# Geography, Income, and Trade when Income Inequality Matters

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**ABSTRACT:** We investigate the relationship between trade costs, the location of economic activity and global income inequality between 1996 and 2011. Specifically we apply the aggregate AIDS-based gravity model as developed in Fajgelbaum and Khandelwal (2016) to a panel of 38 countries to generate a new measure of *market potential*. We then relate this measure of market potential to country level GDP per capita and find a significant relationship. As a determinant of GDP per capita, this measure performs as well, if not better than, CES-based measures. The AIDS model allows for non-homotheticities in demand allowing for the possibility that nations produce different types and qualities of goods and that income inequality and GDP per capita matter for the direction of trade. These forces also matter for market access, unlike CES-based market potential measures which are typically a function of overall income and trade costs.

# 1. Introduction

Three significant macro-trends in the global economy over the past three decades are

- Falling trade costs
- Changes in economic geography associated with economic convergence in East Asia
- Increased income inequality within countries

The first two have been the object of myriad studies in the new economic geography literature. In this view, market access determines the joint location of economic activity and incomes. Such a view has been fairly successful in explaining past changes in incomes (Redding and Venables, 2004; Head and Mayer, 2011; Jacks and Novy, 2011). Market potential, a trade cost-adjusted measure of demand for a nation's output, is consistently found to be a positive and significant determinant of GDP per capita.

How does within country income inequality fit into the picture? Previous research on market potential assumes this variable away. The standard Dixit-Stiglitz-Norman formulation of preferences, widely used in the trade and geography literature, imposes that consumers are homogenous; income inequality is irrelevant. In a recent exploration, Fajgelbaum and Khandelwal (2016) lay a foundation for exploration of this issue. Starting from the Almost Ideal Demand System (AIDS), an expenditure system with a long-tradition (Deaton and Muellbauer, 1980), Fajgelbaum and Khandelwal (2016) show how to generate a gravity equation of trade that allows for non-homotheticicities in consumer demand. Since the gravity model is really a general equilibrium expression for (in this case) demand for a nation's output, this is the building block for assessing what the new economic geography calls *market potential*.

In this paper we follow the derivation of Fajgelbaum and Khandelwal (FK) for a one-sector gravity model that allows for non-homotheticicities in demand.[1] With this gravity equation and a simple assumption for the supply side we are able to derive an expression for *market potential* in this demand

[1] As FK note, without non-homotheticicities, the gravity equation from the flexible demand system would be the homothetic translog gravity equation studied by Feenstra and Weinstein (2010) or Novy (2012).

system. We gather data for a panel of 38 countries for the years 1996, 2001, 2006 and 2011 and estimate a single sector version of the non-homothetic gravity equation with aggregate bilateral trade data. Consistent with the literature (Hallak, 2010; Hallak and Schott, 2011, and Feenstra and Romalis, 2014), we find strong and intuitive evidence that richer countries generally export higher income elastic goods. At the same time, we provide some limited evidence on the dynamics of these income elasticities. Next we proceed to relate market potential to income per capita. In this demand system, market potential consists of two components. The first is a term related to a nation's trade costs. The second involves the interaction between the supply side (i.e., a nation's average income elasticity) and world demand. World demand, the sum of country demands, depends not on total incomes but on incomes per capita and the within country distributions of income as well. This last term raises the potential that growth abroad does not necessarily translate into higher income at home via the market potential channel unless a country is able to export products with high income elasticities. We are also able to compare the non-homothetic measure of market potential to a CES-based measure in terms of goodness of fit in the wage equation relationship. We find that the non-homothetic market potential performs better in predicting the level of GDP per capita in a cross-section while both models prove similar in terms of predicting medium horizon changes.

Our paper is inspired in part by the theoretical growth literature (Matsuyama, 2002) as well as from contributions in trade (Matsuyama, 2000; Fieler, 2011 Markusen, 2013). The focus of these papers was generally to describe the conditions for demand-led modern economic growth when the income distribution mattered, or to provide an exploration of the product range exported, imported and consumed at various levels of income per capita. FK provide an elegant and innovative solution to the "welfare gains from trade" when income the income distribution matters. This boils down to a general equilibrium analysis of the changes in real wages when trade costs change. A trade view is crucial in this regard since trade shares in expenditure often range between 20% and 30%. The market potential approach is broader in the sense that it explores the relationship between the world income distribution (i.e. equilibrium wages) and the economic geography of total demand. In a more ambitious framework of economic growth that accounts for within the country income distribution the two variables would be strongly related (Matsuyama, 2002). Our paper supplies a first pass in assessing how important these relationships might be bearing in mind their relevance due to the dramatic convergence process and unprecedented rises in within country income inequality in the past several decades.

## 2. Model

We follow the international trade setup in FK (2016) which is based on an Almost Ideal Demand System (AIDS) expenditure system. The AIDS system is an approximation to almost any demand system. AIDS features non-homothetic preferences and product-specific income elasticities (assumed constant throughout). AIDS allows for flexible expenditure patterns and the aggregate equilibrium expenditure relationship is a function not only of relative prices but also average expenditure (i.e., per capita income) *and* the distribution of expenditure (i.e., within country income inequality).

The world consists of a finite number $D$ countries $(1,\ldots,D)$ where $s$ indexes the source or exporting country and $d$ denotes a particular destination. We impose an Armington assumption so that each country produces one product.[2] As in FK, each variety's demand has its own income elasticity such that demand for backpacks from China might decrease with income while demand for backpacks from Denmark could increase with income.

Suppliers in source country $s$ produce their good under perfect competition at price $p_s$. Labor is the only factor of production and each country has a productivity level $Z_s$. With perfect competition and constant returns to scale, the prevailing wage, adjusted for productivity is $w_s = p_s Z_s$. Heterogeneity across households within country $s$ is due to differing endowments of units of labor, $z_h$, so that household $h$ receives an income $x_h = z_h\, w_s$. Country $s$ then has an average income $\overline{x}_s = w_s \overline{z}_s$ . The income distribution in country $s$ is characterized by a Theil index $\Sigma_s$.

There are international and domestic trade costs such that in order to receive one unit of a product $\tau_{sd}$ units must be shipped. We impose the regularity condition throughout that domestic trade costs equal one. With this assumption, the price per-unit paid in destination $d$ for the product with origin $s$ is $p_{sd} = \tau_{sd}\, p_s$.

Working with the expenditure share in country $d$ for goods from origin $s$ it is possible to formulate a gravity equation of bilateral trade. After imposing some simplifying assumptions on the

(1)

[2] FK build their model up from the product level and then aggregate up at the country level. The income elasticity we estimate is the scaled average income elasticity at the country level.

(semi) elasticities of substitution (see equation (21) in FK), the share of exports $X_{sd}$ from country $s$ to country $d$ in total expenditure $Y_d$ of country $d$ is given by

$$\frac{X_{sd}}{Y_d} = \alpha_s - \gamma \ln\left(\frac{\tau_{sd} p_s}{\overline{\tau}_d\, \overline{p}}\right) + \beta_s \left[\ln\left(\frac{\overline{x}_d}{a(\mathbf{p}_d)}\right) + \Sigma_d\right]$$

where the product of $\overline{\tau}_d = \exp\left(\frac{1}{D}\sum_{d=1}^{D} \ln(\tau_{sd})\right)$ and $\overline{p} = \exp\left(\frac{1}{D}\sum_{d=1}^{D} \ln(p_d)\right)$ allow for multilateral resistance to matter.

