# Market Potential and Development

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**AND DEVELOPMENT**

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# MARKET POTENTIAL AND DEVELOPMENT

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# ABSTRACT

## Market Potential and Development*

This paper provides evidence on the long-term impact of market potential on economic development. It derives from the New Economic Geography literature a structural estimation where the level of factors' income of a country is related to its export capacity, labelled Market Access (MA) by Redding and Venables (2004), or Real Market Potential (RMP) by Head and Mayer (2004). The empirical part evaluates this market potential for all countries in the world with available trade data over the 1960-2003 period and relates it to income per capita. Overall results show that market potential is a powerful driver of increases in income per capita.

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# 1 Introduction

This paper provides evidence on the long-term impact of market potential on economic development. Providing explanations for cross-country differences in development levels is perhaps one of the most important question in economics. A large number of alternative frameworks have been proposed, and the literature has recently focused on whether physical geography, culture or institutions matter most in the long term economic performance of countries (Acemoglu et al. 2005 provide a nice summary of the different theories in competition, arguing strongly in favor of the institutions' view). I focus here on a different explanation, where *economic* geography, synthesized and measured though a market potential index is key in economic development. The paper derives from the New Economic Geography literature a structural estimation where the level of factors' income of a country is related to its export capacity, labeled Market Access (MA) by Redding and Venables (2004), or Real Market Potential (RMP) by Head and Mayer (2004). The empirical part evaluates this market potential for all countries in the world with available trade data over the 1960-2003 period and relates it to income per capita. Overall results show that market potential is a powerful driver of increases in income per capita and average wages.

This paper extends our knowledge on how market potential affects development in several dimensions. First and most important, I show that the cross-sectional striking success of the economic geography to predict income per capita in Redding and Venables (2004) holds when considering panel data. This reinforces their finding strongly, and confirms other recent panel data results, mostly done on an infra-national basis. Second, the results are robust to an instrumentation strategy intended to capture omitted variable bias that would survive the introduction of country-level fixed effects. Third, I allow for a larger set of trade costs variables, notably border effects, colonial preferences and regional agreements, all of them have a time-varying effect in my specification. This enables to do simulations regarding policy changes and how those would affect income per capita through market potential, which is the fourth value added of this paper. The remainder of the paper is as follows: Section 2 spells out the theoretical foundations of my exercise. Section 3 describes the data used, while Sections 4 and 5 present respectively econometric results for the gravity estimates that help build the market potential and the economic development regressions themselves. Section 6 concludes.

# 2 Theory

Redding and Venables (2004) and Hanson (2005) were the first contributions to emphasize the implications of the economic geography model in terms of wage differentials and to apply it empirically to wages in US counties for Hanson, and to the income per capita levels in the world for Redding and Venables. The relationship uncovered explains the level of factor incomes in a country $i$ (wages if labor is the only factor) by a weighted sum of expenditures of all countries in the world. The weights are bilateral trade costs from $i$ to each of the destination countries for $i$'s exports. The resulting term is labeled

Market Access (MA) by Redding and Venables (2004), Market Potential by Hanson (2005) or Real Market Potential (RMP) by Head and Mayer (2004), the "real" aspect being detailed below. Here I will adopt the market potential terminology in order no to introduce confusion since market access is also often used for describing the level of tariffs and other barriers faced by a country.

The relationship between factor incomes and market potential has been labeled the *wage equation*. The founding contributions use the now classical Dixit-Stiglitz type of monopolistic competition combined with iceberg trade costs. One might argue that this is maybe not the most relevant framework for developing economies, at least in some industries. It however seems that this prediction is somehow more general than what was originally thought. The main elements for the wage equation to emerge seem to be a gravity structure of bilateral trade combined with some rigidity in the distribution of output shares of different countries in the world. I will here build on Head and Mayer (2008) and try to keep as general as possible.

## 2.1 Gravity and the wage equation

The derivation makes use of the gravity equation that explain the pattern of bilateral trade flows. Gravity involves two important constraints: budget allocation for the importer and market-clearing for the exporter. Consider an exporter country $i$ and an importer country $j$. Budget allocation considers $X_j$ the total expenditure of $j$ to be allocated between exporting countries, and $\Pi_{ij}$ the proportion of income allocated to country $i$. By definition:

$$X_{ij} = \Pi_{ij} X_j, \tag{1}$$

where $\sum_i \Pi_{ij} = 1$ and $\sum_i X_{ij} = X_j$.

The important step to derive a gravity equation from (1) is to show that $\Pi_{ij}$ can be expressed in the following multiplicatively separable form:

$$\Pi_{ij} = \frac{A_i \phi_{ij}}{\Phi_j}. \tag{2}$$

Loosely speaking, $A_i$ represents "capabilities" of exporter $i$, $0 \leq \phi_{ij} \leq 1$ represents the ease of access of market $j$ to exporters in $i$, and $\Phi_j$ measures the set of opportunities of consumers in $j$ or, equivalently, the degree of competition in that market.

A wide range of different micro-foundations yield the crucial requirement of equation (2). Those include Dixit-Stiglitz monopolistic competition, Anderson and van Wincoop (2003) model based on national product differentiation, but also comparative advantage models such as Eaton and Kortum (2002) and more recently models incorporating firms' heterogeneity such as Chaney (2007). All those models have their budget allocation rule imply a gravity equation for bilateral trade which takes a simple multiplicative form:

$$X_{ij} = A_i \times \phi_{ij} \times X_j / \Phi_j, \tag{3}$$

and $\Phi_j = \sum_h \phi_{hj} A_h$, with different definitions of $A_i$ and $\phi_{ij}$ depending naturally on the specific structure of the model.

As a second accounting identity, it has to be that the sum of $i$'s shipments to all destinations—including itself—equals the total value of $i$'s production, noted $Q_i$.

$$Q_i = \sum_j X_{ij} = A_i \sum_j \frac{\phi_{ij} X_j}{\Phi_j}. \tag{4}$$

If $B_i$ is country $i$'s trade balance, we have $Q_i \equiv X_i + B_i$. At the world level, $\sum_j B_j = 0$, and therefore production must be equal to expenditure, $Q = X$.

If we have data on both expenditures $X_j$ and production, $Q_i$, then the market-clearing condition tell us something about the unobserved attribute of the exporter, $A_i$. To see this define $s_j^X = X_j/X = X_j/Q$ as country $j$'s share of world expenditure (and production). Next, define the following term:

$$\Phi_i^* = \sum_h \frac{\phi_{ih} s_h^X}{\Phi_h}. \tag{5}$$

This term is central in what follows. It is an index of market potential or market access (the same as in Redding and Venables, 2004, Head and Mayer 2004 or Hanson, 2005). Relative access to individual markets is measured as $\phi_{ih}/\Phi_h$. Hence, $\Phi_i^*$ is an expenditure-weighted average of relative access.

