

# Navigating the Geography of Regional Disparities: Market Access and the Core-Periphery Divide

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## Abstract

This paper investigates the impact of market proximity on subnational development world-wide, considering the heterogeneous effects on core and peripheral regions, as well as on countries with different income levels. A gravity-based market potential index is revised to accurately assess distances for land and maritime trips to better capture geographic limitations. Estimations are performed in cross-section with country-fixed effects, by addressing endogeneity issues with instrumental variables. Robustness checks are also conducted with panel data on a smaller sample. The findings reveal that regions with better access to markets and port experience higher regional income per capita, with the effect being higher for wealthier regions. Peripheral regions consistently exhibit a 2 percentage point lower elasticity to market potential compared to core regions. The paper also highlights the potential negative impact of proximity to foreign markets on peripheral regions, especially if they are central to foreign core markets without free trade agreement in place between the respective countries. Results suggest that policies which aim at improving the connectivity of peripheral regions to core domestic markets and develop trade agreements could help mitigate the adverse effects of trade barriers and reduce regional disparities within countries.

*Keywords:* Market Potential, Economic Geography, Regional Development, Core-Periphery

*JEL Classification:* F15, O18, R11

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# 1 Introduction

The core-periphery divide has important consequences that extend to the rise of protest movements and voting decisions cleavage, ultimately shaping a nation’s political landscape. Among recent prominent examples are Brexit in the United Kingdom (Abreu and Öner, 2020), the election of Trump in the United States (Rodríguez-Pose et al., 2020), and the rise of far-right votes in various European countries (Dijkstra et al., 2020). They have shed light on the deep-seated frustrations arising from regional disparities and have highlighted the sense of marginalization and resentment felt by individuals who perceive that urban elites are favored over citizens in rural and peripheral regions.

Understanding the causes of regional development disparities is crucial to reduce inequalities within countries and foster social cohesion. Among these factors, proximity to markets has been suggested as a key factor of development. Proximity to demand allows firms to save costs from transportation in shipping their goods. Thus, they can afford to pay higher wages to their workers, which results in higher levels of development of the firm’s location as the population gets richer. This intuition is embodied in the *international trade wage equation* developed by Fujita et al. (1999). On another hand, the existence of agglomeration economies plays as a centripetal force for wealthy areas but can harm poorer areas since firms, industries, and workers tend to locate near each other, where is located the economic activity (Rosenthal and Strange, 2004). Despite the growing concern for peripheral areas that are doomed to be left far behind, the differential impact of market access on development between core and peripheral regions remains a topic that has not been clearly studied in the literature. This paper is going to fill this gap.

(How much) Does proximity to markets matter in explaining intranational regional development disparities conditional on regional productivity? This paper contributes to the ongoing debate in the New Economic Geography literature by addressing broader questions. It explores the consistency of this effect across countries, the robustness of different measures of market access, and the differential impact on core and peripheral regions. The study also investigates the distinct effects of centrality to domestic and foreign markets on core and peripheral regions. These questions are crucial in the context of increasing integration and interdependence among countries and regions, where foreign markets and internal transportation infrastructures play a substantial role in shaping subnational development. This integration and interdependence have been pivotal in recent events, including the Brexit referendum and voting decisions in the United States and various European countries. By examining the relationship between market proximity and regional development, policymakers can develop more targeted policies to foster sustainable and inclusive growth.

Empirical tests of the international trade wage equation of Fujita et al. (1999) emerged in the last two decades, originally focusing on inequality across countries (Redding and Venables, 2004; Fingleton, 2008; Head and Mayer, 2011; Jacks and Novy, 2018). Proximity to wealthy countries is consistently related to their development level. However, considering a country as a market is a substantial simplification. The vast literature of firm location theory together with the core-periphery model developed by Krugman (1991) justify this argument. The concentration of economic activity is often observed in specific locations, commonly referred to as the “core.” Typically, core regions are home to a megapolis, and experience vastly different conditions compared to other regions within the same country (Baldwin and Martin, 2004; S. J. Redding, 2022).

In the last decade, the focus of the falsification test of the international trade wage equation has switched from cross-countries inequality to within-country inequality. The literature on subnational development emphasizes the diversity of regions within a country and recognizes that subnational approaches can be more effective than national approaches for promoting development. Regions

can also be a more relevant unit of analysis for representing markets and understanding the impact of market proximity. For these reasons, the present paper adopts a regional-level position. Due to data availability of development measures and covariates at the regional level, the literature has focused on single-country analysis. Papers have studied the case of the United States, European countries, and more recently, emerging and developing countries. The wider geographical scope of analysis in the literature is found to be at the European level using the rich data produced by European institutions (Niebuhr, 2006; Head and Mayer, 2004; Brühlhart et al., 2004; Breinlich, 2006; Head and Mayer, 2006; Brakman et al., 2009; Bruna et al., 2016).

The generalization of the statement to the entire world is hindered by the scarcity of data on regional development measures and covariates, as well as the lack of data required for computing sophisticated market access indexes. The scarcity of data on physical infrastructure for each country and the underutilization of the gravity trade literature, which examines the impact of different distance measures on trade, contribute to these limitations despite their significance as fundamental components for market access measures. This paper aims to address these gaps by making four significant contributions to the literature.

The first contribution of the paper is to provide a falsification test of the international trade wage equation at the regional level within countries and generalize the test to the whole world using a complete set of countries. For robustness, I control for regional development covariates which proxy for regional productivity, such as population education and density, natural resources, and climatic conditions. The study relies on the large regional dataset built by Gennaioli et al. (2013), which gathers information on Gross Domestic Product (GDP) and covariates for more than 1,500 subnational regions in 107 countries. The dataset covers about 70% of the world’s surface and more than 90% of its GDP for the year 2005. For robustness checks, I use a regional panel dataset of about 1,000 regions in 72 countries from Gennaioli et al. (2014) with similar information.

The second contribution is the computation of the index of proximity to markets, the *market potential*,<sup>1</sup> which summarizes the market capabilities of all the regions present in the sample, weighted by their geographical proximity. An effort has been made to fully consider international interactions from trade building a gravity-based index. The proximity function takes into account factors such as common language, national contiguity, colonial ties, common currency, and regional trade agreement as determinants that facilitate closer trade relations between countries and regions, even when they are physically distant. Additionally, since “around 80 per cent of global trade by volume and over 70 per cent of global trade by value are carried by sea and are handled by ports worldwide” as reported by (The Review of Maritime Transport 2018, UNCTAD), I consider international distances between regions through land and maritime shortest paths passing by world ports.<sup>2</sup> Considering the predominant role of transportation infrastructures and geographic limitations allows to recover the travel path of commodities as closely as possible.

The third contribution is on the investigation of the differences in the elasticity coefficients to market potential between core and peripheral regions and how differently they are affected by proximity to foreign markets. To this matter, a classification of regions is done using k-means clustering conditional on the regional economic production. Each country is split into 3 groups of subnational regions: the core, the semi-periphery and the periphery. While core regions benefit from a better access to larger markets, peripheral regions face higher transportation costs, making it more difficult for them to attract investment and develop competitive industries. By employing this

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<sup>1</sup>The concepts of market potential and market access are used interchangeably throughout the paper.

<sup>2</sup>The title *Navigating the Geography of Regional Disparities* is justified by this aspect of the paper. The term “navigating” is used to refer to the maritime routes taken by ships between world ports, which serves as a metaphor for the investigation of the determinants of subnational disparities.

classification of regions, the analysis is better equipped to consider the regional variation within countries and gain a better understanding of the specific challenges faced by peripheral regions, specifically according to proximity to domestic and foreign core regions.

The fourth and final contribution lies in a comprehensive examination of the mitigation effects of proximity to markets, specifically focusing on centrality to core markets, distinguishing between domestic and foreign contexts. By incorporating measures of centrality into the regression analysis, we gain a deeper understanding of how proximity to affluent markets impacts regional disparities, addressing a gap in the existing literature. Unlike market potential indexes that do not capture fully the nuanced agglomeration effects dividing core and periphery regions, this approach sheds light on this aspect. Additionally, differentiating between centrality to core foreign markets with and without free trade agreements underscores their role in reducing trade barriers, which can be particularly important for regions in the periphery of the economic activity. The effect of an improved centrality to foreign cores with trade agreement following such agreement is investigated with the panel sample.

The analysis is first performed in cross-section to gather as many observations worldwide as possible. The country fixed-effects allow to control for national unobservable variables, as well as to compare the regional observations with their national average for each country. I address endogeneity issues with instrumental variables using a centrality index and a spatial lagged market potential as instruments. The former summarizes the central position to others, and the latter the proximity to foreign markets. Finally, to further test the robustness of the results, the analysis is conducted in panel on a smaller sample of countries.

Results show that proximity to markets is a strong and robust determinant of subnational development all around the world. A 1% increase in the regional market potential is associated with an increase in GDP per capita about 0.1% with respect to countries' average. This elasticity coefficients are similar to those found in single-country analysis ([Brakman et al., 2004](#); [Mion and Naticchioni, 2009](#); [Pires, 2006](#); [Kosfeld and Eckey, 2010](#)) and developing countries such as Brazil ([Fally et al., 2010](#)), China ([Baum-Snow et al., 2015](#)) or Chile ([Paredes, 2013](#)). It is also similar to coefficients found in European regional analysis ([Niebuhr, 2006](#); [Head and Mayer, 2006](#); [Brakman et al., 2009](#)). On the other hand, lower coefficients are found with respect to those from country level analysis ([Head and Mayer, 2011](#)). This could be attributed to the lower levels of development variation within countries, as compared to the variation across countries. Additionally, the access to ports is revealing to be a powerful determinant of both higher market potential and higher income per capita.

Upon further investigation, heterogeneous elasticity coefficients of regional development to market potential are observed, revealing distinct impacts based on regions' GDP levels. Core regions benefit more from market proximity compared to the (semi-)periphery, with peripheral regions exhibiting a coefficient that is 2 percentage points lower than that of core regions. While the proximity to foreign regions has no significant effect on core regions, it can adversely affect (semi-)peripheral regions. Notably, among peripheral regions, those with higher centrality to foreign cores experience lower levels of development within the same country. This finding aligns with [Adam et al. \(2021\)](#), which demonstrates that subnational regions located at international borders tend to have lower income per capita levels. It becomes evident that not only border regions but also regions in the periphery of national economic activity can be adversely impacted by close proximity to foreign markets.

Furthermore, the investigation emphasizes that the impact of proximity to core markets differs depending on whether they are domestic or foreign, as well as whether a region's country has a free trade agreement with others. Proximity to domestic cores exhibits positive effects on regional

development, while proximity to foreign cores without a trade agreement has a negative impact, particularly on peripheral regions. A discussion on firms selection attempting to explain the latter result is provided. Interestingly, the effect of proximity to foreign cores with a free trade agreement is not significantly different from zero. This suggests that the existence of a FTA can help alleviate the negative impact of close proximity to foreign core markets, as supported by the findings of [Adam et al. \(2021\)](#). It can also contribute to reducing regional disparities through the convergence of market selection resulting from the implementation of free trade policies. The panel data analysis reveals that when countries establish a trade agreement and enhance their connections to foreign cores through FTAs, there is an expected increase in a region's GDP per capita, although the statistical significance is somewhat limited. These findings align with the notion that the presence of a free trade agreement holds the potential to foster regional development, even in peripheral areas.

Results highlight the concern for the development divide between core and periphery regions, where the latter tend to have lower income per capita, market potential, and growth rate. To reduce regional disparities and bridge the development gap between core and periphery regions, one possible approach is to enhance subnational integration by improving national connectivity through transportation infrastructure. Ensuring better access to core national regions is crucial to prevent the periphery from being left behind and being excessively impacted by a too close proximity to foreign cores. Moreover, policies aimed at improving trade relations and establishing free trade agreements with foreign countries may be beneficial for peripheral regions. Policymakers should also implement policies that encourage economic activity in peripheral regions to prevent the economic activity from flowing away towards core regions.

The paper is organized as follows. Section 2 provides a review of the existing literature on regional development and market potential and highlights the gaps in the literature that this paper aims to fill. Section 3 introduces the regional market potential indexes used for the analysis. Section 4 presents the data. Section 5 presents the descriptive statistics. Section 6 develops the empirical method. Section 7 shows and interprets the results. Finally, Section 8 concludes.

## 2 Literature

### 2.1 Wage Equation and Regional Development

Since the emergence of the New Economic Geography literature following the eminent works of [Krugman \(1980\)](#) and [Krugman \(1991\)](#), accessibility to markets has been showed to have a strong impact on the spatial distribution of economic activity. [Fujita et al. \(1999\)](#) have developed a full general equilibrium model with international trade and monopolistic competition, composed by agricultural and manufacturing sectors, which relies on labor immobility. Firms operate under increasing returns to scale and produce differentiated products. From profit maximization, the model express the increasing relationship between factor incomes and market access. This relationship is referred as the *international trade wage equation*.

In particular, a special focus is given on the model developed by [Redding and Venables \(2004\)](#). Redding and Venables' model, which extends the Fujita model by including transport frictions in trade and intermediate goods in production, shows that geographic location affects per capita income via flows of commodities, production factors, and ideas. Distant countries incur trade barriers such as transport costs and cultural differences, leading to reduced market access for exports and imports and lower maximum wage firms can afford to pay due to their zero-profit condition.

Head and Mayer (2011) developed a similar intuition based on the gravity equation for bilateral trade flows and market clearing conditions. The focus has been made on differences in wages, as labor is assumed to be the immobile factor in these theoretical models. However, the wage equation can be generalized to all immobile inputs. Both model imply that distance to markets affects the equilibrium factor prices and so, rises cross-countries income inequality.

The empirical regional-level analysis has widely been developed in the last decade. The literature has focused on single-country analysis due to data availability, such as the United States, European countries, and more recently, emerging and developing countries.<sup>3</sup> The wider geographical scope of analysis in the literature is found to be at the European level (Niebuhr, 2006; Head and Mayer, 2004; Breinlich, 2006; Head and Mayer, 2006; Brakman et al., 2009; Bruna et al., 2016). The statement has not yet been generalized to the whole world, which is the intention of the present paper.

The literature on subnational development distinguishes between two types of geography that characterize regions and cities: first-nature and second-nature. The former refers to regional natural endowment, such as proximity to water, altitude or climate. The latter refers to the interactions a region can entertain with other regions, depending on its location with respect to them. The literature has argued that the attractiveness of a region is best described by intra-regional characteristics (P. P. Combes et al., 2005; Brakman et al., 2009).<sup>4</sup> The present paper is going to question this statement.

In particular, my analysis was inspired by Gennaioli et al. (2013)'s, who investigate the determinants of regional development according to human capital and institutional quality, controlling for first-nature geography. They attest the primary importance of human capital for both regional and national development, while the institutional quality is only significant at the country level. While an effort has been made regarding the first-nature geography dimension, they have omitted the spatial interdependence of regions. Nevertheless, they considered proximity to the coast, which can be used as a proxy for proximity to foreign markets. The variable is showed to have a highly positive significant impact on the regional development levels.

The present paper reevaluates the determinants of regional development with a proper measure of accessibility to markets, referred as market potential, controlling for first-nature geography and education.

## 2.2 Market Potential

Market potential measures the proximity to demand from a given location and represents the attractiveness of a region based on its geographic position and that of its potential trading partners. It reflects a region's potential to trade with others and access different markets. It is calculated by adding the economic size of all other regions, weighted by the distance that separates them.

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<sup>3</sup>Single-country studies of the effect of market access on regional development have been conducted for the United States (Hanson, 2005; Fallah et al., 2009; Donaldson and Hornbeck, 2016; Hornbeck and Rotemberg, 2021), Italy (Mion, 2004; Mion and Naticchioni, 2009; A'Hearn and Venables, 2013; Daniele et al., 2018), Spain (Pires, 2006; López-Rodríguez et al., 2008), Germany (Brakman et al., 2004; Kosfeld and Eckey, 2010) or Finland (Ottaviano and Pinelli, 2006). Other studies have focused on emerging and developing countries, such as Mexico (Chiquiar, 2008), Chile (Paredes, 2013), Brazil (Fally et al., 2010; Hering and Paillacar, 2016), Turkey (Karahasan et al., 2016; Özgüzel, 2022), China (Hering and Poncet, 2010; Baum-Snow et al., 2015; Zou et al., 2021), India (Donaldson, 2018; Bonadio, 2022).

<sup>4</sup>Studying the case of Chile, Paredes (2013) claims that spatial wage inequality may be better explained by amenities than by market access in low income countries. However, some papers demonstrate that the wage equation can holds also in developing and emerging economies (Chiquiar, 2008; Fally et al., 2010; Karahasan et al., 2016; Hering and Poncet, 2010).



Regions with high market potential are those that are close to wealthy regions with high demand and market capacities, which allows for low transport costs and higher trade volumes. In contrast, periphery regions, far from the demand, experience low market potential.

The internal market of a region also determines its level of market potential. The local market potential depends on its own market capacity and its internal distance as a proxy for internal transport costs. The wealthier the market, the higher the region’s own demand, and the higher its market potential. But the larger its land area, the higher the transport costs faced by firms to sell their commodities on average, and the lower the local market potential.

Three different computation methods of the index are developed in the literature: (1) the simple index, as expressed in [Harris \(1954\)](#), (2) the gravity index and (3) the infrastructure index. The first method is a simple function summing the income of the geographical entities, weighted by the inverse of the distance between them ([Mion, 2004](#); [Hanson, 2005](#); [Mion and Naticchioni, 2009](#); [López-Rodríguez and Andrés Faiña, 2006](#); [Fallah et al., 2009](#)). Despite the relevant effort of computing market potential indexes which may better translate market accessibility forces, the predictive power of this index has been shown to be as high as other more sophisticated indexes ([Daniele et al., 2018](#)).

The second computation method relies on the estimation of the international trade gravity equation and uses other variables of proximity to weight the markets’ income, as well as price indexes obtained from exporter and importer fixed effects. This method was adopted by [Redding and Venables \(2004\)](#) and [Head and Mayer \(2011\)](#) for computing indexes at the national level. At the regional level, price indexes has hardly been computed from gravity-based fixed effects since intra-national trade data between sub-national entities is not commonly observable. Some authors have done so, for Brazil ([Fally et al., 2010](#); [Hering and Paillacar, 2016](#)) and China ([Hering and Poncet, 2010](#)). In addition to physical distance between regions or cities, they include other type of proximity measures such as contiguity, common language and regional trade agreement.

The third method for market potential index computation usually relies on the expression of the simple market potential index developed by [Harris \(1954\)](#), using distance measures considering physical infrastructures. A first attempt was made by [Hanson \(2005\)](#), considering a ”hub-and-spoke” geodesic distance function, which assumes that goods transported from one county to another must pass through a transportation hub located in the home state of the originating county. Since, road and rail distance has been taken into account ([Pires, 2006](#); [Ottaviano and Pinelli, 2006](#); [Paredes, 2013](#); [A’Hearn and Venables, 2013](#); [Karahasan et al., 2016](#)), as well as travel time by car ([Brakman et al., 2004](#); [Niebuhr, 2006](#); [Baum-Snow et al., 2015](#)) or train ([Zou et al., 2021](#)). Other studies have incurred freight transportation costs as well. For example, [Donaldson and Hornbeck \(2016\)](#) and [Hornbeck and Rotemberg \(2021\)](#) compute average price per ton of transported goods by available transportation routes, using rail and waterways distance. They also use different estimates of elasticity to distance rather than the  $-1$  coefficient used in the simple market potential index.

Few papers integrate the role of international markets in their single-country analysis. An even smallest amount considers the predominant role of ports and maritime transport networks ([Ducruet, 2020](#)). In the case of China, [Baum-Snow et al. \(2015\)](#) considers road travel time from each prefecture city to the nearest of the nine largest international ports by value of shipments, as well as the average cost of shipment. In the case of India, [Bonadio \(2022\)](#) estimates trade costs related to ports’ access via roads as well as ports’ quality, in order to evaluate the relative importance of both infrastructures in shaping international market access of regions. The worldwide scope of my analysis does not allow me to integrate ports’ quality, neither inland transportation networks in the market potential indexes. However, an effort has been made to give structure to the function of physical distance.

In this paper, the gravity-based approach is used, with an effort towards the infrastructure approach. I compute two indexes with different specifications of the distance function. Both indices integrates cultural, historical and economical proximity, such as done in the literature using the simple and the gravity index, but different measures of physical distance. The first index uses the haversine distance function, while for the second index, the distance function is provided with more structure, considering the inland shortest path between regions and ports, as well as the overseas shortest path between ports. This distance function considers the world's geography by integrating the delimitation of land and sea spaces and the predominant role of ports in international trade. Next subsection presents the regional market potential indexes.

### 3 Regional Market Potential

To compute the potential to trade of each region, I assume a complete network of regions, where they are supposed to be all interlinked. The intensity of their potential interactions is proportional to their market size weighted by their proximity. The market potential index is expressed as follows:

$$MP_i = \sum_{j \neq i} y_j \frac{\tilde{y}_j}{\tilde{y}_{\max, c_j}} \tau_{ij} + b \times y_i \frac{\tilde{y}_i}{\tilde{y}_{\max, c_i}} \tau_{ii} \quad (1)$$

where  $y_j$  is the GDP of region  $j$ ,  $\tilde{y}_j$  is the GDP per capita of region  $j$ ,  $\tilde{y}_{\max, c_j} = \max_{1 \leq k \leq n} \tilde{y}_k$  is the maximum regional GDP per capita among observations within country  $c_j$ ,  $\tau_{ij}$  represents the trade costs between regions  $i$  and  $j$ ,  $\tau_{ii}$  is the internal transport costs in region  $i$ , and  $b$  is the regional border effect.

The market potential index is composed by two components: the local market potential and the non-local market potential. The former is the second term on the formula's right-hand side, composed by the income information of region  $i$  and the weight ranking his hierarchy position among the richest regions in term of GDP. The regional border effect  $b$  is giving weight to the internal demand of region  $i$ <sup>5</sup>. The intra-regional transportation costs are expressed as follows<sup>6</sup>:

$$\tau_{ii} = \left[ \frac{2}{3} \sqrt{\frac{\text{area}_i}{\pi}} \right]^{-1} \quad (2)$$

The non-local market potential  $NLMP_i$  - first term on the right-hand side of equation 1 - corresponds to the sum of the GDP of all regions  $j$  different to  $i$ , which is multiplied by a weight indicating how well is ranked its income per capita compared to the richest region, i.e. the one with

<sup>5</sup>The regional border effect is very rarely estimated in the literature due to the lack of trade flows data between regions of a same country. To proxy for this border effect, I compute  $b$  as the average ratio between the maximum domestic market potential on the maximum local market potential among regions in each country, with domestic market potential being the regional market potential with respect to all regions in the same country and the local market potential being the very own market potential of a region, excluding other regions. This ratio forces the local market for a region to weight in the total domestic market, since local demand is also important. I find that  $b = 1.5$  for  $MP^{(h)}$  index, and  $b = 1.8$  for  $MP^{(s)}$  index. As a comparison, [Coughlin and Novy \(2021\)](#) have estimated states' border effect to be about 1.5 on average in the case of the United States of America for balanced sample over the years 1993, 1997, 2002, and 2000. Hoping that future research will attend to estimate the proper regional border effect within countries for a wider set of countries.

<sup>6</sup>Regions are assumed to be circle-shaped, with the capital city at their center. Then, the average distance from the center of the region and its borders is calculated as a proportion of its radius, with the radius computed as the square root of the land area divided by  $\pi$ . The radius is weighted by  $2/3$ , assuming that the economic activity is relatively concentrated toward the center ([Head and Mayer, 2011](#)). Hence, this distance function is an approximation of the average distance between every two cities in region  $i$ .



the highest level of GDP per capita.<sup>7</sup> Hence, if  $j$  is the richest region of the sample, the coefficient will be equal to 1. Otherwise, it belongs to  $]0;1[$ . This ratio gives more weight to richer regions and illustrates their competition power. The closer to 1 the ratio, the higher region's  $j$  market power. This component gives the market capacity of region  $j$  and is reduced by the trade costs,  $\tau_{ij}$ , that it faces to import commodities from region  $i$ .

For the latter variable, I consider two specifications. The first one is expressed as follows:

$$\tau_{ij}^{(1)} = \text{dist}_{ij}^{(\text{haversine})} \hat{\beta}_1 \times \left[ \mathbb{1}_{\{c_i \neq c_j\}} e^{\hat{\beta}_2 \mathbb{1}_{\text{language}_{ij}} + \hat{\beta}_3 \mathbb{1}_{\text{contiguity}_{ij}} + \hat{\beta}_4 \mathbb{1}_{\text{colony}_{ij}} + \hat{\beta}_5 \mathbb{1}_{\text{rta}_{ij}} + \hat{\beta}_6 \mathbb{1}_{\text{currency}_{ij}}} + \mathbb{1}_{\{c_i = c_j\}} e^{\hat{\beta}_7} \right] \quad (3)$$

with  $\text{dist}_{ij}^{(\text{haversine})}$  the physical distance between regions  $i$  and  $j$ , computed as the haversine distance, determined by the great-circle distance between two geocodes, which proxies for transportation costs.  $\mathbb{1}_{\{c_i = c_j\}}$  and  $\mathbb{1}_{\{c_i \neq c_j\}}$  dummies indicating whether region  $j$  belongs to the same country than region  $i$ .  $\mathbb{1}_{\{c_i = c_j\}} e^{\hat{\beta}_7}$  corresponds to the national border effect.<sup>8</sup> It reflects the fact that a pair of regions belonging to the same country is more prone to trade together than with a region abroad, due to more similar consumption preferences, easier communication and the absence of tariffs and customs.