The last term in (1) features the exporter specific income elasticity of its product, $\beta_s$, which determines, in part, the partial effect on the expenditure share of a rise in the sum of real average income of the importing country $\frac{\overline{x}_d}{a(\mathbf{p}_d)}$ and its Theil index, a measure of inequality. Note that $a(\mathbf{p}_d)$ is a homothetic price index as defined in FK. We also call attention to the fact that $\sum_{s=1}^{D} \beta_s = 0$ and $\sum_{s=1}^{D} \alpha_s = 1$. For the latter we have imposed the assumption that the preference parameters in FK, $\alpha_{sd}$, consist of an exporter fixed effect $\alpha_s$ (and later a zero mean, finite variance disturbance at the importer level). The property of the demand system that all income elasticities sum to 0 implies some exporters will have negative income elasticities while others will have positive income elasticities. Countries with negative income elasticities will see declining expenditure shares in the destination as the destination country becomes richer or income becomes more unequally distributed. The former would occur to exports from a low income, low quality country as its partner country developed. The reason why the income elasticity has the same impact on trade for changes in inequality as for changes in average income is that higher because of aggregation. Inequality turns out to be associated with a higher level of income in the "representative" budget (Deaton and Muellbauer, 1980) in this demand system.

The gravity equation also depends in a simple way on supply forces and not just demand. This allows us to find a relationship between per capita income (i.e. payments to immobile factors of production) and international demand. The motivation for this wage equation comes from traditional models of economic geography in the vein of Fujita, Krugman, and Venables (1999). These models, based on homothetic demand, produce a tight relationship between payments to the factors of production and "market potential" referred to as a "wage equation". In these models, market potential is related to the economic size of destination markets, proxied by total income, with each destination's income being weighted by its proximity to the source country. In such a model, with constant marginal costs and a representative household, countries have higher prices and wages when demand is high for its goods. This occurs when consumers (foreign and domestic) are richer and more proximate. Similar logic applies in the non-homothetic demand system albeit with a different functional form. Non-homothetic demand implies that the impact of foreign demand depends on the supply side in an interesting way not applicable in the CES framework as we will see.

We derive a wage equation relating income per capita (payments to factors of production) to market potential as defined in this demand system. We use the expression for nominal wages $w_s = p_s Z_s$ to substitute for $p_s$ in equation (1) and the fact that the sum of sales across all destinations, $\sum_d x_{sd}$, must equal total income $Y_s$.Using equation (1) the following relationship between "adjusted wages", $\gamma \ln(w_s) + \frac{Y_s}{Y_W}$, in country $s$ (suppressing year subscripts), trade costs and supply and demand forces is given by

$$\gamma \ln(w_s) + \frac{Y_s}{Y_W} = \ln(Z_s) - \sum_d \frac{Y_d}{Y_W} \alpha_{sd} - \gamma \left[ \sum_d \frac{Y_d}{Y_W} \ln\left( \frac{\tau_{sd}}{\bar{\tau}_d \, \bar{p}} \right) \right] + \beta_s \left[ \sum_d \frac{Y_d}{Y_W} \left( \ln\left( \frac{\bar{x}_d}{a(\mathbf{p}_d)} \right) + \Sigma_d \right) \right]. \qquad (2)$$

It is clear by inspection of (2) that wages are negatively related to an output weighted average of bilateral trade costs relative to average or "multilateral" trade costs in the destination country. We call this first term $MP1 \equiv -\gamma \left[ \sum_d \frac{Y_d}{Y_W} \ln\left( \frac{\tau_{sd}}{\bar{\tau}_d \, \bar{p}} \right) \right]$.

Secondly, wages are related in an interesting way to destination demand shifters. We call this modified demand shifter $MP2 \equiv \beta_s \left[ \sum_d \frac{Y_d}{Y_W} \left( \ln\left( \frac{\bar{x}_d}{a(\mathbf{p}_d)} \right) + \Sigma_d \right) \right]$. Income is always increasing in *MP2*, but *MP2 declines* when $\beta_s < 0$. While richer and more unequal destination markets are associated with higher adjusted incomes for high income elasticity countries, these variables *have the opposite effect* on countries when $\beta_s < 0$. This result stems from the Engel curves implicit in the demand system and gives support for the idea that as households become richer the share of expenditure on low-income elasticity goods declines. This dynamic highlights an open-economy demand channel for economic growth which is a feature in the literature (Matsuyama, 2000).

We impose the following regularity condition for now to assist in estimation of (2). First the bilateral preference shocks are modeled as an exporter fixed effect and a random, mean zero pair-specific effect:

$$\alpha_{sd} = \alpha_s + \varepsilon_{sdt}.$$

# 3. Empirical Results

We proceed by estimating the non-homothetic gravity equation to show that this relationship provides a good fit for the bilateral export data and to establish that our baseline estimations are in line with FK's estimations. We then use these estimates to obtain two measures related to market potential, namely the trade cost term *MP1* and the income-elasticity adjusted world income shifter, *MP2*. These market potential terms are the key explanatory variables in estimating (2). We also provide a simple comparison between how well the non-homothetic market potential measure and a CES-based measure of market potential predict GDP per capita. Our data consist of a balanced panel of 38 countries for the benchmark years 1996, 2001, 2006 and 2011. Our data appendix details the sources and calculations we used in constructing the relevant variables we need to proceed with this estimation.

## 3.1 Gravity

Table 1 shows results of the following gravity equation based on (1) for each year in our sample:

$$\frac{X_{sdt}}{Y_{dt}} - \frac{Y_{st}}{Y_{Wt}} = \alpha_s - \gamma_t T_{sd} \ln\left(\frac{\tau_{sd}}{\bar{\tau}_d}\right) + \beta_{st}\Omega_d + \eta_{sdt}. \tag{3}$$

Throughout what follows, we impose the following functional form for trade costs $\tau_{sd} = dist_{sd}^{\rho} b_{sd}^{-\delta_1} g_{sd}^{-\delta_2} \eta_{sd}$ where $dist_{sd}$ is the bilateral distance between countries, $b_{sd}$ is an indicator equal to 1 when two countries share a border, $g_{sd}$ equals 1 when two countries share a common language, and $\eta_{sd}$ is a random, unobservable component at the country-pair level.

Distance is negatively and significantly associated with bilateral trade shares, while sharing a common language and a border are associated with higher trade shares. It is important to include the domestic trade flows in these regressions otherwise, in un-reported regressions, we find that the coefficients on our trade cost proxies are dramatically changed. We also note that the point estimates on our trade costs are dramatically stable across time both in terms of their magnitude and their statistical significant.

Regressions in Table 1 also provide estimates of country-level income elasticities as in FK which we do not report. However, Figure 1 gives an indication and shows the univariate regression line for the regression of the logarithm of GDP per capita on our estimates of $\beta_s$. Our results are strongly consistent with those of FK's Figure I and Table I. Both their data and our replication show a strong positive relationship between GDP per capita and $\beta_s$. Differently from FK we have a panel of data which allows us to examine changes in the income elasticities. For two large and important countries in the developing world, we find interesting results. While $\hat{\beta}_{China}$ increased and became positive between 1996 and 2011 moving from -.005 (s.e. = 0.025; 95% C.I. -0.055 to 0.044) to 0.01 (s.e. = .02 ; 95% C.I. -0.03 to .05). For India, the opposite happened. The point estimate for $\hat{\beta}_{India}$ started negative and became more negative falling from -.028 (s.e. = 0.03 ; 95% C.I. -0.09 to 0.03) to -0.05 (s.e. 0.04; 95% C.I. -0.13 to 0.04) over the same 15 year period. Generally speaking, these differences across the two countries and over time are not statistically significant.