Hence, using (5) and (4), market-clearing conditions yields a very simple relationship between the exporter's capabilities $A_i$, its share of production $s_i^Q \equiv Q_i/Q$ and its market potential index $\Phi_i^*$:

$$A_i = s_i^Q (\Phi_i^*)^{-1} \qquad \text{or} \qquad s_i^Q = A_i \Phi_i^*. \qquad \text{or } A_i^{-1} s_i^Q = \Phi_i^* \tag{6}$$

This relationship is very general since it relies only on the gravity assumptions, namely the multiplicative budget allocation rule, and market clearing. The last formulation is particularly illustrative of the forces at work in an economic geography model. An exogenous increase in market potential $\Phi_i^*$, can translate in two different effects: one on $s_i^Q$, one on $1/A_i$. $A_i$ in all models involves a negative function of prices charged by $i$ firms, and therefore also their production costs. Suppose for a minute that those are constant. A rise in market potential is therefore beneficial to firms located in $i$, and attracts firms there, raising $s_i^Q$. This is the mechanism behind the home market effect, as detailed in Head and Mayer (2006). On the contrary, suppose that the country's share of production is left unchanged. The rise in market potential will have to be entirely absorbed through a decrease in $A_i$, that is an increase in prices, and therefore wages practised in $i$. This is the source of the wage equation, which therefore should hold for this class of model when the production structure across countries exhibits some rigidity, which is the case in Dixit-Stiglitz, and in Anderson van Wincoop (2003) notably. In practice, both effects can naturally enter into play, their respective size depending on how rigid are the mobility of factors and wages respectively. In what follows, I develop the wage equation part of this fundamental relationship, and show that it is quite successful empirically, as in the existing literature.

The precise derivation of an estimable wage equation involves to specify two things more precisely: $A_i$ and $s_i^Q$. In some models, and in particular in Dixit-Stiglitz-Krugman, $s_i^Q$ is in fact a constant. Indeed in this model, all firms are symmetric and the zero profit condition imposes a uniform firm-level production of $q^*$. The exporter's capabilities being $A_i = N_i p_i^{1-\sigma}$, we obtain

$$p_i^{1-\sigma} = \frac{N_i p_i q^*}{N_i Q} (\Phi_i^*)^{-1} \qquad \Rightarrow \qquad p_i = \kappa_1 (\Phi_i^*)^{1/\sigma}, \tag{7}$$

where $\kappa_1 = \left(\frac{q^*}{Q}\right)^{1/\sigma}$ is a constant. This equation means that firms in $i$ faced with a good access to world markets (a high $\Phi_i^*$) can increase their price accordingly.[1] To simplify suppose that the production process in $i$ involves an immobile composite factor, labor with share $\beta$, price $w_i$ and productivity $z_i$. Other factors of production (with share $\alpha$ are supposed to have a constant price over countries, $r$. Since producer prices in the DSK model are a simple markup over marginal costs, $p_i = \frac{\sigma}{\sigma-1}\frac{r^\alpha w_i^\beta}{z_i}$, we obtain the wage equation:

$$w_i = \kappa_2 \times z_i^{1/\beta} \times (\Phi_i^*)^{1/(\beta\sigma)}, \tag{8}$$

where $\kappa_2 = \left(\frac{\sigma-1}{\sigma r^\alpha}\kappa_1\right)^{1/\beta}$ is again a constant. Wages in $i$ will be a positive function of the productivity of workers there ($z_i$) and market potential of the country ($\Phi_i^*$). In the empirical part of the paper, I will consider that productivity of an economy $i$ is a positive function of the average years of schooling of its working age population. The empirical counterpart of $\Phi_i^*$ is more complex and deserves its own subsection.

## 2.2 Market Potential computation

In the Dixit-Stiglitz model of trade, the set of alternatives to consumers in $h$, $\Phi_h$ is inversely related to the CES price index of accessing all varieties from this country $1/\Phi_h = P_h^{1-\sigma}$. Market potential can be re-expressed as

$$\Phi_i^* = 1/Q \times \sum_h \phi_{ih} X_h P_h^{1-\sigma}, \tag{9}$$

and bilateral trade as

$$X_{ij} = A_i \phi_{ij} X_j / \Phi_j = N_i p_i^{1-\sigma} \phi_{ij} X_j P_j^{1-\sigma}, \tag{10}$$

This equation can be estimated using a bilateral trade dataset, taking logs, specifying a vector if trade costs composing $\ln \phi_{ij}$ and absorbing $\ln(N_i p_i^{1-\sigma})$ as a fixed effect for the exporter country ($\text{FE}_i$) and $\ln(X_j P_j^{1-\sigma})$ as a fixed effect for the importer country ($\text{FE}_j$). The market potential can therefore be re-constructed as

$$\widehat{\Phi_i^*} Q = \sum_h \widehat{\phi_{ih}} \exp(\widehat{\text{FE}_j}). \tag{11}$$

[1] In fact, firms in this model must increase their price if the zero profit condition is to be satisfied, since such an increase reduces the demand they face.

The second stage wage equation in logs becomes then

$$\ln w_i = \kappa_3 + \frac{1}{\beta} \ln z_i + \frac{1}{\beta\sigma} \ln \mathrm{RMP}_i, \tag{12}$$

where $\mathrm{RMP}_i \equiv \widehat{\Phi_i^*}$, and the constant is now $\kappa_3 = \ln \kappa_2 + \frac{1}{\sigma} \ln Q$.

As in Redding and Venables (2004), I consider income per capita to be a natural proxy for the price of immobile factors in $i$, $w_i$. The real market potential RMP is therefore an element explaining income per capita of the country. An empirical issue with RMP is that it contains own income $X_i$, causing evident endogeneity issue. This problem is all the more important that local trade costs are lower than international trade costs, a well documented fact, known as the border effect, which I will estimate below. A solution that has been proposed by the literature is to calculate a

$$\mathrm{FMP}_i \equiv \sum_{h \neq i} \widehat{\phi_{ih}} \exp(\widehat{\mathrm{FE}_j}),$$

which does not include own demand of the country. This alleviates the endogeneity problem although it does not constitute an ideal solution as will be clear below.

# 3 Data

The needed data for the empirical exercise is fairly standard. The first stage is a fixed effect gravity equation that require bilateral trade flows over a long time period, obtained from IMF DOTS, and a vector of trade impediments, obtained from CEPII.[2] The second stage involves factor incomes on the left hand side, and productivity on the right hand side, combined with the first stage market potential estimate. Following Redding and Venables, I consider income per capita of the country to be a good measure of immobile factor incomes.[3] Skill measures come from Barro and Lee.

I will present below RMP estimated from two different methods. They differ in one dimension which is how the effect of national borders is considered. More precisely, in $\mathrm{RMP}_i = \sum_h \widehat{\phi_{ih}} \exp(\widehat{\mathrm{FE}_j})$, there is an issue about the measurement of $\phi_{ii}$. In addition to having shorter distance, self-trade has a preferential dimension, that has been widely documented in the border effect literature (see Anderson and van Wincoop, 2004 for a survey of the evidence). Redding and Venables (2004) deal with this by an adjustment on the distance coefficient, which they divide by two for self-trade in their preferred specification. Head and Mayer (2004) adopt a different approach by estimating those border effects in the first step. This method involves measuring self trade for all countries in the world over the period. At the industry level, this is fairly easy, one just has to take global production of an industry, and retrieve total exports to obtain "exports" to

[2] `http://www.cepii.fr/anglaisgraph/bdd/distances.htm`

[3] It is possible to go into deeper industry level detail, where the LHS variable becomes average wage in the industry. Head and Mayer (2006) do this for a European sample, Paillacar (2008) provide data and analysis for a much larger sample of countries and years.

self. For aggregate trade, this is a little bit more subtle, since one needs to retrieve total exports from the value of production that is actually tradable in the country. I follow Wei (1996) initial method here and consider the non-service part of the country's GDP to be its tradable part. In what follows, the two methods will be referred to as RV04 and HM04 respectively.