The set of dummy variables equal interacted with the dummy  $\mathbb{1}_{\{c_i = c_j\}}$  are equal to one if countries  $c_i$  and  $c_j$  of regions  $i$  and  $j$  respectively share a common border, colonial ties, a regional trade agreement and the same currency, as well as if regions  $i$  and  $j$  share a common language predominantly spoken. These latter variables reflect the cultural and economic proximity between two regions from different countries, which alleviates the effect of distance between them. When  $\mathbb{1}_{\text{language}_{ij}}$ ,  $\mathbb{1}_{\text{contiguity}_{ij}}$  and  $\mathbb{1}_{\text{colony}_{ij}}$  dummies equal one, they represent lower communication costs, more similar preferences and long term trade, historical and political relationships, which are supposed to increase trade volumes between two regions.  $\mathbb{1}_{\text{rta}_{ij}}$  dummy indicates whether the two countries have a trade agreement that lowers trade costs, and  $\mathbb{1}_{\text{currency}_{ij}}$  represents the ease for two countries trading with the same currency, as they avoid buying foreign exchange.

The distance between two countries is usually computed as the haversine distance. However, it is a basic measure of distance. This paper provides a better measure of geographical distance, which aims at following as closely as possible the travel undergone by goods from a territory to another, distinguishing the world's areas covered by land and ocean<sup>9</sup>. The new distance measure is built considering port access<sup>10</sup> for trade that might be undertaken overseas, as well as the shape of land masses, so the path between two regions can get around bodies of water.

To do so, I first collect data on world ports geolocation, and use high-resolution geography data from [Wessel and Smith \(1996\)](#), which provides boundaries between land masses and ocean. From the geographical polygon, I give different values for land masses and ocean and rasterize

<sup>7</sup>This ratio is included in the index in order to integrate regional competitiveness. To compute the index with a gravity-based approach, importer and exporter fixed effects are usually included. However, the international trade data used in this paper rely on total bilateral trade flows. Thus, trade flows are not directed - it is not possible to identify an importer and an exporter - and are not at the regional level. Thus, including importer and exporter fixed effects is not relevant.

<sup>8</sup>The literature has estimated  $\hat{\beta}_7 = 1.96$  on average ([Head and Mayer, 2014](#)).

<sup>9</sup>In 2002, sea transport accounted for 44% of goods, measured in value, traded between the EU and the rest of the world. Measured in volume, the share was about 78%. Regarding road and rail transportation, the share was about 30% in value and 13% in volume (Source: [Statistics Explained](#) - Eurostat, 2021). As air transportation can be approximated by the haversine distance function, and that it represents a lower share of traded goods as measured both in value and volume, it is not particularly considered in this paper.

<sup>10</sup>The importance of ports on trade performance has been highlighted in the literature on trade facilitation and logistics ([Limão and Venables, 2001](#); [Blonigen and W. W. Wilson, 2008](#); [Portugal-Perez and J. S. Wilson, 2012](#)).

the map in order to compute shortest paths between each pair of points. The shortest path is computed following the grids of the maps between these points. I first compute the shortest path between each pair of regions by land, then between each pair of region-port by land, and finally, the shortest path between pairs of ports by sea (see figure 8 in the appendix for a visual example of the computation). The dataset results in distances computed between each pair of regions, with their associated closest port<sup>11</sup>, combining distance by land and sea.

Then, the shipment distance function is computed as follows:

$$\text{dist}_{ij}^{(\text{shipment})} = \begin{cases} \kappa_{io}^{\gamma_1} \kappa_{od}^{\gamma_2} \kappa_{dj}^{\gamma_3} & , \text{ if } \kappa_{od} \neq 0 \wedge \frac{\kappa_{io} + \kappa_{dj} + \kappa_{od}}{\kappa_{ij}} < 2 \\ \kappa_{ij}^{\gamma_4} & , \text{ otherwise} \end{cases} \quad (4)$$

where  $\kappa_{od}$  corresponds to a proxy for the ocean shipping costs. It is the shortest path between the origin port  $o$  and the destination port  $d$ . Variable  $\kappa_{io}$  is the distance from the region center of region  $i$  to its closest port  $o$ , and  $\kappa_{dj}$  is the distance from the region center of region  $j$  to its closest port  $d$ . Hence,  $\kappa_{io}$  and  $\kappa_{dj}$  is the distance traveled by land, and  $\kappa_{od}$  is the distance traveled by sea. I denote by  $\kappa_{ij}$  the distance between regions  $i$  and  $j$  by land, without passing by any port. If regions  $i$  and  $j$  are not connected by land, I define  $\kappa_{ij} = \infty$ . Coefficients  $\gamma_1$ ,  $\gamma_2$ ,  $\gamma_3$  and  $\gamma_4$  are expected to be negative.

The maritime distance function structure  $\kappa_{io}^{\gamma_1} \kappa_{od}^{\gamma_2} \kappa_{dj}^{\gamma_3}$  is similar to the one of Bonadio (2022), but he rather uses a port quality measure instead of the maritime distance between ports. Port quality is an important factor of trade costs, however I do not have enough information to estimate it. Moreover, considering maritime distance between ports is relevant as transportation costs also increase with distance on the sea.

The inland and overseas shortest path between regions and ports are computed as straight lines and curves, assuming a continuous space with continental borders constraints. I do not consider physical transportation routes and real costs in the measure as it has been done by some papers in the literature presented in the previous subsection. To do so with a worldwide scope is not possible since this data is not available for most of the countries. The method used in this paper still made progress in considering the actual world geography.

Equation 4 integrates a condition of convenience with respect to sea freight. It considers if it is impossible to travel from  $i$  to  $j$  by land due to non-continuous land area, and if the whole distance between  $i$  and  $j$  by sea is not larger than twice the land distance between the two, if and only if the maritime distance does not equal zero. Indeed, two regions or countries will not find any interest to reach the same port to trade between each other. The ratio of distances lower than 2 assume regions to use land transportation if the distance travelled by sea is too important with respect to the land distance between two regions, even if maritime transportation is known to display scale economies in the whole transportation costs.

I define  $\mathbb{1}_{\text{maritime route}}$  as the convenience condition to ship goods overseas. It equals one if the condition is respected, i.e. if it is convenient for exporters to send its good overseas, zero otherwise. Then, the alternative measure of trade costs becomes:

$$\begin{aligned} \tau_{ij}^{(2)} = & \left[ \kappa_{io}^{\hat{\gamma}_1} \kappa_{od}^{\hat{\gamma}_2} \kappa_{dj}^{\hat{\gamma}_3} \mathbb{1}_{\text{maritime route}} + \kappa_{ij}^{\hat{\gamma}_4} (1 - \mathbb{1}_{\text{maritime route}}) \right] \times \left[ \mathbb{1}_{\{c_i=c_j\}} e^{\hat{\beta}_7} \right. \\ & \left. + \mathbb{1}_{\{c_i \neq c_j\}} e^{\hat{\beta}_2 \mathbb{1}_{\text{language}_{ij}} + \hat{\beta}_3 \mathbb{1}_{\text{contiguity}_{ij}} + \hat{\beta}_4 \mathbb{1}_{\text{colony}_{ij}} + \hat{\beta}_5 \mathbb{1}_{\text{rtai}_{ij}} + \hat{\beta}_6 \mathbb{1}_{\text{currency}_{ij}}} \right] \end{aligned} \quad (5)$$

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<sup>11</sup>Bonadio (2022) shows however that firms do not always use the closest port, but incur additional internal costs to reach a port of higher quality.

with  $\tau_{ij}^{(1)}$  the trade costs using the haversine distance as a proxy for transportation costs,  $\tau_{ij}^{(2)}$  the trade costs using the shipment distance function which considers land and sea areas, as well as ports location.

As described above, two indexes of regional market potential are computed with two different measures of geographical distance, the first being computed as the haversine distance  $\text{dist}_{ij}^{(h)}$ , and the other as the overseas shipping distance  $\text{dist}_{ij}^{(s)}$ . Hence, the analysis will be conducted using the two different indexes of market potential  $\text{MP}_i^{(h)}$  and  $\text{MP}_i^{(s)}$ . Section A presents the methodology for the computation of the indexes. Coefficients of equations 3 and 5 are estimated to be:  $[\hat{\beta}_1, \hat{\beta}_2, \hat{\beta}_3, \hat{\beta}_4, \hat{\beta}_5, \hat{\beta}_6, \hat{\beta}_7, \hat{\gamma}_1, \hat{\gamma}_2, \hat{\gamma}_3, \hat{\gamma}_4] = [-1.18, 0.66, 1.12, 1.37, 0.47, 0.79, 1.96, -0.07, -0.96, -0.06, -1.00]$

Next section describes the regional data used for the computation of the indexes and the analysis.

## 4 Data

The regional data used in this paper mainly come from the dataset built by [Gennaioli et al. \(2013\)](#), with more than 1,500 subnational regions, from 107 different countries, out of the 195 recognized around the world, in the year 2005<sup>12</sup>. This substantially large dataset considers a broad range of geographical, educational, cultural and institutional variables to disentangle the determinants of development at the regional level all over the world.

The regional data of [Gennaioli et al. \(2013\)](#) have been collected at the highest administrative level available for each country: regions, provinces, counties and municipalities, and then aggregated the data to regions and provinces. Since [Gennaioli et al. \(2013\)](#) focus on regions, and aim at identifying the determinants of development within countries, they do not include countries with no subnational administrative divisions in the sample.

The dataset contains the Gross Domestic Product (GDP) per capita of regions on the sample, measured in current purchasing-power-parity (PPP) dollars<sup>13</sup>. This variable is used to proxy for regional development as the dependant variable in the analysis. I also use the GDP as one of the main component of the indexes of market potential. Figure 6 in the appendix shows the world map with the regional data available.

The dataset also includes three measures of geography and natural resources which proxy for the first nature geography: temperature, oil production per capita and the inverse distance to the coast. The first two are gathered from the WorldClim database. The temperature in 2005 is proxied by the average temperature during the period 1950-2000.

Then, two proxy variables of the regional human capital are the population size, which comes from the City Population database, and the average years of education of the 15-year-old and older population, collected from UNESCO database. Zero year of school are allocated for the pre-primary level, six additional school years for the primary education and twelve for those who have completed secondary school. For each region, average years of schooling is computed as “the weighted sum

<sup>12</sup>The dataset is available on the [website of Rafael La Porta](#).

<sup>13</sup>The dataset built by [Gennaioli et al. \(2013\)](#) gathers regional income data for 107 countries in 2005, drawn from sources including national statistics offices and other government agencies (42 countries), Human Development Reports (36 countries), OECDStats (26 countries), the World Bank Living Standards Measurement Survey (Ghana and Kazakhstan), and IPUMS (Israel). Their measure of regional income per capita is based on value added but they used data on income (6 countries), expenditure (8 countries), wages (3 countries), gross value added (2 countries), and consumption, investment, and government expenditure (1 country) to fill in missing values. They measured regional income in current PPP dollars because they lacked data on regional price indexes. To ensure consistency with the national GDP figures reported by World Development Indicators, they adjusted regional income values so that, when weighted by population, they total the GDP at the country level.

of the years of school required to achieve each educational level". The choice of these variables to explain the development of regions and countries is deeply justified in the development and economic geography literature. Thus, they are not discussed in this paper.

The variable of interest, the regional market potential, is based on the GDP of each region, which proxies for the size of their demand size. To get the most realistic market potential indexes as possible, it is best to consider a complete network of every region around the world. However, there are missing data in the data set of [Gennaioli et al. \(2013\)](#) as they did not include countries for which there were no subnational division data. To solve for this problem in the indexes computation, the GDP information of 68 countries is added from the gravity database developed by CEPII. This extrapolation allows to include a hundred more observation of world's markets into the market potential indexes computation.

In order to compute the distance between each region, which proxies for transport costs, the latitude and longitude are needed for each region. To do so, regions are geocoded on R software, by using a geocoding API key with Google Maps Platform. After having collected latitude and longitude for each region, an expanded dataset that associates every pair of regions is created, and the distance between each of them is computed using the haversine formula for the measure  $\text{dist}_{ij}^{(h)}$ , and as the shortest path by land and sea for the measure  $\text{dist}_{ij}^{(s)}$  presented in section 3.

In order to compute the average internal distance of each region, the land area information is used from Statoids.<sup>14</sup> In order to relate for cultural distances between regions, information on the languages spoken in each region is collected from the same source. Data on countries contiguity and colonial ties is collected from CEPII gravity database ([Gaulier and Zignago, 2010](#)). Moreover, information on regional trade agreement and currencies at the country level are collected from the country-level dataset by [de Sousa \(2012\)](#)<sup>15</sup>. The dataset covers 199 countries for the time period 1958-2015. The CEPII database also gathers information on trade for all country pairs between 1996 and 2020.<sup>16</sup> I use this data to estimate the trade elasticity coefficients to resistance and facilitator variables from the gravity equation.

Finally, geodata on global ports from WPI database are collected in order to compute the shipment distance functions.<sup>17</sup> The database contains the location and physical characteristics of 3,630 ports worldwide, as well as the facilities and services that they offer. I select coastal ports of a substantial size,<sup>18</sup> excluding the smallest ports that may not be used for trade. I also exclude river ports,<sup>19</sup> since rivers' recognition make considerably heavier the shortest path algorithm work. Then, I match to each region its closest port. By doing so, 463 ports remain. Figure 7 in Appendix B shows the matched ports on a map.

To evaluate if the relationship between the market potential and regional development is robust and persistent over time, I gather panel data from [Gennaioli et al. \(2014\)](#) for the same variables present in their cross-section version for the period 1976-2010.<sup>20</sup> Since there is a substantial amount

<sup>14</sup>Visit the [Statoids website](#) to find the database - Gwillim Law. Administrative Divisions of Countries. McFarland & Company, Jefferson, North Carolina, October 1999.

<sup>15</sup>Visit the [website of the author](#) to find the databases.

<sup>16</sup>The transnational trade panel data comes from [BACI](#).

<sup>17</sup>Visit the [WPI website](#) to find the database.

<sup>18</sup>WPI has classified ports' size in four groups according to their total area, wharf space and facilities, i.e. large, medium, small and very small. I exclude the very small ports from the dataset.

<sup>19</sup>[Frensch et al. \(2023\)](#) found that in the case of Europe, international rivers have a modest impact on trade.

<sup>20</sup>The original dataset from [Gennaioli et al. \(2014\)](#) contains different levels of definition of administrative regions for 13 countries compared to the first one from [Gennaioli et al. \(2013\)](#). In particular, the second dataset contains smaller regions. Thus, an effort has been made to combine these two datasets. To do so, I identify and gather regions defined at a lower administrative scale in a larger region, as defined in the regional [Gennaioli et al. \(2013\)](#) data.

of missing observations in the early years, I restrict the panel to the period from 1995 to 2010, with 5 years interval and adjust some observations of years around years multiples of 5 in case of missing data.<sup>21</sup> The panel data gather observation for 1,064 subnational regions from 72 countries.

## 5 Descriptive statistics

### 5.1 Regional Income Disparities

This section presents the state of regional inequalities within countries that can be observed in the data. Figure 1 displays the Gini coefficient which compares 2005's regional GDP per capita within each country in the sample. The coefficient ranges from 0 to 1, with zero-value referring to completely equal distribution of income per capita across regions, and unit-value referring to the extreme situation of one region holding the total national income, and the rest having no income at all. In other words, the greater the Gini coefficient, the greater development disparities in terms of income per capita distribution across regions. On the map, the darker a country, the greater its territorial inequality.

Kenya exhibits the greatest disparity in regional income per capita, with a Gini index of 0.45, followed by 11 other countries, including Indonesia, Thailand, South Africa, Argentina, Panama, Mozambique, Iran, Russia, Peru, China and Vietnam, all located mainly in South America and Asia. These 12 countries have a Gini index of over 0.3. Conversely, Egypt, Azerbaijan, Pakistan, Syria, France, Malawi and Israel show the least disparity between regions, with a Gini index of less than 0.07. This result is partly due to the fact that some countries have few recognized regions, with Egypt, Israel, Malawi and Pakistan having only 2 to 6 regions in countries with areas ranging from 20,000 to 1 million square kilometers.

The calculations here display different results than usual analysis of inequality of income, since the focus is given on territorial income per capita inequality rather than household income inequality. Thus, the map in Figure 1 is different than the one available on the [World Bank website](#). Their Gini index ranges from 0.25 to 0.65 in 2005, suggesting that household income inequality is, in general, higher than regional income per capita inequality within countries. The most unequal countries according to their calculations were South Africa and Latin American countries, while the most equal countries were in Western Europe. However, we find similar Gini coefficients for Asian countries, around 0.4.

Figure 2 depicts the disparity in development between regions within countries, indicated by the ratio of maximum to minimum income per capita. Typically, countries with high Gini indices have a larger ratio of maximum to minimum income per capita. However, the relationship between the two measures of inequality is non-linear, despite a significant correlation of approximately 0.71. Consequently, the ranking of inequality shifted.

Russia has the greatest level of inequality, with its richest region, Tyumen, being 43 times wealthier than the poorest region, Republic of Ingushetia. This disparity is not surprising, as the country's economic activity is concentrated in a few regions, while others have lower levels due to geography and climate. Indonesia and Kenya follow with a ratio of 20. Argentina, Iran, the Democratic Republic of the Congo, Peru, India, Colombia, and China follow with ratios decreasing towards 9. The least unequal countries have ratios between 1 and 1.5, except for France where

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Among them, I sum the GDP, the population size and the production of oil, and I compute the average amount of education years and the average temperature.

<sup>21</sup>For example, if a country has observations for the year 1994-2001-2005-2010, they are reported to the years 1995-2000-2005-2010 so to have homogeneous time periods between observations.

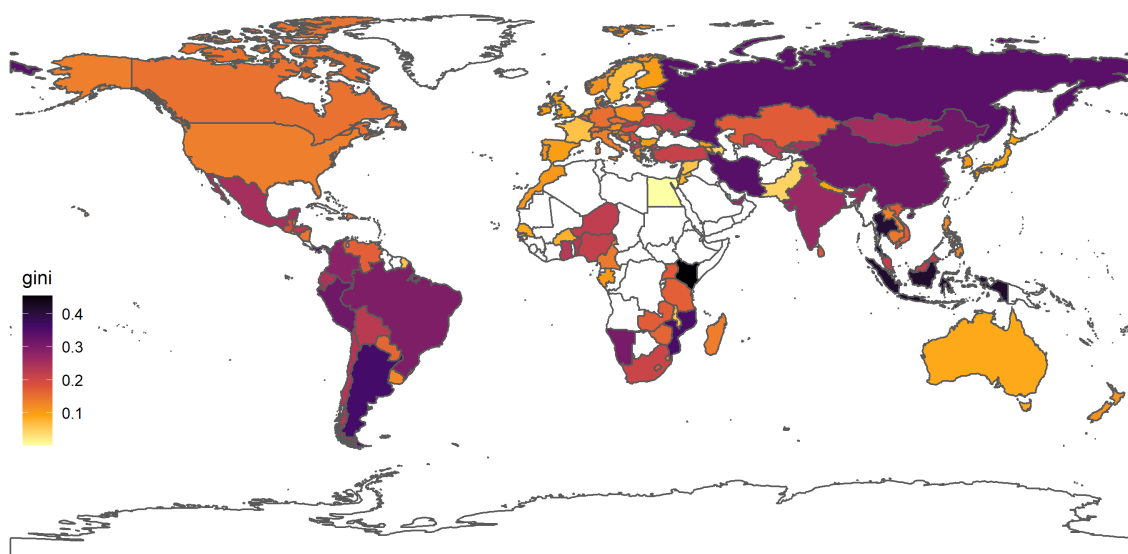


Figure 1: Gini index with respect to regional income per capita in 2005

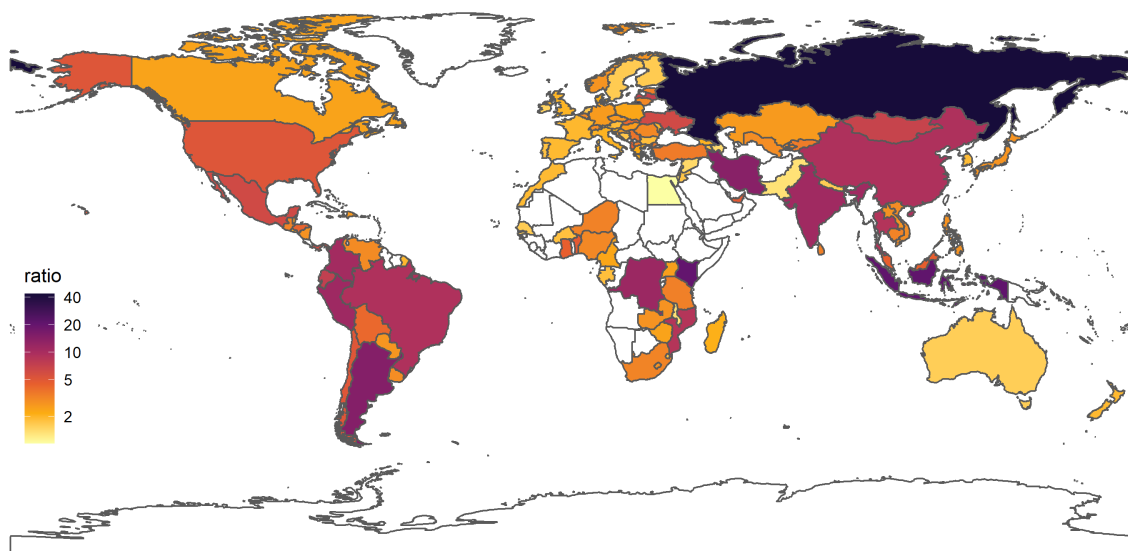


Figure 2: Ratio highest/lowest regional income per capita in 2005



the wealthiest region is twice as wealthy as the poorest in terms of GDP per capita. While both measures of inequality are imperfect, they provide insight into existing regional disparities within countries.

## 5.2 Regional Market Potential Disparities

As there are great disparities in regional income per capita, there may be so in the regional market potential. Figure 4 displays the maximum to lowest market potential ratio within countries, considering the index  $MP^{(s)}$ , which includes the shortest path distance by land and sea between regions. The income per capita is significantly correlated with the market potential ratios, with a correlation coefficient about 0.7. In other words, higher disparities in regional development should go in hand with higher disparities in trade opportunities.

Russia has the highest ratio of 90, followed by Argentina with a ratio of 32, and Japan with a ratio of 20. These countries have even greater disparities in terms of market potential than in terms of GDP per capita. In Europe, while regional development disparities appear higher in the East than the West, the opposite trend is observed for market potential. Higher ratios of highest-to-lowest market potential indicate significant spatial agglomeration. The wealthiest regions have wealthier neighboring regions, while the poorest regions are located further away. A high ratio indicates strong wealth agglomeration over space. However, a high ratio can also be due to larger regional area delimitation, resulting in greater distances between regions. This explains the significant disparities between regions in Australia and the United States (where regions are defined as states). African countries display particularly low differences in market potential due to similar foreign market potential indices. Their distance from the world's wealthiest regions is similar.

Table 13 presents the descriptive statistics of the variables used in the analysis for the whole 2005's sample, as well as by country income group following the World Bank classification: *High income*, *Upper middle income*, *Lower middle income* and *Low income*. The table indicates that market potential indexes using different distance functions are similar. Additionally, the richer the country, the higher the average regional GDP per capita, education level and market potential indexes. Standard deviations of GDP per capita and market potential are equal in the overall sample, but among high and upper-middle-income countries, the standard deviation of GDP per capita is lower than that of market potential. The opposite is observed in low-income countries. Notably, higher-income groups exhibit greater standard deviations in market potential.

## 5.3 Core and Periphery Divide

To examine regional heterogeneity and economic agglomeration, I categorize each country's regions into three groups based on their Gross Domestic Product: (1) core regions, the wealthiest regions, (2) periphery, the poorest regions, and (3) semi-periphery, those in between. I use k-means clustering to assign regions to their respective group. Note that countries have varying numbers of regions in each group. For countries with fewer than three regions, such as Ireland, no cluster classification is provided.

