Chapter 9

The Economic Geography of Most North-Western Region of Spain: Galicia and the Effect of Market Access on Regional Development Levels

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Additional information is available at the end of the chapter

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Abstract

This chapter estimates the nominal wage equation of the geographical economics literature using data on the Galician regions over the period 2003–2013. The results of the estimations show the existence of a spatial wage structure across the Galician regions with a clear West-East gradient. Additionally, we have controlled for the inclusion of potential covariates that might be influencing the levels of regional per capita income such as educational attainment levels and technological levels. The results are robust to these alternative estimations

Keywords: regional economics, market potential, Galicia, center-periphery, geographical economics

1. Introduction

Economic activities tend to cluster in space (Florence [1]; Hoover [2]; Fuchs [3]; Enright [4]; Ellison and Glaeser [5]; Dumais et al. [6]; Porter [7]). Hall and Jones [8] note that high-income countries are concentrated in small areas in the northern hemisphere and that per capita productivity declines as the distance to cities in New York, Brussels and Tokyo increases. The theory of the new economic geography (NEG) (Krugman [9, 10]) also known as geographic economy (Brakman et al. [11]) has emerged as a very prominent branch within the space economy to analyze the concentration of economic activity in space and the center-periphery patterns that present economic activities at different levels of spatial aggregation. In this theoretical context, Redding and Venables [12] reached a conclusion similar to that of Hall and Jones [8] when estimating the nominal wage equation for a world sample of countries.

Breinlich [13], Bruna et al. [14], Lopez-Rodriguez and Faiña [15], among others, resorting to geographic economics literature, also show that the spatial distribution of income in European regions follows a clear center-periphery pattern. At the country level, the concentration of economic activity was also widely covered and analyzed by geographic economics literature (see Fally et al. [16]; Lopez-Rodriguez and Nakamura [17]; Mion [18]). The concentration of economic activity is also manifested at levels of aggregation below the national scale such as at regional level within each country, suggesting that the location of economic activities in space has a fractal character. Therefore, forces similar to those that operate when we study concentration patterns worldwide or at European level could be relevant to explain the location of economic activities at smaller scales. In this chapter, we intend to apply the geographical economy literature approach to help understand the disparities in per capita income levels observed in the Galician regions over the period 2003–2013. The rest of the chapter is structured as follows: Section 2 presents the theoretical foundations of the center-periphery model of economic geography. Section 3 contains the econometric specifications, the data source, and the construction of the variables. Section 4 presents the results of the estimates and unravels the channels of influence by examining possible cofactors that could affect per capita income levels at the county level and which are related to the market potential and, finally, Section 5 contains a summary of the main contributions of the chapter.

2. Theoretical background: the nominal wage equation of the core-periphery geographical economics models

The so-called "wage equation" of the NEG (multiregional version of Krugman 1991 model)[1] relates the regional wages with the size of the markets available to each region. It explains the equilibrium nominal wages in the manufacturing sector of each region *i* (*wi*) as a weighted sum of the volume of economic activity in the surrounding locations $j = 1,\ldots,R$. More specifically, on one hand it takes into account the region *j*'s volume of demand of individual manufacturing varieties. This element is the quotient between their demand of manufacturing goods ($\mu j E j$) and an index capturing the level of competition in *j*'s market (Sj), where Ej and μj are *j*'s total expenditure and manufacturing share of expenditure, respectively. On the other hand, the second element determines *j*'s demand of the specific variety produced in region *i*. It is the transport cost from region *i* to *j* destination (Tij), to the power of one minus the elasticity of substitution among the varieties of industrial goods ($\sigma > 1$) or range of product differentiation. A market-clearing condition defines the wage equation:

$$w_i = \left[\sum_{j=1}^{R} \frac{E_j \mu_j}{S_j} T_{i,j}^{1-\sigma} \right]^{1/\sigma} = [HMP_i]^{1/\sigma} \qquad (1)$$

In the geographical economics literature, the right-hand side of Eq. (1) is referred to as market access (Redding and Venables [12]) and real market potential (see Head and Mayer [20]).

[1]Other related NEG models can be seen in Fujita et al. [19].

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This simplification of the nominal wage equation is very similar to the Harris [21] market potential function in the sense that economic activity is more important in those regions which are close to large markets.

3. Econometric specifications

If we take logarithms in expression (1), the cross section estimate of the nominal wage equation for the regions $i = 1, \ldots, n$ is based on the estimation of the following expression:

$$lnw_i = \alpha + \beta \ln HMP_i + u_i \tag{2}$$

where u_i is the error term that reflects the effects of the omitted variables and therefore the deviations of the assumptions raised in the theoretical model, and the other variables correspond to the definitions given in the previous sections. Eq. (1) relates the nominal wage in region i to income in other regions, weighted by distance.

However, the estimation of Eq. (1) could be simply capturing a correlation with omitted variables such as infrastructure, human capital, levels of innovation, and so on. Therefore, to avoid these problems, we carried out an estimation of an extended regression equation of the following type:

$$lnw_i = \alpha + \beta \ln HMP_i + \sum_{n=1}^{N} \gamma_{in} X_{in} + u_i \tag{3}$$

where X_{in} is a vector of control variables and γ_{in} are the coefficients associated to the vector of control variables.

Eqs. (2) and (3) have an intercept (α) that collects all model parameters that are assumed to be common to all regions.

If we generalize the notation of the econometric version of the cross section estimates Eqs. (2) and (3) to a notation for the estimation of the previous equations using panel data and assuming that we have T periods, the expressions would be

$$lnw_{it} = \alpha + \beta \ln HMP_{it} + u_{it} \tag{4}$$

$$lnw_{it} = \alpha + \beta \ln HMP_{it} + \sum_{n=1}^{N} \gamma_{int} X_{int} + u_{it} \tag{5}$$

4. Data source and variable construction

The data used for the estimation of Eqs. (2)–(5) are data collected for 53 regions in which Galicia is divided during the years 2003–2014. The data come from different statistical sources: Socio-Economic Atlas Caixanova (2005–2009), Galician Institute of Statistics (IGE, in

Galician[2]), Michelin guide online,[3] Ministry of Finance and Public Administration, Survey of Infrastructure and Local Equipment, Bank of Spain, and Continuous Register of Inhabitants.