# 4 Gravity results

The first step estimates a gravity-type relationship where bilateral trade is regressed each year on a set of importer and exporter dummies and on a vector of trade impediments that is larger than the one used by Redding and Venables (2004), who focus on distance and contiguity only. The components of $\phi_{ij}$ include distance and contiguity, but also common language, colonial links, dummies for common membership of a regional trade agreement (RTA), a currency union (CU) or GATT/ WTO. Summarizing results from the HM04 method estimation, including border effects, the average fit is .73, with an average number of observations around 13000. The average coefficients on trade costs are very much in line with existing findings. The coefficients for distance is very close to -1 and common language, RTA and GATT membership have comparable mean effects around .4.

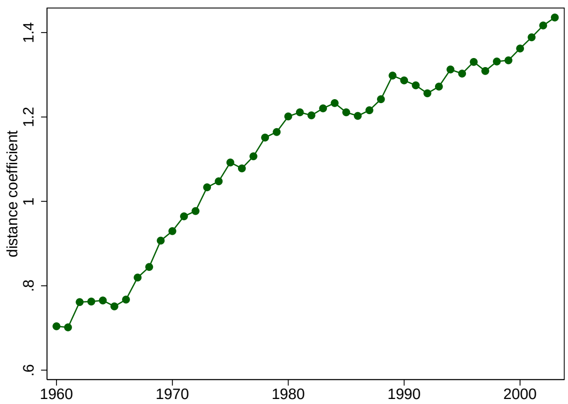
I present figures of the resulting coefficients over time. The most interesting and puzzling result is the increasing coefficient of distance on trade flows over time in panel (a) of figure 1. This trend is not isolated in the literature. Disdier and Head (2008) report such an evolution in their meta-analysis of distance coefficients in gravity equations. In what is perhaps the most comparable set of results in terms of estimation method, Redding and Schott (2003) show in their Table 1, that the coefficient on distance starts at -1.18 in 1970 and rises gradually to end at -1.49 in 1995 (they only include contiguity in the regression as a control for trade costs, which might explain the slightly lower impact of distance in their case in all years).[4]

Panel (b) of figure 1 shows a more expected result, namely that the impact of national borders decreases over time. Note however that the estimated negative impact of crossing a national border on trade flows remains considerable in 2003, with a dividing factor around 50. This figure naturally aggregates very different situations, and is probably driven by developing countries that are usually estimated to have much larger border effects. Figure 2 present the schedule of estimated coefficients for colonial linkages and common RTA membership across time. The preferential trading relationship between ex-colonies and their ex-hegemon has a striking downward trend. While the effect remains strongly positive in the early 2000s, the relative deterioration of historical preferences is extremely clear, and should have important consequences for the market potential of

[4]This puzzling increase in the impact of distance might be due to several statistical artifacts. For instance, increased regionalism combined with the end of colonialism in this period. I do however control for those two factors here. Also the increase in the number of trade partners in the database, mostly from small and remote countries might cause this trend. I restricted the sample to the set of country pairs with positive trade for at least 25 years and obtained very similar results.

Figure 1: The effects of distance and national borders on trade

(a) distance




(b) national borders

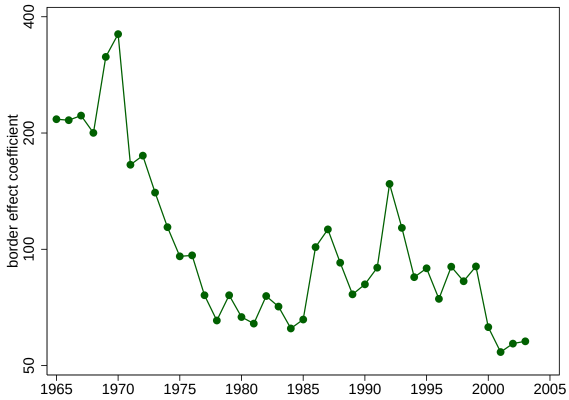
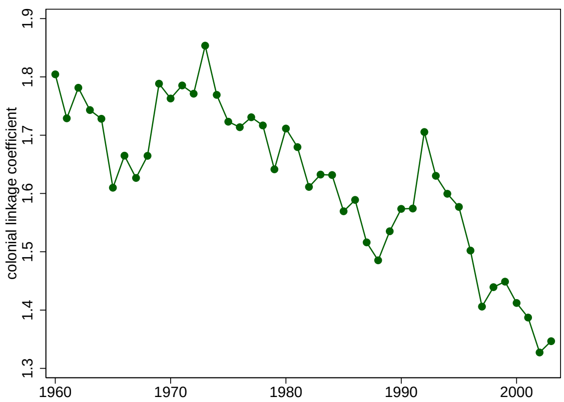
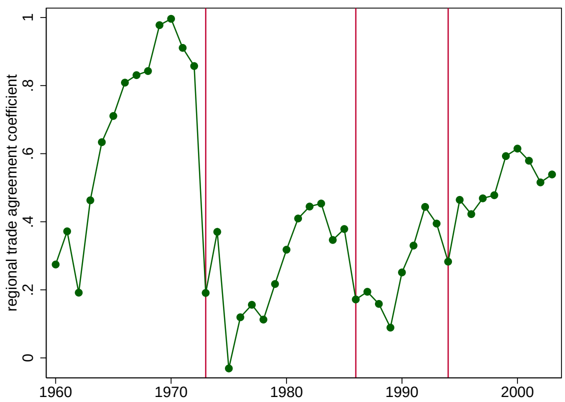



Figure 2: The effects of colonial linkages and regional agreements on trade

(a) ex-colonies




(b) RTAs



the ex-colonies, which are usually small markets located near to other small markets. I will return to that point in the next section. The evolution of the RTA coefficient seems to be strongly influenced by changes in the composition of the main agreements. The effect drops massively around 1973 and 1986 which are dates of significant entries into the European Community (UK, Ireland and Denmark in the first case, Spain and Portugal in the second). Entries of countries into an RTA tends to initially lower the statistical estimate of its effect quite naturally. The effect is also present in 1994, when Mexico adds to the already free trade area between the USA and Canada to form NAFTA.