Statistics on these clusters are presented in table C. The core cluster counts between 1 and 6 regions, i.e. between 2% and 38% of the total amount of regions within countries. The semi-periphery counts between 1 and 12 regions, i.e. 3% and 67% in the total amount of regions within countries. Finally, the periphery counts between 1 and 66 regions in each country, which represents from 17% to 93% of the whole national territory. Therefore, the world counts much more peripheral

|   | (1)                | (2)                |
|---|--------------------|--------------------|
| $\mathbb{1}_{\text{semi-periphery}}$  | -0.39***<br>(0.04) | -0.33***<br>(0.05) |
| $\mathbb{1}_{\text{periphery}}$   | -0.62***<br>(0.05) | -0.43***<br>(0.06) |
| $\mathbb{1}_{\text{semi-periphery}} \times \mathbb{1}_{\text{Upper-middle income country}}$ |                    | -0.06<br>(0.09)    |
| $\mathbb{1}_{\text{semi-periphery}} \times \mathbb{1}_{\text{Lower-middle income country}}$ |                    | -0.01<br>(0.09)    |
| $\mathbb{1}_{\text{semi-periphery}} \times \mathbb{1}_{\text{Low income country}}$          |                    | -0.32**<br>(0.14)  |
| $\mathbb{1}_{\text{periphery}} \times \mathbb{1}_{\text{Upper-middle income country}}$      |                    | -0.32***<br>(0.11) |
| $\mathbb{1}_{\text{periphery}} \times \mathbb{1}_{\text{Lower-middle income country}}$      |                    | -0.17<br>(0.12)    |
| $\mathbb{1}_{\text{periphery}} \times \mathbb{1}_{\text{Low income country}}$               |                    | -0.45**<br>(0.18)  |
| Num. obs.   | 1516               | 1516               |
| Num. groups: code   | 104                | 104                |
| Adj. R <sup>2</sup> (full model)  | 0.93               | 0.93               |
| Adj. R <sup>2</sup> (proj model)  | 0.23               | 0.25               |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . The dependant variable is the regional income per capita (in log). Robust standard errors adjusted for clustering on each country are in parentheses. Regressions include country fixed effects.

Table 1: Regional Development, the Core and Periphery Divide

regions than core regions. On average, the GDP per capita is higher in core regions compared to semi-peripheral and peripheral regions. This observation also holds true for population density and years of education.

To observe regional disparities of income between core and peripheral regions within countries, I run regressions of income per capita on the different clusters' dummies, including country fixed effects. Table 1 show the results. The average income per capita in semi-peripheral and peripheral regions are found to be respectively 39% and 62% lower than that of core regions. When investigating differences between core and peripheral regions in the different countries' income groups, results show that the core-periphery divide is greater for upper-middle and low income countries than high-income and low-middle income countries.

Tables 15 and 16 in the appendix show the results using education, density and market potential indexes as dependant variables. (Semi-)peripheral regions are shown to be less educated, less inhabited and further from markets than core regions. Additionally, results show that the lower the income group of countries, the higher the disparities in education levels between core and peripheral regions.

Now that we have showed evidence of the existence of strong disparities within countries, it is also possible to study their evolution using panel data. Figure 3 shows the average growth in the Gini coefficient within countries from 1995 to 2010. We observe that 38% of the countries saw the dispersion of income per capita to decrease, with a Gini coefficient average growth ranging from 0 to -10% (from yellow to green areas on the map), while the others saw their disparities between

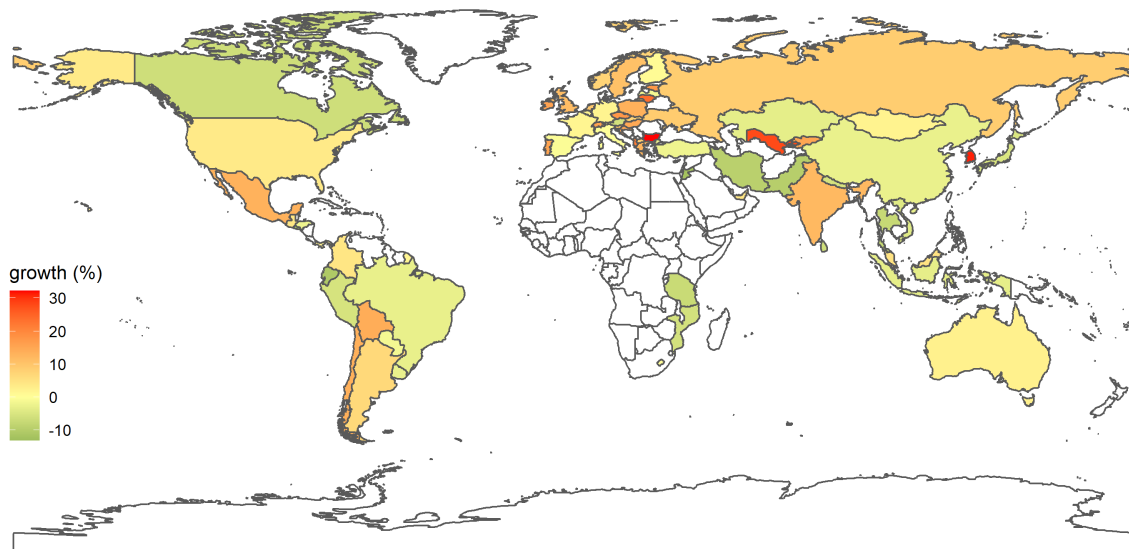


Figure 3: Gini coefficient average growth from 1995 to 2010

regions to increase, with a Gini coefficient average growth ranging from 0 to 30% (from yellow to red areas on the map). The observed increase in regional disparities suggests a growing tendency towards divergence in the levels of development between different regions.

To investigate differences in development trends experienced by core and peripheral regions, I regress the regional income per capita on the year and interacts it with dummies for semi-peripheral and peripheral regions with country fixed effects. Results are displayed in table 2. Conditional on countries' unobservables characteristics, findings reveal that core regions witness annual average growth rate in income per capita about  $(\exp^{0.0254} - 1) \times 100 = 2.57\%$  on average, while the growth rate experienced by (semi-)peripheral regions is 0.02 percentage points lower. Adding interactions terms with dummies of countries' income group, it is found that the lower the countries' income, the higher the growth rate of their core regions, but also the lower the growth rate of their peripheral regions. These results suggest a possible convergence among core regions worldwide, but also an increasing divergence in development levels between core and periphery regions within countries. Wealthier regions experience higher growth than poorer regions, which widens the difference in their levels of development.

This increase in regional disparities between core and peripheral regions raises serious equity concerns. While regional disparities can be natural to a certain extent, because of different natural conditions and resources' availability, the rise to persistent and wider disparities highlight a concentration process of economic activity, leaving peripheral areas behind. Indeed, markets favor some places over others. Favored places and firms located there may gain in terms of productivity from the benefits of agglomeration economies, and further grow over time. On the contrary, remote and low productive areas become further remote and less productive, under-utilizing their potential and experiencing retrained growth. This paper aims at testing this assumption, using the market potential indexes and other regional development covariates.

Next section presents the empirical model for the study of subnational development determinants used as a falsification test for the international trade wage equation at the regional level

|   | Model 1                | Model 2                |
|---|------------------------|------------------------|
| year  | 0.0254***<br>(0.0029)  | 0.0179***<br>(0.0035)  |
| year $\times$ $\mathbb{1}_{\text{semi-periphery}}$  | -0.0002***<br>(0.0000) | -0.0001***<br>(0.0000) |
| year $\times$ $\mathbb{1}_{\text{periphery}}$   | -0.0002***<br>(0.0000) | -0.0002***<br>(0.0000) |
| year $\times$ $\mathbb{1}_{\text{upper-middle income country}}$   |                        | 0.0090*<br>(0.0047)    |
| year $\times$ $\mathbb{1}_{\text{lower-middle income country}}$   |                        | 0.0099<br>(0.0094)     |
| year $\times$ $\mathbb{1}_{\text{low income country}}$  |                        | 0.0288***<br>(0.0062)  |
| year $\times$ $\mathbb{1}_{\text{upper-middle income country}} \times \mathbb{1}_{\text{semi-periphery}}$ |                        | -0.0000<br>(0.0001)    |
| year $\times$ $\mathbb{1}_{\text{upper-middle income country}} \times \mathbb{1}_{\text{periphery}}$      |                        | -0.0001**<br>(0.0001)  |
| year $\times$ $\mathbb{1}_{\text{lower-middle income country}} \times \mathbb{1}_{\text{semi-periphery}}$ |                        | -0.0001<br>(0.0001)    |
| year $\times$ $\mathbb{1}_{\text{lower-middle income country}} \times \mathbb{1}_{\text{periphery}}$      |                        | -0.0001<br>(0.0001)    |
| year $\times$ $\mathbb{1}_{\text{low income country}} \times \mathbb{1}_{\text{semi-periphery}}$          |                        | -0.0003***<br>(0.0001) |
| year $\times$ $\mathbb{1}_{\text{low income country}} \times \mathbb{1}_{\text{periphery}}$               |                        | -0.0003***<br>(0.0001) |
| Num. obs.   | 3566                   | 2946                   |
| Num. groups: code   | 58                     | 49                     |
| Adj. R <sup>2</sup> (full model)  | 0.8985                 | 0.8837                 |
| Adj. R <sup>2</sup> (proj model)  | 0.2204                 | 0.2350                 |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . The dependant variable is the GDP per capita (in log). Robust standard errors adjusted for clustering on each country are in parentheses. Estimations include country fixed-effects.

Table 2: Regional Development, Core and Periphery Divide

within countries.

## 6 Empirical Model

The effect of market potential on wages can be estimated by transforming the wage equation in the logarithm form. The coefficient estimated will be interpreted as an elasticity. In other words, I am looking for the percentage change in wages according to a 1% change in market potential. Following [Redding and Venables \(2004\)](#) and [Head and Mayer \(2011\)](#), who empirically tested the international trade wage equation at the country level, income per capita is used as a proxy for wages. Following this strategy, I can enlarge the interpretation of the usual wage equation and read the estimated coefficient of market potential as the elasticity of regional development with respect to market potential.

Assessing development by income per capita is largely adopted in the literature and allows to overcome the lack of available data regarding wages at the regional level worldwide, even if it is generally reasonable to criticise this strategy. Indeed, GDP per capita is not the only measure of development. There exist a large variety of indexes taking in consideration level of education, institutions, health care, etc. However, GDP per capita has a general impact on all of these variables. Indeed, richer countries tend to display higher educational and health care attainments, which essentially participate to the welfare of societies. Thus, GDP per capita may be reasonable to consider as a proxy for development.<sup>22</sup> This paper is therefore moving away from the traditional international trade wage equation and attempts to study what determines regional development disparities.

## 6.1 Baseline estimation

To conduct the analysis, the regional income per capita is regressed on market potential and covariates that are known to have a significant impact on regional development within countries. The covariates are geographical variables and human capital proxies, presented in section ???. I expect the errors terms of GDP per capita regressions to be correlated with some specific group effect. Each region in a single group may be correlated but independent across groups, i.e.  $Cov(u_{c_i,i}, u_{c_i,j}) = \zeta_{ij}^{c_i}$  and  $Cov(u_{c_i,i}, u_{c_j,j}) = 0$  for any region  $i \neq j$  belonging to countries  $c_i$  and  $c_j$ .<sup>23</sup> Country fixed effects are included in order to control for the long-run and historical factors that have shaped the economic development of countries and their institutions, aiming at reducing the omitted variable bias.

Unlike [Gennaioli et al. \(2013\)](#), I do not use their institutional quality index at the regional level because it is not found to affect GDP per capita and is limited to too few regions. I assume that institutional quality is uniform within a country and accounted for by using country fixed effects. Using country fixed effects eliminates the between-country variation by demeaning the data within countries. Hence, the results will be interpreted as average effects with respect to countries' average. The following regression is estimated:

$$\ln \text{GDPpc}_i = \alpha_1 \ln \text{MP}_i^{(h,s)} + \sum_{k=1}^5 \delta_k X_i^{(k)} + \zeta_c + u_i \quad (6)$$

where  $\alpha_1$  is the coefficient of interest,  $\text{MP}_i^{(h,s)}$  the market potential index computed either with the haversine distance  $\text{dist}_{ij}^{(h)}$ , either with the shipment distance function  $\text{dist}_{ij}^{(s)}$  defined in equation 4,  $\zeta_c$  the country fixed-effect. Component  $X_i^{(k)}$  represents the GDP per capita covariates, with  $k$  referring to each of the five following variables: temperature, inverse distance to port, oil production per capita, average years of education, and population density.

<sup>22</sup>Further research can be conducted using other proxies for development. A difficulty in doing so may be in the absence of a database with as many regional observations worldwide. For the same reason, Gross Value Added (GVA) per capita is not used as a proxy for wages. This is not a serious limitation as studies that use GVA per capita ([Breinlich, 2006](#); [Bruna et al., 2016](#)) find similar results than those using GDP per capita ([Head and Mayer, 2006](#)) in the case of Europe. Moreover, in some countries, wages are set at the national level for many production sectors.

<sup>23</sup>The average number of observations per country is about 14.2, with the minimum about only 2 regions (Egypt and Ireland), and the maximum about 80 regions (Russia).

## 6.2 Robustness

### 6.2.1 Proxies of market potential

The market potential variables are suspected to be endogenous since their local component is expressed as the local  $GDP_i$ . It induces a problem of reverse causality between the regressor and the regressand since income and market potential are simultaneously determined. It possibly creates biased OLS coefficients for market potential. To first solve for this problem, I replace the market potential by the non-local market potential, i.e.  $NLMP_i$ .<sup>24</sup> Doing so deletes the endogenous local part of the market potential.

However, proxying the market potential  $MP_i$  by the non-local market potential  $NLMP_i$  may not be sufficient to erase the problem of endogeneity, and the coefficients of non-local market potential indexes could still be biased. As the first Law of Geography by Tobler (1969) states: “Everything is related to everything else, but near things are more related than distant things”. To further delete the near information in market potential indexes, market potential indexes are also proxied by the foreign market potential  $FMP_i$ . It deletes information on domestic regions. The correlation between market potential and foreign market potential indexes are about 0.55 and 0.64 respectively for the indexes including distance measures expressed as  $dist_{ij}^{(h)}$  and  $dist_{ij}^{(s)}$ .

The non-local market potential  $NLMP^{(h)}$  represents about 96% (98% for the  $NLMP^{(s)}$  index) of the market potential on average, while the foreign market potential, about 65% (69% resp.). Thus, the omission of the local and domestic part of the market potential is substantial. Regressing the GDP per capita on market potential and covariates, and each of the variables  $NLMP_i$  and  $FMP_i$  allow us to test whether proxies are good if they are redundant, i.e. insignificant as the proxied variable is present in the regression. The foreign market potential is found to be a better proxy for the market potential index, as its elasticity coefficients are insignificant.

### 6.2.2 2SLS estimations

We saw that the local market potential represents a substantial part of the market potential. Erasing information on the local market may not be the best solution to solve for endogeneity as it induces a problem of omitted variable. There may also be the problem of spatial endogeneity. In order to better solve the endogeneity problem and to keep the local and domestic information of the market potential at the same time, Two-Stage-Least-Squares (2SLS) estimations are conducted.

Redding and Venables (2004) chose the log distance to the three biggest international markets as instruments for their market access index, which are Japan, Western Europe, with Belgium at its center, and the USA. Head and Mayer (2011) chose to use a centrality index, which is computed as the sum of the distances between every countries. The higher their centrality measure, the closer a country to all the other markets regardless of their market size, and the lower its transportation costs.

Using this latter IV strategy to regions, the instruments are found not to be exogenous. The arising problem comes from the fact that the size of regions has a direct impact on proximity to other markets, as well as on GDP per capita. A smaller region in terms of land area tend to be closer to other markets, since its centroid is naturally closer to others than a vaster region. Thus, its centrality index will be higher, since the sum of the inverse of distances is naturally higher. However, administrative regions that have been designed to be smaller in terms of land area are often the regions with the highest level of GDP and GDP per capita. Centrality is a good instrument for

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<sup>24</sup>Non-local market potential is also often referred as external market potential (Harris, 1954).



market potential considering countries, but it is not when considering sub-national regions, which are defined for administrative and political purposes.

The IV strategy I am using in this paper is halfway between Head and Mayer's and Redding and Venables'. I define centrality<sub>*i*</sub>, the harmonic centrality of each region with respect to the richest market of each country in the sample. The index provides information on the proximity to these markets such as the higher the index, the closer the region to the richest national markets. It may help better capturing the regional heterogeneity in proximity to rich regional markets. The instrument is computed as follows:

$$\text{centrality}_i = \sum_{j(r)} \frac{1}{\text{dist}_{ij(r)}^{(h,s)}} \quad (7)$$

with  $r$  the richest region in terms of GDP of country  $j$ , and  $\text{dist}_{ij(r)}^{(h,s)}$  the distance between  $i$  and  $r$  for each country  $j$ , computed as the haversine distance and as the shipment distance function defined in equation 4. More particularly, centrality<sub>*i*</sub><sup>(*h*)</sup> is going to depend on  $\text{dist}_{ij(r)}^{(h)}$ , and centrality<sub>*i*</sub><sup>(*s*)</sup> on  $\text{dist}_{ij(r)}^{(s)}$ . The first stage regression is expressed as follows:

$$\ln \hat{\text{MP}}_i^{(h,s)} = \lambda_1 \ln \text{centrality}_i^{(h,s)} + \sum_{k=2}^6 \lambda_k X_i^{(k)} + \zeta_c + \epsilon_i \quad (8)$$

Another instrument used for market potential is the foreign market potential. Indeed, it is found to not have a significant impact on the regional income per capita, and it is redundant when including it in equation 6, i.e. its coefficient is not significant - see the results in section 7.2.2. Hence, another version of the first stage regression is:

$$\ln \hat{\text{MP}}_i^{(h,s)} = \theta_1 \ln \text{FMP}_i^{(h,s)} + \sum_{k=2}^6 \lambda_k X_i^{(k)} + \zeta_c + \epsilon_i \quad (9)$$

### 6.2.3 Panel estimation

To test whether regional development is robustly explained by market potential, I estimate the model with the panel data, and interact the country fixed effects with years, and denote it as  $\zeta_{ct}$ . Doing so allows to control for heterogeneity of countries at different points in time.<sup>25</sup> In particular, these country-year fixed effects allows to control for possible change in institutional quality over time at the country level. Coefficient  $\alpha_1$  gives the average effect of a regional market potential deviation from country-year average.

## 6.3 The Core and Periphery Divide

The heterogeneous effect of market potential on regional development is also investigated for different groups of regions identified within each country according to their GDP levels using k-means

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<sup>25</sup>Note that the only source of temporal variation for the market potential indices is the GDP information. Literature has shown that ocean shipping costs are falling over time for all countries as improved technologies reduce port time and speed sea travel and larger containers transport larger volumes of commodities. In particular, Hummels (2007) reports that from the 80s to 2000s, shipping costs have been declining steadily. However, the shipment distance function used in the computation of market potential indexes do not vary in this analysis. This omission can be translated in a decrease in the elasticity coefficients to market potential over time. We do not find that the coefficient change (see results from the cross-sectional estimations for 1995, 2000 and 2005 in table 24).

clustering. The resulting groups of regions are classified as core, semi-periphery and periphery regions. They reflect the results of agglomeration effects described by [Krugman \(1991\)](#). I estimate the following specification:

$$\ln \text{GDPpc}_i = \alpha_1 \ln \text{MP}_i^{(h,s)} + \sum_{g=2}^3 \alpha_g \ln \text{MP}_i^{(h,s)} \times \mathbf{1}(\Gamma_i = \gamma_g) + \sum_{k=1}^5 \delta_k X_i^{(k)} + \zeta_c + u_i \quad (10)$$

with  $\Gamma_i$  the classification of region  $i$ , with  $\gamma_g = \{\text{core}, \text{semi-periphery}, \text{periphery}\}$  the different values of  $\Gamma_i$ .  $\alpha_1$  is the average percentage change of a 1% increase in market potential index from the national average for a core region, ceteris paribus.  $\alpha_2$  and  $\alpha_3$  are the effect of the two interaction terms of the market potential variable and dummies, which are equal to 1 if region  $i$  is a semi-periphery or a periphery region respectively, zero otherwise. In other words, they represent the difference in percentage points of the elasticity to market potential between (semi-) peripheral and core regions. In order to investigate potential heterogeneity effects accross countries, I split the sample into four groups based on the level of income of each country: high-income, upper-middle-income, lower-middle-income, and low-income countries. It allows to determine the different degrees of sensitivity to market access for core and periphery regions across different countries' income levels.

### 6.3.1 Centrality to core markets

Additionally, the study delves deeper into the impact of proximity to domestic and foreign core regions on (semi-)peripheral regions. In order to do this, other measures of centrality are used, which are based on the inverse haversine distance between a region and the national or foreign core regions. Note that based on the k-means clustering of regions according to their GDP levels, countries in the sample contain between one to three core regions. By adding these centrality measures to the regression, we can better understand the effect of proximity to the wealthiest markets and address some of the limitations of the market potential indexes. These indexes, which involve summing up a large number of values, fail to capture the agglomeration effects that often divide core and periphery regions. By considering measures of centrality, we can gain a more precise understanding of the link between market access to core domestic and foreign regions and regional development disparities between core and peripheral regions.

I distinguish centrality to foreign core regions between centrality to foreign core with a free trade agreement and without. Being in close proximity to foreign cores without a trade agreement can impede trade due to national barriers such as tariffs, quotas, and regulations. These barriers restrict the movement of goods, services, and investments, increasing costs and hindering trade for peripheral regions. Despite their geographical closeness, the absence of a trade agreement limits the potential economic benefits that could arise from proximity to foreign cores, resulting in missed trade opportunities and reduced growth prospects.

I will contrast the findings with those of [Adam et al. \(2021\)](#) who find that that subnational regions near international borders often exhibit lower per capita income levels and that trade agreements at these borders can mitigate this negative impact by facilitating trade and reducing barriers. Although the present papers' specification regarding proximity to foreign cores without a trade agreement may not directly align with Adam and coauthors' results, they provide additional insights into the compensatory role of trade agreements in mitigating the adverse consequences of geographical proximity to foreign cores.

The four centrality measures are:

$$\text{centrality}_i^{\text{domestic cores}} = \sum_j \frac{1}{\text{dist}_{ij}} \times \mathbb{1}(\Gamma_j = \text{core}) \times \mathbb{1}(c_i = c_j) \quad (11)$$

$$\text{centrality}_i^{\text{foreign cores}} = \sum_j \frac{1}{\text{dist}_{ij}} \times \mathbb{1}(\Gamma_j = \text{core}) \times \mathbb{1}(c_i \neq c_j) \quad (12)$$

$$\text{centrality}_i^{\text{foreign cores, FTA}} = \sum_j \frac{1}{\text{dist}_{ij}} \times \mathbb{1}(\Gamma_j = \text{core}) \times \mathbb{1}(c_i \neq c_j) \times \mathbb{1}(\text{rta}_{c_i, c_j} = 1) \quad (13)$$

$$\text{centrality}_i^{\text{foreign cores, no FTA}} = \sum_j \frac{1}{\text{dist}_{ij}} \times \mathbb{1}(\Gamma_j = \text{core}) \times \mathbb{1}(c_i = c_j) \times \mathbb{1}(\text{rta}_{c_i, c_j} = 0) \quad (14)$$

where  $\mathbb{1}(\Gamma_j = \text{core})$  correspond to a dummy stating that region  $j$  is a core region in country  $c_j$ .  $\mathbb{1}(c_i = c_j)$  refers to domestic relationship and indicates that countries of regions  $i$  and  $j$  are the same if the dummy equals 1, zero otherwise.  $\mathbb{1}(c_i \neq c_j)$  refers to foreign relationship where countries of regions  $i$  and  $j$  are different. If they are different, the dummy equals 1, zero otherwise. Among those foreign relationships, a distinction is done between  $\mathbb{1}(\text{rta}_{c_i, c_j} = 1)$  and  $\mathbb{1}(\text{rta}_{c_i, c_j} = 0)$ , which indicate whether or not the countries of regions  $i$  and  $j$  have a trade agreement in 2005.

I estimate the following specifications:

$$\ln \text{GDPpc}_i = \sum_{w=1}^W \alpha \ln \text{centrality}_i^{(w)} + \sum_{k=1}^5 \delta_k X_i^{(k)} + \zeta_c + u_i \quad (15)$$

$$\ln \text{GDPpc}_i = \sum_{g=1}^3 \sum_{w=1}^W \alpha_{wg} \ln \text{centrality}_i^{(w)} \times \mathbb{1}(\Gamma_i = \gamma_g) + \sum_{k=1}^5 \delta_k X_i^{(k)} + \zeta_c + \gamma_g + u_i \quad (16)$$

with the first one investigating the effect of the centrality measures that contain different weights which indicate whether it relates to centrality to domestic or foreign cores, with and without free trade agreement. The second specification estimate the coefficients for each cluster group of regions, i.e. the core and the (semi-)periphery.

I conduct robustness checks using panel data to further assess the effects of centrality on foreign core regions that have a trade agreement with the region's country of reference. Specifically, I evaluate the impact of signing a trade agreement by computing the centrality index for foreign core regions with a trade agreement for each year of the panel sample (1995, 2000, 2005, 2010) and explore how variations in the index influence regional development. When a country signs a trade agreement with another, the centrality index of its regions increases as I add the sum of the inverse distances to the core regions of the second country. I estimate the following regressions:

$$\ln \text{GDPpc}_{it} = \alpha \ln \text{centrality}_{it}^{\text{foreign cores, FTA}} + \sum_{k=1}^5 \delta_k X_{it}^{(k)} + \zeta_{ct} + u_{it} \quad (17)$$

$$\ln \text{GDPpc}_{it} = \sum_{g=1}^3 \alpha_g \ln \text{centrality}_{it}^{\text{foreign cores, FTA}} \times \mathbb{1}(\Gamma_i = \gamma_g) + \sum_{k=1}^5 \delta_k X_{it}^{(k)} + \zeta_{ct} + \zeta_i \times \gamma_g + u_{it} \quad (18)$$

where  $\alpha$  is the average percentage effect of a 1% increase in the variable  $\text{centrality}_{it}^{\text{foreign cores, FTA}}$  due to trade agreement with other countries, and  $\alpha_g$  is the specific effect for each group of regions, the core and the (semi-)periphery.  $\zeta_{ct}$  is a country-year fixed effect and  $\zeta_i \times \gamma_g$  a region-cluster group fixed effect. Results are displayed and discussed in next section.