In relation to the dependent variable, wages, these have been approached using both nominal per capita income and per capita income in constant terms of 2006. This approach is frequent in the geographic economy literature (Redding and Venables [12]; Brakman et al. [22]). In a more precise way, the variables are as follows:

1. Nominal per capita income (Y): represents annual GDP per capita at the county level expressed in euros in current terms for the period 2003–2014. Sources: Socio-Economic Atlas Caixanova (2005–2009) and Galician Institute of Statistics (IGE).

2. Real per capita income (YR): Represents annual real per capita GDP at the county level (expressed in constant euros (base 2006)). Sources: Authors' calculations based on data on nominal per capita income along with the 2006 base CPI provided by the Instituto Galego de Estatística (GCE) for each of the years of the specified period.

With respect to the key variable in the estimation of the nominal wage equation, the market potential, we use the market potential definition of Harris [21] to construct this variable. The way in which the market potential of Harris [21] is constructed using the inverse of the distance as a weighting scheme allows one cross section to be compared for different periods of time. Both Head and Mayer [23] and Breinlich [13] obtain similar results in their estimates of the nominal wage equation for European regions by using both the measures derived from the structural equation of the center-periphery model of the geographic economy and the measure more ad hoc of the market potential of Harris [21]. Although the geographic economy framework remains here as a starting point, the use of Harris''s market potential [21] allows us to focus on the effects that the relative location of some regions in relation to others has on the levels of local per capita income. Therefore, for each region we construct an index of market potential that considers the sum weighted by the distance of the volume of economic activity *Mj* in the adjacent regions. The weighting scheme is a function that decreases with the increase in the distance between the locations *i* and *j*. The distance between places *i* and *j* (d_{ij}) is to be measured in two different ways:

a. On the one hand, the distances between regions *i* and *j* are approximated considering the kilometers that separate the capitals of the regions *i* and *j*. The use of physical distances can represent not only trade costs but also "relative" trade costs (Yotov [24]) and capture non-trade barriers (Linders et al. [25]) and spillovers.

b. On the other hand, we also consider the distance expressed in terms of time necessary to cover the distance separating the capitals of regions *i* and *j*. This weighting scheme allows controlling for the quality of the infrastructure, since two regions for which the physical distance is the same can have different access times depending on the quality of the infrastructure, physical geography of the region, and so on, and therefore the level of centrality of the region could be biased in case of using a weighting based only on the

[2]Website of the Galician Institute of Statistics (IGE): http://www.ige.eu/
[3]Website of the Michelin Guide: http://www.viamichelin.es/

distance expressed in kilometers. For the calculation of the access times between regions, the information obtained from the website of the Michelin Guide has been used by choosing the route that represents the shortest time.

The calculation of the local market potential has a domestic or internal component (market potential created by the region itself) and an external one (market potential created by the rest of the regions that compose our space analysis unit). In relation to domestic market potential, we need to know the internal distance within each region (d_{ii}). The standard methodology assumes that the spatial units (in our case the regions) are circular and the internal distance is approximated by a function that is proportional to the square root of the area of each region. Taking into account that we consider the circle-shaped space units, the radius of region i is $r_i = \sqrt{\text{area}_i/\pi}$. In this chapter, two measures of internal distance are used to build the domestic market potential. On the one hand, the work of Keeble et al. [26] chooses as measure of internal distance $d_{ii} = 1/3r_i = 0.188\sqrt{\text{area}_i}$ to allow the potential concentration of economic activity in and around the center. On the other hand, the formulation was followed by other authors such as Crozet [27], Head and Mayer [28], and Nitsch [29] as internal distance measure $d_{ii} = 2/3r_i = 0.376\sqrt{\text{area}_i}$. The calculation of the domestic market potential by approaching internal distances to Keeble et al. [26] increases the role of the internal market compared to the use of the 2/3 approximation of the radius used by other authors. Cambridge Econometrics [30] also calculates the internal distance between the regions of the European Union by approximating it by 40% of the radius, therefore its weighting is between the two measures used in this chapter.

If we exclude domestic market potential (DMP_i) in our formulation of market potential, we would be including measurement errors since we are substantially reducing the contribution that the most economically important regions are generating to the market potential indicator (Breinlich [13]; Head and Mayer [23]). A problem arising from its inclusion is that it aggravates the endogeneity problem associated with the use of the potential market variable in our estimates. Taking into account, on the one hand, what was commented earlier, and that according to the structural equation of the geographical economy model it is necessary to measure the accessibility of the companies to all the markets and considering that for each region i the companies have access to R-1 markets Potential within the community, the market potential of Harris [21] for each time period $t = 1, \ldots, T$ can be formulated mathematically so as to separate the domestic or internal component and the external component:

$$HMP_{it} = \sum_{n=1}^{N} \frac{M_{jt}}{d_{ij}} = \frac{M_{it}}{d_{ii}} + \sum_{j\neq 1}^{R-1} \frac{M_{jt}}{d_{ij}} = DMP_{it} + FMP_{it} \tag{6}$$

The second addend of the market potential expression of Harris [21] has received different names in the literature, "non-local" market potential (Head and Mayer [23]), "surrounding" (Blonigen et al. [31]), or "foreign" (Brakman et al. [22]).

The Harris approach has been widely used in regional economics. One of the reasons is that it offers a way to capture the first Law of Geography of Tobler [32], which would be quoted later by the literature of Space Econometrics: "everything is related to everything else, but things nearby are more related than things far away." In the 1990s, Krugman's [9, 10] works in the field of international economics and geographic economics using general equilibrium frameworks provided the microeconomic foundations for the physical analogies of the Harris' [21] indicator (see Krugman [9, 33]).

In this chapter, we have approximated the variable that collects the economic activity M_j through different proxies:

a. Nominal GDP of each region.

b. Real GDP of each region.

c. Population of each region.