One issue which remains to be explored is the relative rankings of the estimated income elasticities. The top five positive values are in order from highest to lowest: Australia, Japan, USA, Taiwan and Korea. The bottom 5 in order from lowest to highest are Belgium, India, Luxembourg, Germany and France. These rankings are not totally intuitive. At the top end, Australia, mainly a commodity and raw materials exporter, would not obviously have the largest income elasticity on many of its exports. The next four countries at the top end compare favorably to intuition based on the economic structure of these countries. Oppositely, Belgium, Germany, and France, exporters of technical equipment and machinery, pharmaceuticals and other advanced products would seem to be suppliers of products which would have high income elasticities. One possibility is that much of international trade occurs in intermediates and not in final products. It may be possible that exports of these products tend to end up in lower income countries at the margin since competition for such products is lower than in the leading countries. We also have

$$T_{sd} = \ln\left(\frac{\tau_{sd}}{\bar{\bar{\tau}}_d}\right) - \left[\sum_d \frac{Y_d}{Y_W} \ln\left(\frac{\tau_{sd}}{\bar{\bar{\tau}}_d}\right)\right]$$

$$\Omega_d = \left[\ln\left(\frac{\bar{x}_{dt}}{a(\mathbf{p}_{dt})}\right) + \Sigma_{dt}\right] - \left[\Sigma_d \frac{Y_d}{Y_W}\left(\ln\left(\frac{\bar{x}_d}{a(\mathbf{p}_d)}\right) + \Sigma_d\right)\right].$$

## 3.2 Wage Equation

We now turn to estimating the wage equation in (2). Our estimating equation is implemented as follows:

$$\ln(w_{st}) + \frac{Y_{st}}{Y_W} = \phi_0 \left[\Sigma_d \frac{Y_{dt}}{Y_{Wt}} \ln\left(\frac{\hat{\tau}_{sdt}}{\bar{\hat{\tau}}_{dt}}\right)\right] + \phi_1 \left[\hat{\beta}_{st} \Sigma_d \frac{Y_{dt}}{Y_{Wt}}\left(\ln\left(\frac{\bar{x}_{dt}}{a(\mathbf{p}_{dt})}\right) + \Sigma_{dt}\right)\right] + \alpha_s + \epsilon_{st}. \quad (4)$$

Here $\hat{\tau}_{sdt} = \left(d_{sd}^{\widehat{\gamma\rho}_t} b_{sd}^{\widehat{-\gamma\delta}_{1t}} g_{sd}^{\widehat{-\gamma\delta}_{2t}}\right)$ is a term that becomes larger when trade costs rise. Sine we use the estimated coefficients from the trade cost vector in Table 1 and multiply coefficients by -1 we expect $\phi_0 < 0$. Additionally, $\hat{\beta}$ indicates we use the estimated income elasticities from the same set of results. Both variables are "generated" regressors and are time varying but come from cross-sectional estimations. Given that these regressors are "generated" we bootstrapped the standard errors in un-reported results and results are qualitatively the same. It is especially important to estimate this relationship using panel data so as to use country fixed effects. We assume the product preference shocks matter are constant across exporters and across time. If these factors are time-varying and correlated with either the trade cost term or the world income shifter then our estimates may remain biased. We assume for now that the latter is not true.

Table 2 shows our results first in year-by-year cross-sectional regressions and then for several variations of a panel data approach. Our wage equation consists of the two market potential terms *MP1* and *MP2*. The trade cost term, *MP1*, is negatively related to income per capita and generally highly statistically significant. The exception is in 2011 (column 4) when the trade cost term is marginally significant and the demand-supply interaction is statistically insignificant. The supply-demand term is positively related to GDP per capita but it is generally insignificant in the cross-section.

To gain more power, and with the assumptions on the unobservable terms made above, we pool the data and use country fixed effects in columns 5-7. In all panel models, market potential is positively associated with income per capita. The point estimates on each term in the market potential equation are roughly the same magnitude as in the cross-sections. This suggests time-invariant unobservable heterogeneity at the country level is not a major concern. A random effects version of the model in Column 5 reveals the same.

In columns 6 and 7, we control for the logarithm of the level of population since population density could be a determinant of per capita incomes/wages. While population (controlling for land area with country fixed effects) is negatively related to income per capita, market potential is still positively correlated with income levels. In column 7 we combine the market potential terms into one, *MP*. Once again, we see a positive and significant relationship between the logarithm of income per capita (adjusted by world income share) and market potential. Regarding the strength of the relationship, we find that a one standard deviation increase in the combined market potential measure would be associated with a roughly 1/5 standard deviation rise in income per capita (assuming a constant world income share).

While this relationship bears resemblance to the standard positive relationship seen in the literature (Redding and Venables, 2004; Head and Mayer, 2011; Jacks and Novy, 2016) there is a significant difference in our results due to the non-homotheticicities captured in the theoretical model. The income shifter, *MP2* affects countries differently. For countries with negative income elasticities, for instance, higher income in their trading partners shifts demand away from domestic products and as a consequence this could lead to lower incomes. Changes in market potential are also obviously related to time-variation in the country-level point estimates of the income elasticities. *MP2* for the USA peaked in 2001 and has fallen by one half between 2006 and 2011 while for Japan it has monotonically declined by as much as 30% between 1996 and 2011. In the major countries of the developing world in our sample, trends are the exact opposite. China has seen a relentless rise in its *MP2*— due partially to the rise in the income elasticity of its exports. On the other hand, *MP2* for

India has stayed relatively flat in accordance with its near-constant (and negative) income elasticity of exports.

As for the trade costs term, *MP1*, the evolution of this term depends heavily on the location of economic activity since our three proxies for trade costs are time invariant. As factory-Asia has expanded and China's global income has risen meteorically, so have trade costs fallen for countries in Asia. *MP1* rose, implying higher international trade costs for the USA, Canada and, Germany and France alike. Despite Japan's proximity to China, its falling world income share has led to a fall in its economic proximity. Korea, China, India, and Indonesia posted declines in their measured proximity. Amongst this group, China witnessed the largest declines.

Figures 2-4 plot changes in *MP1*, *MP2*, and *MP* = *MP1* + *MP2* between 1996 and 2011 against the change in GDP per capita (again, 1996-2011) which allow us to see the relationship between medium horizon changes in income per capita and changes in market potential at the same horizon. All figures show the expected relationships. The underlying coefficient for *MP1* is significant (t-statistic = -9.52), *MP2* is not highly significant (t-statistic = 1.37) while *MP* is significant at the 1 percent level (t-statistic = 2.56). Figure 4 shows that the largest gains in *MP* were in Australia, China, Canada and Korea. The largest declines in this comprehensive measure were in Germany, the USA, France, Belgium, and Japan.

## 3.3 Comparison of CES and AIDS/Non-Homothetic Market Potential

We provide one benchmark comparison for the non-Homothetic market potential measure by making a comparison to market potential generated from a constant elasticity/constant markup (CES) demand system. The latter was first systematically estimated from gravity models by Redding and Venables (2004). Jacks and Novy (2016) provide a new and elegant derivation of market potential based on observable trade and income data and a plausible functional form for trade costs. They have kindly shared their data with us for the years and countries in which our sample overlaps. Using our notation and letting $\sigma$ be the elasticity of substitution across varieties of products, their measure is given as:

$$MP_s^{CES} = \frac{Y_s Y_W}{(\tau_{ss}^{\sigma-1} X_{ss} Y_W)^{\frac{1}{2}}}.$$

Figures 5 and 6 show scatter plots and a regression line for a simple univariate relationship between the logarithm of GDP per capita and both *MP* and $MP^{CES}$ in 2006 the latest year for which we have an overlapping sample available.