## 7 Results

In this section, evidence is presented on the determinants of regional development, first in cross-section in 2005, then in panel estimations for the years  $t = \{1995; 2000; 2005; 2010\}$ . A particular focus on the effect of market potential is given. Regressions allow to test the international trade wage equation and to compare coefficients with the structural parameter from the theory.<sup>26</sup>

### 7.1 Baseline estimations

Univariate regressions of GDP per capita on market potential and its proxies are presented in table 17 in the appendix. Results show positive and highly significant coefficients for the estimations with the different distance function. Moreover, coefficients corresponds to the theoretical predictions. They are close to the expected values of the parameter, i.e. between 0.10 and 0.33. In particular, if the average region in a country experience a 1% increase in its market potential, it is expected to increase its GDP per capita by 0.2%. The R-squared statistics indicate that variations in regional  $\ln \text{GDPpc}$  are explained by between 4% and 6% of the variations in  $\ln \text{MP}$  within countries. R-squared statistics are lower when considering the non-local market potential indexes, i.e. 0.02. The foreign market potential does not seem to explain regional development.  $\text{MP}^{(h)}$  and  $\text{MP}^{(s)}$  display similar coefficients among the different specifications.

Table 3 shows the baseline results in cross-section for the year 2005. The estimations are controlled for other geographical variables and human capital proxies, such as *temperature*, known to affect labor productivity, *inverse distance to the closest port*, which is used as another measure for the impact of international trade activities as it can proxy for foreign markets proximity, *production of oil per capita*, as it is a particular endowment that affect development in specific ways, and finally *average years of education* and *population density*, which both play a role as knowledge resources and production means. The covariates tend to reduce the biases of the univariate regressions.

Conditional on time-invariant characteristics of countries, the elasticity coefficient of regional development to market potential is found to be equal to 0.10, and 0.05 for the non-local market potential. In other words, a 1% higher market potential index is associated to a 0.1% higher GDP per capita. These coefficients correspond to high values of elasticity of substitution between varieties. Notice that the non-local market potential as measured by port accessibility and ocean shipment distance function give a relatively lower confidence interval, but the p-value is still about 0.057. The foreign market potential is not found to have a significant impact on the GDP per capita differences within countries. It is also the case when we exclude *inverse distance to the closest port* from the regression.

Despite the non-significance of the foreign market potential coefficient, accessibility to foreign markets as proxied by the inverse distance to ports is found to be a highly significant determinant of GDP per capita. The coefficient is robustly estimated to be equal to 0.14. The oil production per capita and the average years of education are also found to explain regional differences in devel-

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<sup>26</sup>Coefficients may be equal to  $1/\beta\sigma$ , with  $\sigma$  the elasticity of substitution between varieties and  $\beta$  the income labor share. Following a methodology derived from a model of international trade in differentiated products and monopolistic competition, the elasticity of substitution between varieties has been estimated in the literature. At the aggregate level, it has been found to be around 6 and 11 - see [Head and Ries \(2001\)](#), [Lai and Trefler \(2002\)](#), [Romalís \(2007\)](#). Depending on the industry field, [Ahmad and Riker \(2020\)](#) find that the elasticity of substitution between varieties can range from 1 to 13, with the median around 2 and 3. On the other hand, the income labor share is generally estimated to be between 0.5 and 0.75 - see [Guerriero \(2019\)](#). Assuming these ranges for  $\sigma$  and  $\beta$ , we can expect the coefficient of interest of the analysis to be in the interval  $[0.10; 0.33]$ , or even in the interval  $[0.44; 2]$  for values in the lower bound of  $\sigma$ .

|                                  | (1)               | (2)               | (3)                 | (4)                 | (5)                | (6)                |
|----------------------------------|-------------------|-------------------|---------------------|---------------------|--------------------|--------------------|
| market potential                 | 0.11***<br>(0.03) | 0.09***<br>(0.03) | 0.06**<br>(0.02)    | 0.05*<br>(0.03)     | 0.07<br>(0.07)     | 0.00<br>(0.09)     |
| inv. dist. port                  | 0.14**<br>(0.06)  | 0.13**<br>(0.06)  | 0.14**<br>(0.06)    | 0.13**<br>(0.06)    | 0.14**<br>(0.06)   | 0.13**<br>(0.06)   |
| years education                  | 0.28***<br>(0.02) | 0.28***<br>(0.02) | 0.28***<br>(0.02)   | 0.28***<br>(0.02)   | 0.28***<br>(0.02)  | 0.28***<br>(0.02)  |
| population density               | -0.00<br>(0.01)   | 0.01<br>(0.01)    | 0.01<br>(0.01)      | 0.01<br>(0.01)      | 0.01<br>(0.01)     | 0.01<br>(0.01)     |
| temperature                      | -0.01<br>(0.01)   | -0.01<br>(0.01)   | -0.01<br>(0.01)     | -0.01<br>(0.01)     | -0.01<br>(0.01)    | -0.01<br>(0.01)    |
| oil per cap.                     | 0.19***<br>(0.04) | 0.19***<br>(0.04) | 0.19***<br>(0.04)   | 0.19***<br>(0.04)   | 0.19***<br>(0.04)  | 0.19***<br>(0.04)  |
| Num. obs.                        | 1,464             | 1,464             | 1,464               | 1,464               | 1,464              | 1,464              |
| Country FE                       | Yes               | Yes               | Yes                 | Yes                 | Yes                | Yes                |
| Num. groups: code                | 103               | 103               | 103                 | 103                 | 103                | 103                |
| Adj. R <sup>2</sup> (proj model) | 0.43              | 0.42              | 0.42                | 0.42                | 0.42               | 0.42               |
| Regressor                        | MP <sup>(h)</sup> | MP <sup>(s)</sup> | NLMP <sup>(h)</sup> | NLMP <sup>(s)</sup> | FMP <sup>(h)</sup> | FMP <sup>(s)</sup> |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . Robust standard errors adjusted for clustering on each country are in parentheses. MP<sup>(h)</sup> considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements. MP<sup>(s)</sup> considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures. NLMP<sup>(h)</sup> and NLMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the local market, i.e.  $y_i \tau_{ii}$ . FMP<sup>(h)</sup> and FMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the domestic markets, i.e.  $\sum_{j \neq i} y_j \tau_{ij}$  with  $i$  and  $j$  both in country  $c$ .

Table 3: Regional Development and Market Potential

opment levels within countries. In particular, an additional year in the average level of education in a region with respect to the national average is found to increase the GDP per capita by 28%. This coefficient is lower than the one obtained by [Gennaioli et al. \(2013\)](#) (see table IV, page 134).

However, it is worth to notice that the effect of education on regional development keeps being much larger than the micro estimates, which are generally of the 0.06-0.10 range from the Mincerian literature. It can be due to the fact that the educational variable is endogenous<sup>27</sup>. [Gennaioli et al. \(2013\)](#) suggest to proxy this variable by the education of the old population, i.e. population of more than 65 years old. This proxy may not be the best as there may be growth long-run effect. However, they claim that it may be sufficient as they not do intervene in the current production. This proxy gives very close coefficients to the other human capital proxy, but has the disadvantage to decrease considerably the amount of observations.<sup>28</sup>

I compare the results with the ones found by [Head and Mayer \(2011\)](#). They use measures of market potential considering countries, with a similar formulation than MP<sup>(h)</sup> index. Their index takes into account distance, contiguity, common language, colonial links, and dummies for common membership of a regional trade agreement (RTA), a currency union and WTO membership. Net of the effect of education levels, they find significant coefficients about 0.41 for the year 1995 without

<sup>27</sup>[Acemoglu et al. \(2014\)](#) instrumented the educational variable by the allocation of protestant missionaries in the early twentieth century

<sup>28</sup>The tables are not reported in this paper, but results can be given under request.

country fixed effects, and 0.55 for the period 1965-2005 with country fixed effects. This is sensitively higher than what we find in the similar regressions considering regions in 2005. It suggests that regional development differences within countries are less sensitive to market potential than national development differences worldwide.<sup>29</sup> This observation can be due to the fact that there exist less variation of GDP per capita and market potential within countries than between countries.

Single-country analysis support this statement. The effect of a 1% increase in the regional market potential is found to increase wages by below than 0.2% in general. This results hold for developing countries such as Brazil (Fally et al., 2010), China (Baum-Snow et al., 2015), Chile (Paredes, 2013), as well as European regions from European analysis (Niebuhr, 2006; Head and Mayer, 2006; Brakman et al., 2009) and single-country analysis (Brakman et al., 2004; Mion and Naticchioni, 2009; Pires, 2006; Kosfeld and Eckey, 2010).

## 7.2 Robustness checks

This section presents the robustness checks undergone to verify the validity of the results first within each country, second using Two-Stages-Least-Square estimations on the cross-sectional sample, and finally on a panel, but smaller, sample.

### 7.2.1 Countries' regressions

Tables 18, 19, 20 and 21 in the appendix display the coefficients per country. These coefficients have been estimated following equation 6 for each country. Most of the estimated coefficients are found insignificant. Some coefficients of market potential elasticity are even found to be negative - in the case of Portugal (7 observations) or Czech Republic (8 observations). This may be due to the level of aggregation of the data. Regions may be too large and too few per country - we report the amount of regions per country in the table.<sup>30</sup> Hence, comparing both observations in the within country analysis gives a non-meaningful and highly negative coefficient. However, it could also testify the strong agglomeration forces within countries, where agglomeration of economic activity is stronger. Rich and large regions might be harmful for surrounding regions, since their mass may attract their population and investments.

We find similar coefficients of market potential among countries that have been studied in the literature. Among high income countries, Italy's coefficient is about 0.4, same as found by A'Hearn and Venables (2013), as showed by Table 18. In particular, results show that Italy is highly sensitive to its foreign market potential, considering the simple haversine distance function as well as the shipment distance function. Spain's coefficient is found to be equal to 0.1, although not significant, with Pires (2006) and López-Rodríguez et al. (2008) finding coefficients between 0.1 and 0.2. This range of value are the ones found for European countries in general (Niebuhr, 2006; Head and Mayer, 2006; Brakman et al., 2009). I find that Denmark and Hungary display significant coefficients about 0.5 for  $MP^{(h)}$  and 0.7 for  $MP^{(s)}$ .

Among upper middle income countries, China displays a coefficient about 0.7, as displayed in Table 19. This elasticity coefficient is higher than the 0.1 coefficient found by Hering and Poncet (2010) and Baum-Snow et al. (2015). Brazil and Turkey display a similar coefficient than Fally et al. (2010) and Karahasan et al. (2016) respectively, but a negative coefficient for Chile, although not significant, contrary to what is found by Paredes (2013). In addition, I find significant coefficients

<sup>29</sup> Another explanation for smaller coefficients is that I control for more geographic variable than Head and Mayer (2011) do, reducing the potential bias in the estimators. With panel data and controlling for auto-correlation, Boulhol and De Serres (2010) find coefficients between 0.07 and 0.1, as I find in table 3.

<sup>30</sup> Note that significant coefficients are associated to countries with at least 20 observations.



about 0.6-0.9 for Columbia and 0.3 for Russia. In both countries, regions are found to be very sensitive to their foreign market access, in particular to the shipment foreign market access for Columbia - the elasticity is estimated about 4.7. Among lower middle income countries, only Indonesia's and India's regions are found to depend on their proximity to markets - as measured with both haversine and shipment distance functions. Their coefficient elasticity are respectively about 0.9 and 0.2. The lack of information for low income countries do not allow me to conclude.

### 7.2.2 2SLS estimations

Two different instruments are used in the Two-Stage-Least Squares estimation. A first one is a centrality index which summarizes the inverse distance to the wealthiest region of each country in the sample, presented in equation 7. The second is the foreign market potential, which is not found to have an effect on GDP per capita, as showed by results above.

First, market potential indexes are regressed on the instrument chosen and the regional development covariates, following equation 8. Then, the second stage consists in regressing the GDP per capita on the fitted market potential values, as well as the regional development covariates. Column 1 and 2 in table 4 show the results of the first and second stage equations, i.e. equations 8 and 6 respectively. Column 3 and 4 show the results for specifications with the first stage expressed in equation 9, using the foreign market potential as instrument.

First stage results show that the higher the centrality of regions in terms of proximity to the wealthier regions from each country, the higher their market potential. More particularly, I find that a region with a 1% higher centrality index than the average region in the same country is predicted to have a 0.08% higher market potential. This result is significant at the 1% significance level. Density is found to be an important determinant of market potential. The larger the population with respect to the regional area, the higher the potential demand and thus, the higher the market potential. Second stage display considerably higher coefficients for market potential indexes than what has been estimated with OLS, suggesting that the effect of regional market potential on development has been under-estimated. Indeed, coefficients are between 0.8 and 0.9 points greater.

In order to check for the instrumentation's relevance, I conduct different tests: (1) endogeneity test, (2) under-identification test<sup>31</sup>, and (3) weak identification test. Because it is assumed that the error terms may be correlated at the national level, justifying the use of fixed effects and standard errors clustering at the country level, a first test relies on the Durbin–Wu–Hausman statistic, a second on the Kleibergen–Paap rk LM statistic, and a third on the Kleibergen–Paap rk Wald F statistic. These three tests are robust to heteroskedasticity.

The first test evaluates whether the OLS and the 2SLS estimates are statistically different, i.e.  $H_0 : \alpha_1^{(OLS)} \neq \alpha_1^{(2SLS)}$ . In other words, it checks for the endogeneity of the market potential variable. The Durbin–Wu–Hausman statistics in column 1 and 2 suggest that the two estimates from the OLS and the IV regressions are statistically different, so that the OLS estimate is inconsistent. However, the second and third IV tests reveal statistics lower than 10<sup>32</sup>. Thus, we can not reject that the instrument is weak, neither that it is redundant. In other words, the instrument seems not to be relevant and the estimated coefficient may be biased.

Since the OLS coefficients for the effect of foreign market potential indexes on regional GDP per capita are not significant, I choose to use them as instruments<sup>33</sup>. The first stage shows highly

<sup>31</sup>With one instrument, the underidentification test is equivalent to the IV redundancy test.

<sup>32</sup>The Kleibergen–Paap rk Wald F statistic from the weak identification test is compared to the Stock–Yogo weak ID test critical values for a 10% maximal IV size, which is about 16.38. Hence, the null hypothesis is not rejected.

<sup>33</sup>Note that the foreign market potential is redundant when adding the variable in equation 6 to be estimated.

|                                  | (1)                  | (2)                  | (3)                  | (4)                  |
|----------------------------------|----------------------|----------------------|----------------------|----------------------|
| <i>Second Stage</i>              |                      |                      |                      |                      |
| temperature                      | −0.01<br>(0.01)      | −0.01<br>(0.01)      | −0.01<br>(0.01)      | −0.01<br>(0.01)      |
| inv. dist. port                  | 0.18<br>(0.14)       | 0.14**<br>(0.09)     | 0.14**<br>(0.06)     | 0.13**<br>(0.06)     |
| oil per cap.                     | 0.24***<br>(0.04)    | 0.23***<br>(0.04)    | 0.19***<br>(0.04)    | 0.19***<br>(0.04)    |
| population density               | −0.13**<br>(0.06)    | −0.08**<br>(0.04)    | 0.00<br>(0.01)       | 0.01<br>(0.01)       |
| years education                  | 0.26***<br>(0.03)    | 0.27***<br>(0.03)    | 0.28***<br>(0.02)    | 0.28***<br>(0.02)    |
| market potential                 | 1.04**<br>(0.51)     | 0.87**<br>(0.42)     | 0.08<br>(0.08)       | 0.00<br>(0.09)       |
| Num. obs.                        | 1,464                | 1,464                | 1,464                | 1,464                |
| Country Fixed Effects            | Yes                  | Yes                  | Yes                  | Yes                  |
| Num. groups: country             | 103                  | 103                  | 103                  | 103                  |
| Adj. R <sup>2</sup> (proj model) | −0.32                | 0.06                 | 0.43                 | 0.42                 |
| Regressor (endogenous variable)  | ln MP <sup>(h)</sup> | ln MP <sup>(s)</sup> | ln MP <sup>(h)</sup> | ln MP <sup>(s)</sup> |
| <i>First Stage</i>               |                      |                      |                      |                      |
| temperature                      | 0.00<br>(0.01)       | 0.00<br>(0.01)       | 0.00<br>(0.00)       | 0.00<br>(0.00)       |
| inv. dist. port                  | −0.04<br>(0.14)      | −0.00<br>(0.11)      | 0.00<br>(0.15)       | −0.08<br>(0.13)      |
| oil per cap.                     | −0.05<br>(0.04)      | −0.06*<br>(0.03)     | −0.02<br>(0.04)      | −0.02<br>(0.03)      |
| population density               | 0.12***<br>(0.02)    | 0.09***<br>(0.02)    | 0.12***<br>(0.02)    | 0.09***<br>(0.02)    |
| years education                  | 0.00<br>(0.02)       | −0.01<br>(0.02)      | 0.02<br>(0.02)       | 0.01<br>(0.01)       |
| centrality                       | 0.05**<br>(0.03)     | 0.07**<br>(0.03)     |                      |                      |
| foreign market potential         |                      |                      | 0.98***<br>(0.13)    | 1.02***<br>(0.16)    |
| <i>Endogeneity test</i>          |                      |                      |                      |                      |
| F stat                           | 16.35<br>[0.00]      | 13.89<br>[0.00]      | 0.23<br>[0.63]       | 1.11<br>[0.29]       |
| <i>Under-identification test</i> |                      |                      |                      |                      |
| Kleibergen-Paap rk LM stat       | 4.23<br>[0.04]       | 5.23<br>[0.02]       | 11.12<br>[0.00]      | 10.71<br>[0.00]      |
| <i>Weak identification test</i>  |                      |                      |                      |                      |
| Kleibergen-Paap rk Wald F stat   | 4.07                 | 5.18                 | 55.29                | 38.77                |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . Robust standard errors adjusted for clustering on each country are in parentheses. MP<sup>(h)</sup> considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements. MP<sup>(s)</sup> considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures. The variables centrality<sup>(h)</sup> and FMP<sup>(h)</sup> (centrality<sup>(s)</sup> and FMP<sup>(s)</sup> respectively), are used as instruments for MP<sup>(h)</sup> (MP<sup>(s)</sup> respectively).

Table 4: IV results

significant elasticity coefficients around unity, with Kleibergen-Paap statistics higher than 10 and 16.38 for the under-identification and weak identification tests respectively. However, the endogeneity test reveals that the effect of the fitted market potential is not different from the OLS specification, with non-significant IV coefficients. This result suggests to believe in the coefficients about 0.1 estimated in column 1 and 2 from table 3. However, 2SLS coefficients are found to be not significant. It could come from the fact that market potential impact regional inequality differently depending on the income group of the country, as explained in section 7.3.2.

Head and Mayer (2006), who estimate market potential indexes for European regions with a similar method, find coefficients about 0.12 in their OLS estimation, and about 0.07 in their IV estimation. These coefficients are similar to those found from the OLS specification - see Table 3.

### 7.2.3 Panel estimations

To test the robustness of the cross-sectional results, we estimate regression 6 with the panel data available for the years 1995, 2000, 2005 and 2010. The panel sample comprises 1,064 subnational regions in 72 countries, although the dataset is unbalanced. On average, each region appears in the sample for 2.9 years, with a minimum of one year and a maximum of four years. However, due to a lack of information on education for some regions during the years 2005 and 2010, a significant number of observations will need to be removed from the estimations. To address this issue, I merge the panel dataset with the 2005 cross-sectional dataset to complete missing observations on education for that year. This will help to improve the completeness of the sample and ensure that the estimations are based on a more representative dataset. First, cross-section regressions with country fixed effects are estimated for each year of the panel sample. Then, panel estimations are performed with fixed effects at the country-year level,  $\zeta_{ct}$ , to control for country-time varying unobservables. Results are displayed in table 24 in the appendix.

Elasticity coefficients to market potential from the different cross-sectional estimations are similar than those found in table 3 - about 0.1 - for the years 1995, 2000 and 2005. Foreign market potential elasticity coefficient is not significant in 2005, as found in table 3, but is significantly equal to 0.1 in 1995 and 0.2 in 2000. However, results for the year 2010 show insignificant coefficients for market potential indices computed with the haversine distance, while indices computed with the shipment function are found to have a significant negative effect on income per capita. Results may be biased as a result of a lack of observations, i.e. only 20 countries are considered.

Results for the complete panel estimations support that a region with a market potential that is 1% higher than the average region within country-year groups is predicted to have a 0.1% higher income per capita. Coefficients display a higher significance level when excluding the year 2010. It is also found that proximity to foreign markets do matter even more significantly than the non-local market potential, while the reverse has been found in cross-section.

Table 25 in the appendix presents the results for the investigation of heterogenous effect of market potential regarding the core-periphery structure of regions within countries. Results still show that peripheral regions robustly display elasticity coefficients lower by 0.01 to 0.02 percentage points lower than core regions.

## 7.3 The Core and Periphery Divide

### 7.3.1 Baseline regressions

The heterogeneous effect of market potential on regional development is investigated with respect to the income position of regions within countries, classified into three different groups: the *core*, the

*semi-periphery* and the *periphery*. This specification is motivated by the [Krugman \(1991\)](#)’s Core-Periphery model which explains how the economic activity can concentrate in specific regions, leaving the periphery behind. The lower the transportation and trade costs to a wealthy region, the higher the agglomeration forces towards this wealthy region. The poorer a market, the higher the agglomeration forces towards wealthy regions. Following this statement, we can wonder if market potential can have a negative effect on development for peripheral regions.

Table 5 shows the results, with the interacted effect of market potential with the regional group dummies. The coefficient of market potential gives the effect of market potential on core regions - the wealthiest in terms of GDP. A 1% increase in the market potential in core regions is expected to increase their GDP per capita by 0.1%. If the region is categorized as a periphery region, the expected effect of market potential on regional development is 0.02 percentage points lower, but still positive. The same result holds for non-local market potential. While proximity to wealthy foreign regions is found to have no effect on core regions, (semi-)peripheral regions are found to have an elasticity coefficient significantly lower by (0.01) 0.02 percentage points. This result suggests that the (semi-)periphery could suffer from too much proximity to foreign markets. A 1% increase in the foreign market potential in peripheral regions can be associated to a decrease by 0.02% in the GDP per capita.

### 7.3.2 Countries’ income group regressions

Table 6 displays the estimated coefficients of the effect of market potential and its proxies on regional development by countries’ income group following the World Bank classification: *High income*, *Upper middle income*, *Lower middle income* and *Low income*. Results show an heterogeneous effect of market potential. Especially, the split of the sample do not give significant estimate of

|  | (1)                | (2)                | (3)                 | (4)                 | (5)                | (6)                |
|--|--------------------|--------------------|---------------------|---------------------|--------------------|--------------------|
| market potential   | 0.12***<br>(0.03)  | 0.10***<br>(0.03)  | 0.08***<br>(0.03)   | 0.07***<br>(0.03)   | 0.09<br>(0.06)     | -0.00<br>(0.08)    |
| market potential $\times \mathbb{1}_{\text{semi-periphery}}$ | -0.01***<br>(0.00) | -0.01***<br>(0.00) | -0.01***<br>(0.00)  | -0.01***<br>(0.00)  | -0.01***<br>(0.00) | -0.01***<br>(0.00) |
| market potential $\times \mathbb{1}_{\text{periphery}}$      | -0.02***<br>(0.00) | -0.02***<br>(0.00) | -0.02***<br>(0.00)  | -0.02***<br>(0.00)  | -0.02***<br>(0.00) | -0.02***<br>(0.00) |
| Num. obs.  | 1460               | 1460               | 1460                | 1460                | 1460               | 1460               |
| Country FE   | Yes                | Yes                | Yes                 | Yes                 | Yes                | Yes                |
| Num. groups: code  | 101                | 101                | 101                 | 101                 | 101                | 101                |
| Adj. R <sup>2</sup> (proj model)                             | 0.47               | 0.47               | 0.47                | 0.47                | 0.46               | 0.46               |
| Regressor  | MP <sup>(h)</sup>  | MP <sup>(s)</sup>  | NLMP <sup>(h)</sup> | NLMP <sup>(s)</sup> | FMP <sup>(h)</sup> | FMP <sup>(s)</sup> |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . Robust standard errors adjusted for clustering on each country are in parentheses. The following covariates are included: temperature, inverse distance to the closest port, oil production per capita and average educational level. MP<sup>(h)</sup> considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements. MP<sup>(s)</sup> considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures. NLMP<sup>(h)</sup> and NLMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the local market, i.e.  $y_i \tau_{ii}$ . FMP<sup>(h)</sup> and FMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the domestic markets, i.e.  $\sum_{j \neq i} y_j \tau_{ij}$  with  $i$  and  $j$  both in country  $c$ .