# 5 Market potential results

## 5.1 Graphical representation

The above summarized gravity equations enable a computation of market potential indices, $\text{RMP}_i$ and $\text{FMP}_i$, along the lines described in section 2.2, for all countries with available trade data over the 1960-2003 period. This will allow to replicate and much further understand the income per capita / market potential relationship uncovered by Redding and Venables (2004). I start by replicating one of their most interesting figure, in which GDP per capita in $i$ is graphed against $\text{RMP}_i$ and $\text{FMP}_i$. I express both in relative terms to the USA in 2003, in order to ease the reading of the axes on figure 3. The existence of a tight relationship between market potential and income per capita is quite clear. Larger and /or more centrally located countries are much richer than countries characterized by a small local market and few or also small neighbors. The case of Belgium and Netherlands is of course very interesting: with the exception of Hong-Kong and Singapour[5], Belgium and the Netherlands are the two top market potential countries in terms of RMP. Looking at panel (b) shows that this comes in great part from their advantageous location, as for Switzerland. Opposed to the case of those countries are the United States and Japan. Both are among the top RMP economies, but that comes almost entirely from their internal demand, since in terms of FMP, panel (b) shows a quite weak position. China and Thailand are similar cases for the developing world. Both have a quite high RMP (which should warrant higher average wages, according to panel a) but a fairly average FMP.

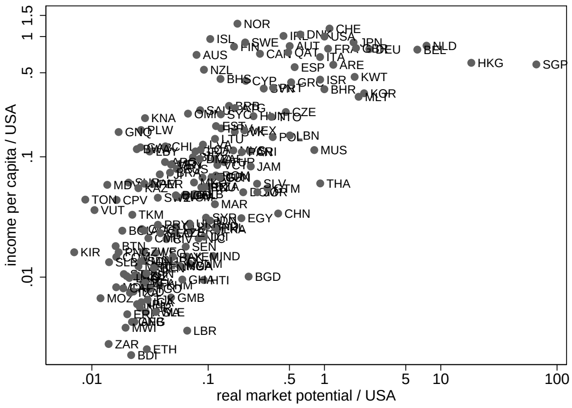
Moving away from cross-section, one can exploit the new dimension of my market potential estimates to evaluate whether this tight relationship has had some persistence over time. Figure 4 confirms that this is the case. In 1970, a year where the United States were still the richest economy in the world, or in 1985 for instance, the statistical association of GDP per capita with RMP is obvious.

I continue the illustration with maps. The preceding graphs show an interesting correlation between RMP and income, but makes it hard to detect what is core in the concept

[5]As can be seen from comparing both panels of figure 3, the very high RMP of Hong-Kong and Singapour comes mostly from the internal part. This comes from the fact that a fairly large expenditure is located in both cases on an extremely small territory. The precise internal distance assumed plays a role in such special cases.

Figure 3: Market Potential and development in 2003

(a) Real Market Potential




(b) Foreign Market Potential

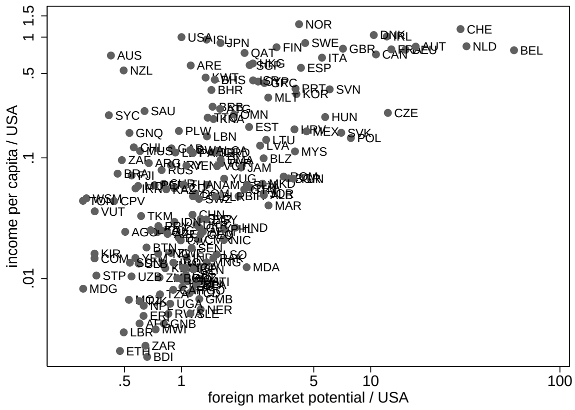
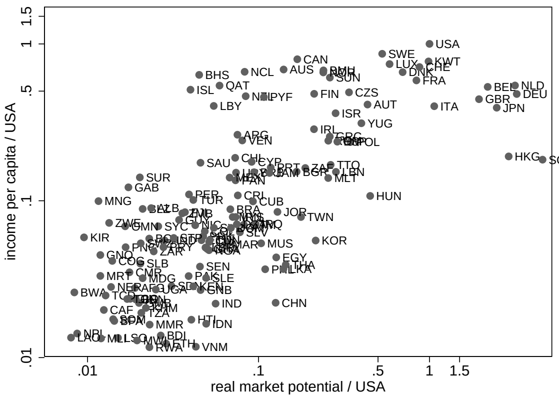
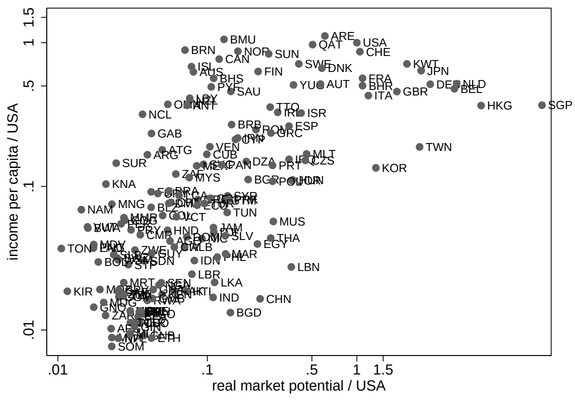



Figure 4: Market Potential and development over time

(a) RMP 1970




(b) RMP 1985



of market potential, the spatial correlation of the forces behind economic development. Indeed, the theory of market potential tells us that being near large markets makes a country richer, and therefore itself a large market. This suggests that in equilibrium, "spatial clubs" of development will form. It will be very hard for a country surrounded by a small and poor economies to reach a high level of income per capita, and inversely, the proximity of large and wealthy countries is a strong advantage in this economic geography world. The maps contained in figures 5 and 6 represent the levels of RMP and FMP in each country in the world, expressed again relative to the United States in 2003. Those are still based on the HM04 methodology. Those figures indeed show evidence of spatial correlation in RMP and even more in FMP. Western Europe, North America and to a lesser extent East Asia are places were the spatial proximity of high GDP countries fuels each other's market potential and therefore income. The case of the United States and its immediate neighbors is illustrative of the problems raised by FMP. While the RMP figure in 2003 predicts the USA to have a much higher income per capita than Canada and Mexico, the reverse is true for FMP. One can also see in the FMP map the extent to which high demand zones exert a positive influence on their neighbors. The "pull-factor" of Western Europe is particularly visible in Eastern Europe and Northern Africa, while central America is clearly benefiting from being close to NAFTA countries in terms of FMP.