*MP* dominates $MP^{CES}$ based on simple measures of regression goodness of fit and statistical significance. Both measures of market potential are statistically significant. The t-statistic for MP is 3.35 while that for $MP^{CES}$ is 2.60. The R-squared and RMSE for *MP* are 0.43 and 0.97 while for $MP^{JN}$ they are 0.12 and 1.17. While the CES model grants Belgium the title of largest market potential, the non-homothetic model suggests that the USA has the largest market potential which we believe is overwhelmingly consistent with intuition about relative market sizes and what we know about the trade costs facing small economies. Both models rank China near the median level of market potential. A rank correlation test fails to reject the hypothesis that the two measures are significantly different however.

Figures 7 and 8 show how model-based predictions of GDP per capita vary. The predicted values for the logarithm of GDP per capita are plotted versus the actual levels with a 45-degree line. The predictions from the non-homothetic model lie significantly closer to the 45-degree-line and therefore provide better predictive power in levels. This result seems to obtain because at the lower end of the world income distribution the CES model predicts much higher market potential than the levels of GDP per capita warrant (e.g., China, Indonesia and India) while Australia and Canada have much lower market potential in the CES-based measure than these large and poor developing countries. This feature is likely because the CES model fails to take into account the importance of GDP per capita and the income distribution. The non-homothetic model penalizes (correctly as far as institution is concerned) large countries like Indonesia, India, Brazil and to an extent China for their low levels of income per capita.

A caveat is due however when we investigate the dynamics of GDP per capita versus changes in market potential. Here, both models seem roughly equivalent. In Figures 9A-9C we plot the actual changes in the logarithm of GDP per capita between 1996 and 2006 against changes in both the CES and the AIDS-based measures of total market potential. Without Belgium, both models have nearly the same RMSE (0.24) and R-squared values (0.45).[3] As a consequence, the regression of actual changes in income on predicted changes using the CES model has an R-squared double that of the AIDS model (0.42 vs. 0.2) while the RMSE is about equivalent. The coefficient in the CES model is larger and closer to 1 (0.45, s.e. 0.10, 95% C.I. 0.23 to 0.68) versus (0.23, s.e. 0.07, 95% C.I. 0.08 to 0.37) for the AIDS model. Figures 10A-10C show the predicted values of the logarithm of GDP per capita from these regressions versus the actual values. In sum, the CES model, when excluding the anomalous case of Belgium does about equally well in predicting medium horizon changes in incomes as the AIDS model.

## 4. Conclusions

We have investigated the relationship between trade costs, the location of economic activity and global income inequality over the last two decades. We apply the AIDS system as developed in Fajgelbaum and Khandelwal (2016). This model allows for non-homotheticicities in demand. The conceptual advantage to this approach is that it allows for the possibility that nations produce different types and qualities of goods and that income inequality and GDP per capita matter for the direction of trade. Both of these are now established regularities in the modern empirical trade literature.

We apply the AIDS/gravity approach to a larger sample of countries than FK but find results ultra-consistent with theirs. Non-homothetic gravity provides plausible and highly stable relationships between directional expenditures shares and common proxies for trade costs. We leverage the gravity relationship in the AIDS model to derive a measure of market potential. Market potential relies on two terms: a trade cost term and a demand shifter. The latter encompasses an interesting interaction between the level of demand and the structure of domestic production. The most novel finding conceptually is that greater foreign demand does not necessarily promote higher sales and wages. The standard positive effect of foreign income on incomes occurs when a country's income elasticity of exports is positive[c1]. On the other hand, for a country with a negative income elasticity, assume

[3] As per theory, we include the world share of expenditure on the right had side when in the AIDS model. Leaving Belgium out of the sample benefits the CES approach since it creates and outlier out of Belgium by giving it the largest rise in market potential of all countries.

consumer's income per capita rises. The negative effect could be offset if inequality were reduced at the same time. Multiple other combinations of this effect are possible and merit further exploration.

Our bottom line is that greater access to consumer via lower trade costs and more spending power remain significant determinants of the world income distribution. Nevertheless, the benefits seem to be conditional on the supply side as much as the demand side. Understanding how the income elasticities of nations have evolved over time also merits further research. We are currently experimenting with longer-run historical data to see if a similar approach can be taken. A constraint is that income inequality measures are scarce in the past. Yet it may be possible to estimate non-homothetic gravity without this variable and still obtain reasonable point estimates. We will update these preliminary results where and when possible.

## Data Appendix

Bilateral Trade Data: WIOD world trade data http://www.wiod.org/home

Trade Cost Proxies: CEPII http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp

- Distance population weighted bilateral distances between cities
- Common border: 1 if two countries share a common land border 0 otherwise
- Shared language: 1 if two countries share an official language 0 otherwise.

Nominal GDP in US Dollars: World Bank, *World Development Indicators*

Real GDP: Penn World Tables

Quality Adjusted Prices: Data underlying Feenstra and Romalis (2014). We adjust expenditures using these data as do FK.

Population: Penn World Tables or World Bank *World Development Indicators*.

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Table 1 Non-Homothetic Gravity Model, 1996-2011

| | (1)<br>1996 | (2)<br>2001 | (3)<br>2006 | (4)<br>2011 |
|---|---|---|---|---|
| Distance | -0.05*** | -0.05*** | -0.05*** | -0.05*** |
| | (0.01) | (0.01) | (0.01) | (0.01) |
| Common Border | 0.11*** | 0.10*** | 0.10*** | 0.10*** |
| | (0.02) | (0.02) | (0.02) | (0.02) |
| Common Language | 0.21*** | 0.20*** | 0.20*** | 0.20*** |
| | (0.03) | (0.03) | (0.03) | (0.03) |
| Observations | 1,600 | 1,600 | 1,600 | 1,600 |
| R-squared | 0.583 | 0.596 | 0.581 | 0.576 |

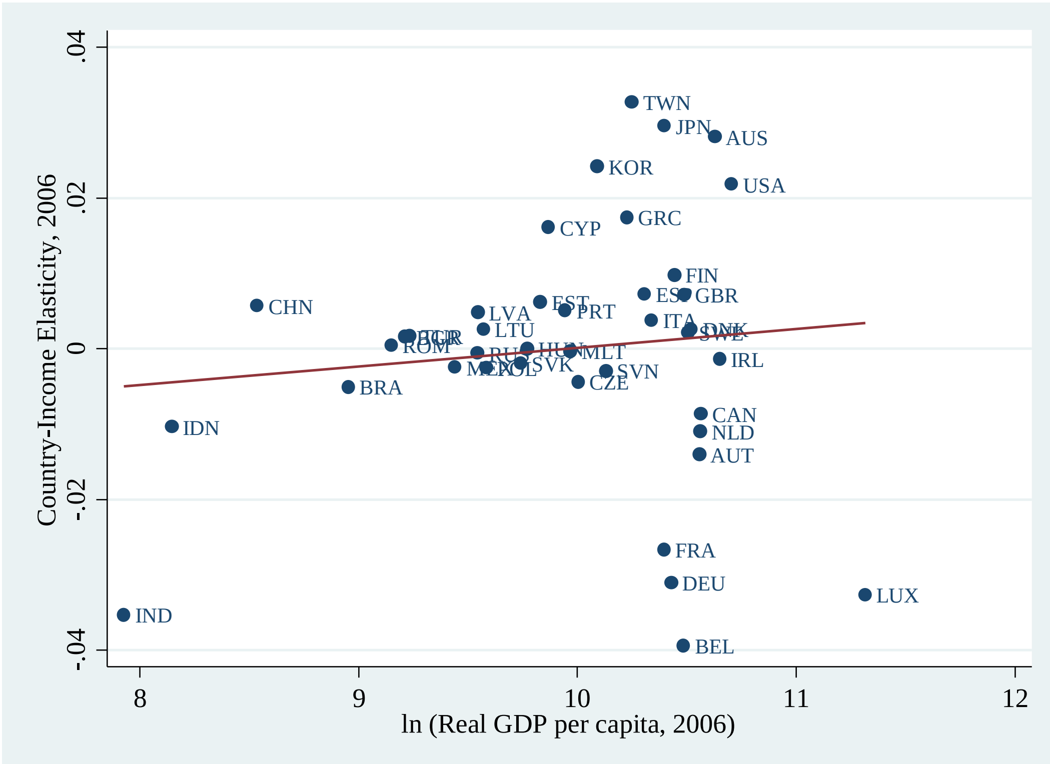
Notes: Table reports OLS regression of equation (3). The dependent variable is the expenditure share for country *d* on products from country *s* less an adjustment for the world income share of *s* as per the theoretical model discussed in the text. Estimation is by OLS. Exporter fixed effects are included in all specifications. Robust standard errors are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 2 Market Potential vs. GDP per capita, 1996-2011