Table 5: Regional Development and Market Potential - Core and Periphery

|  | (1)                | (2)                | (3)                 | (4)                 | (5)                | (6)                |
|--|--------------------|--------------------|---------------------|---------------------|--------------------|--------------------|
| <i>High income countries</i>                                 |                    |                    |                     |                     |                    |                    |
| market potential   | 0.04<br>(0.03)     | 0.04<br>(0.03)     | 0.02<br>(0.02)      | 0.03<br>(0.03)      | 0.14<br>(0.10)     | 0.09<br>(0.09)     |
| market potential $\times \mathbb{1}_{\text{semi-periphery}}$ | -0.01***<br>(0.00) | -0.01***<br>(0.00) | -0.01***<br>(0.00)  | -0.01***<br>(0.00)  | -0.01***<br>(0.00) | -0.01***<br>(0.00) |
| market potential $\times \mathbb{1}_{\text{periphery}}$      | -0.01***<br>(0.00) | -0.01***<br>(0.00) | -0.01***<br>(0.00)  | -0.01***<br>(0.00)  | -0.01***<br>(0.00) | -0.01***<br>(0.00) |
| Num. obs.  | 441                | 441                | 441                 | 441                 | 441                | 441                |
| Num. groups: code  | 29                 | 29                 | 29                  | 29                  | 29                 | 29                 |
| Adj. R <sup>2</sup> (proj model)                             | 0.42               | 0.42               | 0.42                | 0.42                | 0.43               | 0.42               |
| <i>Upper-middle income countries</i>                         |                    |                    |                     |                     |                    |                    |
| market potential   | 0.16***<br>(0.05)  | 0.13**<br>(0.06)   | 0.12**<br>(0.05)    | 0.10<br>(0.06)      | 0.14<br>(0.13)     | -0.06<br>(0.17)    |
| market potential $\times \mathbb{1}_{\text{semi-periphery}}$ | -0.01<br>(0.00)    | -0.01<br>(0.00)    | -0.01*<br>(0.00)    | -0.01*<br>(0.00)    | -0.01*<br>(0.00)   | -0.01*<br>(0.00)   |
| market potential $\times \mathbb{1}_{\text{periphery}}$      | -0.02***<br>(0.01) | -0.02***<br>(0.01) | -0.02***<br>(0.01)  | -0.02***<br>(0.01)  | -0.02***<br>(0.01) | -0.02***<br>(0.01) |
| Num. obs.  | 519                | 519                | 519                 | 519                 | 519                | 519                |
| Num. groups: code  | 29                 | 29                 | 29                  | 29                  | 29                 | 29                 |
| Adj. R <sup>2</sup> (proj model)                             | 0.52               | 0.51               | 0.51                | 0.51                | 0.50               | 0.50               |
| <i>Lower-middle income countries</i>                         |                    |                    |                     |                     |                    |                    |
| market potential   | 0.21**<br>(0.09)   | 0.25**<br>(0.10)   | 0.14***<br>(0.04)   | 0.18***<br>(0.06)   | -0.00<br>(0.15)    | 0.05<br>(0.23)     |
| market potential $\times \mathbb{1}_{\text{semi-periphery}}$ | -0.01***<br>(0.00) | -0.01***<br>(0.00) | -0.01***<br>(0.00)  | -0.01***<br>(0.00)  | -0.01**<br>(0.00)  | -0.01**<br>(0.00)  |
| market potential $\times \mathbb{1}_{\text{periphery}}$      | -0.02***<br>(0.01) | -0.02***<br>(0.01) | -0.02***<br>(0.01)  | -0.02***<br>(0.01)  | -0.02***<br>(0.01) | -0.02***<br>(0.01) |
| Num. obs.  | 368                | 368                | 368                 | 368                 | 368                | 368                |
| Num. groups: code  | 29                 | 29                 | 29                  | 29                  | 29                 | 29                 |
| Adj. R <sup>2</sup> (proj model)                             | 0.51               | 0.51               | 0.50                | 0.50                | 0.49               | 0.49               |
| <i>Low income countries</i>                                  |                    |                    |                     |                     |                    |                    |
| market potential   | 0.27<br>(0.52)     | -0.01<br>(0.65)    | 0.14<br>(0.50)      | -0.09<br>(0.62)     | 1.21<br>(1.04)     | 0.30<br>(1.03)     |
| market potential $\times \mathbb{1}_{\text{semi-periphery}}$ | -0.01*<br>(0.01)   | -0.01*<br>(0.01)   | -0.01*<br>(0.01)    | -0.01*<br>(0.01)    | -0.01*<br>(0.01)   | -0.01*<br>(0.01)   |
| market potential $\times \mathbb{1}_{\text{periphery}}$      | -0.02**<br>(0.01)  | -0.02**<br>(0.01)  | -0.02**<br>(0.01)   | -0.02**<br>(0.01)   | -0.02**<br>(0.01)  | -0.02**<br>(0.01)  |
| Num. obs.  | 132                | 132                | 132                 | 132                 | 132                | 132                |
| Num. groups: code  | 14                 | 14                 | 14                  | 14                  | 14                 | 14                 |
| Adj. R <sup>2</sup> (proj model)                             | 0.55               | 0.54               | 0.54                | 0.54                | 0.56               | 0.54               |
| Regressor  | MP <sup>(h)</sup>  | MP <sup>(s)</sup>  | NLMP <sup>(h)</sup> | NLMP <sup>(s)</sup> | FMP <sup>(h)</sup> | FMP <sup>(s)</sup> |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . Robust standard errors adjusted for clustering on each country are in parentheses. The following covariates are included: temperature, inverse distance to the closest port, oil production per capita and average educational level. MP<sup>(h)</sup> considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements. MP<sup>(s)</sup> considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures. NLMP<sup>(h)</sup> and NLMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the local market, i.e.  $y_i \tau_{ii}$ . FMP<sup>(h)</sup> and FMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the domestic markets, i.e.  $\sum_{j \neq i} y_j \tau_{ij}$  with  $i$  and  $j$  both in country  $c$ .

Table 6: Regional Development and Market Potential - by countries' income group (2005)

the effect of market potential for high income and low income countries. Moreover, differences in market potential explains higher regional development differences in lower middle income countries than in upper middle countries. The former display elasticity coefficients about 0.21, 0.25 for  $MP^{(s)}$ , while the latter about is 0.16, 0.13 for  $MP^{(s)}$ . This result is in line with [Boulhol and De Serres \(2010\)](#) who find that, in the sample of [Redding and Venables \(2004\)](#), higher income OECD countries display a lower coefficient elasticity of GDP per capita to market access than for the whole sample of OECD countries, which is also lower than coefficients for the whole sample. Hence, they show that pooling developed and developing countries in country-level analysis lead to upward biased estimators ([Redding and Venables, 2004](#); [Head and Mayer, 2011](#)).

### 7.3.3 Centrality to domestic and foreign cores

Results above have suggested that proximity to foreign markets is not necessarily beneficial for development, especially for the (semi-)periphery. It is natural to think that, within countries, regions with the strongest foreign market potential are located at the national borders. Hence, it is possible to relate this result to the trade border literature introduced by [McCallum \(1995\)](#). International trade is found to be more costly than intra-national trade among regions within a country. In addition, while the discussion is still vivid, there is a consensus that international trade increases income ([Frankel and Romer, 1999](#); [Anderson et al., 2020](#)). As a result, if international borders decrease trade between regions, and if trade leads to income growth, regions at the border may display lower income levels than the national average since their location places them further to central national regions and closer to foreign regions. This statement is supported by [Adam et al. \(2021\)](#), where they find that subnational regions at the international borders have lower income per capita levels, while trade agreements at borders can compensate this negative border effect.

Another explanation for a potential negative impact of a close proximity to foreign markets is market selection and spatial sorting of firms within countries. [Melitz and Ottaviano \(2008\)](#) argues that easier international trade increases competition due to good access to foreign goods, leading to the demise of less productive firms and an overall higher productivity. On another hand, [P.-P. Combes et al. \(2012\)](#) highlights how denser cities foster competition, allowing only the most productive firms to survive. As a result, firms are spatially sorted based on their productivity, with peripheral regions typically accommodating the least productive firms.

Among core domestic regions, firms selection effect may result in higher levels of productivity and higher development, while among peripheral regions, where the least productive firms are concentrated, proximity to core foreign markets can be harmful if firms cannot face the international competition. With a free trade agreement, it is possible that competition generalizes to the whole country, erasing the development level disparities among peripheral regions, whatever their physical proximity to foreign core markets.

In order to expand upon the previous assertion, I examine the impact of proximity to markets within clusters and examine the effects of centrality to core domestic and foreign markets. I regress regional per capita income on development covariates with fixed effects at the country level, as well as at the cluster level, and include the centrality indexes as independent variables. To account for the impact of free trade agreements and for comparability with the results found by [Adam et al. \(2021\)](#), I also differentiate between centrality to foreign cores with and without such agreements. Results are presented in tables 7 and 26, which respectively excludes and contains the market potential indexes as controls.

Table 7 shows that overall centrality to cores have no effect on regional development. However, when decomposing the index of centrality to cores into its domestic and foreign components, it



|   | (1)             | (2)              | (3)               | (4)               | (5)              | (6)               |
|---|-----------------|------------------|-------------------|-------------------|------------------|-------------------|
| centrality <sup>cores</sup>   | -0.03<br>(0.05) |                  |                   |                   |                  |                   |
| centrality <sup>domestic cores</sup>  |                 |                  | 0.03*<br>(0.02)   |                   | 0.04<br>(0.02)   |                   |
| centrality <sup>foreign cores</sup>   |                 |                  | -0.31**<br>(0.14) |                   |                  |                   |
| centrality <sup>foreign cores, no FTA</sup>   |                 |                  |                   |                   | -0.31*<br>(0.16) |                   |
| centrality <sup>foreign cores, FTA</sup>  |                 |                  |                   |                   | -0.11<br>(0.12)  |                   |
| centrality <sup>cores</sup> $\times \mathbb{1}(\gamma_g = \text{core})$                           |                 | 0.33**<br>(0.14) |                   |                   |                  |                   |
| centrality <sup>cores</sup> $\times \mathbb{1}(\gamma_g = \text{semi-periphery})$                 |                 | -0.05<br>(0.05)  |                   |                   |                  |                   |
| centrality <sup>cores</sup> $\times \mathbb{1}(\gamma_g = \text{periphery})$                      |                 | -0.02<br>(0.07)  |                   |                   |                  |                   |
| centrality <sup>domestic cores</sup> $\times \mathbb{1}(\gamma_g = \text{core})$                  |                 |                  |                   | 0.31***<br>(0.11) |                  | 0.31**<br>(0.15)  |
| centrality <sup>domestic cores</sup> $\times \mathbb{1}(\gamma_g = \text{semi-periphery})$        |                 |                  |                   | 0.02<br>(0.02)    |                  | 0.02<br>(0.02)    |
| centrality <sup>domestic cores</sup> $\times \mathbb{1}(\gamma_g = \text{periphery})$             |                 |                  |                   | 0.05**<br>(0.02)  |                  | 0.06*<br>(0.03)   |
| centrality <sup>foreign cores</sup> $\times \mathbb{1}(\gamma_g = \text{core})$                   |                 |                  |                   | -0.18<br>(0.13)   |                  |                   |
| centrality <sup>foreign cores</sup> $\times \mathbb{1}(\gamma_g = \text{semi-periphery})$         |                 |                  |                   | -0.32**<br>(0.14) |                  |                   |
| centrality <sup>foreign cores</sup> $\times \mathbb{1}(\gamma_g = \text{periphery})$              |                 |                  |                   | -0.33**<br>(0.15) |                  |                   |
| centrality <sup>foreign cores, no FTA</sup> $\times \mathbb{1}(\gamma_g = \text{core})$           |                 |                  |                   |                   |                  | -0.23<br>(0.25)   |
| centrality <sup>foreign cores, no FTA</sup> $\times \mathbb{1}(\gamma_g = \text{semi-periphery})$ |                 |                  |                   |                   |                  | -0.30<br>(0.19)   |
| centrality <sup>foreign cores, no FTA</sup> $\times \mathbb{1}(\gamma_g = \text{periphery})$      |                 |                  |                   |                   |                  | -0.30**<br>(0.15) |
| centrality <sup>foreign cores, FTA</sup> $\times \mathbb{1}(\gamma_g = \text{core})$              |                 |                  |                   |                   |                  | -0.06<br>(0.12)   |
| centrality <sup>foreign cores, FTA</sup> $\times \mathbb{1}(\gamma_g = \text{semi-periphery})$    |                 |                  |                   |                   |                  | -0.11<br>(0.11)   |
| centrality <sup>foreign cores, FTA</sup> $\times \mathbb{1}(\gamma_g = \text{periphery})$         |                 |                  |                   |                   |                  | -0.12<br>(0.12)   |
| Num. obs.   | 1460            | 1460             | 1460              | 1460              | 1392             | 1392              |
| Num. groups: code   | 101             | 101              | 101               | 101               | 97               | 97                |
| Adj. R <sup>2</sup> (proj model)  | 0.30            | 0.30             | 0.31              | 0.32              | 0.32             | 0.33              |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . Robust standard errors adjusted for clustering on each country are in parentheses. The following covariates are included: temperature, inverse distance to the closest port, oil production per capita and average educational level. The market potential and centrality variables are entered with the logarithm in the regressions.  $MP^{(h)}$  considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements.  $MP^{(s)}$  considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures.

Table 7: Regional Development, the Core and Periphery, and Centrality to cores

is found that centrality to domestic cores has a positive impact on regional development, while centrality to foreign cores has a negative impact, especially for peripheral regions (see columns 3

|  | (1)            | (2)             | (3)             | (4)            |
|--|----------------|-----------------|-----------------|----------------|
| centrality <sup>foreign cores, FTA</sup>   | 0.07<br>(0.05) | 0.10*<br>(0.05) |                 |                |
| centrality <sup>foreign cores, FTA</sup> $\times \mathbb{1}(\gamma_g = \text{semi-periphery})$ |                | 0.03<br>(0.03)  | 0.12*<br>(0.07) | 0.07<br>(0.05) |
| centrality <sup>foreign cores, FTA</sup> $\times \mathbb{1}(\gamma_g = \text{periphery})$      |                | -0.01<br>(0.03) | 0.09*<br>(0.05) | 0.08<br>(0.06) |
| centrality <sup>foreign cores, FTA</sup> $\times \mathbb{1}(\gamma_g = \text{core})$           |                |                 | 0.10*<br>(0.05) | 0.05<br>(0.04) |
| Num. obs.  | 2676           | 2395            | 2395            | 2049           |
| region FE  | 1105           | 890             | 890             | 882            |
| cluster group FE   |                | 3               | 3               | 3              |
| country $\times$ year FE   | 162            | 143             | 143             | 127            |
| Covariates   | No             | No              | No              | Yes            |
| Adj. R <sup>2</sup> (full model)   | 0.98           | 0.98            | 0.98            | 0.98           |
| Adj. R <sup>2</sup> (proj model)   | -0.00          | -0.00           | -0.00           | 0.24           |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$

Table 8: Regional Development and Trade Agreement - Panel

and 4). The negative impact is primarily driven by proximity to foreign cores that have no free trade agreement with the region's country (see columns 5 and 6). The effect of proximity to foreign cores with a trade agreement is also negative but not significant. In other words, the periphery gains from proximity to domestic cores, but loses from proximity to foreign cores without trade agreements. This result give external validity to those found by Brülhart (2006) in the context of European Union integration, that has favoured both countries' peripheral and core regions.<sup>34</sup>

To put the results in a nutshell, consider an example where two peripheral regions  $i$  and  $j$  have equal distance to the core domestic region  $d$ , but the distance between  $i$  and a core foreign market  $f$  is lower than distance between  $j$  and  $f$ . Region  $i$  is supposed to trade more with  $f$  than  $j$  does due to lower transportation costs and thus higher trade potential. Region  $i$  also faces higher competition than  $j$  does, leading into firms exit from the market. Since peripheral regions may have low-productivity firms, firms selection can be detrimental to regional development. Region  $i$  may not benefit from agglomeration economies from proximity to  $f$ , due to cultural and linguistic differences. With FTA, the competition faced by regions  $i$  and  $j$  may be similar despite differences in distances since trade is liberalized. The strength of market selection may converge too, leading to no significant spatial differences between peripheral regions  $i$  and  $j$ .

Table 26 in the appendix present results with market potential control. Including the market potential index in the regression reveals a negative effect of centrality to domestic cores for core regions, although this effect is not statistically significant (columns 7 and 8). This finding underscores the spatial division that arises from economic agglomeration, where cores are located at a certain distance from each other, and peripheral regions fill the space between them. Nevertheless, the positive and significant effect of market potential still supports the idea that regions closer to domestic cores tend to be wealthier. On the other hand, centrality to foreign cores remains a signif-

<sup>34</sup>In particular, Brülhart (2006) finds that countries' peripheral regions grew in terms of manufacturing employment, while core regions grew in terms of service employment.

icant predictor of regional development even with the market potential control. The closer regions are to foreign cores, the poorer they tend to be, with this relationship particularly pronounced for peripheral regions (columns 7 and 8), everything else being equal.

To gain further insights into the impact of free trade agreements, I employ panel data to examine whether the act of signing a free trade agreement contributes to regional development, with a specific emphasis on the periphery, which is the primary area of concern. Table 8 shows the results. I find that a 1% increase in the centrality to foreign cores with a trade agreement is expected to lead to a 0.07% increase in a region's GDP per capita (see column 1). This effect is approximately 10% for core regions, while there is no significant difference in estimates for the semi-periphery and the periphery (column 2). The estimated coefficient for each cluster group is presented in column 3, where all coefficients are approximately 0.1. This suggests that a 1% increase in the centrality to foreign cores resulting from the signing of an agreement is associated with a 0.1% increase in a region's GDP per capita. However, this effect is only statistically significant at the 10% level and becomes insignificant when accounting for development covariates.

While this study provides valuable insights, further research is needed to fully understand the dynamics of proximity to foreign markets, market selection, and regional development. Future studies should employ micro-founded analyses to explore the specific mechanisms of firms' selection, consider the heterogeneous impacts of trade on different regions, and account for local economic factors. By delving deeper into these aspects, researchers can validate and refine the assumptions made in this study, ultimately providing a more comprehensive understanding on challenges face by peripheral areas.

## 8 Conclusion

The main objective of this paper is to explore the key factors contributing to regional development disparities within countries and investigate the role played by proximity to markets on the core-periphery divide. Moreover, this paper contributes to provide a falsification test to the international trade wage equation developed by Fujita et al. (1999) at the regional level with a worldwide scope. By analyzing these factors across a wide range of regions and countries, this research aims to provide a more comprehensive understanding of the international trade wage equation and its implications for regional disparities.

I use an extended regional dataset which includes more than 1,500 subnational regions, from 107 different countries, out of the 195 recognized around the world. This dataset contains information on regional economic activity, geography and education, to control the estimations for these regional development covariates. Hence, market potential indexes are built at the regional level, following a gravity-based approach. One of the contributions of the paper lies in the computation of a more accurate measure of distance between markets, which considers land masses and ocean areas in the market potential distance function. I compute the inland shortest path between regions and ports, as well as the overseas shortest path between ports.

Results provide evidence that access to markets has a significant impact on regional development for both specification of market potential presented. In particular, proximity to demand is associated to a more intense economic activity and a higher income per capita. In other words, regions surrounded by rich markets may be richer than regions with poor neighbours, due to lower trade costs as stated by the wage equation, but also to positive externalities. This statement can be confirmed by the fact that the market potential index computed on the basis of the haversine distance function seems equally robust than the one constructed with the shipment distance func-

tion. It suggests that other things than goods may flow from a region to another, which does not rely on port connection, such as knowledge and people.

Connecting regions between each other seems to be an important challenge to tackle in order to develop and increase living conditions everywhere. However, heterogeneous effects exist conditional on the national income group the regions belong to, as well as on the regional core-periphery structure within countries. On one hand, the effect of market potential is found to be particularly strong in both upper- and lower-middle-income countries. On the other hand, (semi-)peripheral regions are found to exhibit lower elasticity coefficients to market potential compared to core regions. Additionally, the study finds that being in close proximity to foreign wealthy markets can be detrimental to (semi-)peripheral regions. Peripheral regions tend to have lower per capita income and lower market potential compared to core regions. Additionally, peripheral regions experience slower growth rates over time, which further widens the income gap between them and core regions. Moreover, due to their lower development elasticity coefficient to market potential, peripheral regions may be less responsive to the growth of surrounding markets, which could leave them even more disadvantaged in the long run.

Further investigation highlights that the impact of proximity to core markets varies depending on whether they are domestic or foreign, as well as whether a region's country has a free trade agreement with others. Proximity to domestic cores is associated with positive effects on regional development, while proximity to foreign cores without a trade agreement has a negative impact for peripheral regions. Interestingly, the effect of proximity to foreign cores with a free trade agreement is not significantly different from zero, suggesting that the presence of a free trade agreement appears to mitigate the negative impact of close proximity to foreign core markets, or at least reduce regional disparities. Indeed, the analysis using panel data indicates that the act of signing a trade agreement, leading to an increase in centrality to foreign cores with FTA, is associated with a rise in GDP per capita, although the statistical significance is modest. These results imply that the existence of a free trade agreement shows potential in fostering regional development, including in peripheral areas. Nevertheless, additional investigation is necessary to comprehensively comprehend the extent and significance of this impact.

These findings underscore the importance of understanding the unique challenges faced by peripheral regions in achieving economic development and suggest the need for policies that are tailored to the specific circumstances of these regions. One policy suggestion that arises from the study is to enhance connectivity between peripheral regions and core domestic regions in order to reduce transportation costs and increase access to domestic demand. Moreover, policies aimed at improving trade relations and establishing free trade agreements with foreign countries may be beneficial to peripheral regions. Simultaneously, it is of utmost importance to foster local economic activity, promote investments, and facilitate the equitable distribution of trade benefits. This approach aims to prevent population and industries from migrating to more developed regions or stifling economic activity due to the closure of low-productivity firms predominantly located in peripheral areas. Implementing such a policy recommendation could effectively mitigate or alleviate the potential adverse consequences associated with excessive proximity to core foreign markets, which may result in heightened competition. By addressing these issues, policy makers can promote sustainable development and reduce regional disparities within countries.

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## Appendix A Regional Trade Gravity Equation and Trade Elasticity

### A.1 Regional Trade Gravity Equation

To express and compute regional market potential indexes, I estimate the gravity equation in order to use the coefficients of trade elasticity to trade costs as explained in section 3. The gravity model states that the force of attraction between two entities depends positively on their respective mass and negatively on the distance between them - the distance playing as a resistance force. Applied to trade, it states that the wealthier and the closer two markets are, the more intense their bilateral trade activity. The underlying mechanisms follow a supply and demand analysis. The larger the exporter's production, the more it is going to sell. The larger the importer's demand, the more it is going to expend. If both markets are close, transportation costs from one to another are low. Thus, the two markets are likely to fulfill their need: to trade between each other.

To estimate the gravity equation, I use transnational trade panel data and estimate the expected trade flows between regions of each pair of countries. I assume that the bilateral trade flows between two regions of different countries is proportional to the share of their regional Gross Domestic Product (GDP) in the overall national GDP. Hence, the wealthier the region, the more it participates to the wealth of its country, and the more intense its international activity. Hence, bilateral trade flows between regions are proxied by:

$$\tilde{\text{TF}}_{ij} = \text{TF}_{c_i c_j} \times \frac{\text{GDP}_i}{\text{GDP}_{c_i}} \times \frac{\text{GDP}_j}{\text{GDP}_{c_j}} \quad (19)$$

with  $\tilde{\text{TF}}_{ij}$  the expected bilateral trade flows between region  $i$  in country  $c_i$  and region  $j$  in country  $c_j$ , with  $c_i \neq c_j$ ,  $\text{TF}_{c_i c_j}$  the observed value of bilateral trade flows observed between countries  $c_i$  and  $c_j$  in the data,  $\text{GDP}_i$  and  $\text{GDP}_{c_i}$  the Gross Domestic Product of region  $i$  and its country  $c_i$  respectively. The closer the ratio  $\text{GDP}_i/\text{GDP}_{c_i}$  to unity, the more country  $c_i$ 's economic activity relies on the one of region  $i$ . The same applies for the ratio  $\text{GDP}_j/\text{GDP}_{c_j}$ .

Then, the gravity equation is expressed as follows:

$$\tilde{\text{TF}}_{ij} = A \times Y_i^{\alpha_1} \times Y_j^{\alpha_2} \times \tau_{ij} \quad (20)$$

with  $A$  a constant,  $\tilde{\text{TF}}_{ij}$  the expected total bilateral trade flows between regions  $i$  and  $j$ ,  $Y_i$  and  $Y_j$  their respective mass, and  $\tau_{ij}$  the resistance term -or proxy of trade costs- between them. The latter variable has been expressed in two manners, as showed in equations 3 and 5.

