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## Development Diagnostics for the Southern Cone

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**May 2014**

**Inter-American Development Bank**  
Country Department Southern Cone

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# Development Diagnostics for the Southern Cone

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May, 2014

## **Abstract**

*This is an update and revision of our 2009 study. Using a broad dataset and an original methodology, this paper reports composite development gaps across economic, social and institutional sectors. We define development gap as the distance between the observed and the expected development level of a country. The gaps are indicators of areas where development needs are bigger. Although we estimate the development gaps for all countries with available data, we focus the analysis of our results in five Southern Cone countries: Argentina, Brazil, Chile, Paraguay and Uruguay.*

**JEL Classification:** O10, O160, O54

## ***1. Introduction***

The challenge of economic development is how to allocate scarce resources to close multiple gaps, in areas as diverse as poverty alleviation and the development of new energy sources. In practice, the allocation of finance and technical assistance across this broad range of development objectives reflects a combination of the government's preferences, political economy issues, more or less well-grounded technical diagnoses, existing expertise in different areas, and, last but not least, the latest fad in the development field.

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<sup>1</sup> Borensztein, Miller and Sanchez are economists at the IDB. Valenzuela is professor of economics at the Universidad de Chile. The first version of this paper was written when Valenzuela was a visiting Research Fellow at the IDB. We would like to thank Juan Ignacio Vizcaino, Diego Barril, Julian Genoud and Andres Schneider for superb research assistance.

The scarcity of financial and human resources makes it impossible to tackle all of these development gaps at the same time. It is then worthwhile to attempt a diagnosis that could help to determine the relative span of development gaps in different areas, and thus provide guidance regarding investment priorities. The snapshot of the size of different development gaps would be a useful tool for both governments and Multilateral Development Banks (MDBs) as a first step towards a systematic formulation of a development investment plan.

In a similar vein, both the Inter-American Development Bank (IDB) and the World Bank (WB) have led a series of studies on developing a Growth Diagnostics Methodology (GDM) for Latin American countries that provide suggestive results regarding the identification of the most binding constraints to economic growth.<sup>2</sup> However, these studies focus only on economic growth, which is but one aspect of development. The scope of this approach is broader, as it also captures other relevant dimensions such as reducing inequality and poverty, improving health and education, strengthening institutions, promoting private sector development, and protecting the environment and responding to climate change.

Indeed, the mission of the IDB—as well as other MDBs—spans all these aspects of development. Some of the sectorial priorities (including infrastructure, education, finance, competitiveness, and institutions) are potential candidates to present binding constraints to sustained economic growth, which can in principle be identified through GDM exercises. However, there are several equally important sectorial priorities which are not evaluated by GDM exercises, including health, poverty, some dimensions of institutional development, and the environment. Hence a strategy that considers the multidimensional aspects of development requires to move beyond the GDM and to develop metrics for identifying where the biggest development gaps are and how to approach them. It would then be interesting to compare the measures of sectorial priorities to the past and current allocation of investment and policy reform efforts.

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<sup>2</sup> See Hausmann, Rodrik and Velasco (2005). The GDM approach was applied to the case of Uruguay by Vaillant et al (2009), the case of Argentina by Sánchez and Butler (2008) and by Auguste (2012), the case of Paraguay by Garay-Armoa and Castilleja (2013), the case of Chile by Braun et al (2007) and in the case of Brazil by Blyde et al (2008).

Ideally, an investment planner would be interested in knowing the contribution to economic and social development of investing \$1 in each of the possible projects. Computing those values, however, would present a number of difficulties. In the first place, the calculation would require the ability to estimate the impact of spending \$1 on improving each specific target indicator, say the poverty rate. This would not be easy, and a consensus view on the best way to invest that dollar to achieve an improvement in poverty rates is likely to be missing. In the second place, it would require making a judgment about the value of the improvement in one indicator relative to another, for example the value of reducing poverty incidence by one percent relative to the value of expanding the internet grid to 1,000 more schools. This is perhaps not impossible with a clear measure of society's priorities, but it is certainly quite difficult and bound to be controversial.

The objective of this paper is more modest. It takes a look from “10,000 feet above” at the degree of achievement relative to an accepted norm in the different development areas, and identifies the most glaring deficits. This should be considered a first step in uncovering the overall pattern of development gaps. More detailed sector studies may reveal, for example, that the apparent underperformance shown by certain indicators respond to idiosyncrasies that are not the result of poor achievement. More detailed studies should also shed light on the sector development gaps that may exist within the country (i.e., across regions and populations groups), as a country may appear to have better than expected educational indicators on average, and yet have high inequality within the population in terms of access to education and educational achievement.

This paper computes development gap measures for countries for ten key sectors on the basis of a number of individual indicators within each sector, which are then aggregated into one single measure. The indicators are drawn from a broad dataset and are those most commonly used to measure the level of achievement of a country in each particular dimension.<sup>3</sup> The methodology is applied to several Latin American countries

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<sup>3</sup> This is easier in some cases than others. There is broad agreement, for example, on the validity of PISA test scores as a measure of educational achievement but gauging the level of innovation activity in the business sector—a high priority target in many Latin American countries—is much more elusive.

and the cases of five Southern Cone countries are discussed in more detail.<sup>4</sup> In broad terms, the results indicate that Argentina, Paraguay and Uruguay are more accomplished in social areas than in economic ones, especially those that measure the dynamism and international competitiveness of the private sector and the development of financial markets, while the opposite pattern is observed in Brazil and Chile. Institutional strength in Argentina, Brazil and Paraguay is below what would be expected for countries with their levels of income, but is above its expected level in Chile, and roughly in line with expectations in Uruguay. Finally, all these countries have environmental indicators that exceed the expected levels given their per capita GDPs.

The remainder of the paper is organized as follows. Section 2 introduces the methodology used to estimate our development gaps, Section 3 discusses the limitations of our methodology and compares it to other related studies, Section 4 presents the data, Section 5 shows our results and main policy implications and Section 6 concludes.

## ***2. Methodology***

We define a development gap as the distance between the observed and the expected value of a development indicator of a country. The expected value of the development indicator, which we call the norm, is obtained from a cross-country regression of the development indicator on the PPP per capita income.

We apply the development gap definition to ten sectors and construct for each one a composite standardized index ranging between -50 and 50. In order to calculate the composite gap, we construct ad hoc gaps for each variable included in a specific sector which are then aggregated.<sup>5</sup>

To construct our gaps by sector we follow three steps:

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<sup>4</sup> The five countries are: Argentina, Brazil, Chile, Paraguay and Uruguay.

<sup>5</sup> The gaps at the variable-level allow us a more focused analysis of specific aspects of development in cases where the general examination is not enough. This is the case when indicator gaps within a sector have different signs cancelling each other in the composite gap at the sector-level. For example, although most South American countries have high levels of educational coverage, they perform poorly in international tests of student assessment.



### Step 1: Regression

We run a cross-country regression of the development indicator on the logarithm of per capita GDP measured in PPP terms. In cases where this relationship is non-linear we apply the specification that better fits in terms of adjusted R-square. We eliminate from the regression outliers whose residuals exceed the thresholds of the 2.5% tails of the distribution. The residuals (observed minus predicted values) from this regression become the unadjusted measure of the development corresponding to this indicator for each country.

**Figure 1**



*Source: Own calculations*

Figure 1 illustrates the methodology for the case of the net enrolment rate in pre-primary education, which is one indicator within the education sector. The solid line in Figure 1 shows the prediction line for the net enrolment rate in pre-primary education from a quadratic regression of this indicator on per capita GDP in PPP terms (expressed in natural logs). We can observe, for example, that in the case of Paraguay this net enrolment rate is smaller than its expected level given Paraguay's per capita income.

Thus, we obtain a negative gap for this indicator. This gap suggests that more support would be required in this area just to lead this country to an acceptable standard given its income level.

### Step 2: Standardization of the gaps

Given the heterogeneity of our indicators, before we aggregate the gaps into a composite gap, we need to standardize the gaps measure. Our simple standardization formula is:

$$STDGAP = \frac{GAP - \mu(GAP)}{\sigma(GAP)}$$

Where *STDGAP* is the standardized gap for a specific variable, *GAP* is the gap (or residual) obtained from the regression, and  $\mu(GAP)$  and  $\sigma(GAP)$  are the mean and standard deviation of the gap across countries, respectively. These standardized gaps are then multiplied by 40 for presentational purposes, such that 95% of the observations will be fall in the  $\{-100, 100\}$  range.

### Step 3: Aggregation

The aggregation of the gaps within a sector into a composite gap by sector is done by computing simple averages of the gaps for the individual indicators. This means that every dimension of an index, or even all variables which make up the index, are assigned equal weighting. For instance, to obtain the gap in the water and sanitation sector we estimate the simple average of the gaps on use of improved drinking water sources and use of improved sanitation facilities. This method is adequate if all the individual gaps are chosen in such a way as to be equally important. For presentational purposes, we truncate the aggregate gaps at -50, 50.

In addition we also use principal component analysis (PCA) to generate an alternative set of weights. In short, PCA is a mathematical procedure that transforms a number of possibly correlated variables into a smaller number of uncorrelated variables called principal components. The first principal component accounts for as much of the

variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible. To do this, PCA examines the statistical correlations across variables and assigns the largest weights to those variables correlated with the other variables. Using two different methods to assign the weights allow us to check the robustness of our composite gaps. Unreported results show that both methodologies (i.e. simple average and PCA) lead to similar results, with just a few exceptions. The correlation of our composite metrics using both methodologies is always close to one. Below, we comment on the cases where there is a divergence between the results from aggregating indicators by simple average or principal components.

### ***3. Limitations of the methodology, and link to previous studies***

#### **3a. Shadow price of development gaps**

There is a recent but growing literature on growth diagnostic models (GDM), based on the methodology proposed by Hausmann, Rodrik and Velasco (2005). This methodology seeks to identify the most binding constraints to growth among infrastructure, human capital, government failures, market failures, savings, financial intermediation, openness to technology flows, capabilities and opportunities for export innovation. Its main innovation lies in that it appraises how binding a constraint is not only by looking at ‘quantities’ (such as international comparisons of financial intermediation/GDP) but also ‘prices’ (ideally, shadow prices) for the different potential constraints. For example, low indicators of educational attainment in a country (a quantity) would normally be interpreted as a sign of scarcity of human capital. However, where there is evidence of low returns to schooling (a price) this would suggest that human capital is low simply because there is no demand for it, possibly owing to insufficient development of a modern private sector. When measures of shadow prices are not available, researchers often use market prices and econometric estimates of the impact of relaxing the constraint as proxies.

At this stage we have no measurement of the shadow prices of the different individual and sector gaps, that is, we can measure how large the gaps are, but not how binding they are.

### **3b. Correlation between gaps and sequencing of gap alleviation**

Related to the previous limitation, there could exist complementarities between development gaps, and closing one gap first could be a prerequisite for closing others. Additionally, we also are concerned with the possibility that attempts at closing some gaps may not be successful unless other gaps are simultaneously closed. Thus far our methodology does not shed light on this issue.

### **3c. Potential biases**

Our measures of the gaps may be tainted by biases in the estimation of the true relationship between the development indicator and the per capita GDP of the country. These biases can originate in the possible endogeneity of the development indicator, in the existence of omitted variables, and in some cases in the presence of truncated dependent variables. We do not deal with these potential problems at this stage.

## ***4. Data***

We organized the data according ten sectors, each of which reflects a different facet of development. The ten dimensions of development achievement are: 1) poverty; 2) health; 3) education; 4) transportation and energy; 5) technological innovation and information and telecommunication technologies; 6) water and sanitation; 7) institutional strengthening and citizen security; 8) financial markets; 9) trade capacity building and private sector development; and 10) environment. These sectors largely match the areas of intervention of the IDB and other MDBs.

Given that no single quantitative or qualitative indicator can thoroughly reflect the multi-dimensional factors that represent the state of a specific sector of development, in order to construct aggregate sectorial development gaps, we collected a set of variables

that are relevant for each of the ten dimensions mentioned above. The strengths and weaknesses of a composite index depend mainly on the significance of the underlying variables. Although the variables have been chosen on the basis of their relevance and analytical soundness, data availability is often an important constraint. While our dataset has on the whole a rather good coverage, data are partly lacking for some countries or years and some variables of interest could not be included. For instance, in education there is an extensive list of variables that report the “quantity” of the education (such as enrolment at different educational levels and adult literacy rate) but there are few variables describing the “quality” of education.<sup>6</sup>

We made our choices in full awareness of missing value problems, and while our results are surely not immune to criticism, we believe that they reflect the best “trade-off” between coverage across countries versus broadness of coverage in variables. Thus, forty nine variables have been used and grouped into our ten sectors. Although most of our variables are hard data, the final dataset displays a mix of quantitative and qualitative information. Appendix 1 presents the variables, their descriptions, definitions and data sources and Appendix 2 reports a more detailed discussion of the variables and the rationale for including them in each sector.

In order to construct our metrics we have collected data for all countries with available data in each of indicators listed in Appendix 1. However, the analysis of our results focuses only on five Southern Cone economies: Argentina, Brazil, Chile, Paraguay and Uruguay. Some descriptive values and statistics of our indicators are presented in Table 1.

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<sup>6</sup> The only quality measures are from the Program for International Student Assessment (PISA), which is a survey of the knowledge and skills of 15-years-olds from the 30 OECD countries and a sample of 35 other countries.

**Table 1**  
**Descriptive Statistics**

	Year	Min.	Max.	Argentina	Brazil	Chile	Paraguay	Uruguay	United States
<b>1. Poverty and Informality</b>									
headcount2	2009	0.1	92.6	3.4	10.8	2.7	14.2	1.6	-
slumpop	2009	3.9	97.0	20.8	26.9	9.0	17.6	-	-
<b>2. Health and Nutrition</b>									
<i>Outcome indicators</i>									
infmort	2011	1.6	119.2	12.6	13.9	7.7	19.1	8.7	6.4
lifeexp	2011	47.0	83.0	76.0	74.0	79.0	75.0	77.0	79.0
doctors	2010	0.0	7.1	3.2	1.8	1.0	-	3.7	2.4
nursing	2010	0.0	24.0	-	6.4	0.1	-	5.5	9.8
beds	2010	0.1	16.5	4.5	2.4	2.0	1.3	1.2	3.0
<i>Input indicators</i>									
pegovhealth	2011	3.6	5,794.5	869.4	477.0	606.7	203.0	817.8	3,954.2
pchealth	2011	17.0	8,607.9	1,433.7	1,042.7	1,292.2	526.5	1,209.7	8,607.9
health2gdp	2011	1.6	19.5	8.1	8.9	7.5	9.7	8.0	17.9
<b>3. Education</b>									
<i>Outcome indicators</i>									
reading	2009	314.0	555.8	398.3	411.8	449.4	-	425.8	499.8
science_math	2009	330.4	587.3	394.5	395.6	434.3	-	427.0	494.7
enrolment	2010	28.5	110.2	95.4	-	86.2	69.5	90.0	98.3
preprimay	2010	1.0	99.5	74.4	-	81.3	32.6	77.7	63.7
literacy	2010	31.1	99.8	97.8	90.3	98.6	93.9	98.1	-
survivalrate5	2011	39.5	100.0	96.6	-	92.9	85.5	94.8	93.7
<i>Input indicators</i>									
educexp	2009	0.8	13.1	6.0	5.6	4.2	4.1	4.2	5.4
educprim	2009	1,037.0	1,749,008.0	129,120.0	169,133.0	164,658.0	34,657.4	-	1,021,910.9
educsec	2009	3,153.4	2,544,212.0	207,511.0	172,189.0	168,143.0	48,660.9	-	1,147,569.1
<b>4. Transportation and Energy</b>									
railarable	2010	0.0	0.9	0.1	0.0	0.4	-	0.2	0.1
roadarable	2010	0.1	527.7	0.7	2.3	6.0	0.8	-	4.1
infrastructure	2011	1.8	6.7	3.5	3.6	5.5	2.5	4.3	5.7
electrification	2009	9.0	100.0	97.2	98.3	98.5	96.7	98.3	-
<b>5. Technological Innovation</b>									
internet	2011	0.0	44.9	9.9	11.6	11.7	1.6	13.5	27.7
broadband	2011	0.0	71.6	10.5	8.6	11.6	0.9	13.5	27.4
cellular	2011	2.6	243.5	134.9	123.2	129.7	99.4	140.8	105.9
firmtechn	2011	3.2	6.5	4.5	5.2	5.4	4.2	4.7	5.9
rd	2009	0.0	4.5	0.6	1.2	0.4	0.1	0.4	2.9
papers1	2009	0.1	1,222.8	91.2	63.7	110.2	1.8	73.6	680.0
usptopat	2011	0.0	413.2	1.2	1.1	2.0	0.2	0.6	-
patents_nonres	2011	0.1	1,882.5	120.4	102.5	142.0	53.8	198.0	821.0
patents_res	2011	0.1	2,772.9	20.2	13.9	19.6	2.8	5.9	795.1
<b>6. Water and Sanitation</b>									
imprinkwater	2010	29.0	100.0	97.0	98.0	96.0	86.0	100.0	99.0
sanitationfac	2010	9.0	100.0	90.0	79.0	96.0	71.0	100.0	100.0
<b>7. Institutional Strengthening and Citizen Security</b>									
doingbus	2011	1.0	185.0	116.0	128.0	33.0	100.0	87.0	4.0
governance	2011	-2.3	1.9	-0.2	0.1	1.2	-0.6	0.8	1.2
security	2011	0.2	1.0	0.5	0.5	0.8	0.5	0.7	0.8
<b>8. Finance</b>									
stnktcap	2010	0.4	431.3	15.1	67.1	132.6	2.1	0.4	112.0
pcrdbofgdp	2010	4.3	434.1	12.7	50.4	78.3	32.3	20.7	194.7
stturnover	2010	0.2	188.6	4.7	62.7	18.9	3.0	2.9	188.6
dem_branch	2010	0.5	105.0	13.2	44.0	17.3	8.3	13.7	35.4
insurance	2010	0.0	5.9	1.1	1.2	1.8	0.5	0.9	3.3
<b>9. Trade Building Capacity and Private Development</b>									
burdencustpr	2011	2.3	6.2	2.7	3.1	5.5	3.9	4.2	4.3
SME Exporters	2009	0.8	59.5	27.4	18.1	16.0	15.2	18.5	-
ISO certification	2009	0.6	43.5	18.2	25.7	22.1	15.0	10.8	-
busentry	2011	0.0	27.7	0.5	2.4	4.1	-	3.4	-
expyppp	2006	2,302.1	17,334.4	9,127.8	10,338.9	6,175.2	7,201.1	9,920.6	14,730.9
<b>10. Environment</b>									
co2	2009	0.0	44.0	4.4	1.9	3.9	0.7	2.4	17.3
change_forest	2011	0.0	354.0	83.8	90.0	106.6	82.3	194.4	102.9