As variables of control, we have decided to incorporate variables that include aspects related to human capital (HSESCOL) and technological capital of each of the regions (PCTADSL). In addition, we have also controlled by the percentage of banking offices per region (POFB) as well as by the percentage of companies dedicated to the manufacturing activities in information and communication technologies (ICT) (PEMTIC). We believe that all these variables could be affecting the per capita income values of the different regions through market potential. The definition of these control variables is as follows:

1. PEMTIC: number of companies dedicated to the ICT manufacturing activities on the population of each region (number of companies/1000 inhabitants). It includes the following headings of the 1993 CNAE: 300 (manufacture of office machines and computer equipment); 313 (manufacture of insulated electrical wires and cables); 321 (manufacture of valves, tubes, and other electronic components); 322 (manufacture of radio and television transmitters and devices for radiotelephony and radiotelegraphy with wires); 323 (manufacture of sound, video recording, and reproducing devices); 332 (manufacture of instruments and devices for measuring, checking, controlling, navigating, and other purposes, other than control equipment for industrial processes); 333 (manufacture of industrial process control equipment). It includes the following sections of the CNAE 2009: 261 (manufacture of electronic components and printed circuits assembled); 262 (manufacture of computers and peripheral equipment); 263 (manufacture of communications equipment); 264 (manufacture of electronic consumer appliances); 268 (manufacture of magnetic and optical media). The time period analyzed includes from 2003 to 2007 and the years 2010 and 2012). Source: Own elaboration based on the classification according to the definition of ICT in WPIIS (2002 and 2007) and the data extracted from the Directory of companies and local units (IGE).

2. HSESCOL: Represents the percentage of students enrolled in second-level studies in general-regime centers (excluding adult mode) divided by the population of theoretical age to take these studies (region population between 12 and 18 years old). Secondary studies include compulsory secondary education (ESO in Spain), ordinary higher secondary-education course, basic vocational training, ordinary medium-level training courses, ordinary higher-level training courses, and professional qualification programs. The data

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available for this variable are for the periods 2005–2012. Source: Own elaboration based on the data extracted from the statistics of non-university education in Galicia, an operation facilitated by the Department of Culture, Education and University Management and the Continuous Register of Inhabitants (IGE).

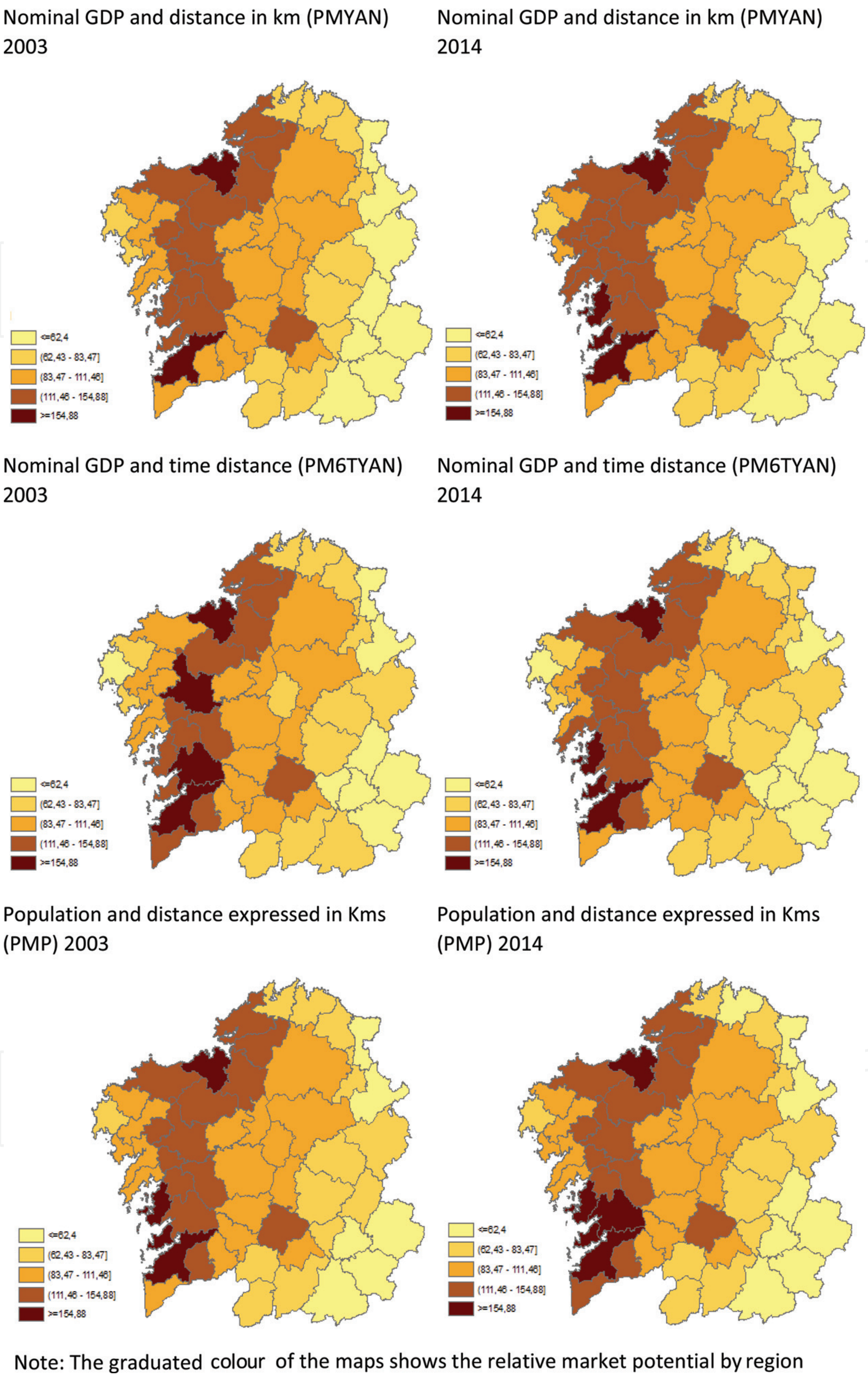
3. POFB: Represents the percentage of offices of credit institution on the inhabitants of each district (credit entities/100 inhabitants). Source: Own elaboration based on the data provided by the Statistical area of the Bank of Spain (as of December 31) and Continuous Register of Inhabitants, on January 1 of the following year (IGE). The data available for this variable are for the 2005–2012 periods except for 2008, 2009, and 2011.