| | (1)<br>1996 | (2)<br>2001 | (3)<br>2005 | (4)<br>2011 | (5)<br>Panel | (6)<br>Panel | (7)<br>Panel |
|---|---|---|---|---|---|---|---|
| *MP1* –Trade Costs | -22.55*** | -18.30*** | -18.24*** | -9.54 | -19.28*** | -18.98*** | --- |
| | (5.33) | (5.03) | (4.65) | (5.78) | (1.93) | (1.84) | |
| *MP2 – Income* × $\beta$ | 7.26 | 6.54 | 7.95 | 4.22 | 1.41** | 1.91** | --- |
| | (4.88) | (4.41) | (5.05) | (4.12) | (0.66) | (0.74) | |
| *MP = MP1 + MP2* | --- | --- | --- | --- | --- | --- | 3.95*** |
| | | | | | | | (1.07) |
| ln (population) | --- | --- | --- | --- | --- | -1.17** | -1.42** |
| | | | | | | (0.47) | (0.60) |
| Observations | 38 | 38 | 38 | 38 | 152 | 152 | 152 |
| R-squared | 0.355 | 0.350 | 0.316 | 0.107 | 0.892 | 0.906 | 0.844 |
| Number of iso | 38 | 38 | 38 | 38 | 38 | 38 | 38 |
| Year fixed effects | Cross-section | Cross-section | Cross-section | Cross-section | Yes | Yes | Yes |
| Country fixed effects | | | | | Yes | Yes | Yes |

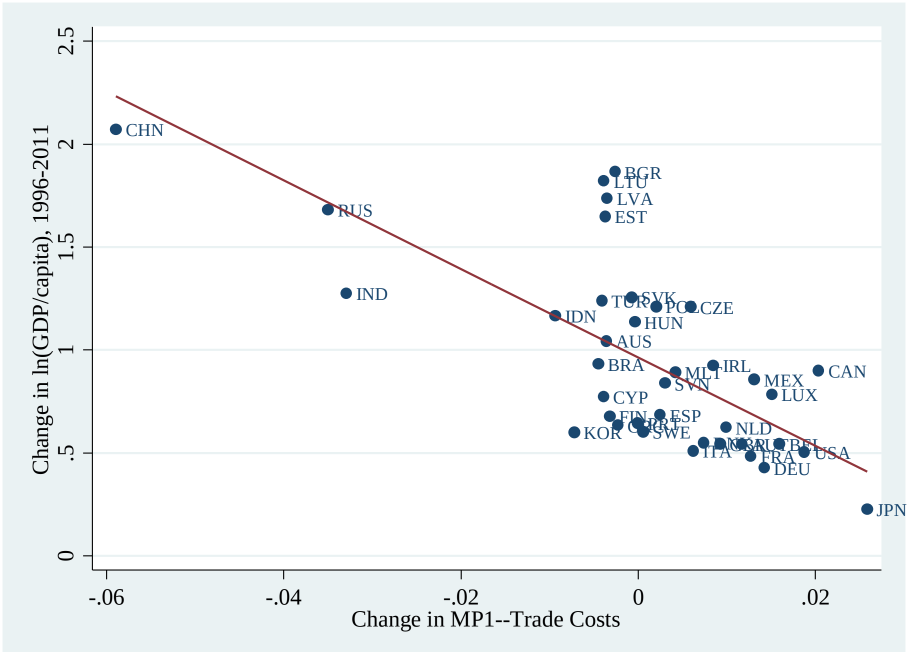
Notes: The dependent variable is the logarithm of GDP per capita in US dollars plus an adjustment for the level of the share of the country in world income. See text for an explanation. Estimation is by OLS. Robust standard errors in parentheses, clustered at the country level in columns 5-7. *** p<0.01, ** p<0.05, * p<0.1

Figure 1 Country-Specific Income Elasticities vs. logarithm of Real GDP per capita, 2006



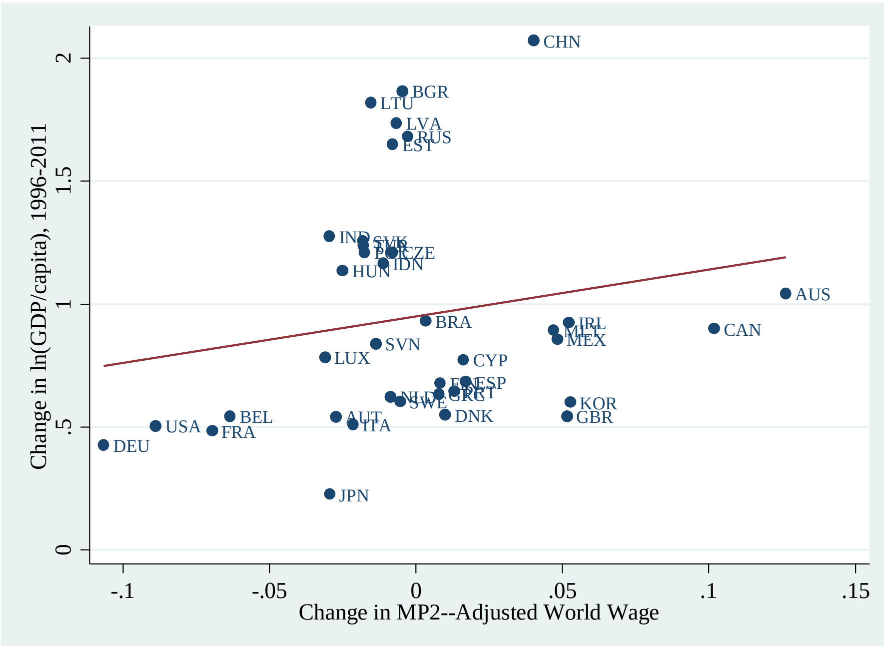

Notes: Income elasticities are estimated from gravity equation (3) for 2006.