The gravity equation is estimated in cross-section as follows:

$$\begin{aligned} \ln \tilde{\text{TF}}_{ij} = & \beta_1 \ln \text{dist}_{ij}^{(\text{haversine})} + \beta_2 \mathbb{1}_{\text{language}_{ij}} + \beta_3 \mathbb{1}_{\text{contiguity}_{ij}} + \beta_4 \mathbb{1}_{\text{colony}_{ij}} \\ & + \beta_5 \mathbb{1}_{\text{rtai}_{ij}} + \beta_6 \mathbb{1}_{\text{currency}_{ij}} + \delta_i + \delta_j + \epsilon_{ij} \end{aligned} \quad (21)$$

$$\begin{aligned} \ln \tilde{\text{TF}}_{ij} = & \gamma_1 \ln \text{dist}_{io}^{(\text{land, from exporter to origin port})} \mathbb{1}_{\text{maritime route}} \\ & + \gamma_2 \ln \text{dist}_{od}^{(\text{sea, between ports})} \mathbb{1}_{\text{maritime route}} \\ & + \gamma_3 \ln \text{dist}_{dj}^{(\text{land, from destination port to importer})} \mathbb{1}_{\text{maritime route}} \\ & + \gamma_4 \ln \text{dist}_{ij}^{(\text{land})} (1 - \mathbb{1}_{\text{maritime route}}) \\ & + \beta_2 \mathbb{1}_{\text{language}_{ij}} + \beta_3 \mathbb{1}_{\text{contiguity}_{ij}} + \beta_4 \mathbb{1}_{\text{colony}_{ij}} + \beta_5 \mathbb{1}_{\text{rtai}_{ij}} + \beta_6 \mathbb{1}_{\text{currency}_{ij}} \\ & + \delta_i + \delta_j + \epsilon_{ij} \end{aligned} \quad (22)$$

with  $\text{dist}_{ij}^{(\text{land})} = \kappa_{ij}$ ,  $\text{dist}_{io}^{(\text{land, from exporter to origin port})} = \kappa_{io}$ ,  $\text{dist}_{dj}^{(\text{land, from destination port to importer})} = \kappa_{od}$  and  $\text{dist}_{ij}^{(\text{sea, between ports})} = \kappa_{od}$  from equation 5. The dummy  $\mathbb{1}_{\text{maritime route}}$  equals 1 if the condition expressed in equation 4 is respected, i.e. if it is more convenient for region  $i$  to send its goods overseas to region  $j$ , and 0 otherwise.  $\tilde{\text{TF}}_{ij}$  is the expected total bilateral trade flows between regions  $i$  and  $j$ , in countries  $c_i$  and  $c_j$  respectively, with  $c_i \neq c_j$ . Since I estimate the effect of distance on trade flows which is time invariant, I cannot use pairs fixed effects to reduce endogeneity problems. However, I include fixed effects for both regions of the pair,  $\delta_i$  and  $\delta_j$ , in order to control for the unobservable and unit-specific confounders in 2005. Therefore, it controls for supply, demand and multilateral resistance terms of each region.

The trade literature has widely estimated coefficients  $\alpha_1$ ,  $\alpha_2$  and  $\beta_1$  in cross-section and repeated cross-section estimations at the national level. Coefficients  $\alpha_1$  and  $\alpha_2$  are generally found to equal 1, and  $\beta_1$  to -1. This result is stable across different periods of time and samples of countries. Coefficients  $\beta_2$ ,  $\beta_3$ ,  $\beta_4$ ,  $\beta_5$  and  $\beta_6$  estimates are supposed to be positive, as they play as trade facilitators. Next subsection presents the results of the estimated coefficients of trade elasticity to trade resistance and facilitator terms at the regional level using expected bilateral trade flows and compares the results with those found in the literature.

## A.2 Regional Trade Costs Parameters Estimations

Table 9 shows the estimated coefficients from equations 21 and 22 in columns 1 and 2 respectively. Without surprise, the estimator of trade elasticity to physical distance is negative regardless of the specification of distance. Trade elasticity to distance, as measured as haversine, is about  $-1.18$  (column 1), meaning that a 1% increase in the great-circle distance in kilometers between two regions of different countries decreases the total bilateral trade flows by 1.18% between them.

Distance as measured by the shortest path in kilometers between regions  $i$  and  $j$  considering land and ocean areas also give negative coefficients of trade elasticity. When it is considered to be convenient for the shipment to be conducted on maritime routes between regions  $i$  and  $j$ , trade elasticity to distance from regions to their closest port is estimated to be about  $[-0.07; -0.06]$ , and between ports about  $-0.96$ . Otherwise, for those pairs that are considered to ship goods by land routes only, the trade elasticity coefficient is  $-1$ .

As expected, contiguity, common language, colonial ties and being part of a regional trade agreement play as trade facilitator forces. Indeed, the corresponding coefficients are found to be significantly positive. Trade elasticity to contiguity and colonial ties are found to be greater than 1. Unexpectedly, the dummy of common currency gives a negative and significant coefficient. It suggests that two regions belonging to two different countries tend to trade less between each other if their countries share a common currency, whereas it is supposed to be a trade facilitator as well.

Section A.3 in the appendix presents the results obtained from estimations undergone at the country level, compares the coefficients with those found in the literature and presents the statistical tests conducted. Elasticity coefficients estimated here are found to be similar to estimates from the country level analysis, as well as to coefficients usually obtained from gravity equation estimations in the literature (see table 11), except for the effect of sharing a common currency.

For the computation of the market potential indexes, I am going to use estimators of distance, and the estimates of trade facilitator found in column 2 table 9, except for the effect of currency which may be badly estimated. Instead, I use the average coefficient of 0.79 estimated in the literature (see column 1 of table 11). Since I express the market potential of subnational regions, I consider regions belonging to same countries as well. However, the worldwide coverage data I use for the gravity equation estimations do not contain intra-national trade flows. The coefficient  $\beta_7$ ,

|  | (1)                | (2)                |
|--|--------------------|--------------------|
| $\text{dist}_{ij}^{(\text{haversine})}$  | -1.18***<br>(0.02) |                    |
| $\text{language}_{ij}$   | 0.71***<br>(0.04)  | 0.66***<br>(0.04)  |
| $\text{contiguity}_{ij}$   | 1.13***<br>(0.05)  | 1.12***<br>(0.05)  |
| $\text{colony}_{ij}$   | 1.34***<br>(0.07)  | 1.37***<br>(0.07)  |
| $\text{rta}_{ij}$  | 0.40***<br>(0.04)  | 0.47***<br>(0.03)  |
| $\text{currency}_{ij}$   | -0.92***<br>(0.11) | -0.81***<br>(0.11) |
| $\mathbb{1}_{\text{maritime route}} \times \text{dist}_{io}^{(\text{land, from i to origin port})}$      |                    | -0.07***<br>(0.01) |
| $\mathbb{1}_{\text{maritime route}} \times \text{dist}_{od}^{(\text{sea, between ports})}$               |                    | -0.96***<br>(0.02) |
| $\mathbb{1}_{\text{maritime route}} \times \text{dist}_{dj}^{(\text{land, from destination port to j})}$ |                    | -0.06***<br>(0.01) |
| $(1 - \mathbb{1}_{\text{maritime route}}) \times \text{dist}_{ij}^{(\text{land})}$                       |                    | -1.00***<br>(0.02) |
| <hr/>  |                    |                    |
| Fixed Effects  |                    |                    |
| region $i$   | Yes                | Yes                |
| region $j$   | Yes                | Yes                |
| Num. obs.  | 2,378,212          | 2,378,212          |
| Num. groups: region $i$  | 1,617              | 1,617              |
| Num. groups: region $j$  | 1,617              | 1,617              |
| Adj. R <sup>2</sup> (proj model)   | 0.33               | 0.33               |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . In parenthesis, the robust standard errors are two-way clustered at the regional level.

Table 9: Gravity Equation Estimates - regional level

which represents the border effect has been estimated to equal 1.96 on average, such as displayed by the coefficients of the variable  $\text{home}_{ij}$  from the meta-analysis of [Head and Mayer \(2014\)](#) (see column 1 of table 11).

Therefore, the vectors of estimators is the following:  $[\hat{\beta}_1, \hat{\beta}_2, \hat{\beta}_3, \hat{\beta}_4, \hat{\beta}_5, \hat{\beta}_6, \hat{\beta}_7, \hat{\gamma}_1, \hat{\gamma}_2, \hat{\gamma}_3, \hat{\gamma}_4] = [-1.18, 0.66, 1.12, 1.37, 0.47, 0.79, 1.96, -0.07, -0.96, -0.06, -1.00]$  From these estimates coefficients, market potential indexes are computed following equation 1.

### A.3 Robustness - Trade Elasticity Estimates Comparison

For robustness, regression 21 is estimated at the country level with the observed trade flows between countries as dependant variable. Results are displayed in table 10. The different columns display the results for different samples of countries. Column 1 includes countries both present in BACI and Gennaioli datasets for the year 2005. Column 2 includes all countries present in BACI dataset for the year 2005. Column 3 and 4 follow columns 1 and 2 respectively, but including all the years

between 1996 and 2010.

Coefficients found with countries as level of geographic unit are very similar. Regarding the effects of having a common currency is still found to be negative, but statistically insignificant for specifications in columns 2 to 4. Hence, the negative coefficient displayed may result from an endogeneity problem and/or a sample selection bias. Further investigation shows that the negative sign becomes positive when adding pair fixed effects. The coefficient takes value around 0.17 with the sample of regression in column (3), significant at the 1% level, and 0.16 with the sample of regression in column (4), significant at the 5% level.

|   | (1)                   | (2)                | (3)                   | (4)                |
|---|-----------------------|--------------------|-----------------------|--------------------|
| $\text{dist}_{c_1c_2}^{(\text{haversine})}$ | -1.21***<br>(0.09)    | -1.40***<br>(0.07) | -1.17***<br>(0.08)    | -1.38***<br>(0.06) |
| $\text{language}_{c_1c_2}$                  | 0.92***<br>(0.16)     | 0.82***<br>(0.11)  | 0.87***<br>(0.21)     | 0.72***<br>(0.10)  |
| $\text{contiguity}_{c_1c_2}$                | 0.86***<br>(0.23)     | 0.72***<br>(0.21)  | 0.81***<br>(0.14)     | 0.70***<br>(0.19)  |
| $\text{colony}_{c_1c_2}$                    | 1.02***<br>(0.29)     | 0.65***<br>(0.15)  | 1.18***<br>(0.29)     | 0.66***<br>(0.14)  |
| $\text{rta}_{c_1c_2t}$                      | 0.32**<br>(0.14)      | 0.51***<br>(0.11)  | 0.32**<br>(0.12)      | 0.44***<br>(0.10)  |
| $\text{currency}_{c_1c_2t}$                 | -0.83**<br>(0.38)     | -0.04<br>(0.35)    | -0.94***<br>(0.31)    | -0.11<br>(0.28)    |
| Fixed Effects                               |                       |                    |                       |                    |
| Country $c_1$                               | Yes                   | Yes                | No                    | No                 |
| Country $c_2$                               | Yes                   | Yes                | No                    | No                 |
| Country $c_1 \times \text{year } t$         | No                    | No                 | Yes                   | Yes                |
| Country $c_2 \times \text{year } t$         | No                    | No                 | Yes                   | Yes                |
| Sample                                      |                       |                    |                       |                    |
| Year  | 2005                  | 2005               | [1996; 2010]          | [1996; 2010]       |
| Countries                                   | BACI $\cap$ Gennaioli | All in BACI        | BACI $\cap$ Gennaioli | All in BACI        |
| Num. obs.                                   | 7,057                 | 18,618             | 99,928                | 254,889            |
| Num. groups: $c_1(\times t)$                | 77                    | 146                | 1,155                 | 2,190              |
| Num. groups: $c_2(\times t)$                | 103                   | 208                | 1,545                 | 3,116              |
| Adj. $R^2$ (proj model)                     | 0.30                  | 0.26               | 0.30                  | 0.25               |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . In parenthesis, the robust standard errors are two-way clustered at the national level. Note that the four first variables in the estimation are time invariant in the period [1996; 2010], while the two latter are time varying for some pairs of countries.

Table 10: Gravity Equation Estimates - national level

The significance tests conducted over the coefficients in tables 9 and 10 examined whether coefficients were statistically different from zero in order to assess the effect of the presented variable on trade. In other words, the test conducted can be written as:  $H_0^{(1)} : \beta = 0$ , with  $H_1^{(1)} : \beta \neq 0$  the alternative, with  $\beta = [\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \gamma_1, \gamma_2, \gamma_3, \gamma_4]$  the set of coefficients to be estimated.

I conduct other statistical tests here. The second test evaluates whether the estimated coefficients in the expected regional trade flows are equal to the ones found from the estimations con-



|   | HM 1  | HM 2  |
|---|-------|-------|
| $\text{dist}_{ij}^{(\text{haversine})}$ | -0.93 | -1.10 |
| $\text{language}_{ij}$                  | 0.54  | 0.39  |
| $\text{contiguity}_{ij}$                | 0.53  | 0.66  |
| $\text{colony}_{ij}$                    | 0.92  | 0.75  |
| $\text{rta}_{ij}$                       | 0.59  | 0.75  |
| $\text{currency}_{ij}$                  | 0.79  | 0.86  |
| $\text{home}_{ij}$                      | 1.96  | 1.90  |

Average trade elasticity to resistance and facilitator variables found in the literature, gathered in the meta-analysis by [Head and Mayer \(2014\)](#). First column displays the average coefficients in the whole sample of gravity models in their analysis, while the second only includes coefficients estimated from structural gravity models.

Table 11: Gravity Equation Estimates - [Head and Mayer \(2014\)](#)

ducted at the national level. The corresponding hypothesis can be written as:  $H_0^{(2)} : \beta^{(1)} = \hat{\beta}_{C1}$ , and  $H_1^{(2)} : \beta^{(1)} \neq \hat{\beta}_{C1}$  the alternative, with  $\hat{\beta}_{C1}$  the set of estimated coefficients table 10 column 1. The same test is undertaken for the estimates  $\beta^{(2)}$  in table 10 column 2.

The third and fourth tests evaluate whether the estimated coefficients from national estimations are equal to the ones found from the meta-analysis of all gravity papers and of structural gravity papers used by [Head and Mayer \(2014\)](#). The hypothesis can respectively be written as:  $H_0^{(3)} : \beta_{C1} = \hat{\beta}_{HM1}$ , with  $H_1^{(3)} : \beta_{C1} \neq \hat{\beta}_{HM1}$  the alternative, and  $H_0^{(4)} : \beta_{C1} = \hat{\beta}_{HM2}$ , with  $H_1^{(4)} : \beta_{C1} \neq \hat{\beta}_{HM2}$  the alternative. The sets of estimated coefficients  $\hat{\beta}_{HM1}$  and  $\hat{\beta}_{HM2}$  are transcribed in columns 1 and 2 of table 11 respectively. Finally, the same hypothesis are tested with  $\beta^{(1)}$  and  $\beta^{(2)}$ .

|   | $\beta^{(1)} = \hat{\beta}_{C1}$ | $\beta^{(2)} = \hat{\beta}_{C1}$ | $\beta_{C1} = \hat{\beta}_{HM1}$ | $\beta_{C1} = \hat{\beta}_{HM2}$ | $\beta^{(1)} = \hat{\beta}_{HM1}$ | $\beta^{(1)} = \hat{\beta}_{HM2}$ |
|---|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|
| $\text{dist}_{ij}^{(\text{haversine})}$ | 0.23                             | -                                | 0.00                             | 0.24                             | 0.00                              | 0.00                              |
| $\text{language}_{ij}$                  | 0.00                             | 0.00                             | 0.01                             | 0.00                             | 0.00                              | 0.00                              |
| $\text{contiguity}_{ij}$                | 0.00                             | 0.00                             | 0.15                             | 0.36                             | 0.00                              | 0.00                              |
| $\text{colony}_{ij}$                    | 0.00                             | 0.00                             | 0.83                             | 0.44                             | 0.00                              | 0.00                              |
| $\text{rta}_{ij}$                       | 0.00                             | 0.00                             | 0.03                             | 0.62                             | 0.00                              | 0.32                              |
| $\text{currency}_{ij}$                  | 0.28                             | 0.95                             | 0.00                             | 0.00                             | 0.00                              | 0.00                              |

The table presents p-values of the tests related to the null hypothesis displayed in the top of each column. A p-value of  $p < 0.05$  rejects the null hypothesis at the 95% confidence level. If  $p \geq 0.05$ , we can consider that the null hypothesis is not rejected.

Table 12: Statistical tests - p-values

Table 12 presents the p-values of the different statistical tests. Columns 1 and 2 show that all variables give elasticity coefficients significantly different from the regional to national gravity equations, the former using expected inter-regional trade flows and the latter using observed international trade flows. This is true except for the haversine distance and the dummy of common currency. Despite the significant difference between estimates, they are similar.

Then, coefficients from the country-level-estimations in table 10 are compared to those from the literature displayed in table 11. The haversine distance is found to be statistically different from  $-0.93$  but not from  $-1.10$ . Among the trade facilitator variables, contiguity, colonial ties and regional trade agreement are found to not be statistically different from the average coefficients estimated in the literature. However, the effect of sharing a currency is unexpectedly found to be

negative, and especially to be equal to the opposite of the ones found in the literature.

## **Appendix B   Figures**

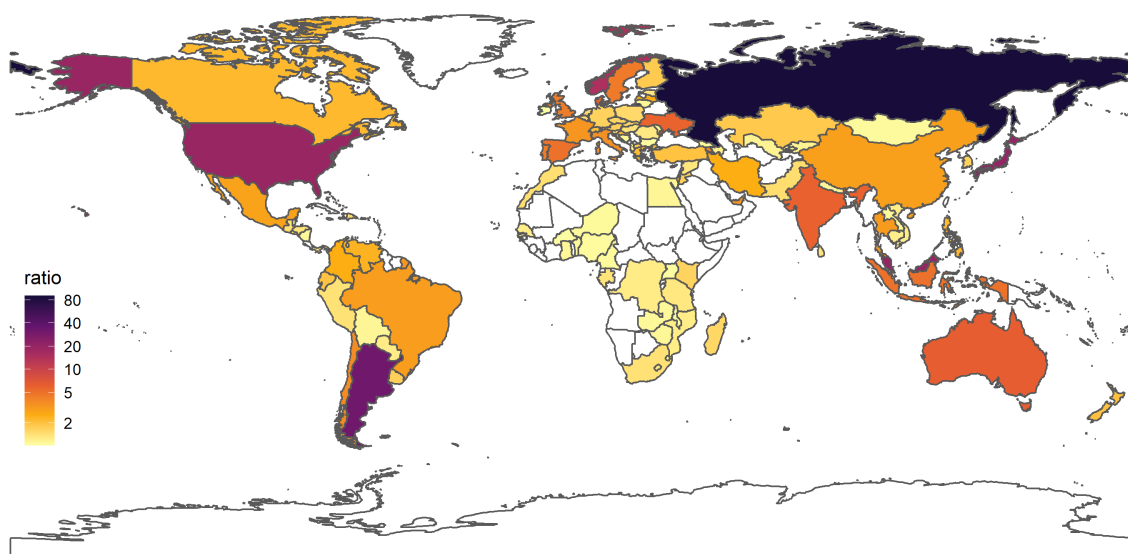


Figure 4: Ratio highest/lowest regional market potential  $MP^{(s)}$  in 2005

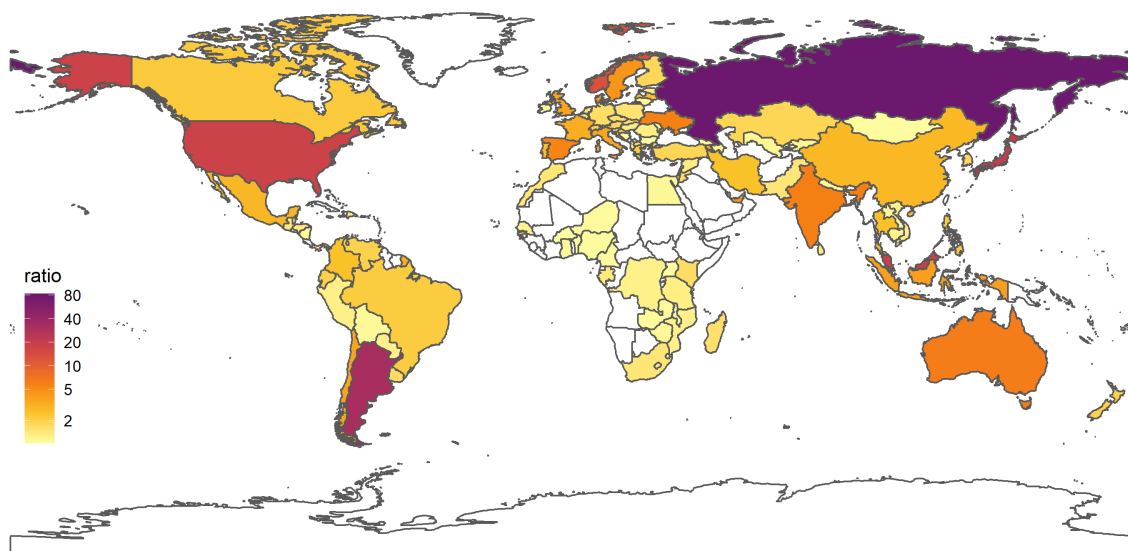


Figure 5: Ratio highest/lowest regional non-local market potential  $NLMP^{(s)}$  in 2005