4. PCTADSL: Represents the percentage of homes with access to the wireless network. This is the best known network (Asymmetric Digital Subscriber Plan). It combines the virtualities of RTB and ISDN so that it soon became the most popular type of connection. It takes advantage of the wiring of the RTB and offers a greater speed, although the speed of descent (discharge of files of Internet) is greater than that of rise. Bandwidth can be reduced by user location. Maximum theoretical bandwidth: 8 Mbps. The data available for this variable correspond to the years 2005, 2010, and 2012. Source: Infrastructure and Local Equipment Survey prepared by the Ministry of Finance and Public Administration. Municipalities with more than 50,000 inhabitants do not fall within the scope of the survey.

All control variables are ratios for which population data have been used from the statistical exploitation of the 2001 and 2011 censuses and the Continuous Register of Inhabitants.

5. Empirical results

The set of maps represented in **Map 1** represents the relative market potential of each Galician region in 2003 and 2014 (Galicia = 100) using different variants when calculating market potential. The first two maps are used to construct the index of market potential nominal GDP and the regional distance expressed in kilometers between capitals of each comarca; the following two maps use the same indicator of the volume of economic activity, nominal GDP, but the distance is expressed in minutes of travel using the shortest route provided by the Michelin guide between the capitals of the regions, and finally the last two maps use the population as an indicator of the volume of economic activity and the regional distance expressed in kilometers between the capitals of each region. As can be seen in all maps, Galicia has a clear center-periphery structure. The market potential in the more Western regions is greater than the market potential in the more Eastern regions. Therefore, there is a clear west-east gradient in the total market potential regardless of the reference year. Nevertheless, if we compare the evolution in time of the west-east gradient of 2003 with that of 2014 of the first two maps and of the last two, we observed in both cases a slight increase of the same. The evolution of the gradient when we measure accessibility in terms of travel time between regions seems to follow a more stable pattern.



Map 1. Local market potential based on nominal GDP and population in relation to the distance between regions 2003 and 2014 (Galicia = 100). Source: See the text.

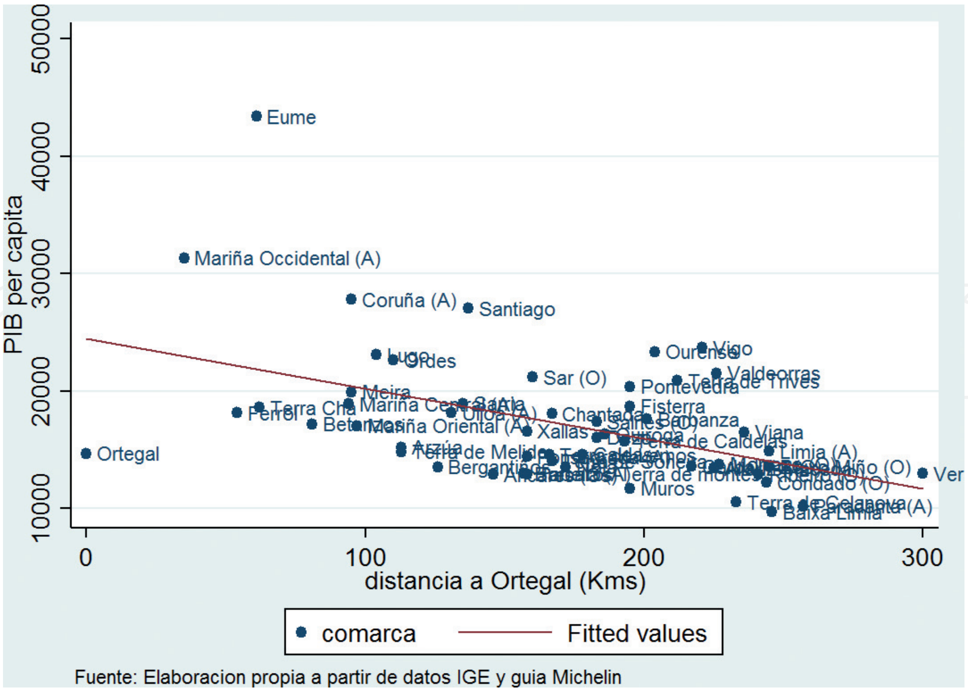


Figure 1. GDP per capita and distance to Ortegal (2012).

The “center-periphery” structure we have represented in terms of market potential (**Map 1**) can also be visualized through a clear spatial gradient for county per capita income levels.

Figure 1 shows the regional per capita income in relation to the distance to the region of Ortegal, a region located in the northwest of the province of A Coruña. The results clearly show that as we move away from the Ortegal region, the average per capita income level (on average) decreases.

Finally, **Figures 2** and **3** show the existence of a positive relationship between the market potential values at the county level and the per capita income levels in the county for both 2003 and 2014. It is, therefore, corroborated from the graphical point of view that the Galician counties with a greater market potential are also the regions that have the highest levels of income per capita. It can be observed that the relationship is robust and is not due to the influence of a few regions.

This “center-periphery” spatial pattern observed at the regional level for Galicia is commonly observed when reference is made to the analysis of the spatial distribution of income in broader geographical environments, for example, for the analysis of countries around the world (Lopez-Rodriguez et al. [34]), regions (NUTS2) within countries (see Lopez-Rodriguez et al. [35]), regions of Europe (see Lopez-Rodriguez and Faiña [36], Lopez-Rodriguez et al. [37]).

The objective of finding a causal relationship between these two variables, market potential and levels of per capita income shown in **Figures 2** and **3** and which has its theoretical basis in the literature of geographical economics, constitutes the central core of the analysis that we carry out in the following sections of this chapter.