## 5. Results

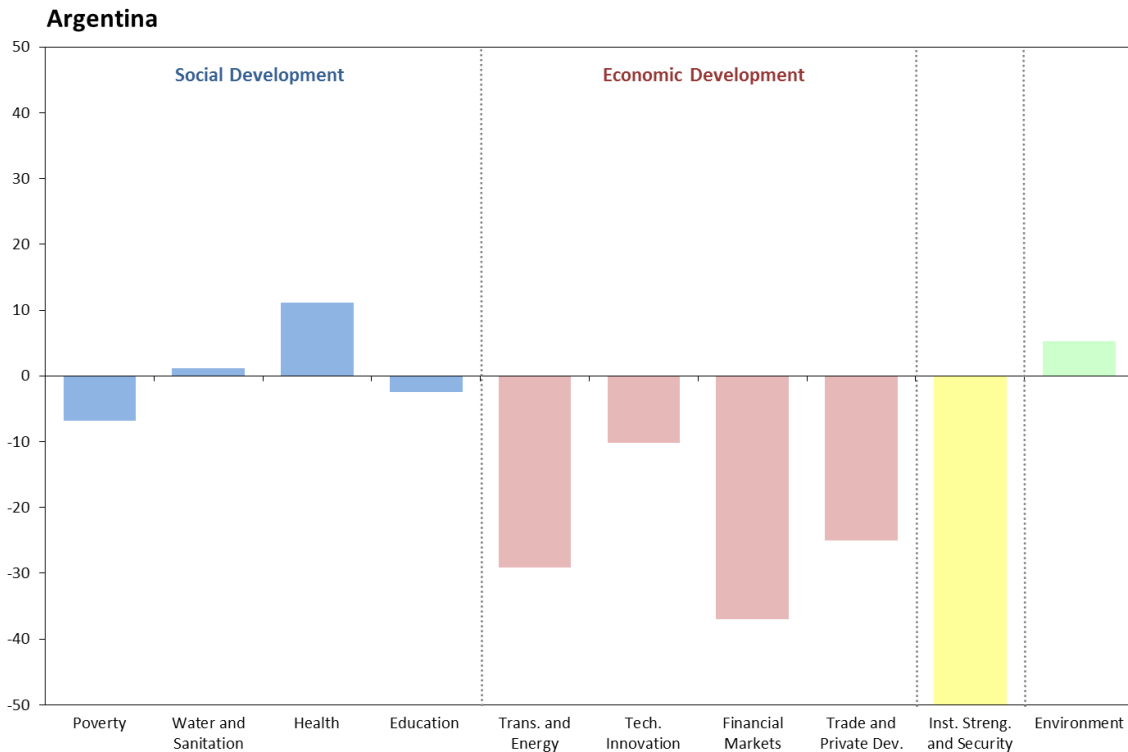
We present our results in three sections. Section 5.1 introduces our main results. It reports development gaps by sectors for Argentina, Brazil, Chile, Paraguay and Uruguay and for a set of benchmark Latin American countries and United States. Next, Section 5.2 analyzes gaps in spending indicators (i.e. input gaps) in order to understand potential causes of the gaps in the outcome indicators. Finally, Section 5.3 gives some examples of how much it would cost to close some gaps.

### 5.1. Actual Gaps

#### Argentina

Argentina, characterized by an export-oriented agricultural sector and substantial benefits from rich natural resources, is one of the countries with highest PPP per capita income in Latin America (see Table 1).

**Figure 1**  
**Development Gaps, Argentina**



Source: Own calculations

As shown in Figure 1, our metrics based on the average gap suggest that Argentina's development priorities lie in the area of institutional strengthening and citizen security, followed by financial markets, transportation and energy, trade capacity and private sector development, technological innovation and ICT. Poverty reduction and education appear as somewhat less critical areas. Argentina appears to be better than expected in the areas of water and sanitation, health and environment. The principal component analysis shows a similar pattern, although it suggests larger negative gaps in education, transportation and energy and in technological innovation and ITCs.

Regarding institutions and citizen security, Argentina shows backwardness in all the sectoral indicators. According the 2012 "Ease of Doing Business" index, Argentina is ranked 124 out of 185 economies. In governance, Argentina is below the world median in four of the six dimensions reported by the Worldwide Governance Indicators (i.e. government effectiveness, regulatory quality, rule of law and control of corruption). Finally, regarding citizen security, for instance, according to the World Economic Forum executive opinion survey 2013 Argentina is ranked 118 out of 148 in the question regarding the business cost of crime and violence, and 143 out of 148 in the reliability on police services.

Financial markets show the largest gap among the economic sectors. This is in line with the fact that Argentina is below its expected level in our five indicators of domestic finance development with very critical levels in some of them. For instance, private credit by deposit money banks and other financial institutions as percentage of the GDP is the lowest of South America (13%), even lower than countries such as Ecuador, Paraguay and Venezuela.

In the area of transportation Argentina presents deficient levels of road and railway networks in addition to low quality of the infrastructure. According to the last World Economic Forum executive opinion survey, Argentina is ranked 102 out of 143 in the question regarding quality of overall infrastructure. In contrast, the percentage of households with an electricity connection is close to one hundred percent.



According to the metrics proposed here, the next most lagging sector in Argentina is trade capacity building and private sector development. The poor indicators of burden of customs procedures, business entry rates, and export sophistication (income content of exports) outweigh the relatively high percentage of SME exporting firms (27%). The share of firms with ISO certification 18% is slightly below the expected value.

The technological innovation and information and telecommunication technologies (ITC) shows an important negative gap, which is largely driven by the fact that almost all the indicators of technological innovation are below expectations: firm level technology absorption, R&D spending/GDP, publication of scientific papers, patents granted by the USPTO, and patent applications by residents. Only patent applications by non-residents are above the norm. Argentina also fares relatively poorly in the area of ITC, as rates of internet subscriptions and broadband use rate are below the norm, while the opposite happens only to cellular line subscriptions.

Despite being one of the Latin American countries with higher per capita income, in Argentina the 3.4% of population living on less than \$2 a day at 2005 international prices is still higher than the percentages observed in Uruguay (1.6%) and in Chile (2.7%). In addition, the proportion of urban population living in slums is almost 21%, although this indicator is roughly in line with expectations.

Although the coverage of the education in Argentina is almost universal with a highly literate population and survival rates to 5<sup>th</sup> grade above expectations, the quality of education creates a development gap. According to the Program for International Student Assessment (PISA) the performance of Argentinean students is quite poor. In a sample of 65 countries<sup>7</sup>, Argentinean students, on average, are ranked in the 58th, 55th and 56th positions in the reading, mathematics and science scale respectively. The gap computed using principal components analysis is much bigger, as this analysis assigns more weight to the quality indicators. Additionally, as we show in the next section, the spending in education is slightly above what is expected for the Argentine income level, suggesting that reforms are needed.

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<sup>7</sup> The sample consists of all 30 OECD member countries plus 35 partner countries.

Argentina has water and sanitation indicators close to their expected levels: 97% of the population has access improved water resources and the 90% have access to improved sanitation facilities.

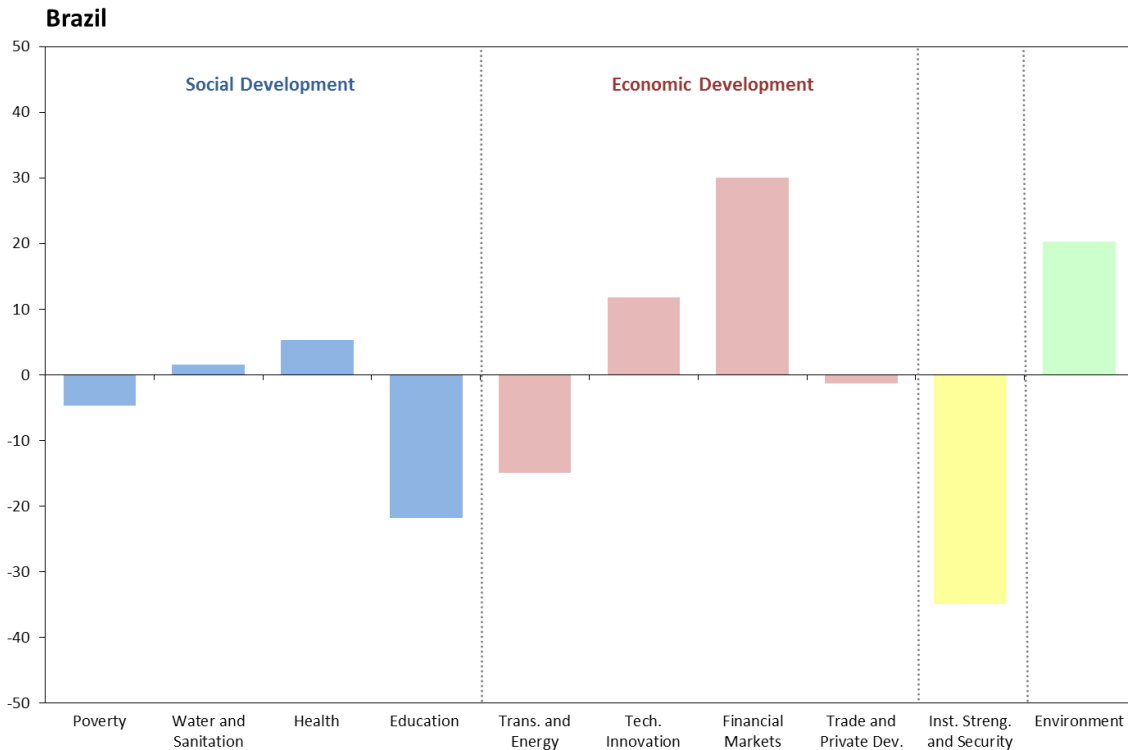
Argentina is better than expected (given its income level) in the health sector . The positive health outcome results from the fact that life expectancy at birth is higher than expected (76 years) and that the number of hospital beds per thousand people is the highest in South America (4.5 per 1,000 people). These positive indicators compensate the slightly bigger than expected infant mortality rate (12.6 per 1,000 live births).

In our composite environment metric Argentina is better than expected regarding the level of Co2 emissions, which compensates the higher than expected deforestation rate (16%, exceeded only by the 18% registered for Paraguay within the Southern Cone). (see Table 1).

## **Brazil**

Brazil is the biggest economy of Latin America and the eighth largest economy in the world, with a GDP that surpasses two trillion dollars. However, its per capita GDP measured by purchasing power parity is lower than Argentina, Chile and Uruguay (see Table 1).

**Figure 2**  
**Development Gaps, Brazil**



*Source: Own calculations*

As shown in Figure 2, our metrics suggest that Brazil’s development priorities lie in the area of institutional strengthening and citizen security, followed by education and by transportation and energy. Next come poverty reduction and trade capacity and private sector development, in descending order of priority. Brazil appears to be better than expected in the areas of water and sanitation, health, technological innovation and ICTs, environment and financial markets, in ascending order of priority. The principal component analysis shows a similar pattern, although it suggests a smaller positive gap in financial markets and a reversal of gaps in technological innovation and ICTs and in trade capacity and private sector development.

The largest negative gap for Brazil is in the area of institutions and citizen security. According to the last Ease of Doing Business report, Brazil is ranked 130 out of 185 economies, sizably below expectations. Brazil is slightly below its expected level in its governance indicators as reported by Worldwide Development Indicators, and significantly below norm in terms of citizen security.

As reported by the 20 results of the Program for International Student Assessment (PISA), Brazilian students, on average, are ranked in the 53rd, 57th and 53rd position in the reading, mathematics and science scale, suggesting that the quality of education is significantly below expectations. The adult literacy rate (90.3%) is also below its expected level.<sup>8</sup> This despite the fact that, as we show in the next section, Brazil shows a higher than expected spending in education, which suggests possible inefficiencies in the allocation of these outlays.

The third biggest gap in Brazil corresponds to transportation and energy. The perception of the quality of infrastructure and the railway network in Brazil are significantly lower than expected, while the density of the road network (relative to arable land) is almost as large as expected. In contrast, the percentage of households with an electricity connection is almost universal and exceeds its expected value.

Brazil still has pending tasks in the sector of poverty reduction. The percentage of population living on less than \$2 a day at 2005 international prices is almost 11%, and the proportion of urban population living in slums is around 27%

Our finding of a small gap in trade capacity building and private development is driven by the burden of customs procedures, where Brazil is the Southern Cone country with the second worst index after Argentina, and by the rate of entry of new business in the country, which is also below expectations. These two gaps offset the stronger than expected indicators that Brazil shows in the areas of ISO certification, percentage of exporting SMEs and the sophistication of its exports. It should be noted that the principal component analysis suggests instead a positive gap for Brazil in this area, by endogenously giving more weight to these last indicators.

The Brazilian marginally positive gap in water and sanitation sector results from a relatively high access to improved drinking water (98% of the population) that offsets the still subpar access to sanitation facilities (79% of the population).

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<sup>8</sup> The last available data for enrolment rates and for survival to 5<sup>th</sup> grade rates correspond to 2005, and hence were not used in the case of Brazil. A previous version of this paper using cross-country data for that year showed that Brazil had enrollment rates slightly below their expected level and that the survival rate to 5<sup>th</sup> grade had a vast gap relative to its expected value.

Brazil has a favorable standing in the area of health, due to the fact that life expectancy, infant mortality rates and the number of doctors and nurses are higher than expected, which compensate the still low number of hospital beds. By contrast, as we show in the next section, Brazil has a bigger positive gap for its indicators of spending in health (especially private spending), pointing towards the presence of inefficiencies in the provision of health services and infrastructure.

Brazil is the only Southern Cone country with a positive gap in the area of technological innovation and information technology and communications. The levels of internet and cellular subscribers (11.6% and 123% respectively) are above their expected levels, although broadband subscription rates (8.6%) are still subpar. Our composite positive gap for this sector is driven by the positive ITC indicators and by the highly favorable indicators of firm-level technology absorption, expenditure in R&D, and patent applications by non-residents in Brazil. Scientific publications per capita, U.S. patents granted to Brazilians and patent applications by residents in Brazil are slightly below their expected values.

Brazil has better than expected environmental indicators, especially in the case of deforestation rate, with CO2 emissions being slightly above the expected level.

The positive gaps observed for most of its financial sector indicators suggest that the domestic financial market is relatively well developed in Brazil. This country has the banking sector with the highest rate of bank branch penetration in the Southern Cone, which provides local business with a wide range of products and is attracting numerous new entrants. The Brazilian stock market is characterized by a capitalization that reaches almost 70% of the GDP and a stock market turnover ratio close to 63%. The insurance premium volume and the private credit, respectively representing 1.2% and 50% of GDP, are slightly below their expected levels.

## Chile

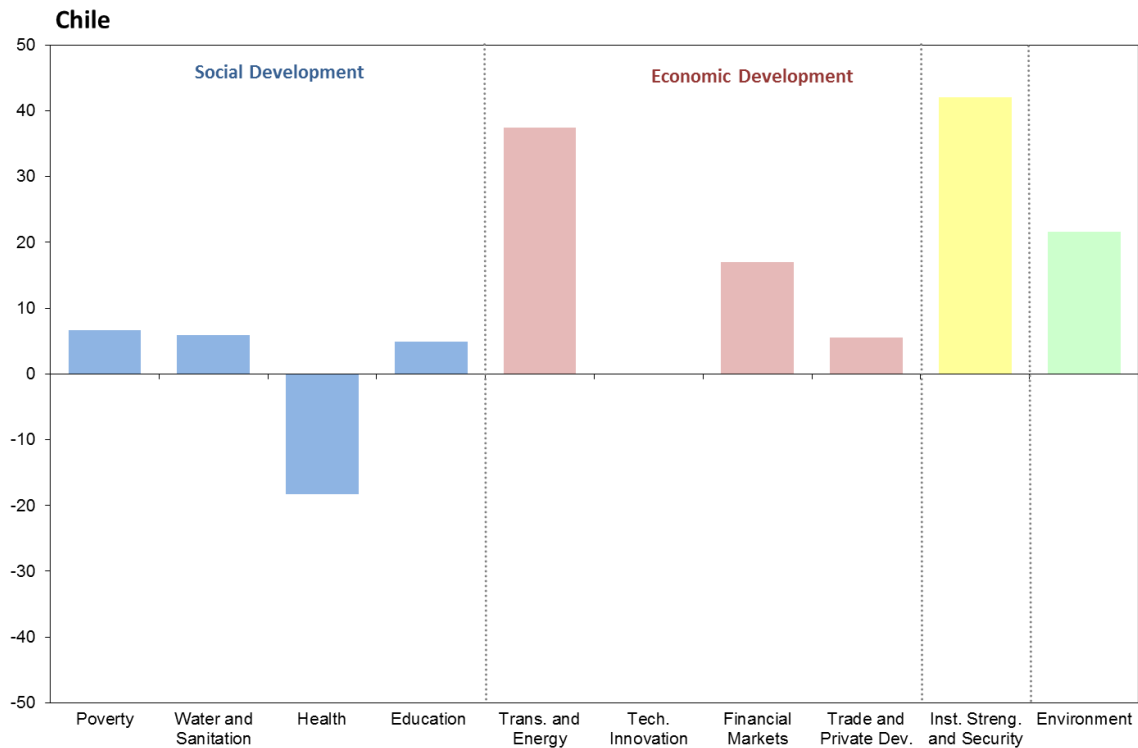
Chile's per capita real income annual growth from 1984 to 2011 averaged 4.18%, far above the rest of South American countries. Thus, Chile has become the country with the highest per capita GDP (at purchasing power parity) in the Southern Cone.<sup>9</sup> As such, Chile is also the only country in the Southern Cone that has been admitted as a full member of the Organization of Economic Co-operation and Development (OECD).

As shown in Figure 3, our metrics suggest that Chile's development priorities lie mostly in the health aspect of development. Chile appears to be very well positioned in the areas of transportation and energy and institutional strengthening and security. It also appears to perform well in the aspects of the environment and financial markets, while still performing reasonably well in poverty reduction, water and sanitation provision, trade capacity building and private sector development and education.