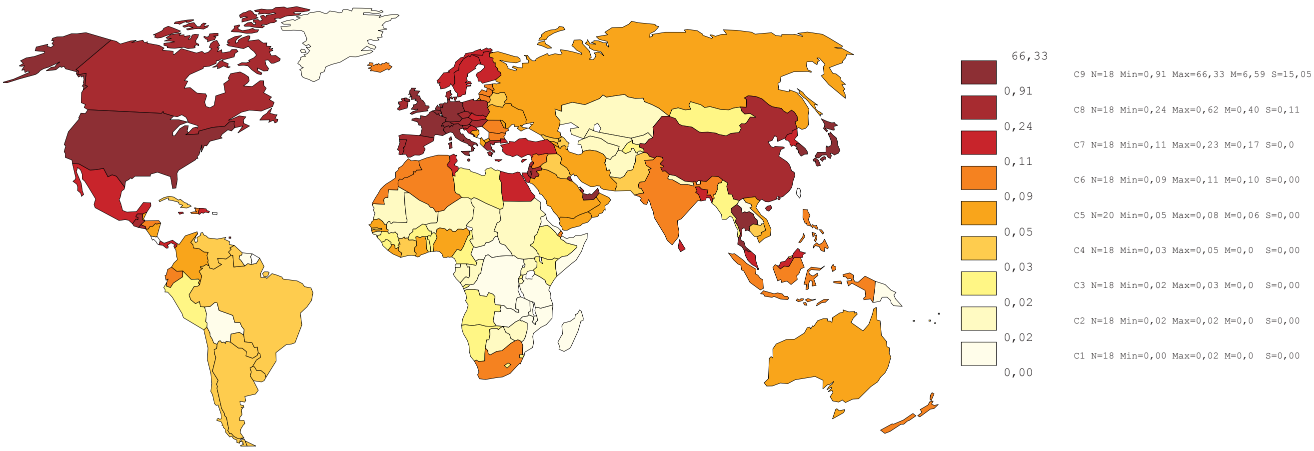



Figure 5: RMP 2003

Figures 7 and 8 are probably the most illustrative of the market potential forces at work over time. Those two figures present maps of the evolution of market potential over time for each country in the world. The precise figure represented is the change in terms of ranks (gained or lost) in the market potential hierarchy, relative to the United States. Both figures, and in particular the Foreign Market Potential one makes very apparent the existence of market potential clubs of countries geographically proximate and having similar rates of high or low income growth that fuel each other market potential, and therefore income growth. East Asian countries are characterized by a very fast growing

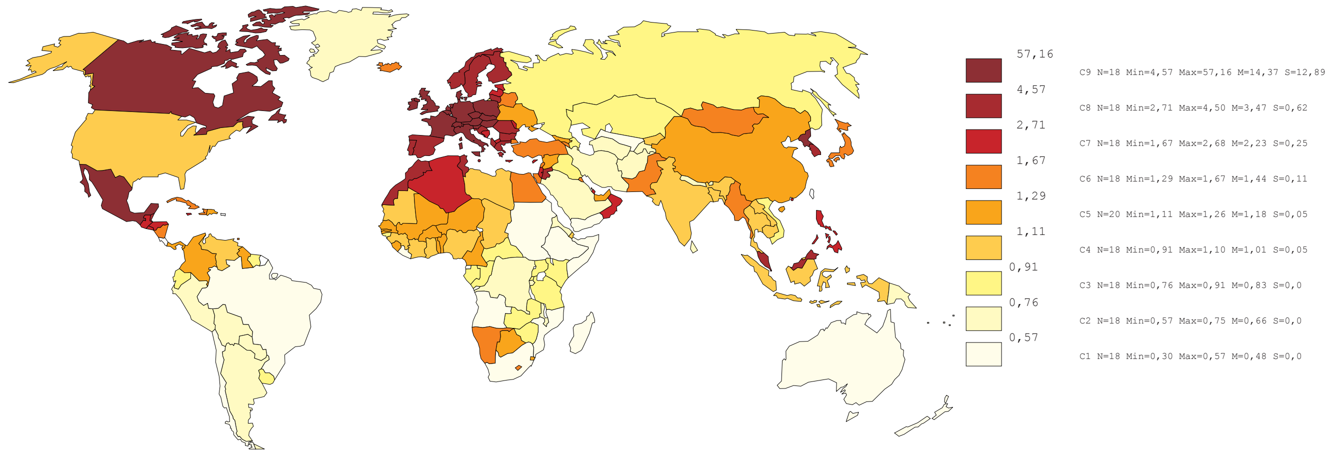



Figure 6: FMP 2003

market potential during the period, while most if not all African countries are faced with neighbors receding in the worldwide hierarchy of market potential, which dampens their possibilities of economic expansion. In Latin and South America, there seem to be a clear gradient, where proximity to the Northern part of the continent helps the growth of market potential. Note also that Eastern Europe suffers from a low growth of the overall market potential during this period, despite a high growth of their FMP, driven by increased access to Western European markets. Particularly striking is the strong performance of three emerging countries over that period in terms of RMP: Mexico, Turkey and Malaysia. The performance of Turkey is particularly remarkable since figure 8 reveals that its FMP, that is the dynamism of its neighbors, actually decreased during that period. On the contrary, Mexico and Malaysia benefited largely from a very dynamic geographic environment.