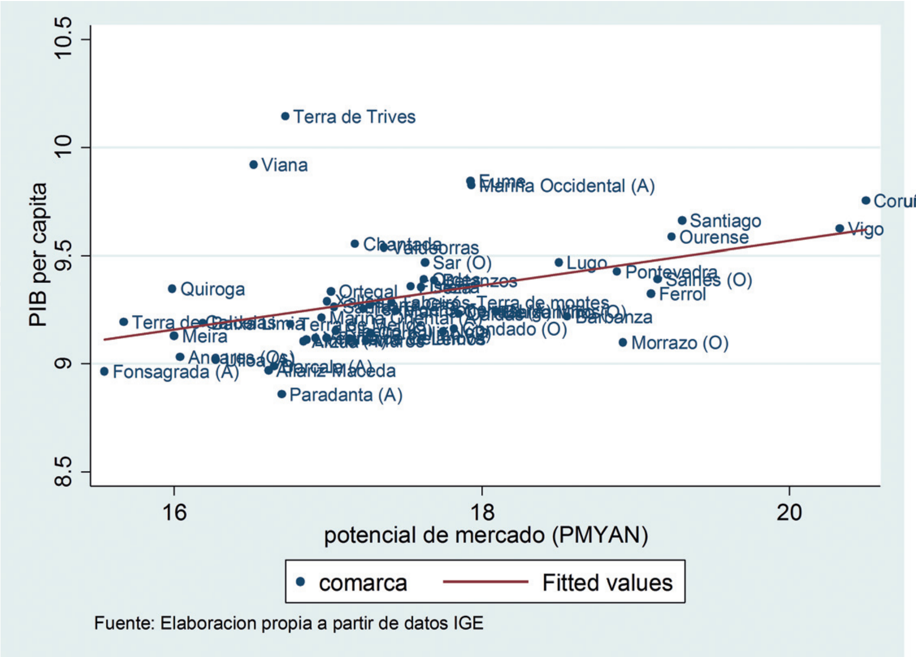


Figure 2. GDP per capita and market potential (2003).

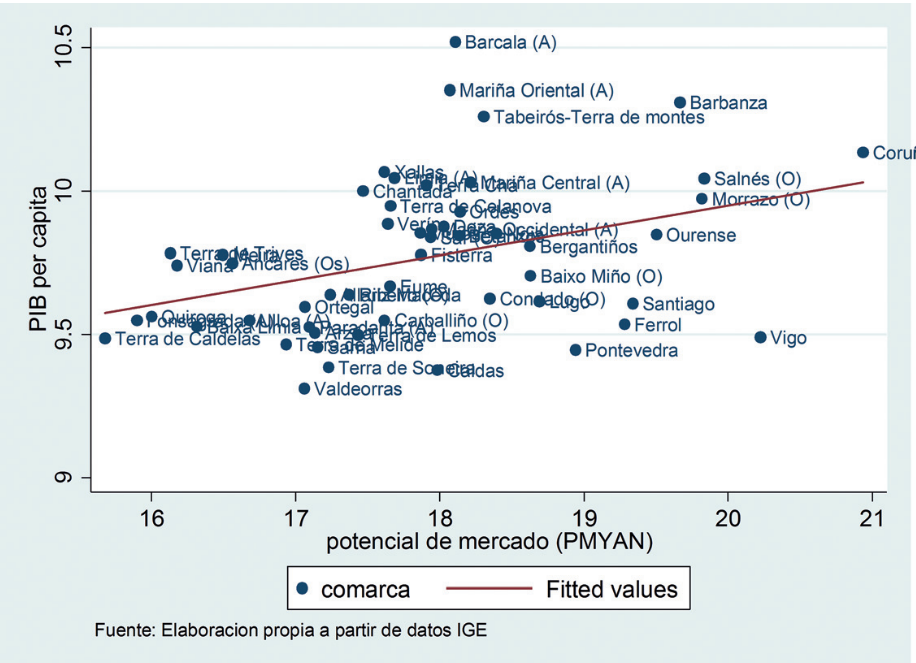


Figure 3. GDP per capita and market potential (2014).

6. Unraveling channels of influence: preferred estimates

Although the list of potential variables that affect local per capita income levels can be very numerous, for the analysis carried out in this chapter we have chosen to include those variables whose influence may be affected by our market potential indicators. Among the variables

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chosen as control variables are, on the one hand, educational levels (HSESCOL). In relation to educational levels, and from a theoretical point of view, Redding and Schott [38] derive a theoretical relationship between human capital and market potential within a center-periphery model of geographic economy. According to these authors, those locations that have high levels of market potential provide long-term incentives for the accumulation of human capital, basically through an improvement in pay schemes for workers with higher qualification levels. Redding and Schott [38] obtain these results in the case that intermediate goods and goods in transport costs are also the relatively more intensive goods in the use of qualified human capital. The theoretical predictions derived from the Redding and Schott [38] model have been contrasted by the same authors using a worldwide sample of countries. Additionally, Lopez-Rodriguez et al. [35, 37] conducted estimations of the Redding and Schott [38] model for the regions of the European Union and for the case of the Romanian regions and Can Karahasan and Lopez-Bazo [39] for the case of the Spanish provinces. In all these cases, the results obtained show that the locations with greater market potential have a greater incentive to the accumulation of qualified human capital. Breinlich [13] and Bruna et al. [40] also use human capital as control in estimating the nominal wage equation for the regions of the European Union.

As can be seen in **Figures 4** and **5**, human capital stocks are highly correlated with market potential, also for the case of the regions in Galicia (at least for our analysis period). These graphs represent the students enrolled in secondary studies over the proportion of students from each region in theoretical age to study those studies for the years 2005 (**Figure 4**) and 2012 (**Figure 5**).