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<sup>9</sup> This economic prosperity has been characterized by a period of economic liberalization, privatization of state own companies, and macroeconomic stabilization. Moreover, during the last two decades this economic performance has been complemented with strengthening of institutions, political stabilization and an increasing focus on social aspects. According to the 2013 Index of Economic Freedom, Chile's economic freedom score is 79, making its economy the 7<sup>th</sup> freest in the 2013 *Index*. Chile enjoys the highest degree of economic freedom in the South and Central America/Caribbean region.

**Figure 3**  
**Development Gaps, Chile**



*Source: Own calculations*

Although Chile is the best achiever in terms of infant mortality rate and life expectancy among Southern Cone countries, it exhibits a large gap in health according to our metrics that is driven by the fact that the number of hospital beds, doctors and specially nurses are all smaller than expected for its per capita income level. This outcome is consistent with the fact that Chile presents lower than expected per capita public spending in health. This is partly offset by private expenditures, which bring total per capita expenditure in health closer to expected.<sup>10</sup>

Chile faces no gap in the aggregate area of technological innovation and information and telecommunication technologies. This country fares below expectations in ITC indicators such as internet and broadband subscriptions, and in technological innovation indicators like international patents, investment in R&D, scientific publications and patent applications by residents. These subpar indicators are offset by the good indicators

<sup>10</sup> In fact total health expenditure as a percentage of GDP is above the norm, reducing somewhat the overall gap in the health sector.

of firm-level technology absorption. The principal components analysis proposes instead the presence of a significantly large negative gap in this sector, resulting from its assigning bigger weight to the subpar indicators of information technologies and of R&D spending and patenting.

Although Chile performs well overall in education, this is mostly due to good indicators in enrollment and literacy. The pre-primary net enrolment ratio is above expectations, while adult literacy rate (97%), gross enrollment ratio and the survival rates to 5<sup>th</sup> grade are slightly above their expected levels. According to the Program for International Student Assessment (PISA) the performance of Chilean students is particularly deficient in the math scale. In a sample of 65 countries, Chilean students, on average, are ranked in the 44th, 49th and 44th positions in the reading, mathematics and science scale respectively. This finding is consistent with the lower than expected public spending in education.<sup>11</sup> The principal components analysis suggests instead a small negative gap in education, by assigning bigger weight to the indicators of quality of education.

Our metrics show Chile to be above expectations in the area of trade capacity building and private sector development. This finding is driven by the fact that Chile ranks 21 out of 143 countries in terms of burden of customs procedures, has a relatively large share of firms with ISO certifications (22%) and a somewhat above average business entry rate (4%). However, Chile performs quite poorly in terms of export sophistication (its exports have a significantly lower income content than those of the other Southern Cone countries). Additionally Chile shows a lower than expected percentage of exporting SME. In this case the principal component analysis proposes once again a small negative gap in this sector by assigning bigger weight to the subpar indicators of export sophistication and exporting SME.

Regarding water and sanitation, our last available observation reports that 96% of the population has both access improved water resources and to improved sanitation

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<sup>11</sup> This is consistent with findings by Lopez and Miller (2008) which find very low public expenditure combined with high inequality explain most of the gap in the quality of education.



facilities. The access to sanitation indicator is above the expected level, while the access to improved drinking water is almost as expected.

The Chilean sustained economic growth of the last two decades has allowed a sizable reduction of poverty. The percentage of population living on less than \$2 a day at 2005 international prices is 2.7% and the proportion of urban population living in slums is 9%, the lowest Southern Cone levels. Nevertheless, the poverty headcount is still larger than it would be expected for a country with Chilean per capita GDP.

Overall, the domestic financial development of Chile is better than expected. The total amount of loans available to economics agent measured as the credit to the private sector as percentage of the GDP (78%) is the highest in the Southern Cone, almost 60% higher the Brazilian level (50%). Although the stock market is characterized by a high capitalization (132%), far above expectations, its turnover ratio is small (19%) and below what would be expected according to its level of income. With respect to bank branch penetration, Chile exhibits a lower than expected number, while insurance activity levels given its per capita income level are slightly above the norm.

Chile is performs better than expected in terms of the aggregate environmental indicator, with a lower than expected levels of CO2 emissions and of deforestation rates.<sup>12</sup>

The positive outcome in transportation and energy is driven by the high quality of overall infrastructure, the relatively high density of railroads (relative to arable land) and the almost universal electrification rate (99%). According to the 2012-13 World Economic Forum executive opinion survey, Chile was ranked 31 out of 144 economies in terms of quality of overall infrastructure. On the other hand, the density of its road network is below expectations. The principal components analysis proposes instead a smaller positive gap in this sector, assigning lower weight to railroad density.

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<sup>12</sup> However, this masks many potential problems. Lopez and Miller (2008) discuss that a large proportion of economic activity in Chile is exploiting natural resources, not always in the most sustainable way as examples in fisheries in the 1990s and salmon aquaculture more recently show.

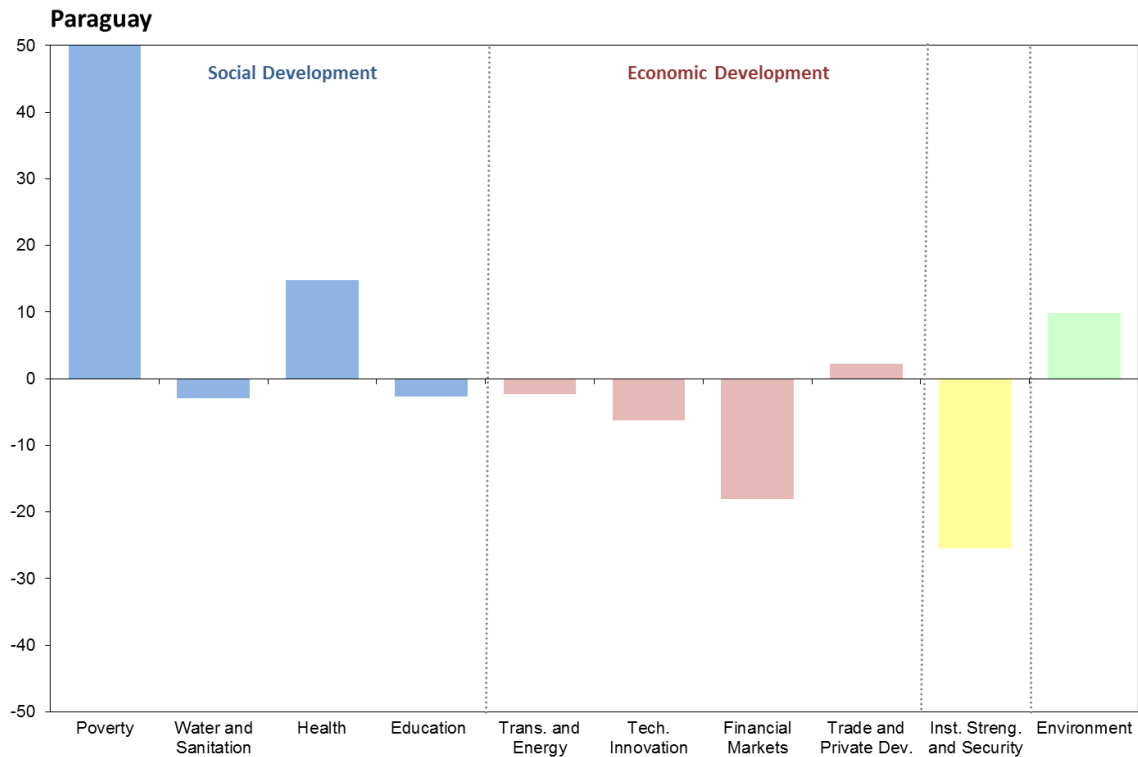
Institutions and citizen security are relatively well developed in Chile, and this is the only Southern Cone country that has a significant positive gap in this sector. According to the last “Ease of Doing Business” index, Chile is ranked 37 out of 185 economies. Additionally, Chile is far above its expected level in the six dimensions of the Worldwide Governance Indicators. Finally, Chile is the only country above its expected level in the area of citizen security with a very strong reliability on police services, a small business cost of crime and violence, and a small rate of homicides.

### **Paraguay**

Paraguay is the poorest economy in the Southern Cone. In 2012, Paraguay’s per capita income at PPP 2005 international prices was roughly half the level of Brazil and around a third of the level of per capita income of Chile.

As shown by Figure 4, our metrics suggest that Paraguay’s biggest development gaps lie in the institutional and economic areas of development. The most critical area is institutional strengthening and citizen security. The next development priorities lie in the areas of financial markets, technological innovation and ICTs, with water and sanitation, education, and transportation and energy exhibiting lower gaps. Paraguay appears to better than expected (given its income level) in the areas of poverty, health, the environment and also in the trade, capacity building and private sector development.

**Figure 4**  
**Development Gaps, Paraguay**



*Source: Own calculations*

The biggest gap for the country lies in the area of institutional strengthening and citizen security. According to the last “Ease of Doing Business” index, Paraguay is ranked 103 out of 185 economies, although this is the ranking that is expected given its income per capita. What drives the sectoral gap is the fact that Paraguay is below its expected level in the six dimensions of governance reported by Worldwide Development Indicators, and that, according to the last World Economic Forum executive opinion survey, in a sample of 144 countries Paraguay is ranked 121 and 138 on business cost of crime and violence and on reliability of police services respectively.

The most lagging sector in the economic dimension of development is financial markets. This outcome results from the fact that Paraguay is far below its expected level in our five available indicators of domestic financial development. Stock market capitalization as percentage of the GDP is 2%, and its turnover ratio is 3% while private

credit as percentage of the GDP is 32%. Bank branch penetration and insurance activity are also below their expected outcomes.<sup>13</sup>

Paraguay has ICT indicators that are low, even taking into account its income level: the rates of penetration of on internet, broadband respectively are 1.6%, 0.9%; while cell phone subscribers are at about expected at 99 per 100 inhabitants. The country really lags behind on the technological innovation area: firm-level technology absorption is well below the expected level, while domestic and international patents, R&D spending and scientific publications are slightly below expectations. Only patent applications by non-residents exceed expectations. The principal component analysis proposes a much bigger negative gap in this sector, assigning more weight to the poorer indicators.

In the water and sanitation sector, 86% of the population has access to improved water resources and 71% have access to improved sanitation facilities. Although the proportion of the population without access to sanitation facilities is as expected for the per capita income of Paraguay; the proportion of the population with reasonable access to an adequate amount of water is below its expected level.

Education in Paraguay has to be analyzed carefully. Given that the indicators of quality of education are not available for Paraguay our metric shows only a small gap in education. This is largely driven by the higher than expected adult literacy rate (95%), and survival rate to 5<sup>th</sup> grade, which somewhat offsets very low pre-primary net enrollment and gross enrollment rates.

The perception of the quality of the infrastructure in Paraguay is one of the worst in the world. According the World Economic Forum survey, Paraguay is ranked 140 out of 144 countries in this subject. Poor quality dominates over quantity, as only 15% of roads are paved (IDB, 2011), and the density of the road network (relative to arable land) is almost as expected. The electrification rate (96%) is much higher than expected for the per capita income of the country.

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<sup>13</sup> This is consistent also with results by Garay et al (2013) that show a banking access index of 25%, about one-half of the Latin American average.

Our small but positive gap in trade capacity building and private sector development is driven by the higher than expected index of burden of customs procedures and the slightly higher than expected proportion of SME exporting firms (15%). However, Paraguay exhibits slightly lower than expected levels of firms with ISO certification (15%) and of sophistication (income content) of its exports. The indicator of business entry rate is missing for Paraguay.

Paraguay has a smaller infant mortality rate (19 out of 1,000 live births) than countries with a similar per capita income and higher than expected life expectancy at birth. The number of hospital beds is below their expected levels, while the number of doctors and nurses are not available. Like most other Southern Cone countries, the overall spending in health is above the expected level, but the government spending in health is below expectations.

Paraguay's environmental achievement is driven by lower than expected CO2 emissions that compensate for a slightly bigger than expected deforestation rate.

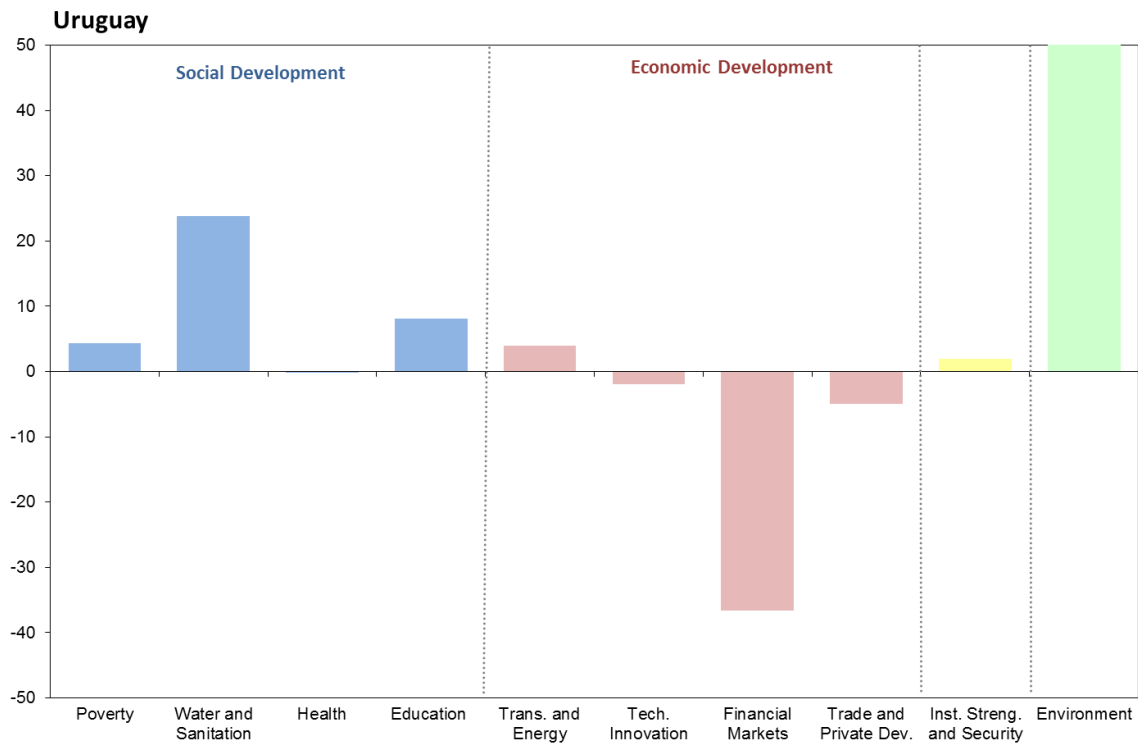
Finally, in comparison to countries with similar level of income, Paraguay has a much smaller than expected proportion of population living on less than \$2 a day at international prices (14%) and of population living in slums (18%).

## **Uruguay**

Uruguay has an economy that is largely based on natural resources, with a large state-owned enterprise sector but also a significant inflow of Foreign Direct Investment in recent years. It has the third largest per capita income (PPP 2005 international prices) among our five Southern Cone countries (See Table 1).

As shown in Figure 5, our metrics suggest that Uruguay's development priorities lie in most of the economic development areas. The most critical sector is financial markets, followed by trade capacity building and private sector development, and technological innovation and ICTs.

**Figure 5**  
**Development Gaps, Uruguay**



*Source: Own calculations*

By contrast, our results suggest that Uruguay is relatively well positioned in the social, institutional and environmental sectors. The country appears to be on its expected level in health, and above expectations (in ascending order) in institutional strengthening and citizen security, infrastructure, poverty reduction, education, water and sanitation and environment.

The biggest gap for Uruguay is the underdevelopment of domestic financial markets. Uruguay is below its expected level in all our five financial indicators. The stock market capitalization (as percentage of the GDP) and the turnover ratio are among the lowest in South America (0.4% and 2.9%, respectively). The credit to the private sector (21% of the GDP) is far below its expected level in comparison to countries like Brazil (50%) and Chile (78%). The banking branch penetration is smaller than in Argentina, Chile and Brazil and the insurance premium volume (0.9%) is half as large as in Chile.

According to the metrics proposed here, the second most lagging sector in Uruguay is trade capacity building and private sector development. The observed gap is driven by the much lower than expected proportion of firms with ISO certification (10.8%), far below countries such as Brazil and Chile where the proportion is higher than 22%. Uruguay is slightly better than expected in all the other indicators (burden of customs procedures, SME exporting firms, export sophistication and business entry rate). The principal components analysis assigns bigger weight to the unfavorable indicator of ISO certification rate, yielding a bigger negative gap for this sector.

The next most lagging sector is technological innovation and ICT. The biggest gaps lie in the area of technological capabilities, as firm-level technology adoption, R&D expenditures, international patents and scientific publications and patent applications by residents are significantly below expectation. Only patent applications by non-residents exceed expectations. The area of ICT is better off: the proportions of people subscribed to internet (13.5%), to and cellular (140.8%) are above the expected levels given Uruguay's per capita income (especially cellular subscriptions). As a result of the compensation between the strength of ICT and the relative weakness of technological capabilities, the synthetic indicator for the sector as a whole is just a tad below its expected level. However, the principal components analysis suggests a much bigger negative aggregate gap for the sector, attaching more weight to the technological capabilities indicators.

Uruguay has slightly higher than expected institutional strength and citizen security. Its standing in the Ease of Doing Business Index of the World Economic Forum is under par (ranking 89 out of 185 countries), but it is compensated by the much higher than expected governance indicators. The country additionally does slightly better than expected in terms of the synthetic indicator of citizen security.

Our metrics further suggest that Uruguay has reached more than acceptable development levels in the social sectors in comparison to countries with similar per capita income. The aggregate health outcome is in line with expected levels. Uruguay has a much lower than expected number of hospital beds that is more offset by the higher than expected number of nurses and doctors, the lower than expected infant mortality rates and

a higher than expected life expectancy. The principal components analysis yields a small positive aggregate gap by assigning less weight to the subpar number of hospital beds. These relatively good health outcome indicators are consistent with the fact that Uruguay's total health expenditures relative to GDP are bigger than expected as shown in the next section.

Uruguay appears better than expected regarding poverty reduction, as the percentage of population living on less than \$2 a day at 2005 international prices is just 1.6%, the second lowest level in the Southern Cone.

In education, the preprimary net enrollment rate (77.7%), the gross enrolment ratio for all levels save pre-primary (90%) and the adult literacy rate (98%) are among the highest in South America, and exceed expectations. The same applies to survival rates to 5<sup>th</sup> grade. In addition, although the quality of the education is still below expectations, the performance of Uruguayan students in international standardized tests has been higher than most of its Southern Cone peers, save for Chile. According to the Program for International Student Assessment (PISA), Uruguayan students, on average, are ranked in the 47th, 48th and 48th position in the reading, mathematics and science scale (out of 65 evaluated countries). It should be noted however that the principal components analysis points to a small negative aggregate gap in this sector, attaching more weight to the education quality indicators. Additionally, Uruguay appears to spend less than expected in education.