Figure 2 Change in GDP per capita 1996-2011 vs. MP1—Trade Costs



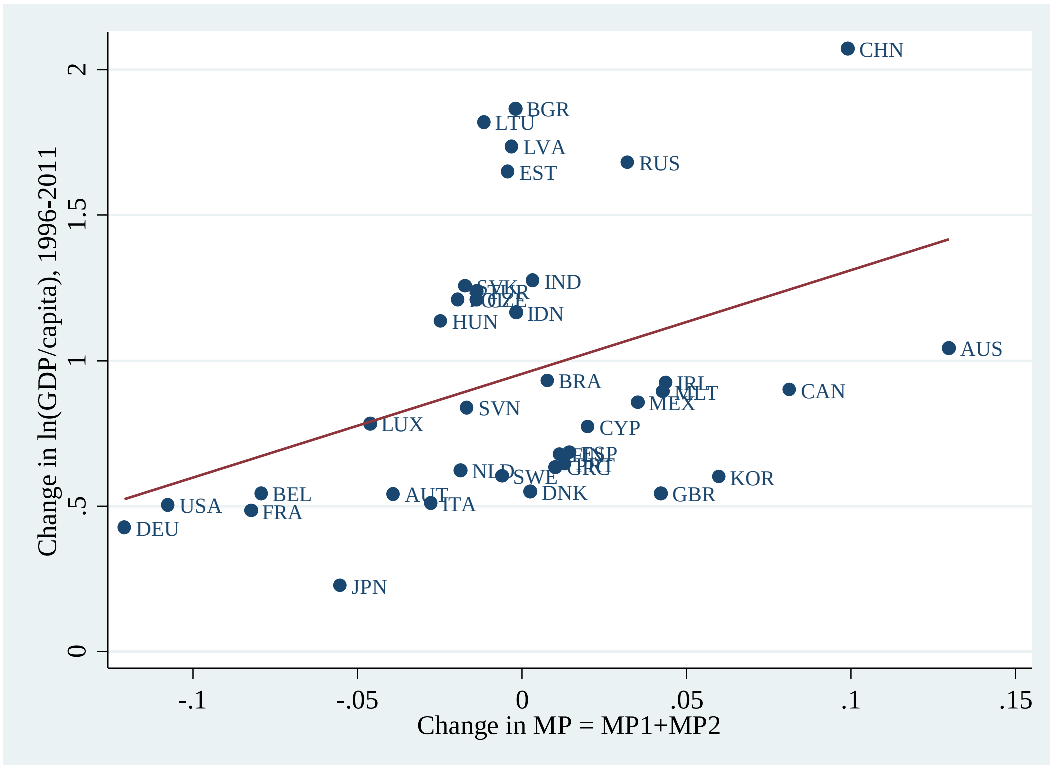

Notes: *MP1* is the trade cost measure of non-Homothetic market potential from equation (4).

Figure 3 Change in GDP per capita 1996-2011 vs. MP2—Adjusted World Wages



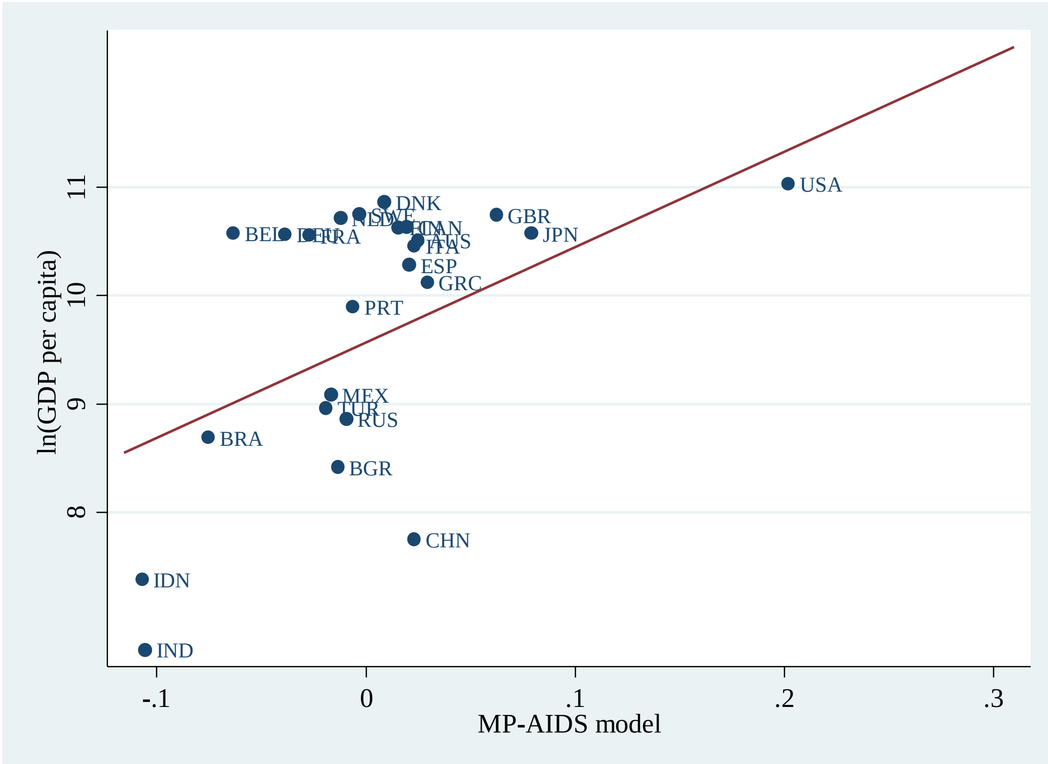

Notes: *MP2* is the trade cost measure of non-Homothetic market potential from equation (4).

Figure 4 Change in GDP per capita 1996-2011 vs. *MP1+MP2*—Total Market Potential



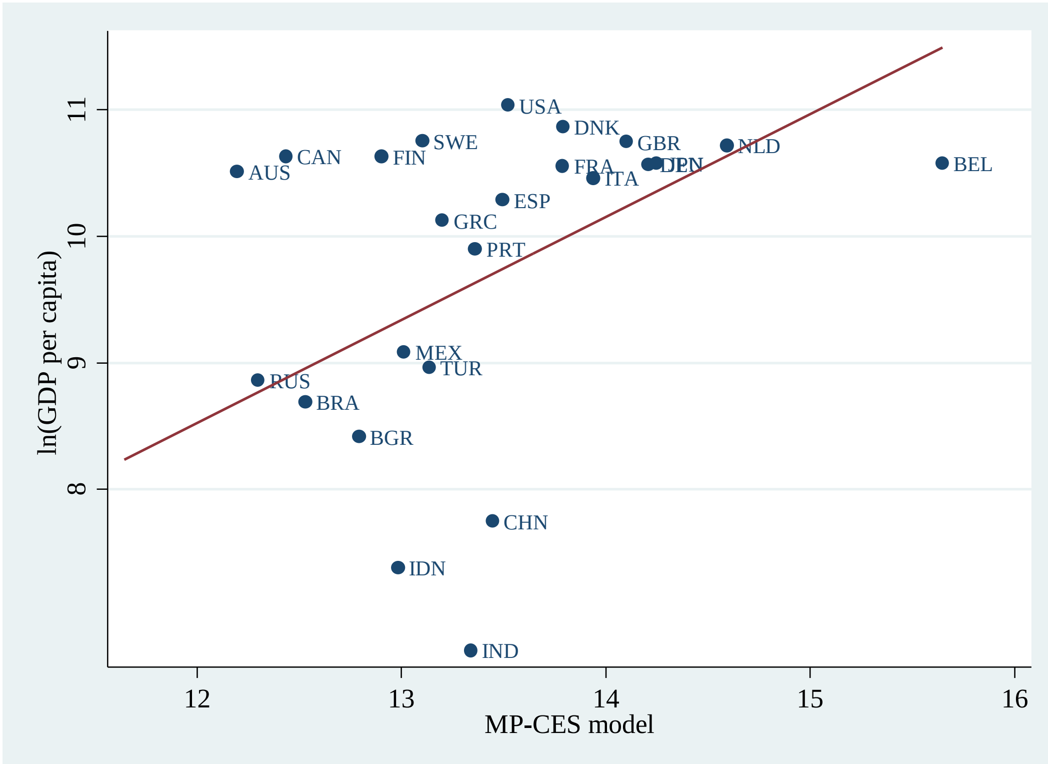

Notes: *MP* is the trade cost measure of non-Homothetic market potential from equation (4) encompassing both the trade cost term and the demand shifters. See the text for further explanation.