Other variables incorporated as controls are the percentage of dwellings within each region with access to the ADSL communications network (PCTADSL) and the number of companies engaged in the ICT manufacturing industries (PEMTIC). Finally, the number of bank offices

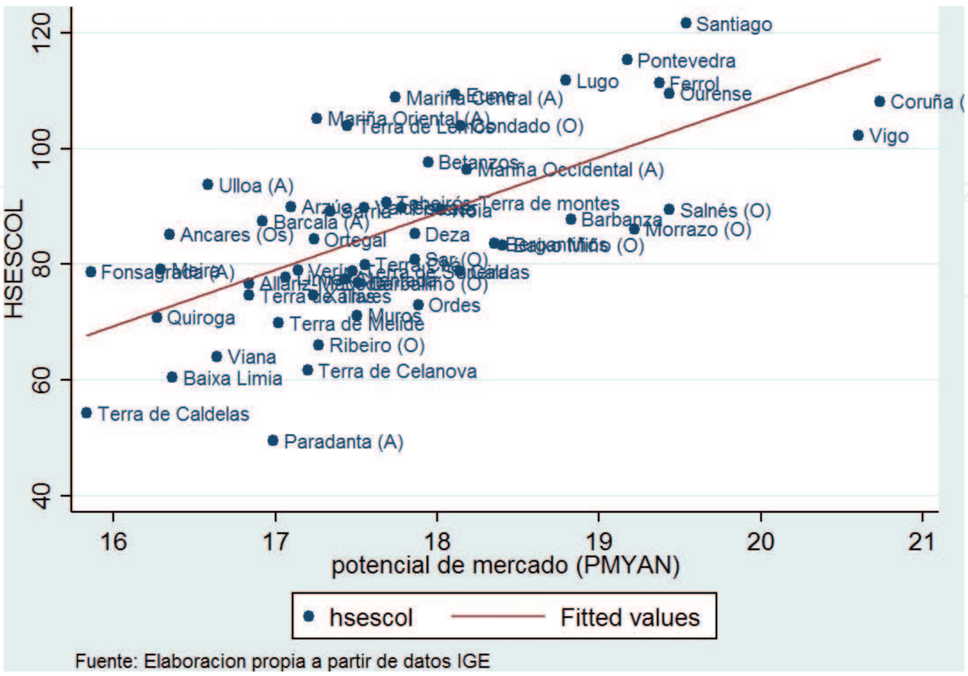

Figure 4. Market potential and high-school student ratio (2005).

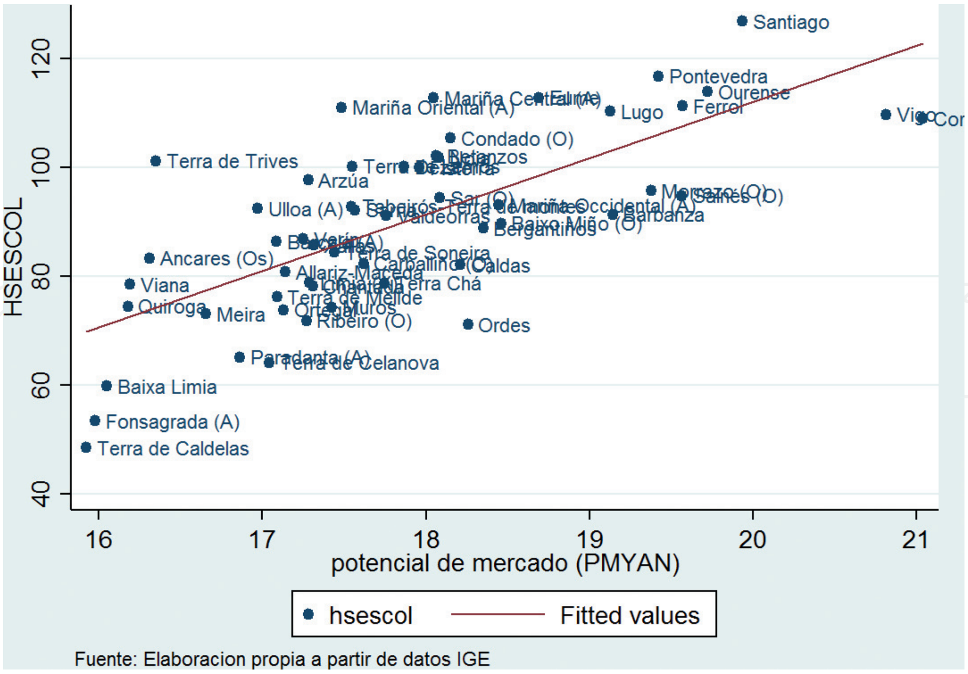

Figure 5. Market potential and high-school student ratio (2012).

per 100 inhabitants (POFB) is also included as a control variable. In this case, the banking offices are usually located according to profitability criteria where they have access to a greater potential number of clients. The market potential as an indicator of accessibility is also guiding the size of the potential demand of each region and therefore a positive relationship between the two variables.

Taking these results into account, one way of unraveling the effects of market potential on local per capita income levels is to incorporate human capital into our initial estimates as an additional regressor. If human capital is included in our initial regressions and they maintain the positive and statistically significant coefficient of market potential, it would mean that the potential market variable is really important in determining income levels for the regions in Galicia.

Table 1 presents the results of the combined effects of market potential, human capital, percentage of banking offices over the county population, percentage of households in the region with ADSL lines, and percentage of companies in the medium- and high-technology sectors over the level of income per capita. For the estimates in column 1, the market potential is constructed using the regional GDP aggregate in constant euros of 2006 as a variable that approximates the economic activity, and the distance between regions is approximated by the distance in kilometers between the capitals of the regions calculating the internal distance with expression $d_{ii} = 2/3r_i = 0.376\sqrt{\text{area}_i}$. In column 2, the market potential is constructed using the regional GDP aggregate in euros constant of 2006 as variable that approximates the economic activity, and the distance between regions is approximated by the distance in kilometers between the capitals of the regions calculating the internal distance with the expression $d_{ii} = 1/3r_i = 0.188\sqrt{\text{area}_i}$. In column 3, the market potential is constructed using the local population as a variable that approximates economic activity, and the distance between