Uruguay has bigger than expected railroad network density and electrification rate (98.3%), which offset the below par perceived quality of infrastructure, making the aggregate infrastructure indicator be slightly above norm.

The second strongest sector of Uruguay (after environment) is water and sanitation. According to the Millennium Development Goal Indicator, the percentage of population with access to improved drinking water sources and improved sanitation facilities already reaches 100%.



Uruguay has a much higher than expected environmental achievement given its per capita GDP, resulting from significantly better than expected CO2 emissions and deforestation rate.

### **Other South American Countries and United States**

Although we focus our analysis in our five Southern Cone countries of interest, in order to have a set of benchmark countries Table 2 reports development gaps for Bolivia, Colombia, Ecuador, Mexico, Peru, Venezuela and United States.

**Table 2**  
**Development Gaps, South America and United States**

Country	Social Development				Economic Development				Inst. Streng. And Security	Environment
	Poverty	Water and Sanitation	Health	Education	Transportation and Energy	Tech. Innovation	Financial Markets	Trade Build. Cap. And Private Dev.		
Argentina	-6.8	1.1	11.1	-2.5	-29.1	-10.2	-37.0	-25.0	-50.0	5.3
Brazil	-4.8	1.5	5.3	-21.9	-15.0	11.7	30.1	-1.3	-35.0	20.3
Chile	6.6	5.9	-18.3	4.9	37.4	-0.1	16.9	5.6	42.0	21.6
Paraguay	50.0	-2.9	14.8	-2.7	-2.4	-6.2	-18.1	2.2	-25.5	9.8
Uruguay	4.4	23.9	-0.2	8.1	3.9	-2.0	-36.6	-4.9	6.8	50.0
Bolivia	-2.1	-48.9	-24.7	11.8	0.4	-21.0	-13.4	0.6	-37.3	8.7
Colombia	7.7	-7.9	-17.7	-8.4	-3.5	-16.9	-4.2	0.4	-14.6	23.4
Ecuador	16.1	21.1	3.4	25.0	1.1	-22.7	-18.2	-35.2	-50.0	6.2
Mexico	4.9	-2.8	-6.8	0.4	-15.6	-17.9	-22.1	-2.1	-37.6	10.3
Peru	-10.3	-31.0	-3.7	-14.4	-16.1	-18.8	9.9	-9.2	-10.0	21.8
Venezuela	-22.9	2.1	-13.4	19.6	-38.0	-29.5	-30.2	-50.0	-50.0	-12.6
United States		-6.1	-9.2	-12.4	-41.1	31.5	49.4	-6.2	13.2	-50.0

## 5.2. *Outcomes versus Inputs*

One possible explanation for the development gaps presented earlier is that they are caused by insufficient investment or a deficiency of policies that govern investment in each sector. In order to assess this possibility we construct the same indicators as above for two of our sectors, health and education, but focusing on gaps in inputs rather than in outcomes. Inputs are defined in terms of social expenditure in these sectors. The list of indicators by outcome and income categories is presented in Appendix 1. Our results, presented in Table 3, report both the outcome and input gaps for the areas of health and education.

**Table 3**  
**Outcomes versus inputs**

<b>Country</b>	<b>Health outcome</b>	<b>Health input</b>	<b>Education outcome</b>	<b>Education input</b>
<b>Argentina</b>	<b>11.1</b>	<b>3.0</b>	<b>-2.5</b>	<b>0.9</b>
<b>Brazil</b>	<b>5.3</b>	<b>8.7</b>	<b>-21.9</b>	<b>21.0</b>
<b>Chile</b>	<b>-18.3</b>	<b>-10.7</b>	<b>4.9</b>	<b>-15.9</b>
<b>Paraguay</b>	<b>14.8</b>	<b>22.3</b>	<b>-2.7</b>	<b>-6.1</b>
<b>Uruguay</b>	<b>-0.2</b>	<b>4.4</b>	<b>8.1</b>	<b>-19.1</b>

*Source: Own calculations*

### **Argentina**

Argentina is the Southern Cone country with the highest level of per capita expenditure in health, although it falls behind Paraguay and Brazil when health spending is measured relative to its GDP (8.1%). According to our health input metric reported in Table 3, the spending in health is slightly higher than expected for its income level. This result is driven by the higher than expected spending relative to GDP, as both total health spending per capita and government health spending per capita are slightly below the norm. In the case of health outcomes we also observe a higher than expected level, suggesting aggregate consistency between health inputs and outcomes.

Regarding education, the spending in this area is a bit above what is expected for the Argentine income level. This result is driven by the much higher than expected public spending in education relative to GDP (at 6% it is the largest in the Southern Cone), which

offsets the subpar spending per student at the primary level. At the same time, our outcome gap reveals that Argentina is below its expected level (and much below if we use the principal component analysis). These results indicate that probably reforms are needed in the educational sector. Recall that the under par outcome is driven by poor student performance in international standardized tests, suggesting that increased investment should really focus on improving “quality” of the education.

### **Brazil**

As shown by Table 3, Brazil exhibits higher than expected spending in health and health outcomes, although the latter has a smaller positive gap. Both gaps are relatively small indicating that overall the health expenditures and their productivity are at acceptable levels according to Brazil’s per capita income. Only the per capita government health spending is below norm.

In contrast Brazil shows an important discrepancy between higher than expected spending in education (especially the spending per student at the primary level) and the lower than expected educational outcome. This implies that priorities in this area may lie mostly in policy reforms rather than increasing investments. The lower than expected level in the outcome gap is driven by the quality of the education suggesting that technical assistance should be relatively more oriented to improve student performance.

### **Chile**

For Chile we observe an apparent efficiency in education, as inputs (spending) are below expectations while outcomes are above norm. By contrast, there is an apparent inefficiency in health services provision, as the negative gap in outcome is bigger than the negative gap in spending. Expenditure in health in Chile as percentage of the GDP is the lowest in the Southern Cone (7.5%), which is reflected in the subpar numbers of beds, nurses and doctors

## **Paraguay**

Our metrics in Table 3 show that the health sector in Paraguay is better than expected in both outcome and input gaps (in comparison to lower-middle-income countries). The expenditure in health in Paraguay as percentage of the GDP is 9.7%. The magnitude of the gap is bigger for spending in health, suggesting that there could be some room for improving the efficiency of health inputs. Paraguay shows a small negative gap in education outcome and a bigger negative gap in spending in education, suggesting that the still subpar inputs are used in a relatively efficient way. This result suggest that government spending in education probably needs to increase in order to bring education achievements at least in line with those of comparator countries.

## **Uruguay**

Finally Table 3 implies that there might be some room for improving Uruguay's health sector, as spending in this sector is a bit above norm (especially in per capita terms), while outcome is just a tad below expectations. Despite a clearly subpar spending in education, the outcome in this sector is slightly higher than expected. These results suggest that in Uruguay education expenditure is very productive and that the country has good opportunities to improve education (especially in quality) by increasing expenditure in this subject and improving its allocation.

### **5.3. *Cost of Closing Gaps***

Using our metrics calculated in Section 5.1, we estimate the cost of closing the gaps in two of our indicators: access to improved drinking water and access to sanitation facilities. Given that estimating the cost of closing gaps is not the goal of this paper we present these estimates as illustrative examples, only for the cases where unit costs were available for our individual indicators. The evaluation of the set of remaining indicators is left as a subject of future research.

Table 4 reports the cost of closing the gap in the two development indicators for which data are available. The table indicates the country, the unit of measurement (such as the number of households in the country or population), the cost by unit (such as the cost of a

connection to water by household), the actual and expected levels for each indicator, the development gap ( $Gap = Observed\ level - Predicted\ level$ ) and the total cost of closing the gap. The total cost in US dollars is obtained using the following equation:

$$Total\ Cost = Unit \times Unit\ Cost \times Gap$$

Regarding access to improved drinking water, among the five countries in analysis, only Chile and Paraguay are slightly below their expected levels. The estimated cost of closing the gap in the water sector is US\$7 million in Chile and US\$10 million in Paraguay.

Argentina and Brazil are below the norm in water and sanitation (only slightly in the case of Argentina). The total investment requirement to close the gap in the sanitation sector is US\$32 million in Argentina and US\$2.7 billion in Brazil.

**Table 4**  
**Cost of closing gaps**

Country	Unit	Unit Cost (US\$)	Actual	Expected	Gap	\$ for closing gap
<i>Access to improved drinking water</i>						
<i>Households</i>						
Argentina	12,914,777	400	97%	96%	0%	\$ -
Brazil	64,873,134	400	98%	94%	0%	\$ -
Chile	5,056,787	400	96%	96%	0.4%	\$ 7,150,427
Paraguay	1,634,363	400	86%	88%	1.5%	\$ 9,862,623
Uruguay	1,184,955	400	100%	96%	0%	\$ -
<i>Sanitation facilities</i>						
<i>Households</i>						
Argentina	12,914,777	700	90%	90%	0.4%	\$ 32,258,685
Brazil	64,873,134	700	79%	85%	6.1%	\$ 2,749,450,259
Chile	5,056,787	700	96%	91%	0%	\$ -
Paraguay	1,634,363	700	71%	71%	0%	\$ -
Uruguay	1,184,955	700	100%	89%	0%	\$ -

## 6. Conclusions

In this paper we have constructed, based on a comprehensive dataset and an original methodology, measures of development gaps in all countries in the world with available data on the target development indicators. We analyze these gaps for five Southern Cone

countries: Argentina, Brazil, Chile, Paraguay and Uruguay. Forty-three outcome indicators and six input indicators were used and grouped in 10 sectors which capture the social, economic, institutional and environmental dimensions of development.

The results show that all Southern Cone countries still need to close significant development gaps in some specific sectors. The areas of relative underdevelopment are quite heterogeneous across countries; while some countries display significant gaps in social areas, other countries evidence significant gaps in economic development. Thus, these results suggest that financial and technical support for physical investment and policy reform are required in most Southern Cone countries in order to close gaps in areas such as institutions, health, education, or financial markets.

Comparing outcome with input gaps, our results give an indication of whether these development gaps could be a consequence of insufficient investment or inefficiencies in government spending in the area. Therefore, these results are relevant to discern if a country requires financial or technical support in a specific area.

Finally, we report estimates of the cost of closing gaps for some specific indicators where unit costs are available. We believe that similar estimations for the set of remainder indicators also deserve examination but this is left for future research.

## Appendix 1. Description of variables

Variable	Description	Source	Last year	Year used
gdppcpcpp_const	GDP per capita, PPP (constant 2005 international \$)	World Development Indicators	2011	
<b>1. Poverty and Informality</b>				
<i>Outcome indicators (2)</i>				
headcount2	Poverty headcount ratio at \$2 a day (PPP) (% of population)	World Development Indicators	2011	2008-2011
slumpop	Slum population as percentage of total urban population	Millennium Development Goal Indicators	2009	2005-2009
<b>2. Health and Nutrition</b>				
<i>Outcome indicators (5)</i>				
infort	Mortality rate, infant (per 1,000 live births)	World Development Indicators/World Health Organization	2011	2011
lifeexp	Life expectancy at birth, total (years)	World Development Indicators/World Health Organization	2011	2011
doctors	Number of Physicians (per 1,000 people)	World Development Indicators/World Health Organization	2012	2009-2012
nursing	Nurses and midwives (per 1,000 people)	World Development Indicators/World Health Organization	2012	2009-2012
beds	Hospital beds (per 1,000 people)	World Development Indicators/World Health Organization	2011	2009-2011
<i>Input indicators (3)</i>				
pcgovhealth	Per capita government expenditure on health (PPP int. \$)	World Health Organization	2011	2011
pchealth	Per capita total expenditure on health (PPP int. \$)	World Development Indicators/World Health Organization	2011	2011
health2gdp	Total expenditure on health (as percentage of GDP)	World Development Indicators/World Health Organization	2011	2011
<b>3. Education</b>				
<i>Outcome indicators (6)</i>				
reading	Mean score in student performance on the reading scale	Pisa (OECD)	2009	2009
science_math	Student performance on math scale and science scale	Pisa (OECD)	2009	2009
enrolment	Gross enrolment ratio. All levels combined (except pre-primary)	UNESCO	2012	2009-2012
preprimary	Net enrolment rate. Pre-primary	UNESCO	2012	2009-2012
literacy	Adult literacy rate (%). Total	UNESCO	2011	2009-2011
survivalrate5	Survival rate to grade 5 (%). Total	UNESCO	2011	2008-2011
<i>Input indicators (3)</i>				
educexp	Public expenditure on education (as % of GDP)	UNESCO	2012	2008-2012
educprim	Expenditure per student, primary	World Development Indicators	2011	2008-2011
educsec	Expenditure per student, secondary	World Development Indicators	2011	2008-2011
<b>4. Transportation and Energy</b>				
railarable	Km of roads (as % of total arable land)	World Development Indicators	2011	2008-2011
roadarable	Km of railways (as % of total arable land)	World Development Indicators	2010	2008-2010
infrastructure	Quality of overall infrastructure	World Economic Forum	2012	2011
electrification	Access to electricity (% of population)	World Development Indicators	2009	2009
<b>5. Technological Innovation</b>				
internet	Internet Subscribers (per 100 inhabitants)	ITU	2011	2009-2011
broadband	Broadband Users (per 100 inhabitants)	ITU	2011	2010-2011
cellular	Cellular subscribers (per 100 population)	Millennium Development Goal Indicators	2011	2010-2011
firmtechn	Firm-level technology absorption	World Economic Forum	2012	2011
rd	R&D spending (as % of GDP)	World Development Indicators	2011	2008-2010
papers1	Number of Scientific papers written in all fields (per million population)	Information Sciences Institute	2009	2009
usptopat	Patents granted by USPTO (per million population)	KAM - World Bank	2011	2010-2011
patents_nonres	Patent applications, nonresidents (per million population)	World Development Indicators	2011	2008-2011
patents_res	Patent applications, residents (per million population)	World Development Indicators	2011	2008-2011
<b>6. Water and Sanitation</b>				
impdrinkwater	Proportion of the population using improved drinking water sources	Millennium Development Goal Indicators	2010	2007-2010
sanitationfac	Proportion of the population using improved sanitation facilities	Millennium Development Goal Indicators	2010	2007-2010
<b>7. Institutional Strengthening and Citizen Security</b>				
doingbus	Ease of Doing Business	World Development Indicators	2012	2011
governance	Average of control of corruption, government effectiveness, political stability and absence of violence, regulatory quality, rule of law, voice and accountability	Worldwide Governance Indicators (World Bank)	2011	2008-2012
security	Average of business cost of crime and violence, reliability of police services, and homicide rate	World Economic Forum / United Nations Office on Drugs and Crime (Homicide Rate)	2012	2008-2012
<b>8. Finance</b>				
stmktcap	Stock market capitalization (as % GDP)	Financial Development and Structure Dataset - World Bank	2011	2009-2011
pcrdbofgdp	Private credit by deposit money banks and other financial institutions (as % GDP)	Financial Development and Structure Dataset - World Bank	2011	2009-2011
stturnover	Stock market turnover ratio	Financial Development and Structure Dataset - World Bank	2011	2009-2011
dem_branch	Commercial bank branches (per 100,000 adults)	World Development Indicators	2011	2009-2011
insurance	Life and non-life insurance premium volume (as % of GDP)	Financial Development and Structure Dataset - World Bank	2011	2009-2011
<b>9. Trade Building Capacity and Private Development</b>				
burdencustpr	Burden of customs procedures	World Development Indicators	2012	2011-2012
SME Exporters	Percentage of SME exporting firms	Enterprise Surveys (World Bank)	2012	2008-2012
ISO certification	ISO certification ownership (% of firms)	World Development Indicators	2012	2008-2012
busentry	New business density (new registrations per 1,000 people ages 15-64)	World Development Indicators	2011	2009-2011
expyppp	Export sophistication measure	World Bank	2006	2006
<b>10. Environment</b>				
co2	CO2 emissions (metric tons per capita)	World Development Indicators	2009	2009
change_forest	Change % of land covered by forest since 1990 (1990-100)	World Development Indicators	2011	2011



## **Appendix 2**

### **Description of variables used in our analysis by sector**

#### **Poverty**

- *Poverty headcount ratio at \$2 a day (PPP)*: It is the percentage of the population living on less than \$2.00 a day at 2005 international prices. The international poverty lines are based on nationally representative primary household surveys.
- *Slum population*: Proportion of urban population living in slums. The actual proportion of people living in slums is measured by a proxy, represented by the urban population living in households with at least one of the four characteristics: (a) lack of access to improved water supply; (b) lack of access to improved sanitation; (c) overcrowding (3 or more persons per room); and (d) dwellings made of non-durable material.

#### **Health**

- *Infant mortality rate*: It is the probability of a child born in a specific year or period dying before reaching the age of one, if subject to age-specific mortality rates of that period. Infant mortality rate is strictly speaking not a rate (i.e. the number of deaths divided by the number of population at risk during a certain period of time) but a probability of death derived from a life table and expressed as rate per 1,000 live births. They also reflect the social, economic and environmental conditions in which children (and others in society) live, including their health care.
- *Life expectancy at birth*: Average number of years that a person can expect to live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.
- *Number of doctors*: Number of medical doctors (physicians), including generalist and specialist medical practitioners, per 1,000 population. Preparing the health workforce to work towards the attainment of a country's health objectives represents one of the most important challenges for its health system.
- *Number of nurses*: Number of nursing and midwifery personnel per 1,000 population.

- *Number of Beds:* Hospital beds include inpatient beds available in public, private, general, and specialized hospitals and rehabilitation centers. In most cases beds for both acute and chronic care are included. It is expressed per 1,000 population terms.
- *Per capita general government expenditure on health (PPP international dollar):* Health financing is a critical component of health systems.
- *Per capita total expenditure on health (PPP international dollar):* Health financing is a critical component of health systems.
- *Total expenditure in health:* Level of total expenditure on health (THE) expressed as a percentage of gross domestic product (GDP).

