}$  Distance between i and j ;  $d_{ii}=0.66 (Area/n)^{1/2}$   
 $n$  Measures the number of regions considered



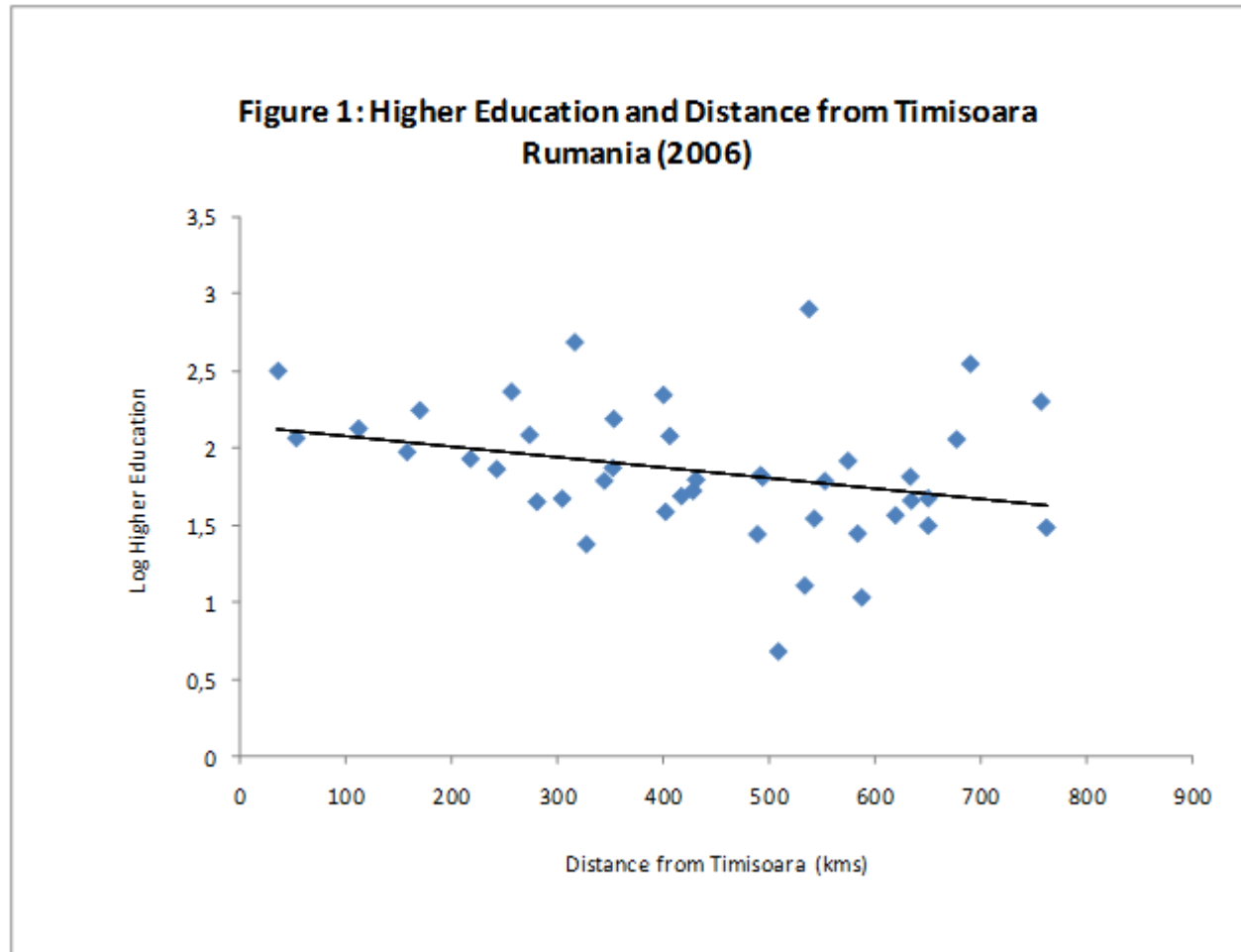
## 4. Empirical Results (I)



## 4. Empirical Results (II)



## 4. Empirical Results (III)



## 4. Empirical Results (IV)

**Table 2: Market Access and Educational Levels: Baseline Estimations  
Romania (2006)**

Dep. Variable	<i>log Higher Education</i>			<i>Log Lower Education</i>	
	(1)	(2)	(3)	(4)	(5)
Regress.					
Constant	1.09 <sup>*</sup> (0.16)	1.20 <sup>**</sup> (0.16)	2.14 <sup>**</sup> (0.16)	4.49 <sup>**</sup> (0.07)	4.54 <sup>**</sup> (0.09)
MAGDP06	0.25 <sup>**</sup> (0.03)	0.22 <sup>**</sup> (0.04)		-0.15 <sup>**</sup> (0.02)	-0.17 <sup>**</sup> (0.02)
Dist.Timisoara			-0.0007 (0.000)		
Est.	OLS	IV	OLS	OLS	IV
Inst. variables					
First stage R2		0.62			0.62
R2	0.59	0.58	0.09	0.59	0.59
J-Statistic					
Prob (F-statistic)	0.00	0.00	0.00	0.00	0.00
N.obs.	42	42	42	42	42