Figure 5 Logarithm of GDP capita vs Market Potential (AIDS/Non-Homothetic model), 2006




Notes: *MP* is the trade cost measure of non-Homothetic market potential from equation (4) encompassing both the trade cost term and the demand shifters. See the text for further explanation.

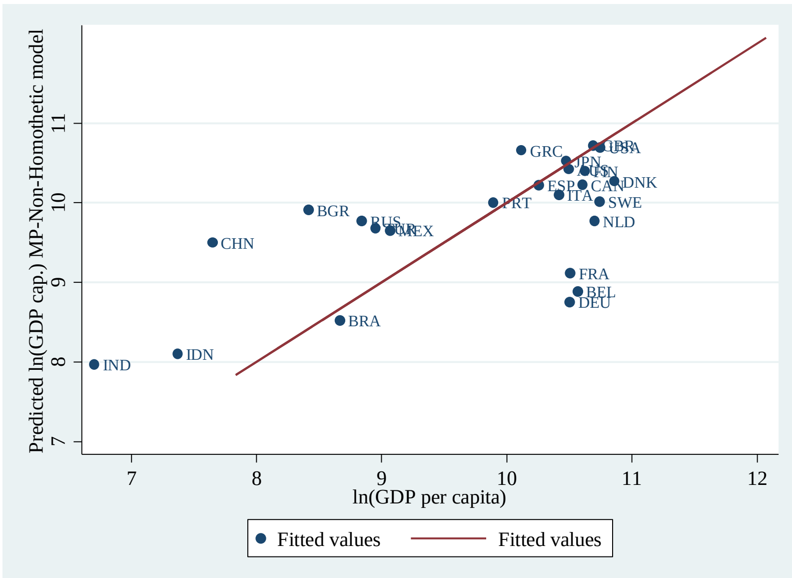
Figure 6 Logarithm of GDP capita vs Market Potential (CES model), 2006




Notes: MP-CES is derived from a CES demand system and is further explained in Jacks and Novy (2016). The regression line is based on a univariate regression of the logarithm of GDP per capita on the CES-based market potential measure.

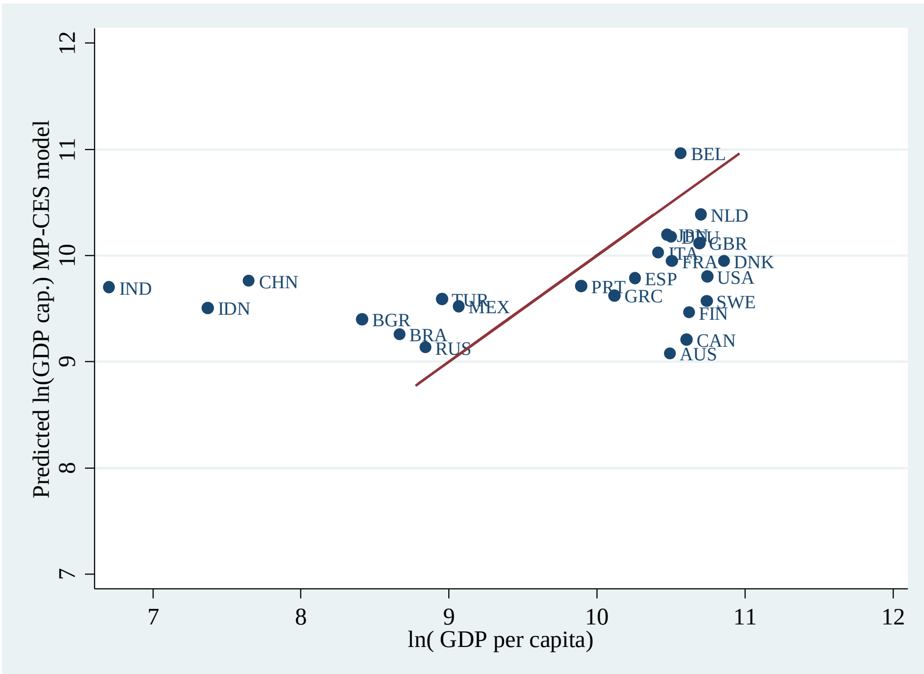
Figure 7 Level Predictions of ln (GDP per capita)

vs. Actual AIDS/Non-Homothetic Model




Notes: The y-axis plots the predicted values of the logarithm of GDP per capita from a univariate regression of the logarithm of GDP per capita on MP (derived from the non-homothetic AIDS model).

Figure 8 Level Predictions of ln (GDP per capita) vs. Actual ln (GDP per capita) CES model




Notes: The y-axis plots the predicted values of the logarithm of GDP per capita from a univariate regression of the logarithm of GDP per capita on CES-MP (derived from a standard CES model of demand) See Jacks and Novy (2017) for further details.

Figure 9A Change in GDP per capita, 1996-2006 vs. Non-Homothetic Market Potential