## **Education**

- *Student performance on the science and mathematics scale:* Mean score of the PISA tests in the student performance on the science and mathematics scale. The mathematical literacy definition for OECD/PISA is “*Mathematical literacy is an individual’s capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual’s life as a constructive, concerned and reflective citizen*”. The scientific literacy definition for OECD/PISA is “*the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity*”.
- *Student performance on the reading scale:* Mean score of the PISA tests in the student performance on the reading scale. The reading literacy definition for OECD/PISA is “*Reading literacy is understanding, using, and reflecting on written texts, in order to achieve one’s goals, to develop one’s knowledge and potential, and to participate in society.*”
- *Gross enrolment ratio:* Number of pupils or students enrolled in all levels of education (*except pre-primary*), regardless of age, expressed as a percentage of the official school-age population corresponding to the same level of education. For the

- tertiary level, the population used is the 5-year age group starting from the official secondary school graduation age.
- *Net Enrolment Rate (pre-primary)* : Total number of pupils or students in the theoretical age group for a given level of education enrolled in that level, expressed as a percentage of the total population in that age group. In this case, the indicator is only based on pre-primary level.
  - *Adult literacy rate*: Literacy computes the number of literate persons in a given age group, expressed as a percentage of the total population in that age group. The adult literacy rate measures literacy in persons aged 15 years and above and the youth literacy rate in persons aged between 15 and 24 years.
  - *Survival rate to grade 5*: The percentage of a cohort of pupils or students enrolled in the first grade of a given level or cycle of education in a given school year who are expected to reach a given grade (5 in this case), regardless of repetition.
  - *Public expenditure on education*: Public expenditure (current and capital) includes government spending on educational institutions (both public and private), education administration as well as subsidies for private entities (students/households and other private entities). It is expressed as percentage of GDP.
  - *Public expenditure per student in primary education*: It is the total public expenditure per student in primary education, expressed in current dollars.
  - *Public expenditure per student in secondary education*: It is the total public expenditure per student in secondary education, expressed in current dollars.

## **Transportation**

- *Rail*: Total railway network divided by arable area. Rail lines are the length of railway route available for train service, irrespective of the number of parallel tracks. Arable area is a country's arable and permanent cropland. The indicator that is usually used is density relative to total land area. However, the desired density depends positively on several factors such as location and density of population. To adjust for

this factors we measure density relative to arable land, as population density tends to be bigger in these areas. This comment also applies to the road network density.

- *Road*: Total road network divided by arable area. Total road network includes motorways, highways, and main or national roads, secondary or regional roads, and all other roads in a country. Arable area is a country's arable and permanent cropland.
- *Infrastructure*: Survey of perception about overall quality of infrastructure, drawn from the World Economic Forum's Executive Opinion Survey. Variable is measure as weighted average of opinions, ranging between 1 (extremely poor) and 7 (extensive and efficient by international standards).
- *Electrification*: Percentage of households with an electricity connection.

### **Technological Innovation**

- *Internet*: Internet Subscribers per 100 inhab. Internet users are people with access to the worldwide network.
- *Broadband*: Broadband Users per 100 inhab. Fixed broadband subscribers are users of the Internet who subscribe to paid high-speed access to the public Internet. High-speed access is at least 256 kilobits per second in one or both directions.
- *Cellular*: Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service using cellular technology, which provide access to the public switched telephone network. Post-paid and prepaid subscriptions are included.
- *Firm-level technology absorption*: Survey of perception about the extent of new technology that the business sector of each country absorbs, drawn from the World Economic Forum's Executive Opinion Survey. Variable is measure as weighted average of opinions, ranging between 1 (not at all) and 7 (aggressively absorb).
- *Research and development spending*: Expenditures for research and development are current and capital expenditures (both public and private) on creative work undertaken systematically to increase knowledge, including knowledge of humanity, culture, and society, and the use of knowledge for new applications. R&D covers basic research, applied research, and experimental development.

- *Papers*: Number of scientific and technical journal articles refer to the number of scientific and engineering articles published in the following fields: physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences.
- *Patents granted by USPTO*: Number of patents granted by country of origin per million people
- *Patent applications by nonresidents*: Patent applications are worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office for exclusive rights for an invention. In this indicator, it is based on nonresidents contributions and it is expressed per million inhabitants.
- *Patent applications by residents*: It is based on residents contributions and it is expressed per million inhabitants.

### **Water and Sanitation**

- *Improved drinking water sources*: Percentage of the population with reasonable access to an adequate amount of water from an improved source, such as a household connection, public standpipe, borehole, protected well or spring, and rainwater collection. Reasonable access is defined as the availability of at least 20 liters a person a day from a source within one kilometer of the dwelling. Drinking-water quality is an issue of concern for human health in developing and developed countries world-wide.
- *Improved sanitation facilities*: Percentage of the population with at least adequate access to excreta disposal facilities that can effectively prevent human, animal, and insect contact with excreta. Providing access to sufficient quantities of safe water and the provision of facilities for a sanitary disposal of excreta are of capital importance to reduce the burden of disease caused by these risk factors.

### **Institutional Strengthening and Citizen Security**

- *Ease of doing business*: This index ranks economies from 1 to 185, with first place being the best. A high ranking (a low numerical rank) means that the regulatory

environment is conducive to business operation. The index averages the country's percentile rankings on 10 topics covered in the World Bank's Doing Business. The ranking on each topic is the simple average of the percentile rankings on its component indicators. The topics covered include starting a business, dealing with construction permits, employing workers, registering property, getting credit, protecting investors, paying taxes, trading across borders, enforcing contracts and closing a business.

- *Governance*: A higher level on this indicator measures a better perception of the governance and control of the corruption in an economy. For each economy the index is calculated as the simple average of its indicator on each of the 6 topics covered in the Worldwide Governance Indicators (e.g. political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption).
- *Security*: In order to measure the degree of security in a country we use three indicators. We utilize the homicide rate in each country and two measures of security's perception. These are: the perception of the cost on businesses from the incidence of common crime and violence and the reliability of police services.

## **Financial Markets**

- *Stock market capitalization*: This measure enables assessment of the possibility for local firms to access stock markets, thus reducing their dependency on traditional banking relationships. High values imply enhanced households' investment opportunities, since larger stock markets also tend to increase firm and risk diversity. It is expressed as percentage of GDP.
- *Private credit*: Total amount of loans available to economic agents. That is, private credit by deposit money banks and other financial institutions. It is expressed as percentage of GDP.
- *Stock market turnover ratio*: It reflects the ratio of the value of shares traded and market capitalization, and may deliver some indication of market absorption capabilities.

- *Commercial bank branches*: It consists in the number of commercial bank branches per 100,000 adults, and indicates how easy it is for a household to borrow money or protect its savings.
- *Insurance premium volume*: It consists in the insurance premium volume as a share of GDP. Life insurance protects households against negative shocks, such as job loss and early mortality.

### **Trade Capacity Building and Private Sector Development**

- *Burden of customs procedures*: This index measure the efficiency of customs procedures (i.e. formalities regulating the entry and exit of merchandise).
- *SME exporting firms*: SMEs are the largest group of industrial units in most developing countries and make a significant contribution to manufacturing output and employment. High rates of SME exporting firms suggest that SMEs play an important role in the process of export-led industrialization with high benefits to the domestic economy.
- *ISO certification*: ISO is the world's largest developer and publisher of International Standards. Standards ensure desirable characteristics of products and services such as quality, environmental friendliness, safety, reliability, efficiency and interchangeability - and at an economical cost.
- *Business entry rate*: It shows the number of new firms and the number of new limited liability corporations, defined as firms registered in the current year of reporting, expressed as a proportion of 1,000 people ages 15-64. New plants often embody innovations, and researchers find that entry is an important source of aggregate productivity growth.
- *EXPY*: Measures the productivity level associated with a country's export basket. This indicator is calculated as a share weighted average of the PRODY of each component of country's export basket, where PRODY measures the productivity associated with the good, calculated as the revealed comparative advantage (RCA) weighted average of the level of income per capita of the country that export that good.

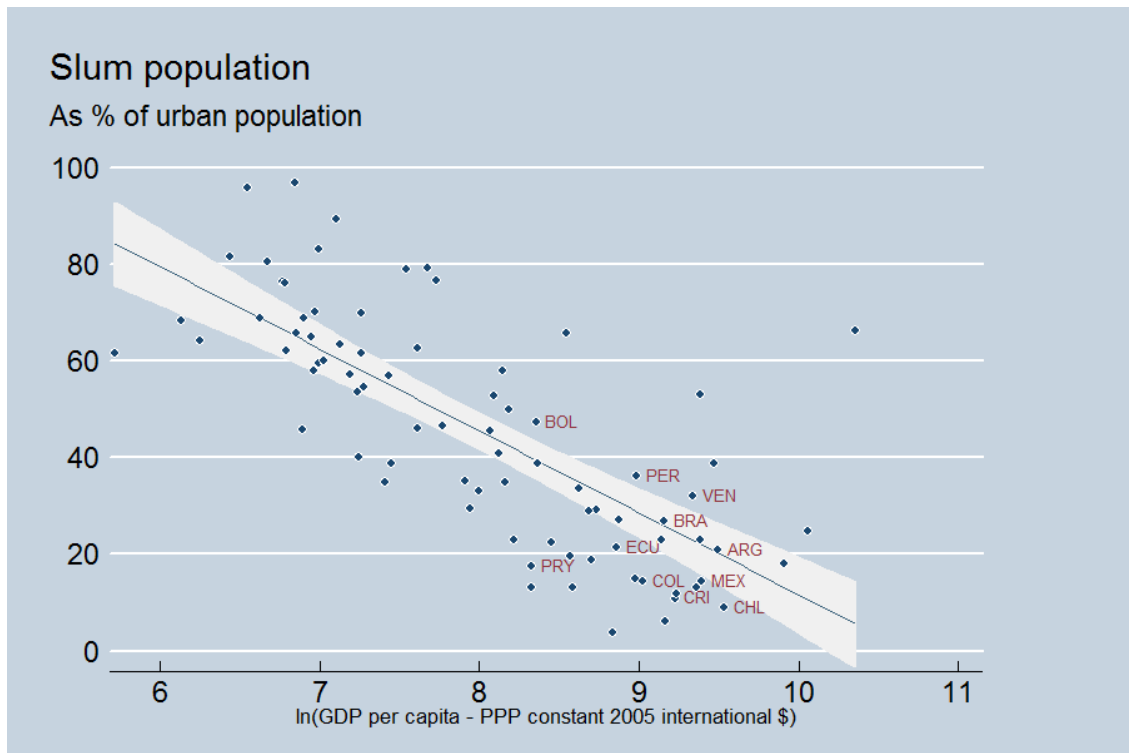
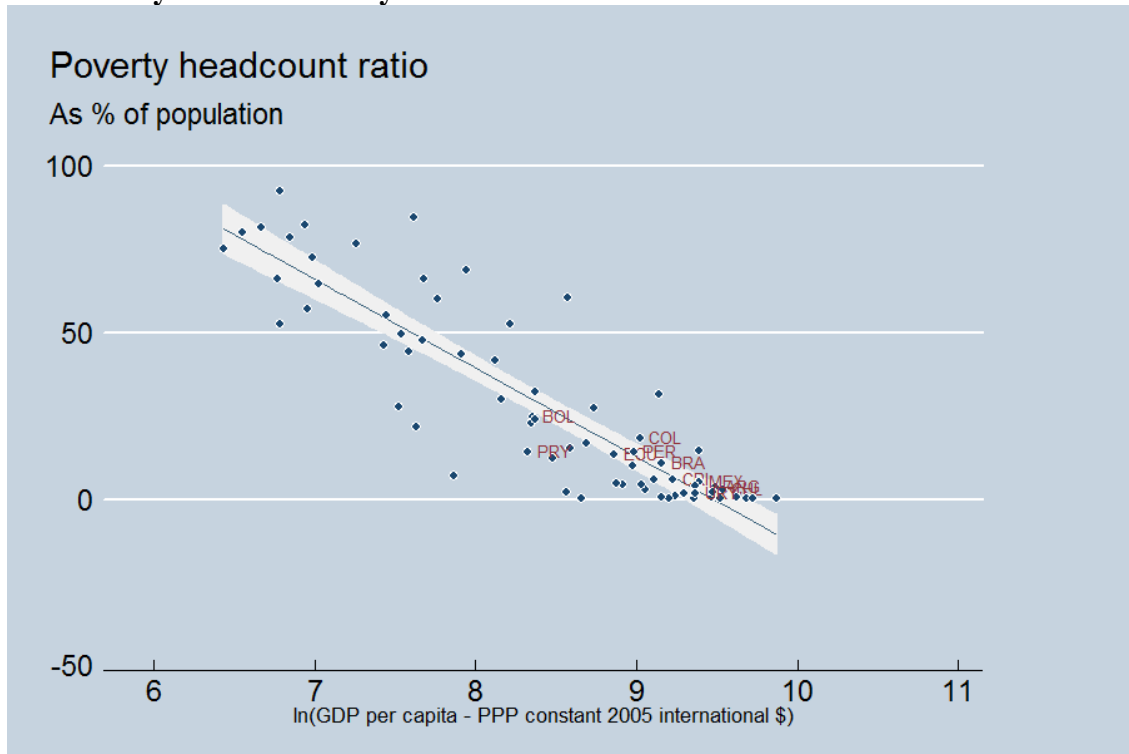
## Environment

- *Co2 emissions:* It is an environment problem. In order to stop global warming, dramatic cuts in all CO<sub>2</sub> emissions must be achieved. The primary human source of carbon dioxide (CO<sub>2</sub>) in the atmosphere is from the burning of fossil fuels for energy production and transport.
- *Deforestation:* Change in the land area covered by forest in the period 1990-2011. In addition to the direct effect of deforestation, it is a source of (CO<sub>2</sub>), which is responsible for more greenhouse gas emissions than all the world's cars, trucks, planes and boats combined.

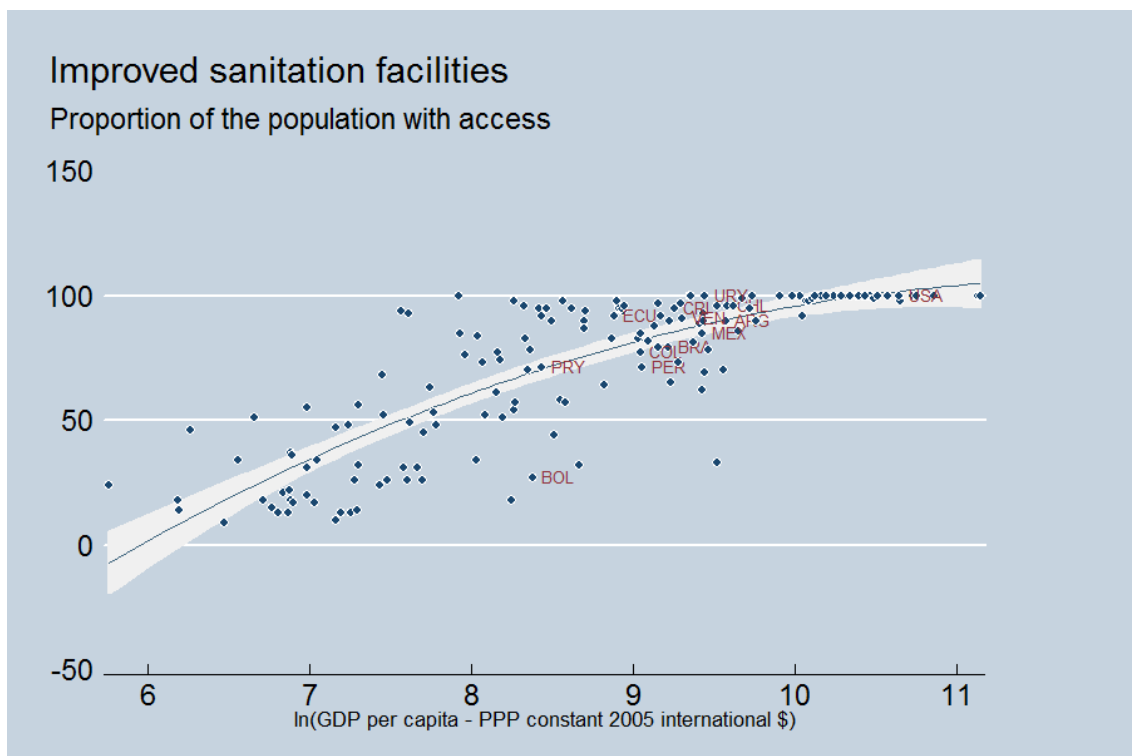
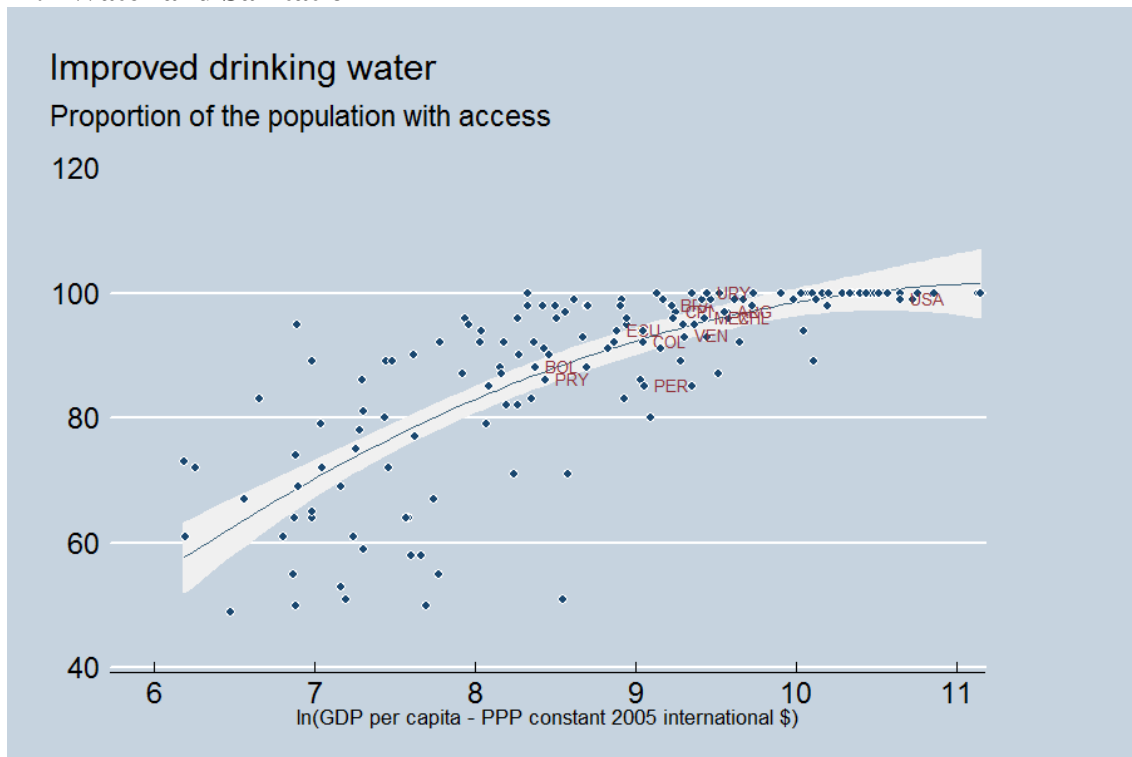