Note: Table displays coefficients and Huber-White heterocedasticity robust standard errors in parenthesis, \*\* indicates coefficient significant at 0.01 level ,

"First stage" R2 is the R2 from regressing market access on the instruments set, Instruments: Distance to Timisoara and region size

Source: Own Elaboration

## 4. Empirical Results (V)

**Table 3: Market Access, Regional Dummies, Educational Levels and Average Years of Education Romania (2006)**

Dep. Variable	<i>Log Lower Education</i>	<i>log Higher Education</i>	<i>log Higher Education</i>	<i>Average Years Education</i>
Regress.	(1)	(2)	(3)	(4)
Constant	4.53** (0.09)	0.92** (0.16)	-2.24 (3.65)	6.01** (0.35)
MAGDP06	-0.15** (0.02)	0.30** (0.05)	0.13** (0.06)	0.60** (0.10)
R&D Expenditure			0.08** (0.03)	
Average Montly Earnings			0.43 (0.54)	
Ethnic minorities			0.004** (0.002)	
Regional Dummies	yes	yes	yes	no
Est.	IV	IV	OLS	OLS
Inst. variables				
First stage R2		0.62		
R2	0.59	0.61	0.68	0.51
J-Statistic				
Prob (F-statistic)	0.00	0.00	0.00	0.00
N.obs.	42	42	42	42

**Note:** Table displays coefficients and Huber-White heterocedasticity robust standard errors in parenthesis, \*\* indicates coefficient significant at 0.01 level, "First stage" R2 is the R2 from regressing market access on the instruments set, Instruments: Distance to Timisoara and region size  
Source: Own Elaboration

## 4. Empirical Results (VI)

**Table 4: Romanian Higher Education as a function of market access: TSLS instrumental variable regression (2006)**

Dep. Variable	<i>log Higher Education</i>							
Regress.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	1.16** (0.44)	1.09** (0.12)	1.14** (0.13)	1.12** (0.13)	0.41** (0.15)	-4.5 (2.61)	-4.5 (2.64)	-1.15 (0.70)
MAGDP06	0.23** (0.09)	0.25** (0.03)	0.23** (0.04)	0.24** (0.04)	0.24** (0.07)	0.12** (0.04)	0.12** (0.05)	0.21** (0.09)
R&D Expenditure						0.07** (0.02)	0.08** (0.02)	0.05** (0.02)
Average Monthly Earnings						0.73** (0.3)	0.74** (0.3)	0.23** (0.11)
Ethnic minorities						0.003* (0.001)	0.003* (0.001)	0.002 (0.002)
Regional Dummies	no	no	no	no	no	yes	yes	yes
<b>Instruments</b>								
1995 Market Access	yes			yes		yes	yes	
1853 commercial route mean distance		yes			yes			yes
Terrain Ruggedness			yes	yes	yes		yes	yes
First stage R2	0.90	0.25	0.19	0.93	0.40	0.95	0.96	0.71
First stage F-test	336.46	150.25	140.77	258.49	189.45	107.51	122.19	10.91
Hansen J Statistic (p-value)	Exactly identif	Exactly identif	Exactly identif	0.49	0.56	Exactly identif	0.47	0.52
N.obs.	42	42	42	42	42	42	42	42
R2	0.58	0.59	0.59	0.59	0.55	0.77	0.77	0.74

Note: Table displays coefficients and Huber-White heterocedasticity robust standard errors in parenthesis, \*\* indicates coefficient significant at 0.01 level, \* denotes statistical significance at 10% level, "First stage" R2 is the R2 from regressing market access on the instruments set, Instruments: 1995 market access (col 1 and col 6), 1853 commercial route mean distance (col 2), ruggedness index (col 3), 1995 market access and ruggedness index (col 4 and col 7), ruggedness index and 1853 commercial route mean distance (col 5 and col 8)

Source: Authors' Elaboration

## 5. Concluding Remarks

- Empirical evidence of a spatial educational attainment structure in Romania
- Penalty of remoteness for human capital accumulation
- Penalty for the economic development and convergence Romanian Counties
- Policy implications

**THANK YOU FOR YOU ATTENTION!**