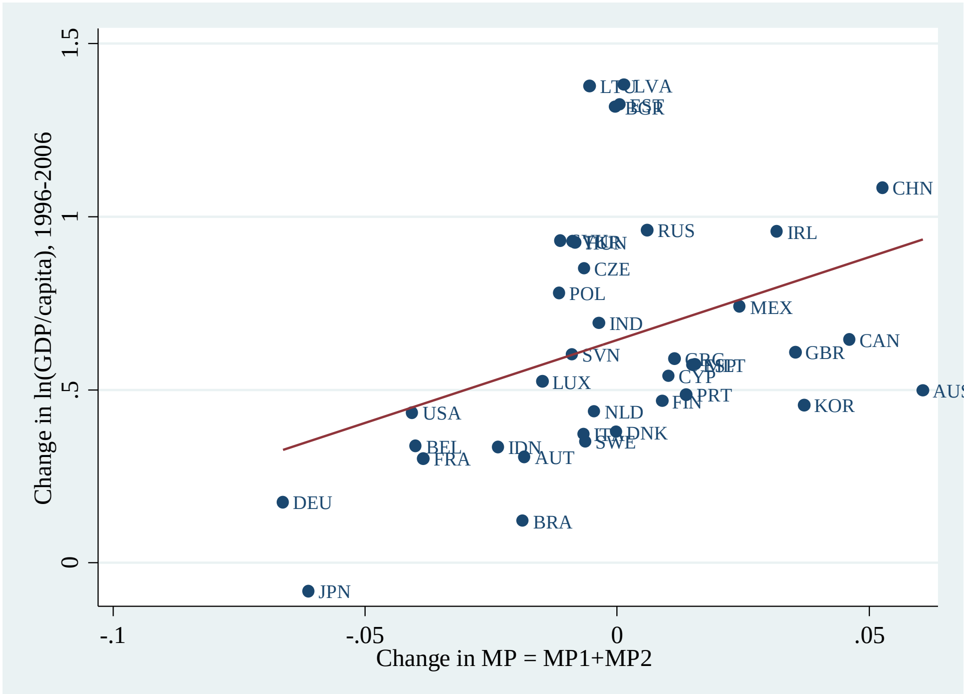



Figure 9B Change in GDP per capita, 1996-2006

vs. change in CES-Market Potential, 1996-2006

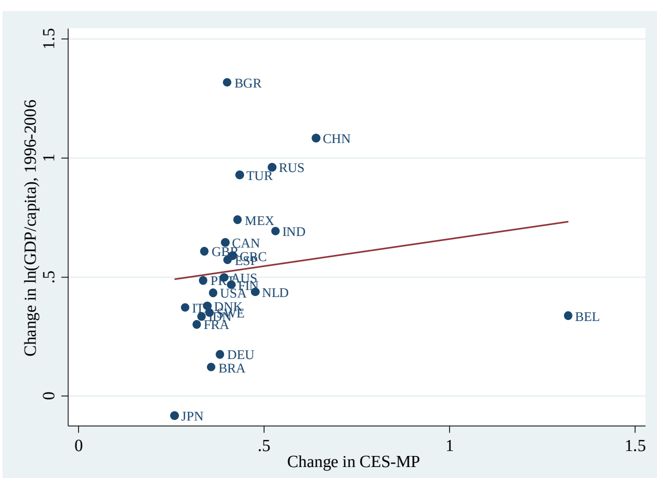
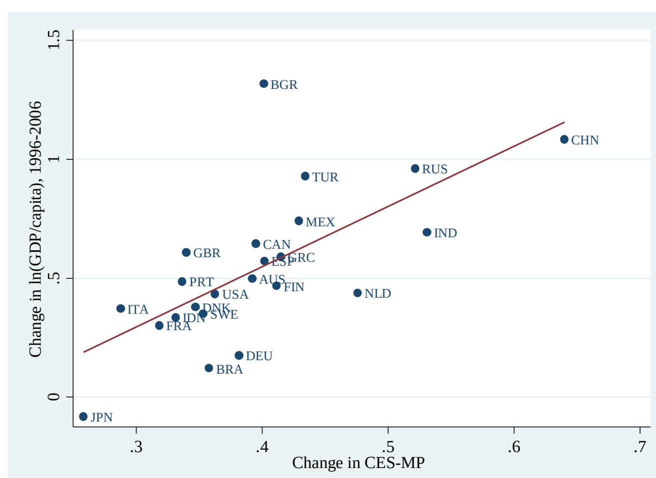



Figure 9C Change in GDP per capita, 1996-2006

vs. change in CES-Market Potential, 1996-2006
(excluding Belgium)




Notes: Figures use changes in the CES-MP measure or the AIDS *MP* measure between 2006 and 1996. See text for an explanation of their construction.

Figure 10A Predicted changes in GDP per capita (1996-2006) vs. Actual Changes in GDP per capita (1996-2006)

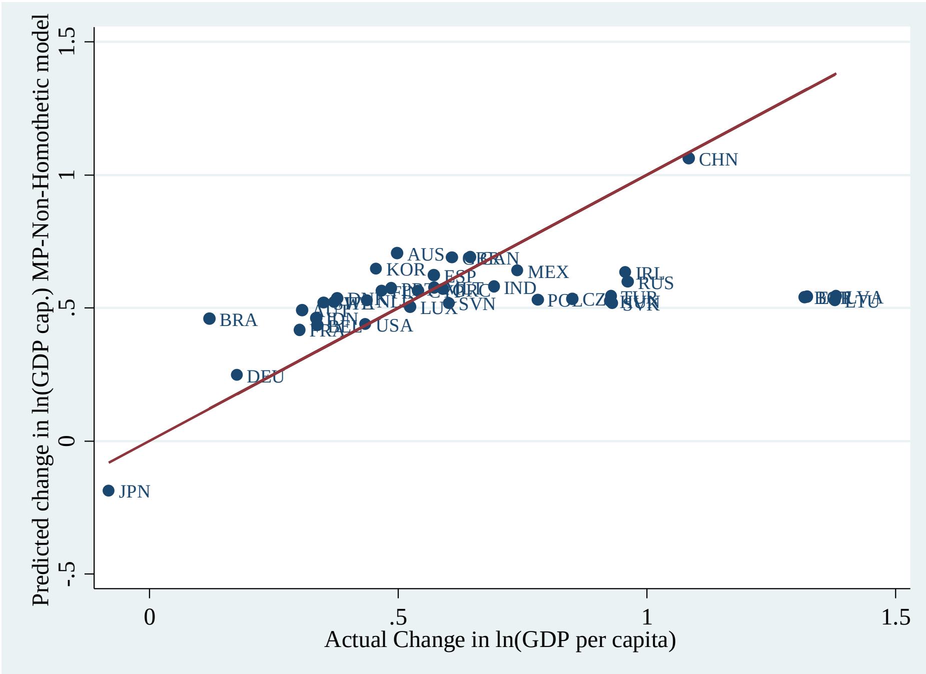



Figure 10B Predicted Change in GDP per capita, 1996-2006 vs. Actual Change in GDP per capita CES-Market Potential

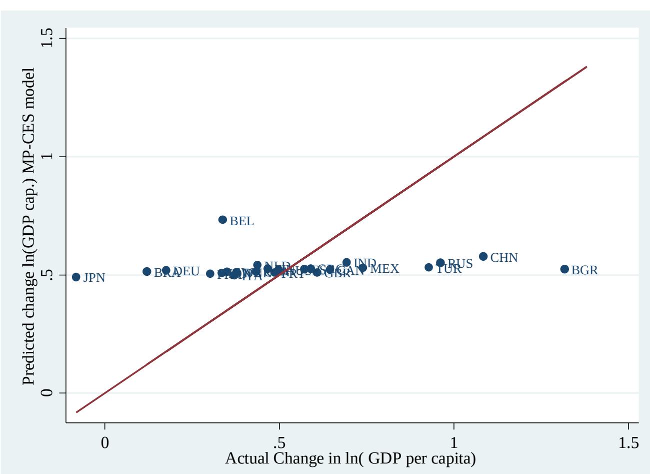
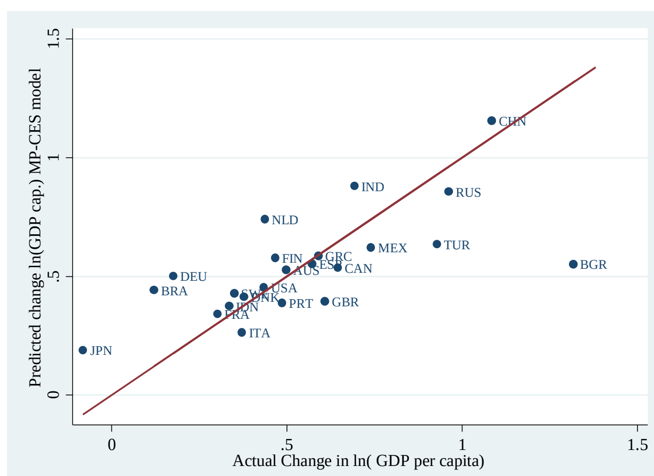



Figure 10C Predicted Change in GDP per capita, 1996-2006 vs. Actual Change in GDP per capita CES-Market Potential (excluding Belgium)




Notes: Figures use changes in the CES-MP measure or the AIDS *MP* measure between 2006 and 1996. See text for an explanation of their construction. The y-axis predictions come from univariate regressions of the logarithm of GDP per capita on each measure of market potential.