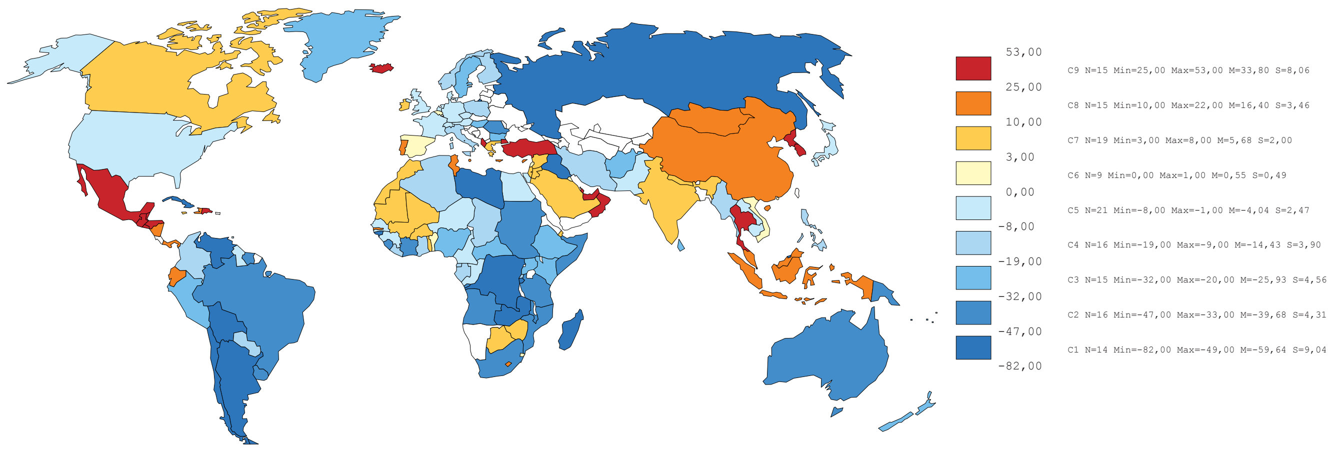



Figure 7: RMP rank evolution 1970-2003

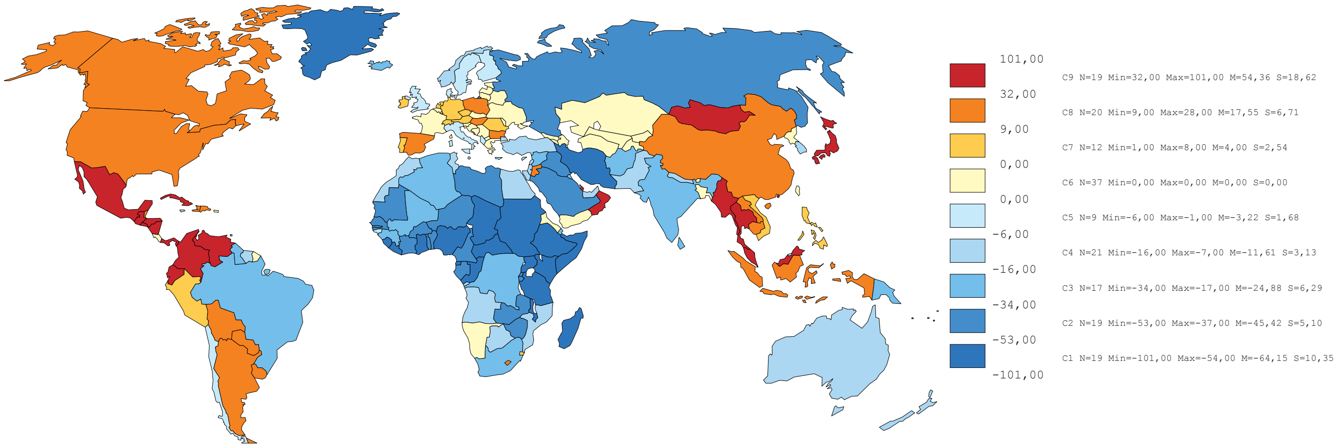



Figure 8: FMP rank evolution 1970-2003

## 5.2 Baseline results

As stated above, I have several specifications of the RMP variable: one that follows the Redding and Venables (2004) approach to internal trade, which simply divides the distance coefficient by half for internal trade. The other following Head and Mayer (2004), who estimate instead border effects in the gravity equation, that is the privileged access of producers to their own market from the data, rather than assuming a functional form of distance on it. In order to provide comparison with existing results, I start with the RV04 specification in Table 1. Column (1) mimics RV04, providing results for a cross section of 182 countries in 1995 (they use 101 countries in 1996, but the skills data I use later is only available every five year, including 1995). The coefficient is .58, slightly larger than the .395 they obtain. I interpret the difference, as well as the respectable but lower fit of .445, as the consequence of the much larger sample of countries used. Column (2) pools over the whole set of years available for our countries, and column (3) presents results with country fixed effects, which are to our knowledge the first *within estimates* of this type of equation. The within results are particularly interesting. Market potential can potentially be correlated with a vast number of other variables relevant to the level and growth of income per capita. This is the rationale behind Table 2 of Redding and Venables (2004), that includes a large number of controls draw from the development literature. Those include primary resource endowments, other features of physical geography, but also measures of property rights protection, and a dummy if the country was under socialist rule between 1960 and 1985. Most of those controls offer variance that is mostly or exclusively cross-sectional. The use of panel data with country fixed effects permits to control for those and all other factors constant over time, that can affect the level of income per capita. As expected, the coefficients on market potential drops but stays very significant and within a range comparable to the literature on this type of estimates.

The last three columns report coefficients using foreign market potential only. Recall that this is a way to alleviate the endogeneity problem, but not a perfect one. Theory requires own market size to affect the level of factors' income of a country, since those sales to domestic consumers often represent a large part of overall sales. Coefficients are somehow surprisingly larger than for the complete market potential, and the fit is lower (more expectedly). Note that this is also the case in Redding and Venables (2004). Once again, the use of panel data reduces the estimated impact of market potential, but leaves it strongly positive and significant.

Table 1: Market Potential and GDP/cap RV method

| | Dependent Variable: ln GDP/cap | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| ln RMP (RV04) | $0.58^a$ | $0.56^a$ | $0.47^a$ | | | |
| | (0.05) | (0.04) | (0.01) | | | |
| ln FMP (RV04) | | | | $0.88^a$ | $0.88^a$ | $0.57^a$ |
| | | | | (0.11) | (0.10) | (0.02) |
| Time Frame | 1995 | 1960-2003 | 1960-2003 | 1995 | 1960-2003 | 1960-2003 |
| Country FE | No | No | Yes | No | No | Yes |
| Observations | 180 | 6761 | 6761 | 180 | 6761 | 6761 |
| $R^2$ | 0.445 | 0.539 | 0.791 | 0.280 | 0.347 | 0.753 |

Note: Standard errors in parentheses. Levels of statistical significance are signaled by *a* (1%), *b* (5%), and *c* (10%). Robust standard errors clustered by country in columns (2), (3), (5) and (6). Those columns also include a full set of year dummies. Within $R^2$ reported in columns (3) and (6).

The RV04 results are therefore robust to panel data estimation, which is the first important and comforting finding of this paper. The impact of economic geography (market access) on income per capita is not driven by some fixed omitted variable in the cross-sectional regression. The within impact is smaller than in the cross-sectional one, as expected but remains economically large in magnitude. Pushing further the inspection of the impact of market potential, one can naturally be worried that some *time varying factor* might be omitted from the regression. The first such factor of concern is of course the evolution of average skills in the population. Theory and dozens of empirical paper tells us that education should enter this equation, and might possibly have a relationship with market potential, for instance if the incentives to accumulate human capital are larger in large/central markets. Note that the original Redding and Venables (2004) paper did not control for skills, although another paper co-authored by Steve Redding shows that indeed the level of skills in a country is related to its market access (Redding and Schott, 2003). More recently, some papers have included education levels as controls: Head and Mayer (2006) on a regional level basis, Fally et al. (2008) and Hering and Poncet (forthcoming) at the individual level for Brazilian and Chinese workers respectively.[6]

[6]Duranton and Monastiriotis (2002) for the UK, Combes, Duranton and Gobillon (2008) for France,

Table 2 includes the Barro and Lee measure of average years of schooling among the more than 25 years old in the population of the country. The cross-sectional and pooled results of market potential in columns 1, 2, 4 and 5 are lowered as expected. The preferred within specification however maintains a very significant and high coefficient on both the complete and foreign measures of market potential.

Table 2: Market Potential and GDP/cap RV method - with skills control

| | Dependent Variable: ln GDP/cap | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Average years of schooling | $0.38^a$ | $0.28^a$ | 0.03 | $0.42^a$ | $0.36^a$ | $0.12^a$ |
| | (0.04) | (0.03) | (0.03) | (0.03) | (0.02) | (0.03) |
| ln RMP (RV04) | $0.28^a$ | $0.31^a$ | $0.50^a$ | | | |
| | (0.06) | (0.05) | (0.03) | | | |
| ln FMP (RV04) | | | | $0.42^a$ | $0.39^a$ | $0.60^a$ |
| | | | | (0.09) | (0.06) | (0.06) |
| Time Frame | 1995 | 1960-2003 | 1960-2003 | 1995 | 1960-2003 | 1960-2003 |
| Country FE | No | No | Yes | No | No | Yes |
| Observations | 108 | 937 | 937 | 108 | 937 | 937 |
| $R^2$ | 0.779 | 0.788 | 0.839 | 0.774 | 0.759 | 0.816 |

Note: Standard errors in parentheses. Levels of statistical significance are signaled by *a* (1%), *b* (5%), and *c* (10%). Robust standard errors clustered by country in columns (2), (3), (5) and (6). Those columns also include a full set of year dummies. Within $R^2$ reported in columns (3) and (6).