### Appendix 3. Regression analysis

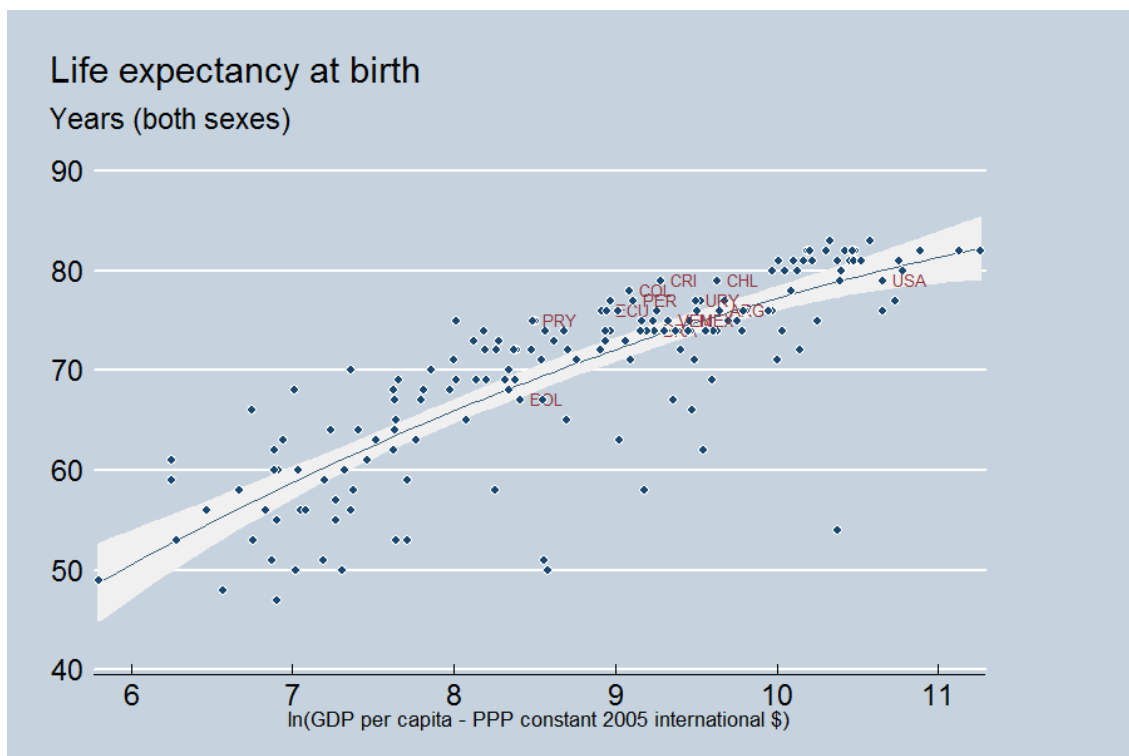
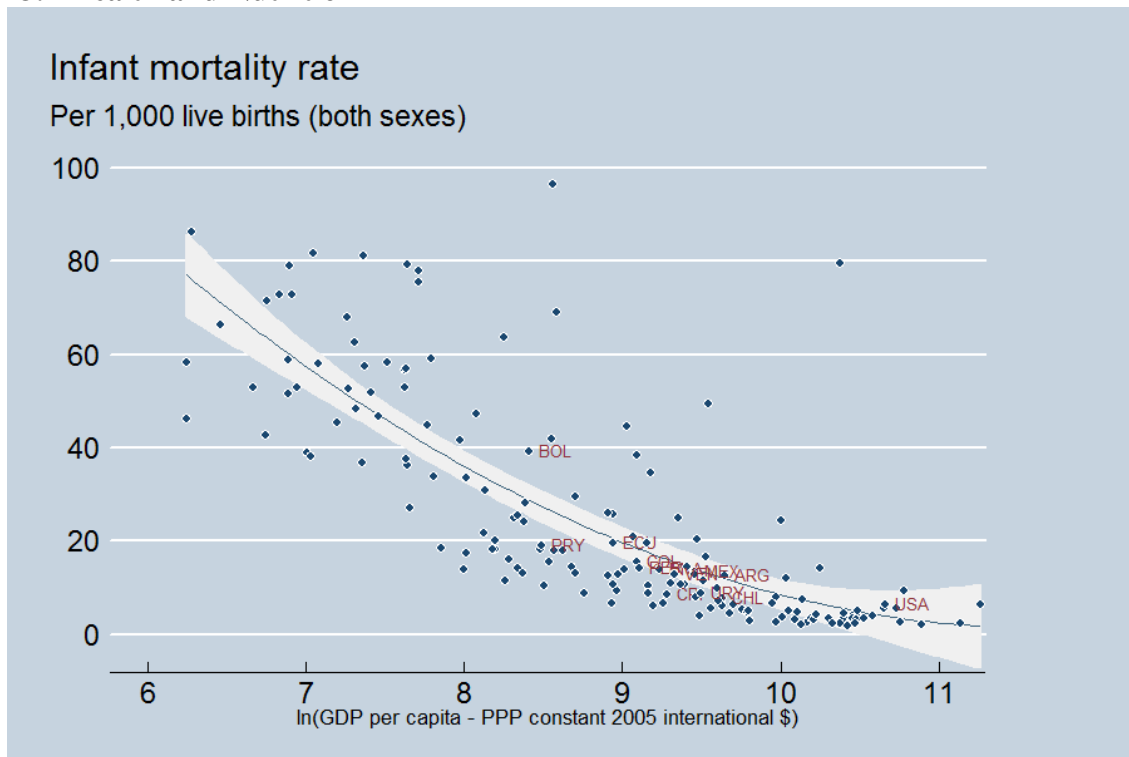
#### 1. Poverty and Informality



## 2. Water and Sanitation

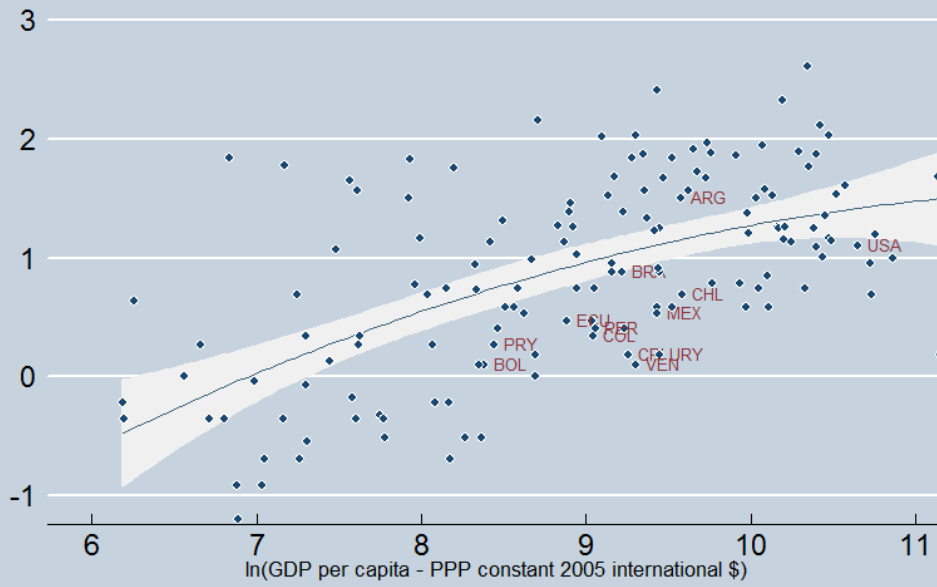


### 3. Health and Nutrition



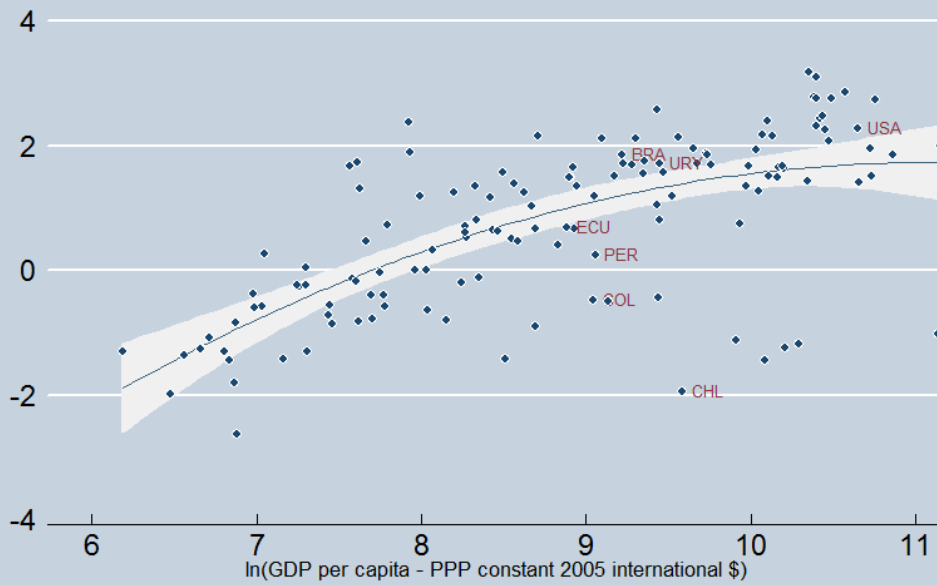
## Number of hospital beds

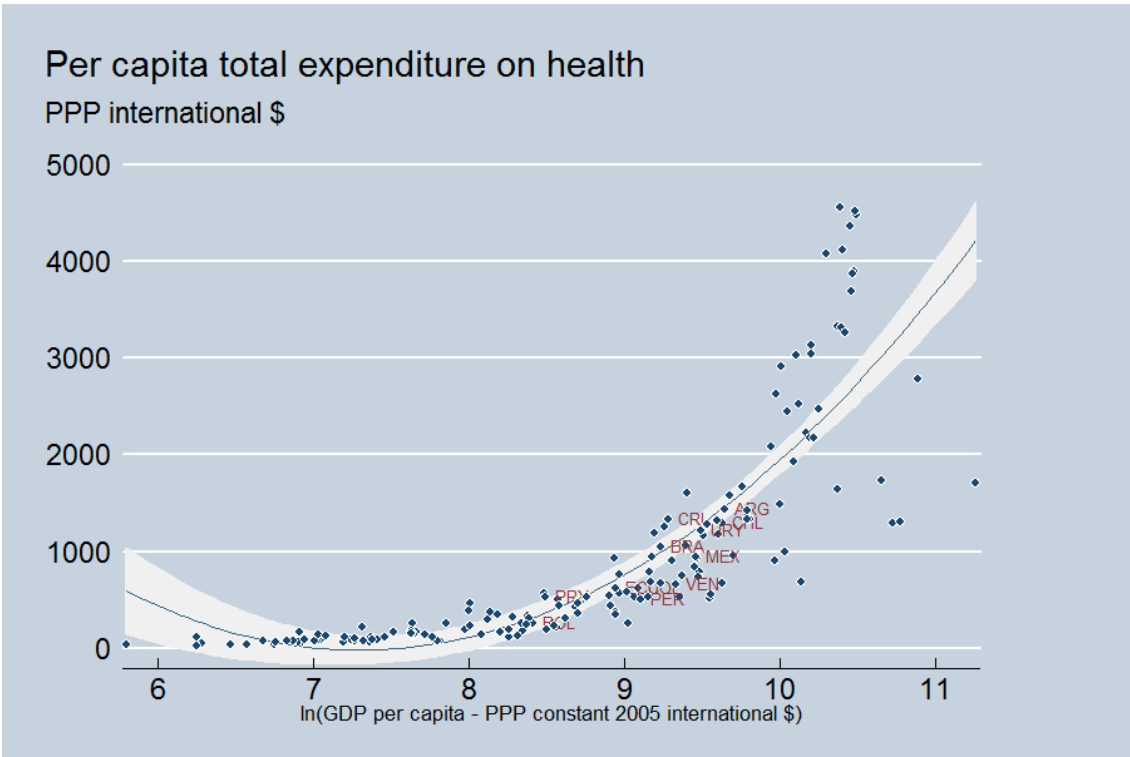
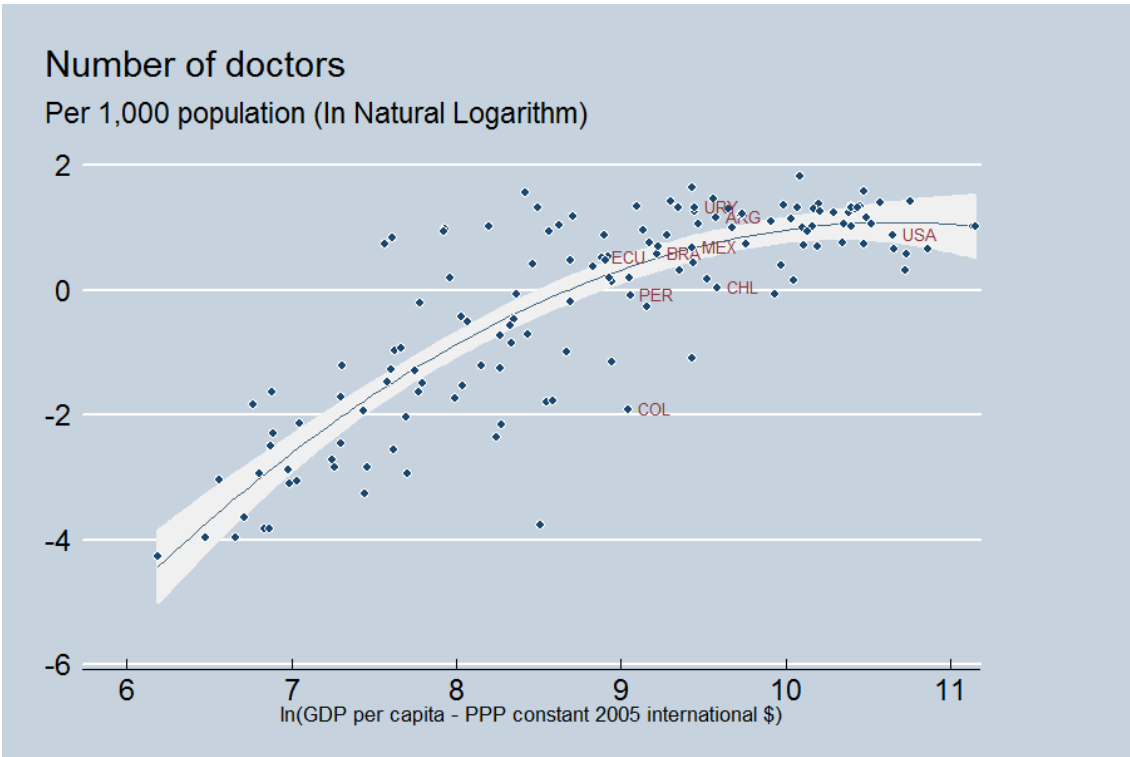
Per 1,000 population (In Natural Logarithm)



## Number of nursing and midwifery personnel

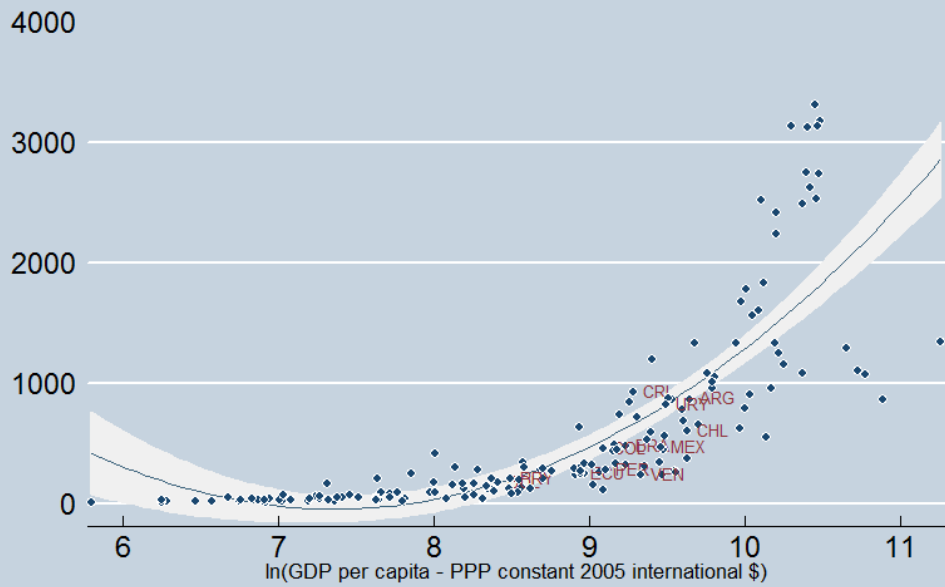
Per 1,000 population (In Natural Logarithm)





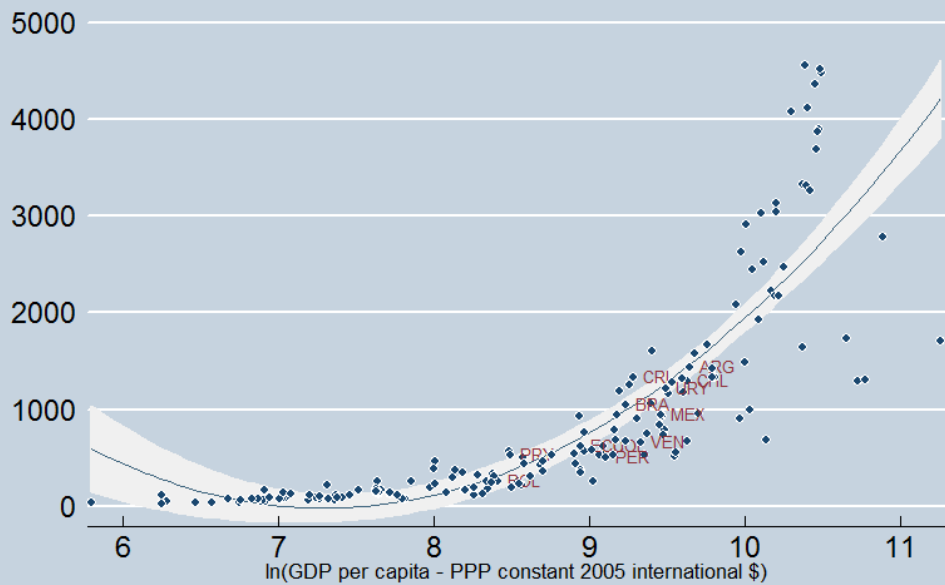
### Per capita government expenditure on health