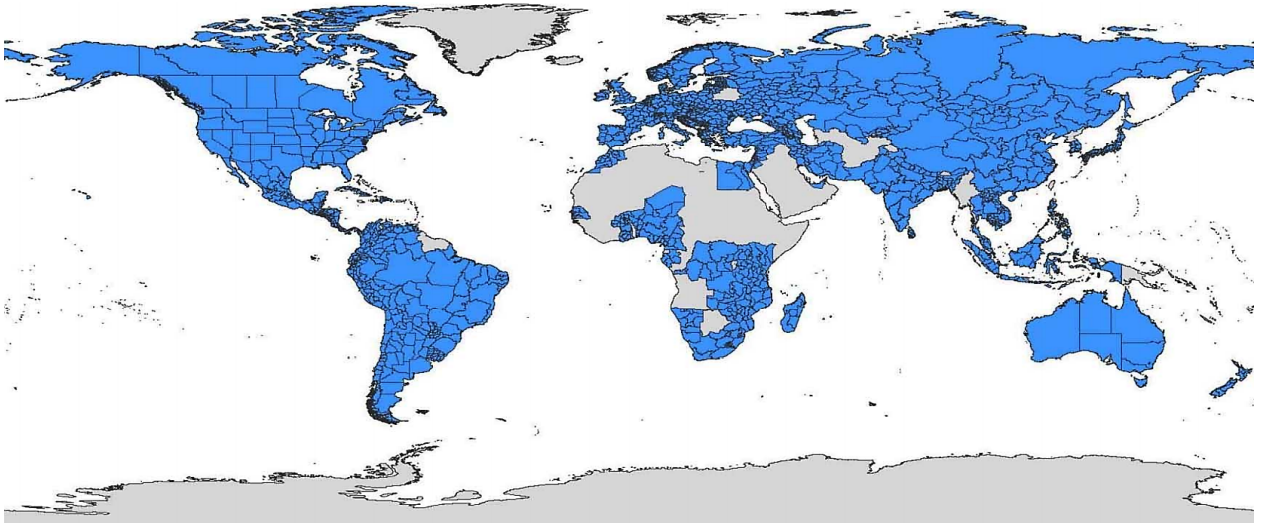


Figure 6: [Gennaioli et al. \(2013\)](#) regional dataset



Figure 7: World ports selected as the closest ports to each region in the sample

## Appendix C Tables

|                           | <i>All countries</i>                 |            |            |           |          | <i>High income countries</i>         |            |            |           |          |
|---------------------------|--------------------------------------|------------|------------|-----------|----------|--------------------------------------|------------|------------|-----------|----------|
|                           | <b>mean</b>                          | <b>min</b> | <b>max</b> | <b>sd</b> | <b>n</b> | <b>mean</b>                          | <b>min</b> | <b>max</b> | <b>sd</b> | <b>n</b> |
| log(GDP pc)               | 8.77                                 | 1.76       | 11.87      | 1.32      | 1502     | 10.02                                | 8.9        | 11.24      | 0.45      | 289      |
| temperature               | 15                                   | -12.73     | 29.15      | 8.45      | 1501     | 10                                   | -12.2      | 27.27      | 4.94      | 289      |
| inv. dist. port           | 0.04                                 | 0          | 1          | 0.18      | 1502     | 0.07                                 | 0          | 1          | 0.23      | 289      |
| log(oil production pc)    | 0.1                                  | 0          | 4.16       | 0.4       | 1502     | 0.05                                 | 0          | 3.13       | 0.27      | 289      |
| log(density)              | 4.17                                 | -2.93      | 12.01      | 1.81      | 1502     | 4.79                                 | -2.93      | 10.23      | 1.55      | 289      |
| years education           | 7.13                                 | 0.22       | 13.21      | 3.16      | 1465     | 10.09                                | 5.3        | 12.94      | 1.71      | 289      |
| log(MP <sup>(h)</sup> )   | 21.21                                | 19.07      | 25.49      | 1.32      | 1502     | 22.74                                | 20.6       | 25.49      | 0.93      | 289      |
| log(MP <sup>(s)</sup> )   | 22.23                                | 20.06      | 25.92      | 1.22      | 1502     | 23.62                                | 21.81      | 25.92      | 0.89      | 289      |
| log(NLMP <sup>(h)</sup> ) | 21.18                                | 19.06      | 25.46      | 1.31      | 1502     | 22.69                                | 20.55      | 25.46      | 0.94      | 289      |
| log(NLMP <sup>(s)</sup> ) | 22.21                                | 20.04      | 25.9       | 1.21      | 1502     | 23.59                                | 21.74      | 25.9       | 0.89      | 289      |
| log(FMP <sup>(h)</sup> )  | 20.53                                | 19.06      | 24.33      | 1.05      | 1502     | 21.61                                | 19.32      | 24.33      | 1.29      | 289      |
| log(FMP <sup>(s)</sup> )  | 21.62                                | 20.03      | 25.2       | 0.98      | 1502     | 22.59                                | 20.19      | 25.2       | 1.29      | 289      |
|                           | <i>Upper middle income countries</i> |            |            |           |          | <i>Lower middle income countries</i> |            |            |           |          |
|                           | <b>mean</b>                          | <b>min</b> | <b>max</b> | <b>sd</b> | <b>n</b> | <b>mean</b>                          | <b>min</b> | <b>max</b> | <b>sd</b> | <b>n</b> |
| log(GDP pc)               | 8.9                                  | 7.35       | 11.12      | 0.55      | 485      | 7.84                                 | 06.09      | 9.75       | 0.57      | 393      |
| temperature               | 14.69                                | -12.73     | 27.99      | 8.66      | 485      | 19                                   | -5.79      | 28.26      | 8.18      | 393      |
| inv. dist. port           | 0.05                                 | 0          | 1          | 0.2       | 485      | 0.02                                 | 0          | 1          | 0.11      | 393      |
| log(oil production pc)    | 0.23                                 | 0          | 3.48       | 0.59      | 485      | 0.02                                 | 0          | 1.98       | 0.12      | 393      |
| log(density)              | 3.74                                 | -2.67      | 10.43      | 1.82      | 485      | 4.24                                 | -1.91      | 9.56       | 1.78      | 393      |
| years education           | 6.89                                 | 2.37       | 11.45      | 1.83      | 485      | 5.05                                 | 0.44       | 12.5       | 2.42      | 393      |
| log(MP <sup>(h)</sup> )   | 20.95                                | 19.54      | 25.04      | 0.76      | 485      | 20.31                                | 19.24      | 23.18      | 0.53      | 393      |
| log(MP <sup>(s)</sup> )   | 21.98                                | 20.75      | 25.45      | 0.69      | 485      | 21.4                                 | 20.31      | 23.68      | 0.47      | 393      |
| log(NLMP <sup>(h)</sup> ) | 20.91                                | 19.52      | 24.91      | 0.75      | 485      | 20.3                                 | 19.24      | 23.18      | 0.53      | 393      |
| log(NLMP <sup>(s)</sup> ) | 21.96                                | 20.75      | 25.34      | 0.68      | 485      | 21.39                                | 20.31      | 23.68      | 0.47      | 393      |
| log(FMP <sup>(h)</sup> )  | 20.3                                 | 19.21      | 22.03      | 0.66      | 485      | 20.13                                | 19.19      | 21.86      | 0.46      | 393      |
| log(FMP <sup>(s)</sup> )  | 21.42                                | 20.59      | 23.05      | 0.6       | 485      | 21.26                                | 20.17      | 22.78      | 0.44      | 393      |
|                           | <i>Low income countries</i>          |            |            |           |          |                                      |            |            |           |          |
|                           | <b>mean</b>                          | <b>min</b> | <b>max</b> | <b>sd</b> | <b>n</b> |                                      |            |            |           |          |
| log(GDP pc)               | 6.38                                 | 1.76       | 8.56       | 1.37      | 134      |                                      |            |            |           |          |
| temperature               | 22.8                                 | -1.58      | 29.15      | 6.19      | 134      |                                      |            |            |           |          |
| inv. dist. port           | 0.03                                 | 0          | 1          | 0.17      | 134      |                                      |            |            |           |          |
| log(oil production pc)    | 0                                    | 0          | 0.08       | 0.01      | 134      |                                      |            |            |           |          |
| log(density)              | 4.29                                 | -0.55      | 12.01      | 1.73      | 134      |                                      |            |            |           |          |
| years education           | 2.98                                 | 0.22       | 11.7       | 2.5       | 134      |                                      |            |            |           |          |
| log(MP <sup>(h)</sup> )   | 19.7                                 | 19.07      | 20.58      | 0.25      | 134      |                                      |            |            |           |          |
| log(MP <sup>(s)</sup> )   | 20.85                                | 20.06      | 21.34      | 0.23      | 134      |                                      |            |            |           |          |
| log(NLMP <sup>(h)</sup> ) | 19.7                                 | 19.06      | 20.58      | 0.25      | 134      |                                      |            |            |           |          |
| log(NLMP <sup>(s)</sup> ) | 20.85                                | 20.04      | 21.34      | 0.23      | 134      |                                      |            |            |           |          |
| log(FMP <sup>(h)</sup> )  | 19.67                                | 19.06      | 20.22      | 0.24      | 134      |                                      |            |            |           |          |
| log(FMP <sup>(s)</sup> )  | 20.83                                | 20.03      | 21.27      | 0.22      | 134      |                                      |            |            |           |          |

Country income groups are defined following the World Bank classification: *High income* (21 countries in the sample), *Upper middle income* (28 countries), *Lower middle income* (31 countries) and *Low income* (14 countries).

Table 13: Descriptive statistics - 2005

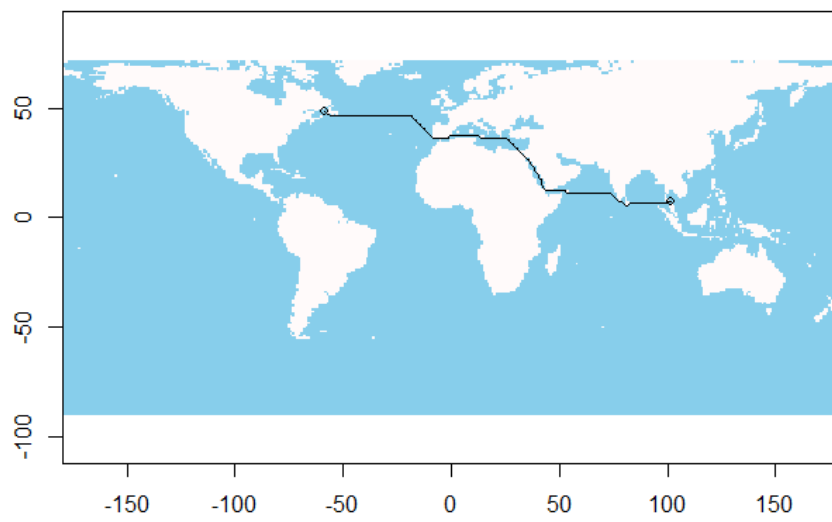


Figure 8: Example of shortest path between ports in Canada and Thailand



|                           | <i>core</i>      |            |            |           |          | <i>semi-periphery</i> |            |            |           |          |
|---------------------------|------------------|------------|------------|-----------|----------|-----------------------|------------|------------|-----------|----------|
|                           | <b>mean</b>      | <b>min</b> | <b>max</b> | <b>sd</b> | <b>n</b> | <b>mean</b>           | <b>min</b> | <b>max</b> | <b>sd</b> | <b>n</b> |
| log(GDP pc)               | 9.11             | 2.63       | 11.42      | 1.31      | 142      | 8.76                  | 1.98       | 11.24      | 1.37      | 379      |
| temperature               | 16.69            | -4.66      | 29.1       | 7.85      | 142      | 15.69                 | -9.1       | 29.15      | 7.95      | 379      |
| inv. dist. port           | 0.08             | 0          | 1          | 0.24      | 142      | 0.06                  | 0          | 1          | 0.22      | 379      |
| log(oil per cap.)         | 0.09             | 0          | 3.48       | 0.45      | 142      | 0.05                  | 0          | 2.42       | 0.24      | 379      |
| log(density)              | 6.17             | 1.42       | 11.1       | 1.86      | 142      | 4.77                  | -0.23      | 12.01      | 1.46      | 379      |
| years education           | 7.84             | 0.25       | 13.21      | 2.98      | 142      | 7.1                   | 0.27       | 12.85      | 3.29      | 379      |
| log(MP <sup>(h)</sup> )   | 21.35            | 19.09      | 25.04      | 1.47      | 142      | 21.25                 | 19.07      | 25.49      | 1.4       | 379      |
| log(MP <sup>(s)</sup> )   | 22.29            | 20.13      | 25.45      | 1.31      | 142      | 22.26                 | 20.06      | 25.92      | 1.28      | 379      |
| log(NLMP <sup>(h)</sup> ) | 21.17            | 19.09      | 24.91      | 1.42      | 142      | 21.21                 | 19.06      | 25.46      | 1.39      | 379      |
| log(NLMP <sup>(s)</sup> ) | 22.19            | 20.13      | 25.34      | 1.28      | 142      | 22.24                 | 20.04      | 25.9       | 1.28      | 379      |
| log(FMP <sup>(h)</sup> )  | 20.57            | 19.08      | 24.27      | 1.14      | 142      | 20.6                  | 19.06      | 24.33      | 1.12      | 379      |
| log(FMP <sup>(s)</sup> )  | 21.69            | 20.13      | 25.17      | 1.05      | 142      | 21.69                 | 20.03      | 25.2       | 1.05      | 379      |
|                           | <i>periphery</i> |            |            |           |          |                       |            |            |           |          |
|                           | <b>mean</b>      | <b>min</b> | <b>max</b> | <b>sd</b> | <b>n</b> |                       |            |            |           |          |
| log(GDP pc)               | 8.71             | 1.76       | 11.87      | 1.3       | 977      |                       |            |            |           |          |
| temperature               | 14.48            | -12.73     | 28.8       | 8.69      | 977      |                       |            |            |           |          |
| inv. dist. port           | 0.03             | 0          | 1          | 0.14      | 977      |                       |            |            |           |          |
| log(oil per cap.)         | 0.12             | 0          | 4.16       | 0.44      | 977      |                       |            |            |           |          |
| log(density)              | 3.65             | -2.93      | 9.17       | 1.64      | 977      |                       |            |            |           |          |
| years education           | 07.03            | 0.22       | 12.83      | 3.12      | 977      |                       |            |            |           |          |
| log(MP <sup>(h)</sup> )   | 21.18            | 19.13      | 24.88      | 1.27      | 977      |                       |            |            |           |          |
| log(MP <sup>(s)</sup> )   | 22.21            | 20.09      | 25.54      | 1.19      | 977      |                       |            |            |           |          |
| log(NLMP <sup>(h)</sup> ) | 21.16            | 19.12      | 24.62      | 1.26      | 977      |                       |            |            |           |          |
| log(NLMP <sup>(s)</sup> ) | 22.2             | 20.09      | 25.44      | 1.18      | 977      |                       |            |            |           |          |
| log(FMP <sup>(h)</sup> )  | 20.49            | 19.12      | 24.2       | 1         | 977      |                       |            |            |           |          |
| log(FMP <sup>(s)</sup> )  | 21.58            | 20.08      | 25.11      | 0.95      | 977      |                       |            |            |           |          |

Table 14: Descriptive statistics by cluster characteristic

|   | (1)                | (2)                | (3)                | (4)                |
|---|--------------------|--------------------|--------------------|--------------------|
|   | ln education       |                    | ln density         |                    |
| $\mathbb{1}_{\text{semi-periphery}}$  | −0.18***<br>(0.03) | −0.04***<br>(0.01) | −1.42***<br>(0.16) | −1.13***<br>(0.28) |
| $\mathbb{1}_{\text{periphery}}$   | −0.27***<br>(0.04) | −0.07***<br>(0.02) | −2.42***<br>(0.16) | −1.99***<br>(0.29) |
| $\mathbb{1}_{\text{semi-periphery}} \times \mathbb{1}_{\text{upper-middle income group}}$   |                    | −0.09***<br>(0.03) |                    | −0.51<br>(0.41)    |
| $\mathbb{1}_{\text{periphery}} \times \mathbb{1}_{\text{upper-middle income country}}$      |                    | −0.16***<br>(0.03) |                    | −0.88**<br>(0.39)  |
| $\mathbb{1}_{\text{semi-periphery}} \times \mathbb{1}_{\text{lower-middle income country}}$ |                    | −0.17***<br>(0.06) |                    | −0.14<br>(0.40)    |
| $\mathbb{1}_{\text{periphery}} \times \mathbb{1}_{\text{lower-middle income country}}$      |                    | −0.28***<br>(0.09) |                    | −0.24<br>(0.40)    |
| $\mathbb{1}_{\text{semi-periphery}} \times \mathbb{1}_{\text{low income country}}$          |                    | −0.55***<br>(0.17) |                    | −0.89<br>(0.68)    |
| $\mathbb{1}_{\text{periphery}} \times \mathbb{1}_{\text{low income country}}$               |                    | −0.67***<br>(0.19) |                    | −0.82<br>(0.55)    |
| Num. obs.   | 1479               | 1479               | 1516               | 1516               |
| Num. groups: code   | 102                | 102                | 104                | 104                |
| Adj. R <sup>2</sup> (full model)  | 0.90               | 0.91               | 0.54               | 0.55               |
| Adj. R <sup>2</sup> (proj model)  | 0.14               | 0.20               | 0.27               | 0.28               |

\*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . The dependant variable is the GDP per capita (in log). Robust standard errors adjusted for clustering on each country are in parentheses. Estimations include country fixed-effects.

Table 15: Core and Periphery Divide, Education and Density

|                                      | (1)                  | (2)                  | (3)                    | (4)                    | (5)                   | (6)                   |
|--------------------------------------|----------------------|----------------------|------------------------|------------------------|-----------------------|-----------------------|
|                                      | ln MP <sup>(h)</sup> | ln MP <sup>(s)</sup> | ln NLMP <sup>(h)</sup> | ln NLMP <sup>(s)</sup> | ln FMP <sup>(h)</sup> | ln FMP <sup>(s)</sup> |
| $\mathbb{1}_{\text{semi-periphery}}$ | −0.20***<br>(0.06)   | −0.13***<br>(0.05)   | −0.05<br>(0.06)        | −0.05<br>(0.05)        | −0.00<br>(0.01)       | −0.02*<br>(0.01)      |
| $\mathbb{1}_{\text{periphery}}$      | −0.36***<br>(0.07)   | −0.25***<br>(0.06)   | −0.18***<br>(0.07)     | −0.15***<br>(0.05)     | −0.02**<br>(0.01)     | −0.05***<br>(0.01)    |
| Num. obs.                            | 1498                 | 1498                 | 1498                   | 1498                   | 1498                  | 1498                  |
| Num. groups: code                    | 103                  | 103                  | 103                    | 103                    | 103                   | 103                   |
| Adj. R <sup>2</sup> (full model)     | 0.91                 | 0.93                 | 0.91                   | 0.93                   | 0.98                  | 0.98                  |
| Adj. R <sup>2</sup> (proj model)     | 0.07                 | 0.05                 | 0.03                   | 0.03                   | 0.00                  | 0.01                  |

\*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . The dependant variable is the GDP per capita (in log). Robust standard errors adjusted for clustering on each country are in parentheses. Estimations include country fixed-effects.

Table 16: Core and Periphery Divide, Market Potential

|                                  | (1)               | (2)               | (3)                 | (4)                 | (5)                | (6)                |
|----------------------------------|-------------------|-------------------|---------------------|---------------------|--------------------|--------------------|
| market potential                 | 0.22***<br>(0.05) | 0.22***<br>(0.06) | 0.14***<br>(0.04)   | 0.15***<br>(0.05)   | 0.13<br>(0.11)     | 0.12<br>(0.13)     |
| Num. obs.                        | 1,502             | 1,502             | 1,502               | 1,502               | 1,502              | 1,502              |
| Country FE                       | Yes               | Yes               | Yes                 | Yes                 | Yes                | Yes                |
| Num. groups: code                | 105               | 105               | 105                 | 105                 | 105                | 105                |
| Adj. R <sup>2</sup> (proj model) | 0.06              | 0.04              | 0.02                | 0.01                | 0.00               | 0.00               |
| Regressor                        | MP <sup>(h)</sup> | MP <sup>(s)</sup> | NLMP <sup>(h)</sup> | NLMP <sup>(s)</sup> | FMP <sup>(h)</sup> | FMP <sup>(s)</sup> |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . The table displays the estimated coefficients from equation 6. Robust standard errors adjusted for clustering on each country are in parentheses. MP<sup>(h)</sup> considers physical distance between regions measured as the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements. MP<sup>(s)</sup> considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures. NLMP<sup>(h)</sup> and NLMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the local market, i.e.  $y_i \tau_{ii}$ . FMP<sup>(h)</sup> and FMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the domestic markets, i.e.  $\sum_{j \neq i} y_j \tau_{ij}$  with  $i$  and  $j$  both in country  $c$ .

Table 17: Regional Development and Market potential - Univariate regressions

|     | MP <sup>(h)</sup> | MP <sup>(s)</sup> | NLMP <sup>(h)</sup> | NLMP <sup>(s)</sup> | FMP <sup>(h)</sup> | FMP <sup>(s)</sup> | N regions |
|-----|-------------------|-------------------|---------------------|---------------------|--------------------|--------------------|-----------|
| AUS | -0.12             | -0.23             | -0.24               | -0.23               | 0.09               | 0.39               | 8         |
| AUT | -3.07             | -2.43             | -2.11               | -2.12               | 0.31               | 0.20               | 9         |
| BEL | 0.03              | -0.21             | -0.25               | -0.39               | -2.24              | -2.83              | 11        |
| CAN | -0.22             | -0.23             | -0.26               | -0.25               | -0.16              | -0.16              | 12        |
| CHE | 0.41              | 0.50              | 0.31                | 0.42                | -0.70              | 0.74               | 25        |
| CZE | -0.82             | -1.04             | -0.80*              | -0.97*              | -3.08              | 0                  | 8         |
| DEU | 0.28              | 0.17              | 0.01                | -0.00               | -0.09              | -0.10              | 16        |
| DNK | 0.57*             | 0.79**            | 0.36                | 0.63**              | 0.09               | 0.50               | 15        |
| ESP | 0.07              | -0.00             | 0.05                | -0.00               | 0.12               | -0.02              | 19        |
| EST | 0.36              | -0.25             | 0.19                | -0.25               | 0.28               | -0.40              | 15        |
| FIN | -                 | -                 | -                   | -                   | -                  | -                  | 5         |
| FRA | 0.02              | -0.10             | -0.06               | -0.14               | -0.00              | -0.09              | 22        |
| GBR | -0.02             | -0.09             | -0.09               | -0.12               | -0.25              | -0.27              | 12        |
| GRC | 0.57              | 0.15              | 0.38                | 0.03                | -0.83              | -0.25              | 13        |
| HRV | 0.52**            | 0.72**            | 0.52**              | 0.72**              | 0.98**             | 1.16**             | 20        |
| HUN | -                 | -                 | -                   | -                   | -                  | -                  | 7         |
| IRL | -                 | -                 | -                   | -                   | -                  | -                  | 2         |
| ISR | -                 | -                 | -                   | -                   | -                  | -                  | 6         |
| ITA | 0.43**            | 0.29              | 0.37**              | 0.26                | 0.57***            | 0.54**             | 20        |
| JPN | -0.01             | -0.02             | -0.03               | -0.03               | 0.19               | 0.09               | 47        |
| NLD | -1.21             | -1.01             | -1.13               | -0.97               | 0.45               | 0.62               | 12        |
| NOR | -0.06             | -0.09             | -0.06               | -0.09               | -0.00              | -0.25              | 19        |
| NZL | -0.04             | -0.09             | -0.09               | -0.09               | -8.57              | 4.69               | 14        |
| POL | -0.04             | -0.12             | -0.19               | -0.21               | -0.12              | -0.18              | 16        |
| PRT | -0.21**           | -0.26**           | -0.33**             | -0.37**             | -0.48*             | 0                  | 7         |
| SVK | -0.27             | -0.40             | -0.23               | -0.35               | 0.36               | 0.63               | 8         |
| SVN | 0.30              | 0.37              | 0.02                | 0.17                | 0.82               | 0.79               | 12        |
| SWE | -0.11             | -0.15             | -0.11               | -0.14               | 0.20               | 0.31               | 8         |
| USA | -0.00             | -0.03             | -0.02               | -0.04               | -0.30              | -0.27              | 51        |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . These coefficients are elasticity coefficients of regional GDP per capita to market potential indexes for each high income country. In each regression, I control for the temperature, the inverse distance to the closest port, oil production per capita, density and average level of education. MP<sup>(h)</sup> considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements. MP<sup>(s)</sup> considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures. NLMP<sup>(h)</sup> and NLMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the local market, i.e.  $y_i\tau_{ii}$ . FMP<sup>(h)</sup> and FMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the domestic markets, i.e.  $\sum_{j \neq i} y_j\tau_{ij}$  with  $i$  and  $j$  both in country  $c$ . List of countries: Australia, Austria, Belgium, Canada, Switzerland, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, Great Britain, Greece, Croatia, Hungary, Ireland, Israel, Italy, Japan, Netherlands, Norvege, New Zeland, Poland, Portugal, Slovakia, Slovenia, Sweden, United States of America.

Table 18: Market Potential Elasticity - High income countries (2005)

|     | MP <sup>(h)</sup> | MP <sup>(s)</sup> | NLMP <sup>(h)</sup> | NLMP <sup>(s)</sup> | FMP <sup>(h)</sup> | FMP <sup>(s)</sup> | N regions |
|-----|-------------------|-------------------|---------------------|---------------------|--------------------|--------------------|-----------|
| AZE | -0.27             | -0.56             | -0.27               | -0.55               | 10.89              | 15.10              | 11        |
| BGR | -                 | -                 | -                   | -                   | -                  | -                  | 6         |
| BIH | -                 | -                 | -                   | -                   | -                  | -                  | 3         |
| BRA | 0.19              | 0.21              | -0.01               | 0.04                | -0.55              | -0.42              | 27        |
| CHL | -0.19             | -0.31             | -0.22               | -0.34               | -1.28              | -0.33              | 13        |
| CHN | 0.70***           | 0.69**            | 0.42                | 0.48                | 1.44*              | -0.61              | 31        |
| COL | 0.64**            | 0.88*             | 0.56*               | 0.78*               | 2.47**             | 4.68**             | 33        |
| DOM | 0.04              | 0.20              | 0.57                | 0.84                | -1.60              | 0.44               | 9         |
| ECU | -1.44             | -2.84**           | -1.03               | -2.82**             | -2.71*             | -2.84***           | 21        |
| GAB | -                 | -                 | -                   | -                   | -                  | -                  | 4         |
| IRN | 0.54              | 0.41              | 0.11                | 0.10                | 0.13               | 0.67               | 30        |
| JOR | -0.18             | -0.52             | -0.20               | -0.53               | 0.06               | -0.18              | 12        |
| KAZ | -                 | -                 | -                   | -                   | -                  | -                  | 6         |
| LBN | -                 | -                 | -                   | -                   | -                  | -                  | 6         |
| LTU | -0.63             | -0.71             | -0.46               | -0.60               | -1.10              | -1.55              | 10        |
| LVA | 0.21              | 0.21              | 0.17                | 0.16                | 2.58               | -2.60              | 33        |
| MEX | -0.04             | -0.35             | -0.26               | -0.41               | 0.34               | -0.55              | 32        |
| MKD | -0.95             | -1.14             | -0.96               | -1.15               | -0.99              | -1.17              | 8         |
| MYS | -0.07             | -0.15             | -0.11               | -0.17               | -2.78              | -3.10              | 14        |
| PAN | -1.46*            | -2.32**           | -1.56**             | -2.34***            | 5.11               | 2.07               | 9         |
| PER | 0.50              | 0.67              | 0.13                | 0.40                | 0.88               | 1.70               | 24        |
| ROU | 1.06              | 1.60              | 1.08                | 1.64                | 2.00*              | 2.33               | 8         |
| RUS | 0.27***           | 0.25**            | 0.24***             | 0.23**              | 0.73***            | 0.63**             | 80        |
| THA | -                 | -                 | -                   | -                   | -                  | -                  | 5         |
| TUR | 0.32              | 0.43              | 0.34                | 0.46                | 0.20               | 0.42               | 12        |
| URY | 0.21              | 0.26              | 0.20                | 0.22                | 0.22               | 0.42               | 19        |
| VEN | 0.03              | 0.03              | -0.01               | -0.01               | 0.43               | 0.40               | 23        |
| ZAF | 0.07              | 0.03              | -0.03               | -0.0                | 5.79               | 10.70              | 9         |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . These coefficients are elasticity coefficients of regional GDP per capita to market potential indexes for each upper middle income country. In each regression, I control for the temperature, the inverse distance to the closest port, oil production per capita, density and average level of education. MP<sup>(h)</sup> considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements. MP<sup>(s)</sup> considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures. NLMP<sup>(h)</sup> and NLMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the local market, i.e.  $y_i \tau_{ii}$ . FMP<sup>(h)</sup> and FMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the domestic markets, i.e.  $\sum_{j \neq i} y_j \tau_{ij}$  with  $i$  and  $j$  both in country  $c$ . List of countries: Azerbaijan, Bulgaria, Bosnia and Herzegovina, Brazil, Chile, Schina, Columbia, Dominican Republic, Ecuador, Gabon, Iran, Jordania, Kazakhstan, Liban, Lituania, Latva, Mexico, Macedonia, Malaysia, Panama, Peru, Romania, Russia, Thailand, Turkey, Uruguay, Venezuela, South Africa.