Tables 3 and 4 replicate the regressions of Tables 1 and 2, with the HM04 method of estimating market potential, which introduces border effects directly, rather than through a differential effect of internal distance. Results are very comparable, with a slightly better fit in general, and larger coefficients for market potential variables. Note also the very high coefficients on the skills variable in the non-within specifications. The lower values obtained when using the country fixed effects reinforce the attractiveness of those specifications: the estimates averaging around .10 are now more comparable to what has been found in the above quoted literature (Head and Mayer, 2006, Fally et al., 2008, and Hering and Poncet, forthcoming).

In the following, I stick to the HM04 methodology, including the Barro-Lee control for skills in the country, which is the specification that seem to yield the most interesting results. It is interesting to quantify a little bit more precisely those results, going further than statistical significance. Consider the following experiment: In 2003, take a country with a low RMP, say the Congo Democratic Republic, and one with a large RMP, say Thailand, which in 2003 has an RMP 66 times larger than CDR. Using the 0.37 estimate of column (2) in Table 4, raising the RMP of CDR to the one of Thailand is predicted

and Mion and Naticchioni (2005) for Italy, had all already shown (in specifications less grounded in economic geography theory) that geographic wage differentials are largely influenced by skill differences.

Table 3: Market Potential and GDP/cap HM method

| | Dependent Variable: ln GDP/cap | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| ln RMP (HM04) | $0.80^a$ | $0.70^a$ | $0.59^a$ | | | |
| | (0.06) | (0.05) | (0.02) | | | |
| ln FMP (HM04) | | | | $0.88^a$ | $0.88^a$ | $0.58^a$ |
| | | | | (0.11) | (0.10) | (0.02) |
| Time Frame | 1995 | 1960-2003 | 1960-2003 | 1995 | 1960-2003 | 1960-2003 |
| Country FE | No | No | Yes | No | No | Yes |
| Observations | 180 | 6245 | 6245 | 180 | 6245 | 6245 |
| $R^2$ | 0.521 | 0.547 | 0.748 | 0.280 | 0.318 | 0.711 |

Note: Standard errors in parentheses. Levels of statistical significance are signaled by *a* (1%), *b* (5%), and *c* (10%). Robust standard errors clustered by country in columns (2), (3), (5) and (6). Those columns also include a full set of year dummies. Within $R^2$ reported in columns (3) and (6).

Table 4: Market Potential and GDP/cap HM method - with skills control

| | Dependent Variable: ln GDP/cap | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Average years of schooling | $0.37^a$ | $0.29^a$ | $0.08^b$ | $0.42^a$ | $0.36^a$ | $0.12^a$ |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.02) | (0.03) |
| ln RMP (HM04) | $0.41^a$ | $0.37^a$ | $0.55^a$ | | | |
| | (0.06) | (0.05) | (0.04) | | | |
| ln FMP (HM04) | | | | $0.42^a$ | $0.39^a$ | $0.65^a$ |
| | | | | (0.09) | (0.06) | (0.06) |
| Time Frame | 1995 | 1960-2003 | 1960-2003 | 1995 | 1960-2003 | 1960-2003 |
| Country FE | No | No | Yes | No | No | Yes |
| Observations | 108 | 866 | 866 | 108 | 866 | 866 |
| $R^2$ | 0.809 | 0.791 | 0.804 | 0.773 | 0.747 | 0.792 |

Note: Standard errors in parentheses. Levels of statistical significance are signaled by *a* (1%), *b* (5%), and *c* (10%). Robust standard errors clustered by country in columns (2), (3), (5) and (6). Those columns also include a full set of year dummies. Within $R^2$ reported in columns (3) and (6).

to increase its GDP per capita by a factor of around 24, while the real ratio in 2003 is around 22. Part of this increase is in fact tautological since own GDP enters RMP as stated above. Another interesting experiment is to raise FMP of a country, which does not include own GDP. Still in 2003, I observe Brazil to be in the tenth percentile of the lowest FMP countries, while Mexico is ranked 18th in terms of FMP, among the top ten percent countries. Using column (5) estimate, the model predicts that based on a 900% difference in FMP, Mexico should have a GDP per capita around five times higher than Brazil, the real factor being 2.24. Last, one wants to evaluate the size of the market potential impact based on within variance alone. Over the last ten years of our sample (1993-2003) the average growth of RMP is 111%, and the corresponding figure for FMP is 161%. Using estimates from columns (3) and (6), this corresponds to a predicted income per capita growth of 61% and 105% respectively. In addition to the very strong fit of the model, and the very high precision of market potential coefficients, the economic magnitude implied by the estimates is therefore quite large.

### 5.3 Instrumented results

As stated above, substituting FMP to RMP helps to solve partially the endogeneity problem, since own income does not appear any more in the explanation of income per capita. However, it is a significant departure from the theory. Returning to maps helps clarify the point. Comparing figures 5 and 6, some striking differences appear. One of them is for the United States. While the United States has a much larger RMP than Canada and Mexico, it has a much lower FMP than both. If foreign demand was the only driver of factor incomes in the NEG model, Canada and Mexico should both be richer than the USA. On the contrary, the NEG model predicts that the United States should be richer than its two neighbors precisely because it has a large internal demand that makes it a more profitable location for firms. The same paradox of FMP is very clearly appearing for Brazil. Hence FMP has nice features, but is clearly not ideal as an instrument for RMP. What is preferable is an instrument that does not use the income information altogether, but keeps the measures of trade costs, including trade costs to self. We look for an exogenous source of variance of RMP that would come from trade costs, in the cross-section and if possible in the time dimension as well. Geographic centrality of $i$ ($\sum_j d_{ij}^{-1}$) is a good candidate that has been used in the literature, but that does not vary over time. A related instrument that does vary over time is $\sum_j \phi_{ijt}$, that is the complete measure of trade costs, including RTAs, currency unions... which vary in membership. Note also that my first-step gravity regression estimates trade costs coefficients (on distance, common language...) for each year. This is another source of variance of the $\phi_{ijt}$ over time that can be exploited. Table 5 reports results. The first stage F-test shows that the two proposed instruments are quite powerful determinants of RMP either in the cross-section or in the temporal dimensions. Column (4) is the most demanding, instrumenting while including the full sets of country and year dummies. The first stage regression exhibits an unreported coefficient of .77 on $\sum_j \phi_{ijt}$ explaining RMP in the pure within dimension, with a t-stat of nearly 13. The second stage result show both a very significant effect of RMP, and a more reasonable coefficient of schooling near .10. Combined with the set of results on FMP, this instrumentation strategy leaves me quite confident that endogeneity, while a potentially serious issue in this type of regression, is not seriously biasing results here.