PPP international \$



### Per capita total expenditure on health

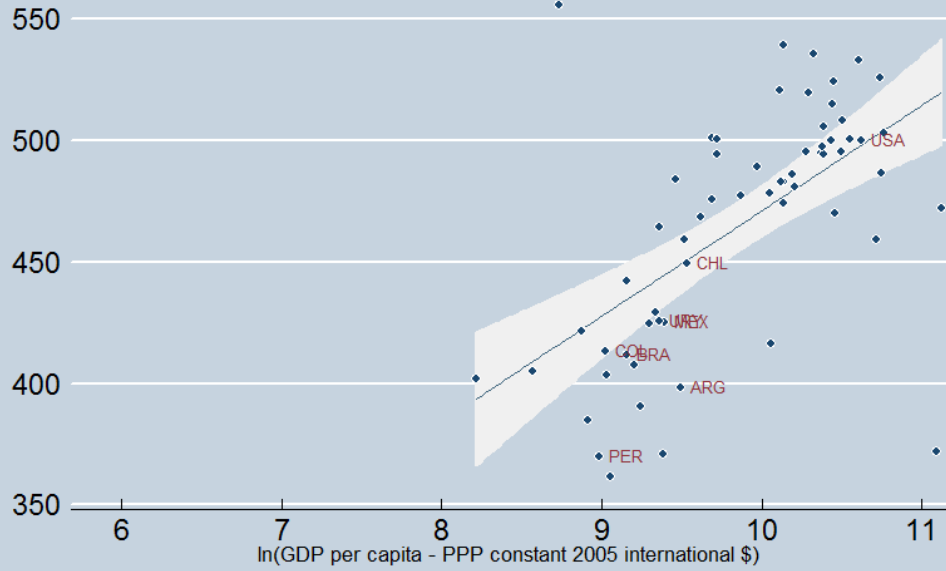
PPP international \$



#### 4. Education

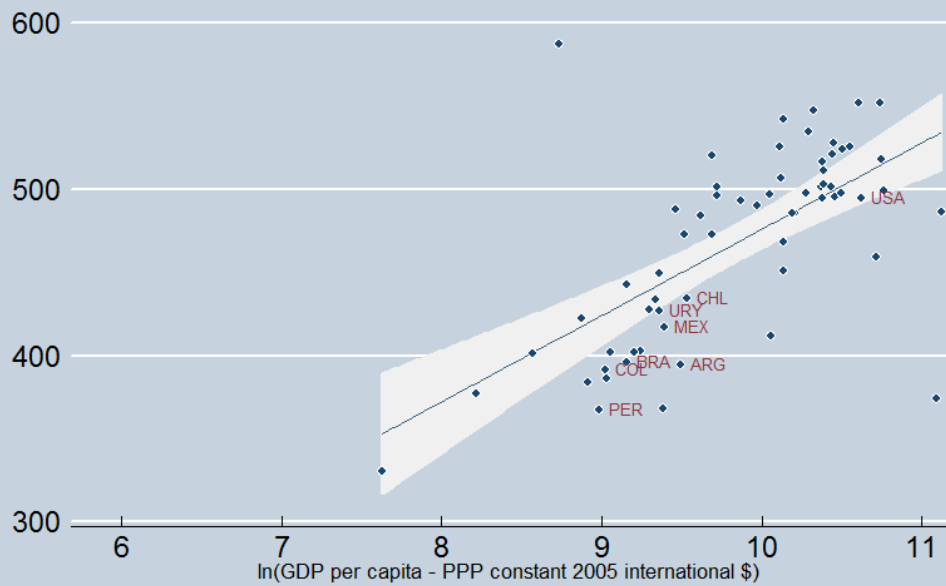
##### Student performance on reading

Mean score from PISA



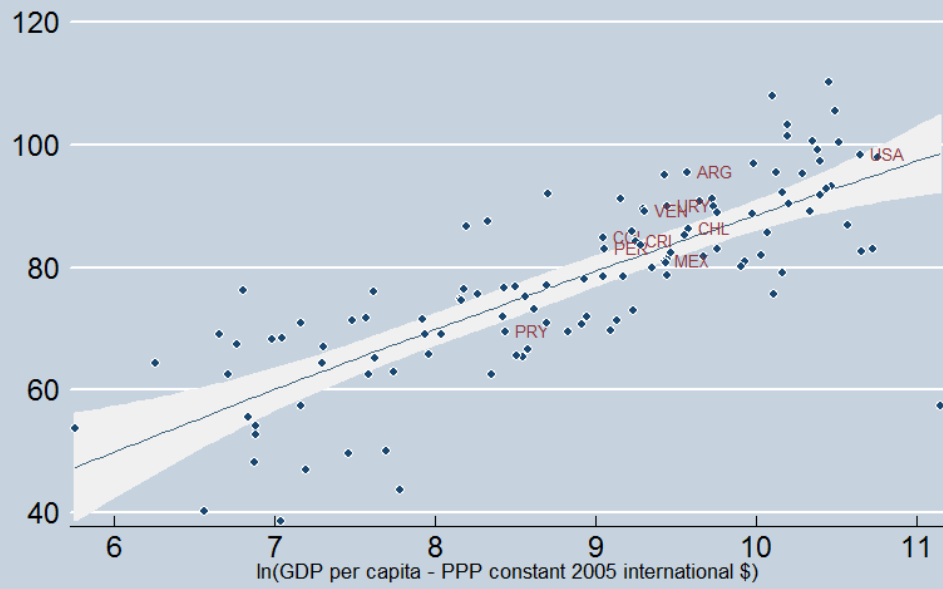
##### Student performance on math scale and science scale

Mean score from PISA



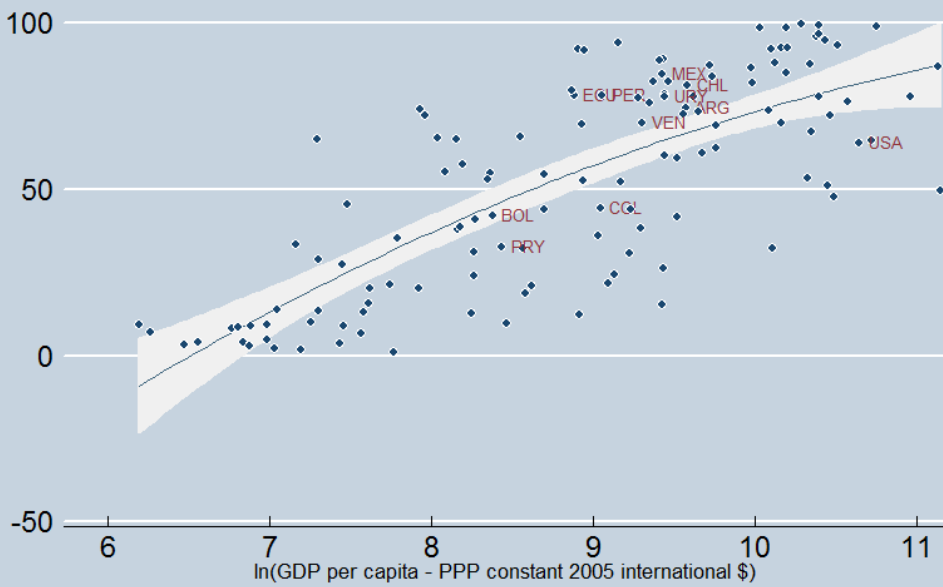
## Gross enrolment ratio

All levels combined (except pre-primary)



## Net enrolment rate

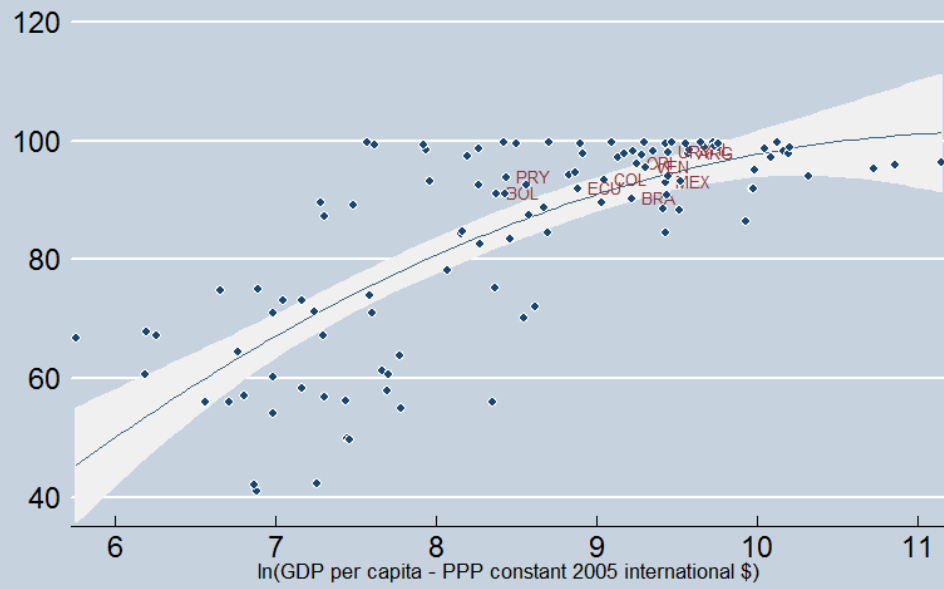
Pre-primary



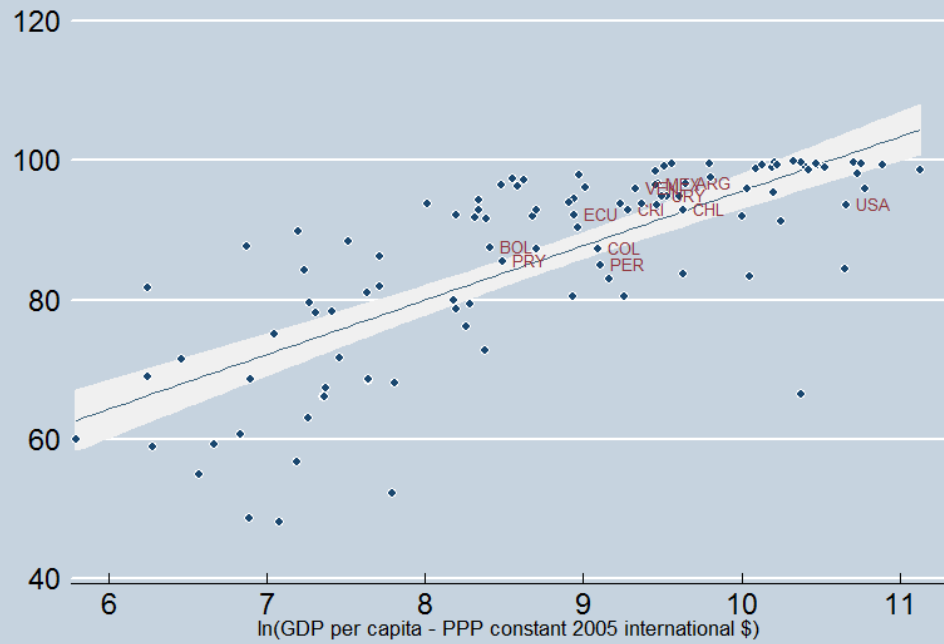


## Adult literacy rate

As % of total adult population

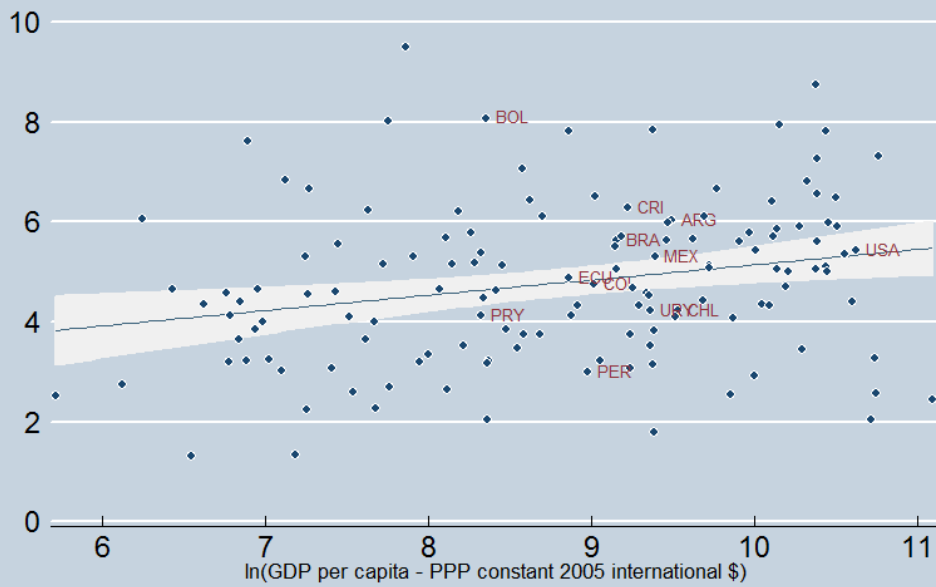


## Survival rate to grade 5



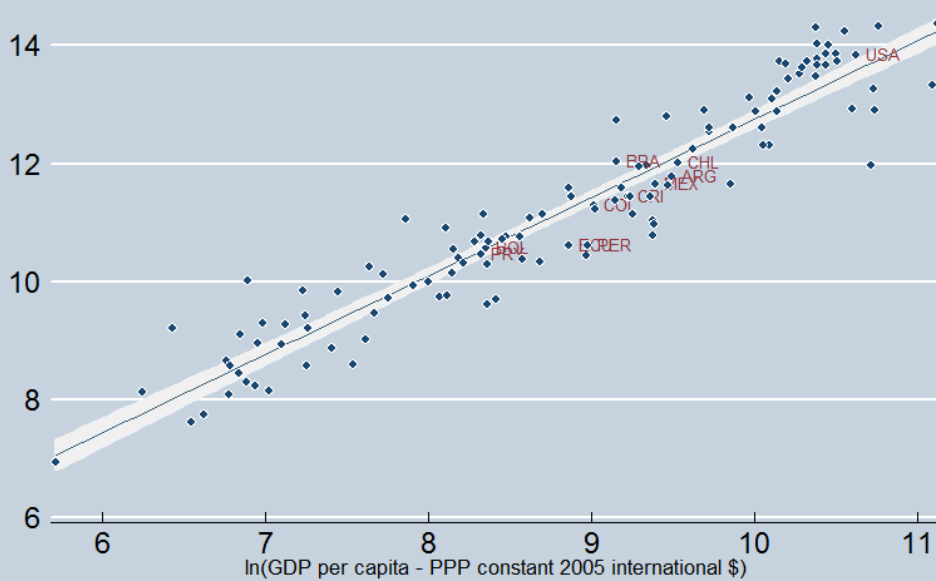
## Public expenditure on education

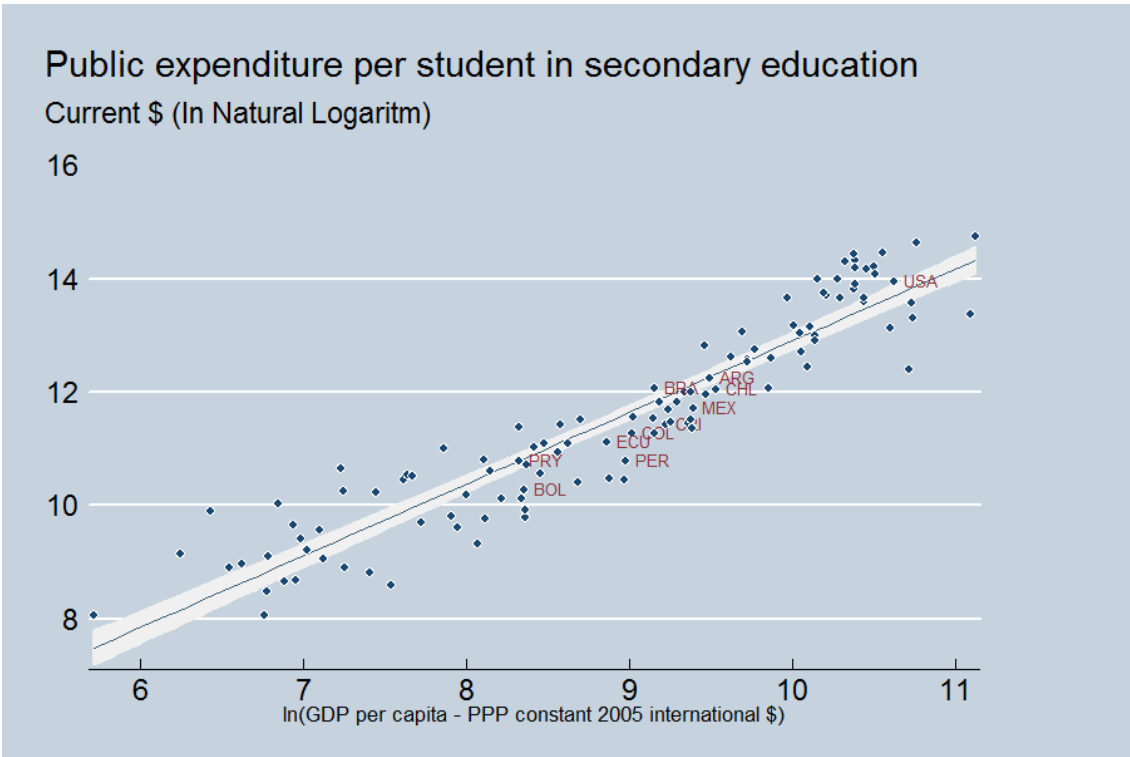
As % of GDP



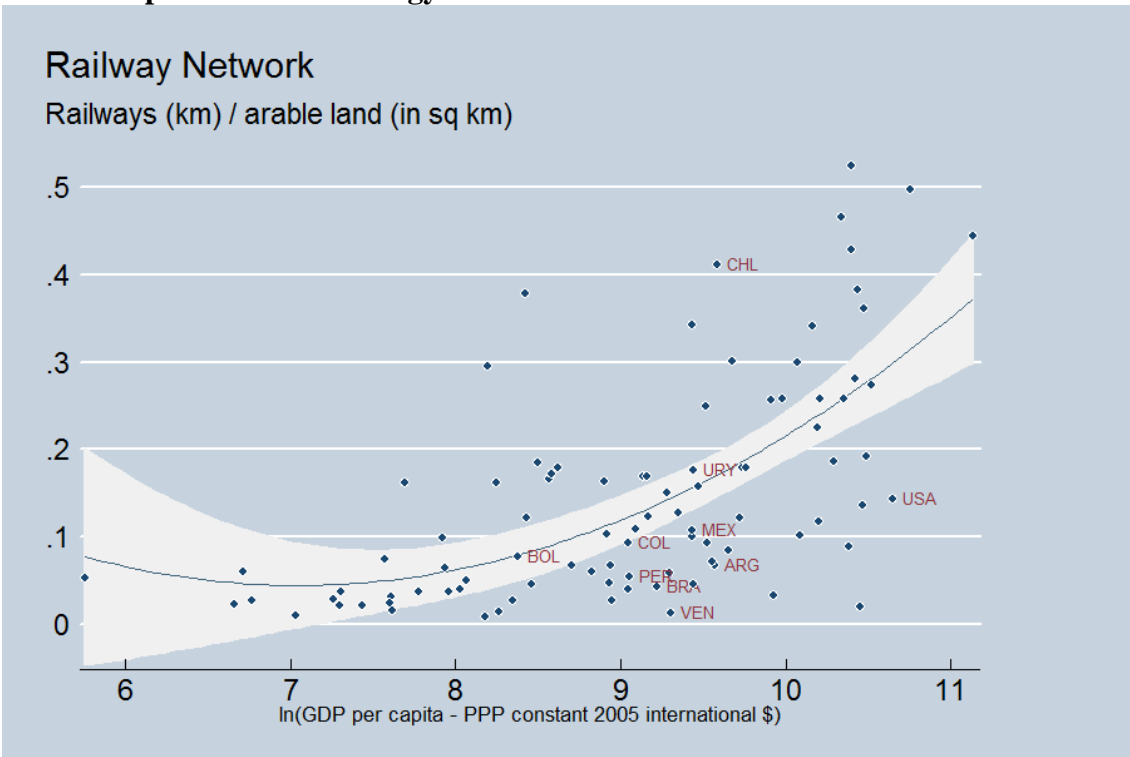
## Public expenditure per student in primary education