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Dependent variable	**Log of per capita income**			
Regressors	**(1)**	**(2)**	**(3)**	**(4)**
Constant	5.88** (1.10)	5.68** (0.90)	7.59** (0.62)	7.56** (0.51)
HSESCOL	0.01** (0.00)	0.01** (0.00)	0.01** (0.00)	0.01** (0.00)
POFB	3.72** (0.59)	3.75** (0.57)	3.55** (0.61)	3.59** (0.59)
PCTADSL	0.0015** (0.0005)	0.0016** (0.0005)	0.0015** (0.0005)	0.0015** (0.0005)
PEMTIC	0.30** (0.11)	0.27* (0.11)	0.32** (0.11)	0.32** (0.11)
PMYAR	0.13* (0.05)			
PM3YAR		0.14** (0.04)		
PMP			0.08* (0.06)	
PM3P				0.08* (0.05)
Estimate	PLS	PLS	PLS	PLS
R^2	0.44	0.45	0.42	0.43
R^2 adjusted	0.42	0.43	0.41	0.41
Prob. (*F*-statistic)	0.00	0.00	0.00	0.00
Number of observations	159	159	159	159

Note: The table shows the coefficients for LS estimates and robust standard errors for Huber-White heteroskedasticity in parentheses. HSESCOL represents the proportion of the population enrolled in secondary studies on the theoretical population of the age to study these studies; POFB, percentage of bank offices, PCTADSL, percentage of households with access to ADSL network; PEMTIC, number of ICT companies; PMYAR, PM3YAR, PMP, and PM3P are the market potentials of the period 2003–2013 according to the details given in the text. For data sources, see text * and ** mean statistical significance at the levels of 10 and 5%, respectively.

Table 1. Unraveling the channels of influence of market potential (2003–2013): distance in km.

regions is approximated by the distance in kilometers between the capitals of the regions, calculating the internal distance with the expression $d_{ii} = 2/3r_i = 0.376\sqrt{\text{area}_i}$. Finally, in column 4 the market potential is constructed using the local population as a variable that approximates economic activity and the distance between regions is approximated by the distance in kilometers between the capitals of the regions, with the internal distance being calculated with the expression $d_{ii} = 1/3r_i = 0.188\sqrt{\text{area}_i}$

The results of the estimates of the first two columns show that, despite the inclusion of control variables, the coefficient associated with market potential continues to show a positive and statistically significant value at the 5% level. In addition, the magnitude of the coefficient still shows a high degree of stability compared to the results obtained in the previous estimates with a value in the environment of 0.13–0.14. Human capital and other control variables are statistically significant at the 5% level and the signs are in line with both theoretical predictions and economic intuition. The results of the estimates presented in columns 3 and 4 show that the market potential is not statistically significant at the 5% level.

We also proceeded to repeat the estimates in **Table 1** using as a distance indicator, in relation to the construction of the potential market variable, the distance measured in minutes of access between the capitals of each region taken from the Michelin Guide and measuring the distance within each region as the necessary minutes to travel the same at three different speeds, 60, 80, and 100 km/h. The variable used to approximate the economic activity in all the estimates has been the aggregate GDP in euro constant in 2006. The results of these estimates are presented in **Table 2**.

The results show that there are no significant changes in relation to previous estimates. Irrespective of whether the construction of the market potential indicator is made taking into account access times between regions, the market potential coefficient remains in line with the theoretical predictions of the geographic economy model and the variable is shown to be statistically significant. In addition, the coefficient shows a great stability around the value 0.13 for all the estimates.

Dependent variable	**Log of per capita income**					
Regressors	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Constant	6.01** (1.14)	5.81** (0.92)	5.91** (1.05)	5.82** (0.83)	5.84** (0.98)	5.85** (0.78)
HSESCOL	0.01** (0.00)	0.01** (0.00)	0.01** (0.00)	0.01** (0.00)	0.01** (0.00)	0.01** (0.00)
POFB	3.68** (0.59)	3.72** (0.57)	3.71** (0.57)	3.73** (0.56)	3.72** (0.56)	3.73** (0.56)
PCTADSL	0.0016** (0.0005)	0.0017** (0.0005)	0.0016** (0.0005)	0.0017** (0.0005)	0.0016** (0.0005)	0.0017** (0.0005)
PEMTIC	0.29* (0.11)	0.27* (0.11)	0.27** (0.01)	0.26* (0.11)	0.27* (0.11)	0.25* (0.11)
PM6TYAN	0.12* (0.06)					
PM6T3YAN		0.13** (0.06)				
PM8TYAR			0.13** (0.05)			
PM8T3YAR				0.13** (0.04)		
PM10TYAR					0.13** (0.05)	
PM10T3YAR						0.13** (0.04)

Dependent variable	Log of per capita income					
Regressors	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Estimate	PLS	PLS	PLS	PLS	PLS	PLS
R^2	0.43	0.45	0.44	0.45	0.44	0.46
R^2 adjusted	0.41	0.43	0.42	0.43	0.42	0.44
Prob. (*F*-statistic)	0.00	0.00	0.00	0.00	0.00	0.00
Number of observations	159	159	159	159	159	159

Note: The table shows the coefficients for LS estimates and robust standard errors for Huber-White heteroskedasticity in parentheses. HSESCOL represents the proportion of the population enrolled in secondary studies on the theoretical population of the age to study these studies; POFB, percentage of bank offices, PCTADSL, percentage of households with access to ADSL network; PEMTIC, number of ICT companies; PM6TYAN, PM6T3YAN, PM8TYAR, PM8T3YAR, PM10TYAR, PM10T3YAR are market potentials for the 2003–2013 periods calculated according to the details given in the text. For data sources, see text * and ** mean statistical significance at the levels of 10 and 5%, respectively.

Table 2. Unraveling the channels of influence of market potential (2003–2013): distance in time.

Tables 3 and **4** present the estimates corresponding to **Tables 1** and **2** but using five time delays of the market potential variable to control for the potential problems of endogeneity between our dependent variable and our main regressor.