Table 19: Market Potential Elasticity - Upper middle income countries (2005)

|     | MP <sup>(h)</sup> | MP <sup>(s)</sup> | NLMP <sup>(h)</sup> | NLMP <sup>(s)</sup> | FMP <sup>(h)</sup> | FMP <sup>(s)</sup> | N regions |
|-----|-------------------|-------------------|---------------------|---------------------|--------------------|--------------------|-----------|
| ARM | 0.22              | 0.44              | 0.21                | 0.44                | 0.36               | 0.43               | 11        |
| BLZ | -                 | -                 | -                   | -                   | -                  | -                  | 6         |
| BOL | -11.12            | -11.33            | -28.04              | -16.17              | 20.23              | 8.39               | 9         |
| CMR | -3.29             | -3.31             | -3.20               | -3.28               | -3.89              | -4.12              | 10        |
| EGY | -                 | -                 | -                   | -                   | -                  | -                  | 2         |
| GEO | -3.16             | -5.79             | -3.10               | -5.56               | -3.96              | -5.32              | 11        |
| GHA | -8.39             | 0.10              | -8.49*              | 0.09                | -1.67**            | 3.22               | 10        |
| GTM | -0.24             | -0.40             | -0.24               | -0.40               | 1.32               | 3.23               | 8         |
| HND | -3.66**           | 1.22              | -3.49               | 1.11                | -3.19**            | 1.13               | 18        |
| IDN | 0.94**            | 0.87*             | 0.68                | 0.63                | 0.69               | 0.70               | 33        |
| IND | 0.19*             | 0.26*             | 0.17*               | 0.26*               | -0.01              | 0.08               | 32        |
| LAO | 0.10              | 0.77              | 0.06                | 0.73                | -0.18              | 0.66               | 18        |
| LKA | -0.37             | -0.58             | -0.43               | -0.60               | 0.17               | -2.12              | 9         |
| LSO | -0.84             | -1.30             | -0.86               | -1.32               | -0.89              | -1.30              | 10        |
| MAR | -0.57             | -0.64             | -0.57               | -0.64               | -0.48              | -0.56              | 14        |
| MDA | -                 | -                 | -                   | -                   | -                  | -                  | 5         |
| MNG | 0.41              | -1.07             | 0.05                | -1.20               | -0.21              | -1.29              | 22        |
| NGA | -                 | -                 | -                   | -                   | -                  | -                  | 6         |
| NIC | -2.50             | -1.08             | -2.49**             | -1.15               | -1.55              | -0.81              | 17        |
| PAK | -                 | -                 | -                   | -                   | -                  | -                  | 5         |
| PHL | -0.02             | -0.05             | -0.03               | -0.05               | 0.30               | -0.14              | 17        |
| PRY | -4.11             | -6.72             | -6.45**             | -7.97**             | -4.24              | -4.95              | 18        |
| SEN | 5.43              | 4.90              | 5.48                | 4.92                | 7.81*              | 5.87               | 10        |
| SLV | -0.21             | -0.10             | -0.20               | -0.12               | -0.53              | -0.03              | 14        |
| SWZ | -                 | -                 | -                   | -                   | -                  | -                  | 4         |
| SYR | -0.52             | -0.74             | -0.51               | -0.72               | -0.61*             | -0.98              | 13        |
| UKR | -0.22             | 0.30*             | 0.21*               | 0.30*               | -1.85**            | -1.61              | 27        |
| UZB | -                 | -                 | -                   | -                   | -                  | -                  | 5         |
| VNM | 1.20              | -3.01             | -2.89               | -6.28               | -2.95              | -6.95              | 8         |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . These coefficients are elasticity coefficients of regional GDP per capita to market potential indexes for each lower middle income country. In each regression, I control for the temperature, the inverse distance to the closest port, oil production per capita, density and average level of education. MP<sup>(h)</sup> considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements. MP<sup>(s)</sup> considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures. NLMP<sup>(h)</sup> and NLMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the local market, i.e.  $y_i \tau_{ii}$ . FMP<sup>(h)</sup> and FMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the domestic markets, i.e.  $\sum_{j \neq i} y_j \tau_{ij}$  with  $i$  and  $j$  both in country  $c$ . List of countries: Armenia, Belize, Bolivia, Cameroon, Egypt, Georgia, Ghana, Guatemala, Honduras, Indonesia, India, Laos, Morocco, Moldova, Mongolia, Nigeria, Nicaragua, Pakistan, Philippines, Paraguay, Senegal, El Salvador, Swaziland, Syria, Ukraine, Uzbekistan, Vietnam.

Table 20: Market Potential Elasticity - Lower middle income countries (2005)



|     | $MP^{(h)}$ | $MP^{(s)}$ | $NLMP^{(h)}$ | $NLMP^{(s)}$ | $FMP^{(h)}$ | $FMP^{(s)}$ | N regions |
|-----|------------|------------|--------------|--------------|-------------|-------------|-----------|
| BFA | 0.34       | -5.20      | 0.05         | -6.69        | 1.91        | 6.27        | 13        |
| COD | -3.08      | -5.01      | -3.34        | -5.00        | -3.05       | -4.99       | 11        |
| KEN | -0.12      | -0.20      | -0.15        | -0.23        | 0.98        | -.78        | 8         |
| KGZ | 3.18       | 5.88*      | 3.16         | 5.87         | 3.05*       | 5.57        | 8         |
| KHM | 1.24       | 1.54       | 1.13         | 1.48         | 1.15        | 1.46        | 15        |
| MDG | -          | -          | -            | -            | -           | -           | 6         |
| MOZ | 0.10       | 0.08       | 0.11         | 0.08         | 0.05        | 0.02        | 10        |
| MWI | -          | -          | -            | -            | -           | -           | 3         |
| NER | -0.94      | -0.54      | -0.97        | -0.56        | -0.98       | -0.56       | 8         |
| NPL | -          | -          | -            | -            | -           | -           | 5         |
| TZA | -1.05      | -0.95      | -1.14        | -1.00        | -1.46       | -1.36       | 21        |
| UGA | -          | -          | -            | -            | -           | -           | 4         |
| ZWE | 5.68***    | 6.99**     | 5.68***      | 6.99**       | 5.68**      | 6.99**      | 10        |

\*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . These coefficients are elasticity coefficients of regional GDP per capita to market potential indexes for each low income country. In each regression, I control for the temperature, the inverse distance to the closest port, oil production per capita, density and average level of education.  $MP^{(h)}$  considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements.  $MP^{(s)}$  considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures.  $NLMP^{(h)}$  and  $NLMP^{(s)}$  are proxies for  $MP^{(h)}$  and  $MP^{(s)}$  respectively, excluding the local market, i.e.  $y_i \tau_{ii}$ .  $FMP^{(h)}$  and  $FMP^{(s)}$  are proxies for  $MP^{(h)}$  and  $MP^{(s)}$  respectively, excluding the domestic markets, i.e.  $\sum_{j \neq i} y_j \tau_{ij}$  with  $i$  and  $j$  both in country  $c$ . List of countries: Benin, Burkina Faso, Kenya, Kyrgyzstan, Cambodia, Madagascar, Mozambique, Malawi, Niger, Nepal, Tanzania, Uganda, Democratic Republic of the Congo, Zimbabwe.

Table 21: Market Potential Elasticity - Low income countries (2005)

|                         | (1)               | (2)               | (3)               | (4)               | (5)               | (6)               |
|-------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| market potential        | 0.12***<br>(0.04) | 0.08**<br>(0.03)  | 0.05**<br>(0.02)  | 0.04<br>(0.03)    | 0.05<br>(0.07)    | -0.02<br>(0.09)   |
| centrality              | 0.05***<br>(0.01) | 0.05***<br>(0.01) | 0.06***<br>(0.01) | 0.06***<br>(0.01) | 0.06***<br>(0.01) | 0.06***<br>(0.01) |
| Num. obs.               | 1464              | 1464              | 1464              | 1464              | 1464              | 1464              |
| Num. groups: code       | 103               | 103               | 103               | 103               | 103               | 103               |
| Adj. $R^2$ (full model) | 0.95              | 0.95              | 0.95              | 0.95              | 0.95              | 0.95              |
| Adj. $R^2$ (proj model) | 0.44              | 0.43              | 0.43              | 0.43              | 0.43              | 0.42              |
| Regressor               | $MP^{(h)}$        | $MP^{(s)}$        | $NLMP^{(h)}$      | $NLMP^{(s)}$      | $FMP^{(h)}$       | $FMP^{(s)}$       |

\*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ . Market potential and centrality indexes are introduced in the logarithm form. In each regression, I control for the temperature, the inverse distance to the closest port, oil production per capita, density and average level of education.  $MP^{(h)}$  considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements.  $MP^{(s)}$  considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures.  $NLMP^{(h)}$  and  $NLMP^{(s)}$  are proxies for  $MP^{(h)}$  and  $MP^{(s)}$  respectively, excluding the local market, i.e.  $y_i \tau_{ii}$ .  $FMP^{(h)}$  and  $FMP^{(s)}$  are proxies for  $MP^{(h)}$  and  $MP^{(s)}$  respectively, excluding the domestic markets, i.e.  $\sum_{j \neq i} y_j \tau_{ij}$  with  $i$  and  $j$  both in country  $c$ .

Table 22: Market Potential and Centrality (2005)

|  | (1)                | (2)                | (3)                 | (4)                 | (5)                | (6)                |
|--|--------------------|--------------------|---------------------|---------------------|--------------------|--------------------|
| market potential   | 0.17***<br>(0.04)  | 0.17***<br>(0.04)  | 0.12***<br>(0.03)   | 0.13***<br>(0.04)   | 0.11*<br>(0.06)    | 0.05<br>(0.06)     |
| market potential $\times \mathbb{1}_{\text{semi-periphery}}$ | -0.04***<br>(0.01) | -0.03***<br>(0.01) | -0.03***<br>(0.01)  | -0.03***<br>(0.01)  | -0.03***<br>(0.01) | -0.03***<br>(0.01) |
| market potential $\times \mathbb{1}_{\text{periphery}}$      | -0.03***<br>(0.01) | -0.03***<br>(0.01) | -0.03***<br>(0.01)  | -0.03***<br>(0.01)  | -0.03***<br>(0.01) | -0.03***<br>(0.01) |
| centrality   | -0.00<br>(0.02)    | -0.00<br>(0.02)    | 0.00<br>(0.02)      | 0.00<br>(0.02)      | 0.00<br>(0.02)     | 0.00<br>(0.02)     |
| centrality $\times \mathbb{1}_{\text{semi-periphery}}$       | -0.17***<br>(0.04) | -0.16***<br>(0.04) | -0.15***<br>(0.04)  | -0.15***<br>(0.04)  | -0.11***<br>(0.03) | -0.11***<br>(0.03) |
| centrality $\times \mathbb{1}_{\text{periphery}}$            | -0.12**<br>(0.06)  | -0.13**<br>(0.06)  | -0.10*<br>(0.06)    | -0.11**<br>(0.06)   | -0.07<br>(0.05)    | -0.07<br>(0.04)    |
| Num. obs.  | 1460               | 1460               | 1460                | 1460                | 1460               | 1460               |
| Num. groups: code  | 101                | 101                | 101                 | 101                 | 101                | 101                |
| Adj. R <sup>2</sup> (full model)                             | 0.95               | 0.95               | 0.95                | 0.95                | 0.95               | 0.95               |
| Adj. R <sup>2</sup> (proj model)                             | 0.48               | 0.48               | 0.47                | 0.4708              | 0.46               | 0.46               |
| Regressor  | MP <sup>(h)</sup>  | MP <sup>(s)</sup>  | NLMP <sup>(h)</sup> | NLMP <sup>(s)</sup> | FMP <sup>(h)</sup> | FMP <sup>(s)</sup> |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . Market potential and centrality indexes are introduced in the logarithm form. In each regression, I control for the temperature, the inverse distance to the closest port, oil production per capita, density and average level of education. MP<sup>(h)</sup> considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements. MP<sup>(s)</sup> considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures. NLMP<sup>(h)</sup> and NLMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the local market, i.e.  $y_i \tau_{ii}$ . FMP<sup>(h)</sup> and FMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the domestic markets, i.e.  $\sum_{j \neq i} y_j \tau_{ij}$  with  $i$  and  $j$  both in country  $c$ .

Table 23: Market Potential and Centrality - Core and Periphery (2005)

|                         | (1)               | (2)               | (3)                 | (4)                 | (5)                | (6)                |
|-------------------------|-------------------|-------------------|---------------------|---------------------|--------------------|--------------------|
| <i>1995 sample</i>      |                   |                   |                     |                     |                    |                    |
| market potential        | 0.10**<br>(0.05)  | 0.08*<br>(0.05)   | 0.03<br>(0.04)      | 0.02<br>(0.04)      | 0.13*<br>(0.07)    | 0.08<br>(0.09)     |
| <i>2000 sample</i>      |                   |                   |                     |                     |                    |                    |
| market potential        | 0.10**<br>(0.05)  | 0.09*<br>(0.05)   | 0.04<br>(0.04)      | 0.04<br>(0.05)      | 0.22***<br>(0.07)  | 0.18*<br>(0.09)    |
| <i>2005 sample</i>      |                   |                   |                     |                     |                    |                    |
| market potential        | 0.11***<br>(0.03) | 0.09**<br>(0.04)  | 0.06**<br>(0.03)    | 0.05*<br>(0.03)     | 0.08<br>(0.08)     | -0.00<br>(0.10)    |
| <i>2010 sample</i>      |                   |                   |                     |                     |                    |                    |
| market potential        | 0.01<br>(0.03)    | -0.07*<br>(0.04)  | -0.06<br>(0.03)     | -0.11**<br>(0.03)   | -0.05<br>(0.08)    | -0.23**<br>(0.10)  |
| <i>1995-2005 sample</i> |                   |                   |                     |                     |                    |                    |
| market potential        | 0.10***<br>(0.02) | 0.08***<br>(0.03) | 0.04**<br>(0.02)    | 0.03<br>(0.02)      | 0.13***<br>(0.05)  | 0.06<br>(0.06)     |
| <i>1995-2010 sample</i> |                   |                   |                     |                     |                    |                    |
| market potential        | 0.08**<br>(0.02)  | 0.05*<br>(0.03)   | 0.02<br>(0.02)      | 0.00<br>(0.03)      | 0.09**<br>(0.04)   | -0.01<br>(0.05)    |
| Regressor               | MP <sup>(h)</sup> | MP <sup>(s)</sup> | NLMP <sup>(h)</sup> | NLMP <sup>(s)</sup> | FMP <sup>(h)</sup> | FMP <sup>(s)</sup> |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . Robust standard errors adjusted for clustering on each country-time group are in parentheses. The following covariates are included: temperature, inverse distance to the closest port, oil production per capita and average educational level. For the cross-sectional estimations of each year, country fixed effects are included. For the panel estimations, country-year fixed effects are included. MP<sup>(h)</sup> considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements. MP<sup>(s)</sup> considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures. NLMP<sup>(h)</sup> and NLMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the local market, i.e.  $y_i \tau_{ii}$ . FMP<sup>(h)</sup> and FMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the domestic markets, i.e.  $\sum_{j \neq i} y_j \tau_{ij}$  with  $i$  and  $j$  both in country  $c$ .

Countries in the 1995 sample: ARG, SVN, NOR, PAK, PAN, PER, POL, PRT, SLV, SWE, THA, TUR, TZA, URY, AUS, AUT, BEL, BGR, BOL, BRA, CAN, CHE, CHL, CHN, COL, DEU, ECU, ESP, FIN, FRA, GRC, GTM, HND, IDN, IND, IRL, ITA, JOR, JPN, KAZ, LKA, LSO, LTU, LVA, MEX, MNG, MYS, NLD. The sample gathers 738 regions in 48 countries.

Countries in the 2000 sample: ARG, SVN, NOR, PAN, PER, POL, PRT, PRY, SLV, SRB, SWE, THA, TUR, TZA, URY, ALB, ARE, AUS, AUT, BEL, BEN, BGR, BOL, BRA, CAN, CHE, CHL, CHN, COL, DEU, ECU, ESP, EST, FIN, FRA, GRC, HND, HRV, HUN, IND, IRL, ITA, JOR, JPN, KAZ, LKA, LSO, LTU, LVA, MEX, MKD, MNG, MOZ, MYS, NLD. The sample gathers 802 regions in 55 countries.

Countries in the 2005 sample: ARG, SVN, NOR, NPL, PAK, PAN, PER, POL, PRT, PRY, RUS, SLV, SVK, SWE, THA, TUR, TZA, UKR, URY, USA, UZB, VNM, ARE, AUS, AUT, BEL, BEN, BGR, BIH, BOL, BRA, CAN, CHE, CHL, CHN, COL, CZE, DEU, ECU, ESP, EST, FIN, FRA, GBR, GRC, GTM, HND, HRV, HUN, IDN, IND, IRL, IRN, ITA, JOR, JPN, KAZ, KGZ, LKA, LSO, LTU, LVA, MEX, MKD, MNG, MOZ, MYS, NGA, NLD. The sample gathers 1129 regions in 69 countries.

Countries in the sample: SVN, NOR, PAN, PRT, RUS, SVK, SWE, USA, VNM, BGR, BRA, CHE, CHN, CZE, FIN, IDN, JPN, KOR, MEX, NLD. The sample gathers 421 regions in 20 countries.

Table 24: Market potential elasticity coefficients - panel

|  | (1)                | (2)                | (3)                 | (4)                 | (5)                | (6)                |
|--|--------------------|--------------------|---------------------|---------------------|--------------------|--------------------|
| <i>1995-2005 sample</i>                                      |                    |                    |                     |                     |                    |                    |
| market potential   | 0.09**<br>(0.04)   | 0.08**<br>(0.04)   | 0.05<br>(0.03)      | 0.05<br>(0.03)      | 0.11*<br>(0.06)    | 0.06<br>(0.07)     |
| market potential $\times \mathbb{1}_{\text{semi-periphery}}$ | -0.01***<br>(0.00) | -0.01***<br>(0.00) | -0.01***<br>(0.00)  | -0.01***<br>(0.00)  | -0.01***<br>(0.00) | -0.01***<br>(0.00) |
| market potential $\times \mathbb{1}_{\text{periphery}}$      | -0.02***<br>(0.00) | -0.02***<br>(0.00) | -0.02***<br>(0.00)  | -0.02***<br>(0.00)  | -0.03***<br>(0.00) | -0.03***<br>(0.00) |
| <i>1995-2010 sample</i>                                      |                    |                    |                     |                     |                    |                    |
| market potential   | 0.08**<br>(0.04)   | 0.05<br>(0.03)     | 0.03<br>(0.03)      | 0.01<br>(0.03)      | 0.08<br>(0.05)     | 0.00<br>(0.05)     |
| market potential $\times \mathbb{1}_{\text{semi-periphery}}$ | -0.01***<br>(0.00) | -0.01***<br>(0.00) | -0.01***<br>(0.00)  | -0.01***<br>(0.00)  | -0.01***<br>(0.00) | -0.01***<br>(0.00) |
| market potential $\times \mathbb{1}_{\text{periphery}}$      | -0.02***<br>(0.00) | -0.02***<br>(0.00) | -0.02***<br>(0.00)  | -0.02***<br>(0.00)  | -0.03***<br>(0.00) | -0.03***<br>(0.00) |
| Regressor  | MP <sup>(h)</sup>  | MP <sup>(s)</sup>  | NLMP <sup>(h)</sup> | NLMP <sup>(s)</sup> | FMP <sup>(h)</sup> | FMP <sup>(s)</sup> |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . Robust standard errors adjusted for clustering on each country-time group are in parentheses. The following covariates are included: temperature, inverse distance to the closest port, oil production per capita and average educational level. For the cross-sectional estimations of each year, country fixed effects are included. For the panel estimations, country-year fixed effects are included. MP<sup>(h)</sup> considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements. MP<sup>(s)</sup> considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures. NLMP<sup>(h)</sup> and NLMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the local market, i.e.  $y_i \tau_{ii}$ . FMP<sup>(h)</sup> and FMP<sup>(s)</sup> are proxies for MP<sup>(h)</sup> and MP<sup>(s)</sup> respectively, excluding the domestic markets, i.e.  $\sum_{j \neq i} y_j \tau_{ij}$  with  $i$  and  $j$  both in country  $c$ .

Table 25: Market potential elasticity coefficients - panel - core-periphery

|  | (1)               | (2)               | (3)               | (4)               | (5)               | (6)               | (7)               | (8)               |
|--|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| market potential   | 0.14***<br>(0.04) | 0.12***<br>(0.04) | 0.15***<br>(0.04) | 0.12***<br>(0.04) | 0.15***<br>(0.05) | 0.13**<br>(0.05)  | 0.16***<br>(0.05) | 0.13**<br>(0.06)  |
| centrality <sup>cores</sup>  | -0.11<br>(0.07)   | -0.09<br>(0.06)   |                   |                   |                   |                   |                   |                   |
| centrality <sup>cores</sup> $\times \mathbb{1}(\gamma_g = \text{core})$                    |                   |                   | -0.37<br>(0.26)   | -0.12<br>(0.22)   |                   |                   |                   |                   |
| centrality <sup>cores</sup> $\times \mathbb{1}(\gamma_g = \text{semi-periphery})$          |                   |                   | -0.13**<br>(0.06) | -0.10*<br>(0.06)  |                   |                   |                   |                   |
| centrality <sup>cores</sup> $\times \mathbb{1}(\gamma_g = \text{periphery})$               |                   |                   | -0.10<br>(0.08)   | -0.08<br>(0.08)   |                   |                   |                   |                   |
| centrality <sup>domestic cores</sup>   |                   |                   |                   |                   | -0.00<br>(0.02)   | 0.01<br>(0.02)    |                   |                   |
| centrality <sup>domestic cores</sup> $\times \mathbb{1}(\gamma_g = \text{core})$           |                   |                   |                   |                   |                   |                   | -0.37<br>(0.28)   | -0.12<br>(0.24)   |
| centrality <sup>domestic cores</sup> $\times \mathbb{1}(\gamma_g = \text{semi-periphery})$ |                   |                   |                   |                   |                   |                   | -0.02<br>(0.02)   | -0.01<br>(0.02)   |
| centrality <sup>domestic cores</sup> $\times \mathbb{1}(\gamma_g = \text{periphery})$      |                   |                   |                   |                   |                   |                   | 0.01<br>(0.02)    | 0.03<br>(0.02)    |
| centrality <sup>foreign cores</sup>  |                   |                   |                   |                   | -0.42**<br>(0.18) | -0.39**<br>(0.18) |                   |                   |
| centrality <sup>foreign cores</sup> $\times \mathbb{1}(\gamma_g = \text{core})$            |                   |                   |                   |                   |                   |                   | -0.32*<br>(0.18)  | -0.27<br>(0.17)   |
| centrality <sup>foreign cores</sup> $\times \mathbb{1}(\gamma_g = \text{semi-periphery})$  |                   |                   |                   |                   |                   |                   | -0.43**<br>(0.17) | -0.40**<br>(0.17) |
| centrality <sup>foreign cores</sup> $\times \mathbb{1}(\gamma_g = \text{periphery})$       |                   |                   |                   |                   |                   |                   | -0.44**<br>(0.19) | -0.41**<br>(0.19) |
| Num. obs.  | 1460              | 1460              | 1460              | 1460              | 1460              | 1460              | 1460              | 1460              |
| Country and Cluster FE   | Yes               | Yes               | Yes               | Yes               | Yes               | Yes               | Yes               | Yes               |
| Num. groups: code  | 101               | 101               | 101               | 101               | 101               | 101               | 101               | 101               |
| Adj. R <sup>2</sup> (proj model)   | 0.32              | 0.31              | 0.32              | 0.31              | 0.33              | 0.32              | 0.34              | 0.33              |
| Regressor  | MP <sup>(h)</sup> | MP <sup>(s)</sup> | MP <sup>(h)</sup> | MP <sup>(s)</sup> | MP <sup>(h)</sup> | MP <sup>(s)</sup> | MP <sup>(h)</sup> | MP <sup>(s)</sup> |

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . Robust standard errors adjusted for clustering on each country are in parentheses. The following covariates are included: temperature, inverse distance to the closest port, oil production per capita and average educational level. The market potential and centrality variables are entered with the logarithm in the regressions. MP<sup>(h)</sup> considers physical distance between regions measured by the haversine distance, cultural proximity measures depending on common language, national common border, colonial ties, and trade facilities implied by a common currency and regional trade agreements. MP<sup>(s)</sup> considers the shortest path by land and sea between regions, passing through their closest ports if needed, in addition to the cultural proximity and trade facilities measures.

Table 26: Regional Development, the Core and Periphery, and Centrality to cores (2)