Table 5: Market Potential and GDP/cap HM method - with skills control and IV

| | Dependent Variable: ln GDP/cap | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| ln RMP (HM04) | $0.40^a$ | $0.40^a$ | $0.30^b$ | $0.35^a$ |
| | (0.12) | (0.10) | (0.12) | (0.10) |
| Average years of schooling | $0.37^a$ | $0.28^a$ | $0.31^a$ | $0.10^a$ |
| | (0.05) | (0.03) | (0.04) | (0.03) |
| Time Frame | 1995 | 1960-2003 | 1960-2003 | 1960-2003 |
| Country FE | No | No | No | Yes |
| IV | $\sum_j d_{ij}^{-1}$ | $\sum_j d_{ij}^{-1}$ | $\sum_j \phi_{ijt}$ | $\sum_j \phi_{ijt}$ |
| First stage F | 31.83 | 23.21 | 12.65 | 127.59 |
| Observations | 108 | 866 | 866 | 855 |
| $R^2$ | 0.809 | 0.791 | 0.789 | 0.797 |

Note: Standard errors in parentheses. Levels of statistical significance are signaled by $a$ (1%), $b$ (5%), and $c$ (10%). Robust standard errors clustered by country in columns (2), (3) and (4). Those columns also include a full set of year dummies. Within $R^2$ reported in columns (4).

## 5.4 Simulated policy changes

An application of the wage equation that has not been used before is to evaluate what would be the market potential effect and therefore the impact on wage / income per capita in the country of a trade policy change. For instance, if a country enters a regional trading arrangement (RTA), its access to demand from other members of the RTA improves, which raises its RMP. the wage equation theoretical framework tells us that this should impact the average wage of the country. By how much depends on a certain number of things: The size and locations of the other members of the RTA (which will determine the RMP boost), and the elasticity of wages to RMP. Theory (equation 12) tells us that this elasticity is $\sigma\beta$, the product of the constant elasticity of substitution and of the share of labor in the production function. Let us take reasonable values for those two parameters such that $\sigma = 5$ and $\beta = 0.2$. Then I run the following experiment: Suppose that in 2003, all RTAs in the world were ended, everything else staying unchanged. What would be the predicted loss of wage / income per capita predicted by the economic geography model? I do the experiment for both RTAs and the WTO and report results for the 50 biggest drops in Table 6. This table reports wage fall in percent of the benchmark wage estimated from the market potential graphed in figure 3. In 2003, the first stage gravity equation reveals that the average RTA raises bilateral trade by $\exp(0.538) - 1 = 71\%$ and that two members of the GATT/WTO have their bilateral trade increased by $\exp(0.592) - 1 = 80\%$. The global effect then depends naturally on the size and locations of your partners in those agreements.

In a world with no RTA, the countries that would be notably poorer are a group of mostly small but relatively rich economies. The small EU countries would notably lose (Ireland has a predicted loss of 20%), but also Canada and Mexico. The low income countries would not in fact lose a lot in terms of market potential, since the RTAs involving them do not count large and/or rich economies among them, Mali for instance is predicted to lose only 1.7 % of its wage level. The picture is radically changed however if the no-WTO world is considered. The most important losses in this case are for the poorest economies in the world, that we have seen have a very low "local" RMP, and depend very much on demand from far away larger markets of WTO members. For instance, the Malian loss would now be 36%. South-South RTAs might be important for other reasons (for instance because of their pacifying effects, see Martin et al. 2008), but in terms of the market potential sources of income per capita differentials, multilateral trade liberalization seems to be much more important. Those simulations should naturally be taken with great caution. The everything-else-equal assumption of the thought experiment might be more reasonable for some countries than for others, and the results are of course sensitive to the assumed value of $\sigma\beta$ and to estimates of trade effects of RTAs and the WTO.

# 6 Conclusion

This paper provides evidence that access to markets, measured here as a theory-based index of market potential is an important factor in development. I generalize the theoretical and empirical finding of Redding and Venables (2004) in many directions, and find very robust evidence that the economic geography of countries matter greatly in their income per capita trajectory. To illustrate, my results show that in 2003, bringing the market potential of the Congo Democratic Republic to the one of Thailand is predicted to increase its GDP per capita by a factor of around 24. The average growth of market potential due to neighbor countries between 1993 and 2003 in our sample is estimated to have raised income per capita by around 105%.

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Table 6: Wage loss predicted from RTA or WTO absence

| World with no RTA | | World with no WTO | |
|---|---|---|---|
| Country | % wage fall | Country | % wage fall |
| SVK | 30.521 | KNA | 43.867 |
| CAN | 29.48 | NAM | 40.936 |
| AUT | 26.572 | NER | 40.246 |
| BGR | 22.272 | CAF | 40.229 |
| CHE | 21.251 | MNG | 40.022 |
| IRL | 20.555 | TCD | 39.699 |
| CZE | 20.341 | MMR | 39.274 |
| ROM | 20.201 | BWA | 38.68 |
| MEX | 16.997 | ZAR | 38.276 |
| HUN | 16.94 | PNG | 37.565 |
| NOR | 16.488 | MOZ | 36.971 |
| MYS | 16.35 | LSO | 36.895 |
| POL | 16.312 | MDV | 35.868 |
| SWE | 15.425 | MLI | 35.759 |
| DNK | 12.768 | SLB | 35.697 |
| FIN | 12.531 | BFA | 35.003 |
| BOL | 11.784 | SVK | 34.98 |
| FRA | 9.136 | BOL | 34.708 |
| URY | 8.394 | MRT | 33.699 |
| PRT | 7.844 | CMR | 33.504 |
| PRY | 7.41 | SUR | 32.971 |
| BEL | 7.211 | CAN | 32.796 |
| HND | 6.535 | ZMB | 32.179 |
| NIC | 6.087 | BLZ | 31.363 |
| ARG | 5.605 | MWI | 31.226 |
| ESP | 5.511 | TGO | 30.687 |
| DEU | 4.875 | GNB | 30.56 |
| ITA | 4.386 | MDA | 30.209 |
| IDN | 3.728 | KGZ | 30.158 |
| CHL | 3.613 | TZA | 30.025 |
| VNM | 3.463 | GIN | 29.736 |
| SLV | 3.447 | ALB | 29.47 |
| VEN | 3.414 | AUT | 29.439 |
| NLD | 3.35 | MKD | 29.185 |
| GRC | 3.194 | BGR | 28.758 |
| COL | 3.15 | CUB | 28.518 |
| PER | 3.005 | SWZ | 28.494 |
| GBR | 2.671 | BEN | 28.443 |
| GTM | 2.537 | GAB | 28.069 |
| ZMB | 2.259 | UGA | 26.918 |
| GAB | 2.128 | ZWE | 26.337 |
| PHL | 1.94 | SLE | 25.458 |
| MWI | 1.814 | TUN | 25.415 |
| ECU | 1.732 | HRV | 25.316 |
| MLI | 1.713 | BDI | 24.893 |
| MRT | 1.657 | GEO | 24.888 |
| BFA | 1.612 | ROM | 24.672 |
| SVN | 1.359 | PAK | 24.319 |
| SDN | 1.244 | RWA | 24.262 |
| CRI | 1.16 | COG | 24.228 |

Note: The table reports predicted wage falls if all RTAs (column 2) or WTO (column 4) were to be abandoned. The simulation supposes $\sigma = 5$ and $\beta = 0.2$ in equation (12).

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