Dependent variable	Log of per capita income			
Regressors	**(1)**	**(2)**	**(3)**	**(4)**
Constant	6.28** (0.14)	6.00** (0.11)	7.59** (0.64)	7.55** (0.52)
HSESCOL	6.28** (0.14)	0.01** (0.00)	0.01** (0.00)	0.01** (0.00)
POFB	3.89** (0.73)	3.96** (0.70)	3.55** (0.61)	3.59** (0.59)
PCTADSL	0.0023** (0.0006)	0.0024** (0.0006)	0.0015** (0.0005)	0.0015** (0.0005)
PEMTIC	0.47** (0.14)	0.45** (0.14)	0.33** (0.11)	0.32** (0.11)
L5.PMYAR	0.10 (0.07)			
L5.PM3YAR		0.12** (0.05)		
L5.PMP			0.08 (0.06)	
L5.PM3P				0.09 (0.05)

Dependent variable	Log of per capita income			
Regressors	**(1)**	**(2)**	**(3)**	**(4)**
Estimate	PLS	PLS	PLS	PLS
R^2	0.52	0.53	0.42	0.43
R^2 adjusted	0.50	0.51	0.40	0.41
Prob. (*F*-statistic)	0.00	0.00	0.00	0.00
Number of observations	106	106	159	159

Note: The table shows the coefficients for MCO estimates and robust standard errors for Huber-White heteroskedasticity in parentheses. HSESCOL represents the proportion of the population enrolled in secondary studies on the theoretical population of the age to study these studies; POFB, percentage of bank offices, PCTADSL, percentage of households with access to ADSL network; PEMTIC, number of ICT companies; L5.PMYAR, L5.PM3YAR, L5.PMP, and L5.PM3P are the market potentials of the periods 2003–2013 lagged five periods. For data sources, see text * and ** mean statistical significance at the levels of 10 and 5%, respectively.

Table 3. Unraveling the channels of influence of market potential (2003–2013): lags and distance in kilometers.

Dependent variable	Log of per capita income					
Regressors	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Constant	6.48** (1.43)	6.12** (1.15)	6.27** (1.31)	6.10** (1.04)	6.17** (1.22)	6.12** (0.97)
HSESCOL	0.01** (0.00)	0.01** (0.00)	0.01** (0.00)	0.01** (0.00)	0.01** (0.00)	0.01** (0.00)
POFB	3.85** (0.74)	3.93** (0.71)	3.89** (0.72)	3.94** (0.70)	3.92** (0.71)	3.96** (0.69)
PCTADSL	0.0024** (0.0006)	0.0024** (0.0006)	0.0024** (0.0006)	0.0024** (0.0006)	0.0024** (0.0006)	0.0024** (0.0006)
PEMTIC	0.47** (0.14)	0.44** (0.14)	0.45** (0.14)	0.43** (0.14)	0.45** (0.14)	0.43** (0.14)
L5.PM6TYAR	0.09 (0.07)					
L5.PM6T3YAR		0.11 (0.06)				
L5.PM8TYAR			0.103 (0.06)			
L5.PM8T3YAR				0.11** (0.05)		
L5.PM10TYAR					0.11* (0.06)	
L5.PM10T3YAR						0.11** (0.05)

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Dependent variable	Log of per capita income					
Regressors	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Estimate	PLS	PLS	PLS	PLS	PLS	PLS
R^2	0.52	0.53	0.52	0.53	0.52	0.53
R^2 adjusted	0.49	0.50	0.50	0.51	0.50	0.51
Prob. (F-statistic)	0.00	0.00	0.00	0.00	0.00	0.00
Number of observations	106	106	106	106	106	106

Note: The table shows the coefficients for MCO estimates and robust standard errors for Huber-White heteroskedasticity in parentheses. HSESCOL represents the proportion of the population enrolled in secondary studies on the theoretical population of the age to study these studies; POFB, percentage of bank offices, PCTADSL, percentage of households with access to ADSL network; PEMTIC, number of ICT companies; L5.PM6TYAN, L5.PM6T3YAN, L5.PM8TYAR, L5. PM8T3YAR, L5.PM10TYAR, and L5.PM10T3YAR are the market potentials of the period 2003–2013 lagged five periods. For data sources, see text * and ** mean statistical significance at the levels of 10 and 5%, respectively.

Table 4. Unraveling the channels of influence of market potential (2003-2013): Lags and distance in time.

The results of the estimates show that the market potential is shown to be positive and statistically significant at the 5% level in those estimates where the domestic market potential is calculated through the approximation to the internal distances within each region as $d_{ii} = 1/3r_i = 0.188\sqrt{\text{area}_i}$

This would be showing that the estimates are sensitive when defining the domestic market potential in the composition of the total market potential of each region. In other words, the relative importance of the region's own activity in relation to the construction of market potential is very relevant.

Finally, the results of this set of regressions confirm the results of the theoretical model and thus show that market potential is an important variable when analyzing the difference in per capita income levels in the regions of Galicia. On the other hand, our results point to the fact that human capital could be playing an important role in the determination of income levels in the Galician regions.

7. Conclusions

In this chapter, we have presented a standard center-periphery model of geographical economics and estimate the so-called nominal wage equation using data from the regions of Galicia for the periods 2003–2013. The main results of the estimates are in line with the theoretical predictions of the model, showing that there is a spatial structure of per capita income levels in the Galician regions. The results of the initial estimates of per capita income levels against market potential have shown that even by controlling for variables that are influenced by market potential, it continues to play an important role in explaining per capita income disparities in Galicia. The results of the estimates have been tested for robustness to control for endogeneity problems by means of past-value estimates (market potential lags) to control for the problems arising from shocks associated with spatially correlated variables, but inter-temporally not correlated. The results of these alternative estimates have also shown that market potential remains positive and statistically significant in the explanation of per capita income levels in the Galician regions. In addition, to unravel the effects of the variables that work through accumulation incentives and that could therefore be linked to the market potential (human capital case), we have extended the base estimates by incorporating as a control in the estimates a proxy for the human capital defined as the proportion of secondary school students over the school-age population of the region. In addition, other control variables such as percentage of banking offices, households with access to ADSL, and percentage of ICT companies within each region were added to the initial estimate. The results of the estimates have shown that the market potential is still relevant in the determination of the levels of income per capita.

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