Current \$ (In Natural Logarithm)



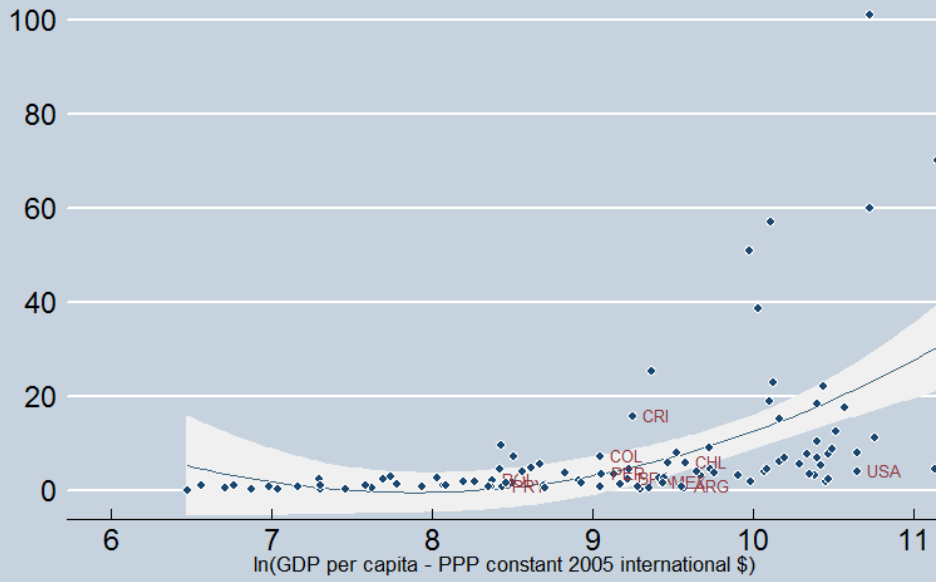


## 5. Transportation and Energy



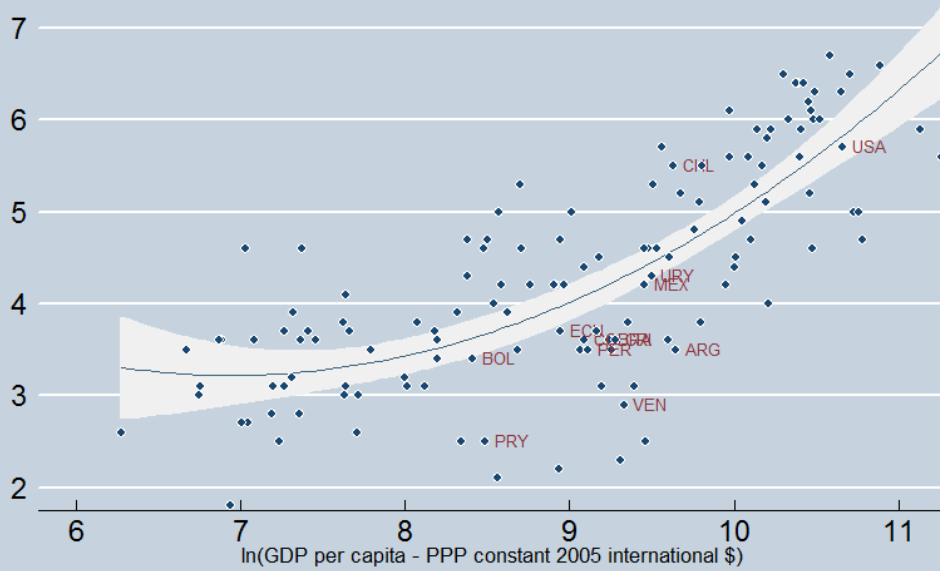
## Road Network

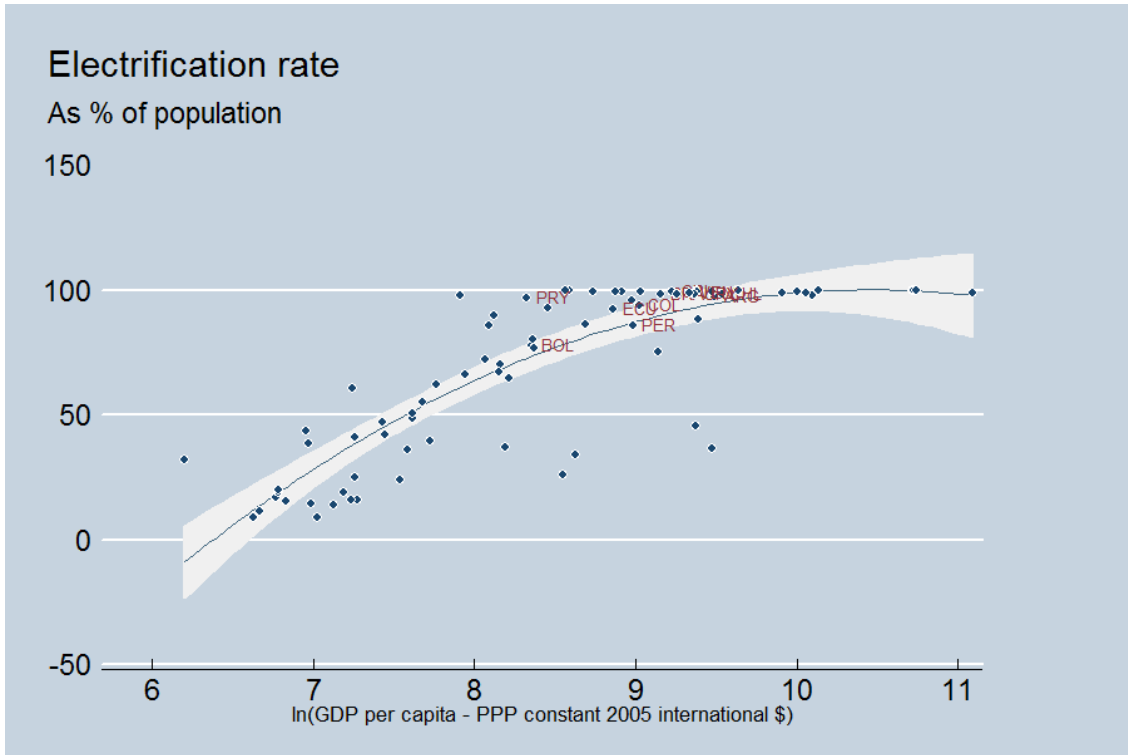
Roads (km) / arable land (in sq km)



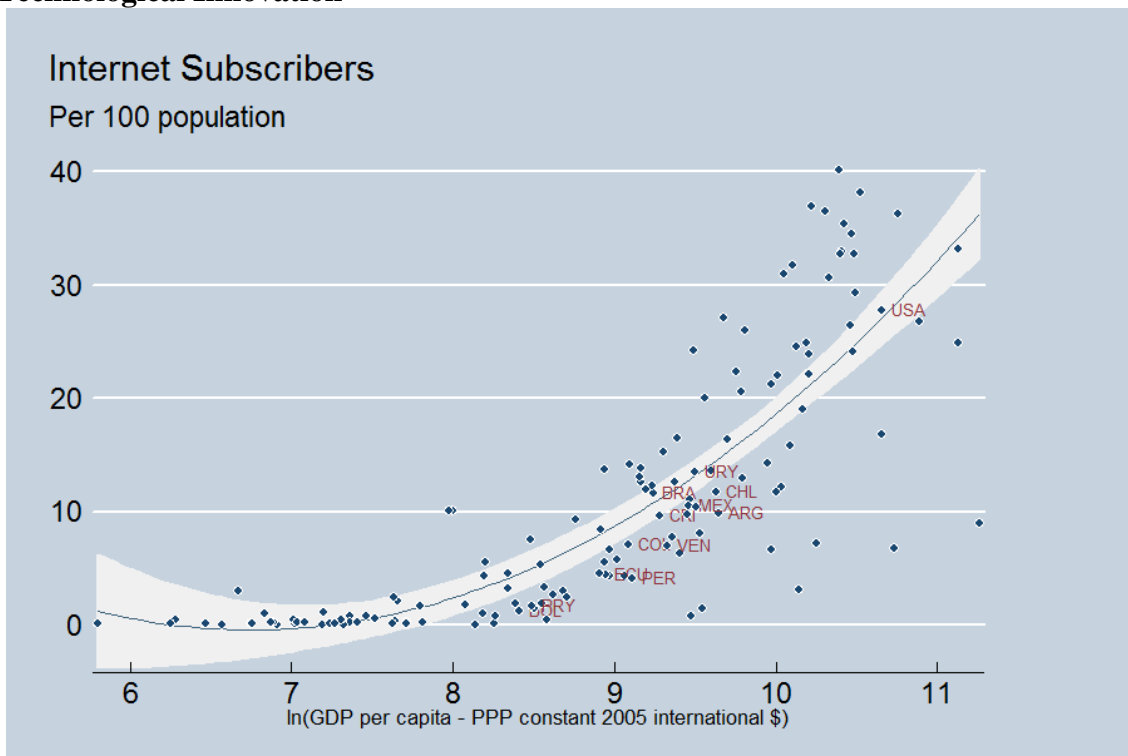
## Quality of overall infrastructure

Index



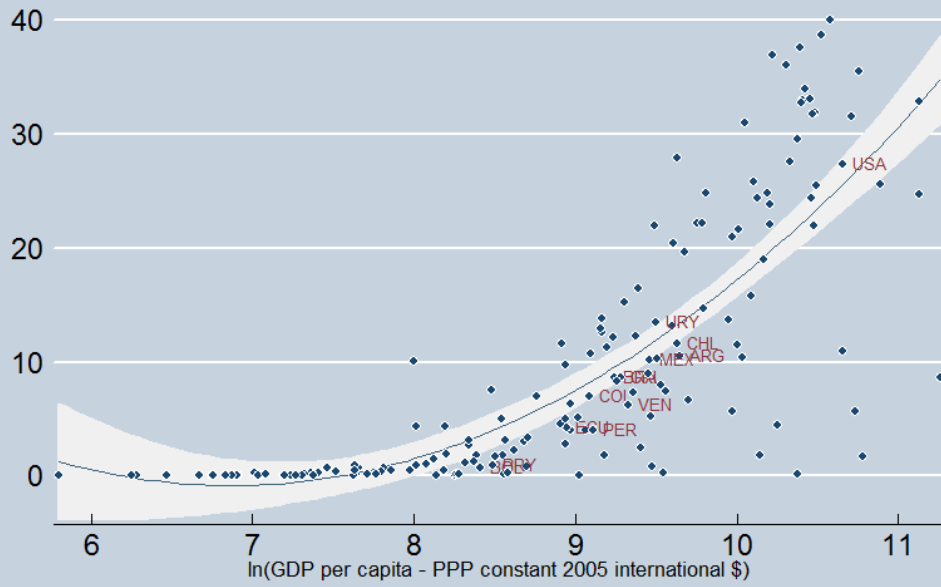


## 6. Technological Innovation



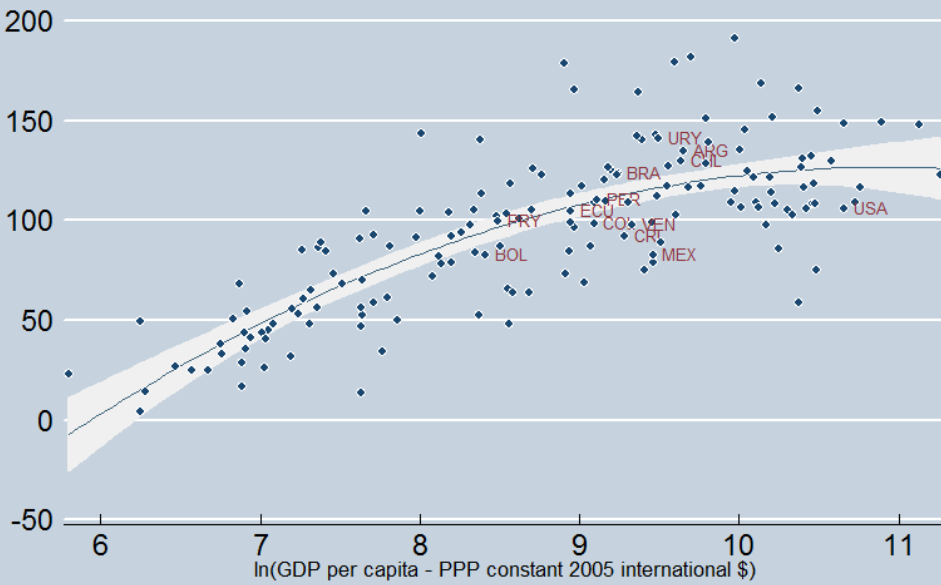
## Broadband Subscribers

Per 100 population



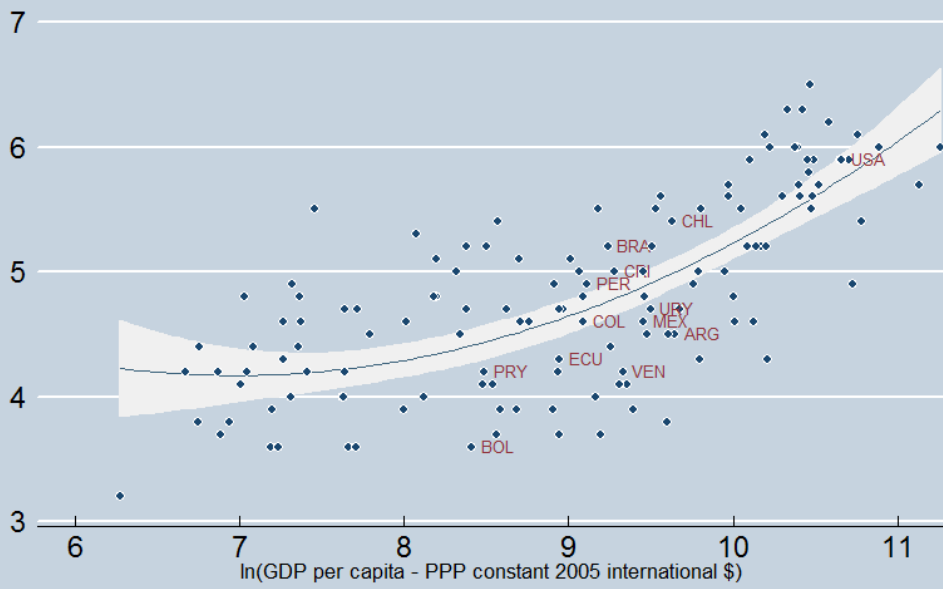
## Cellular subscribers

Per 100 population



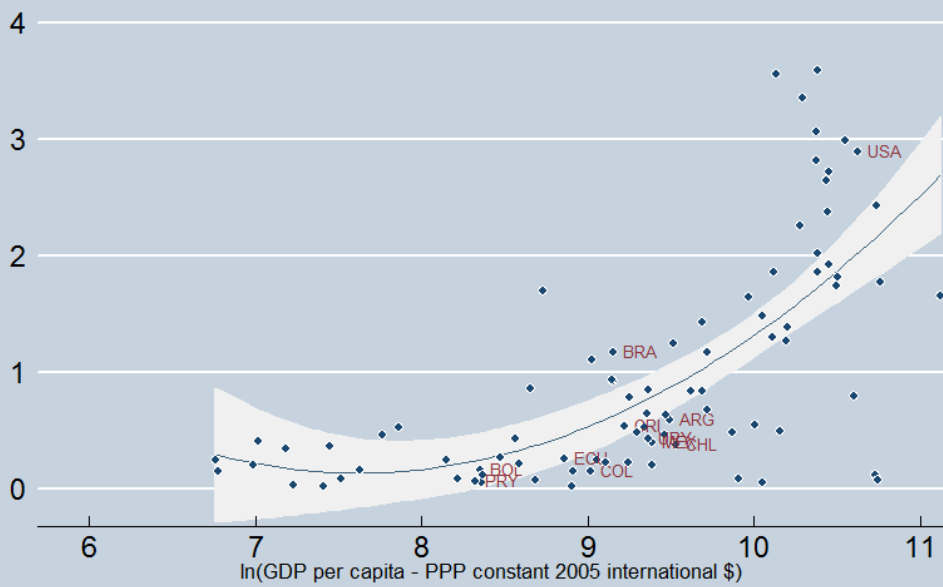
## Firm-level technology absorption

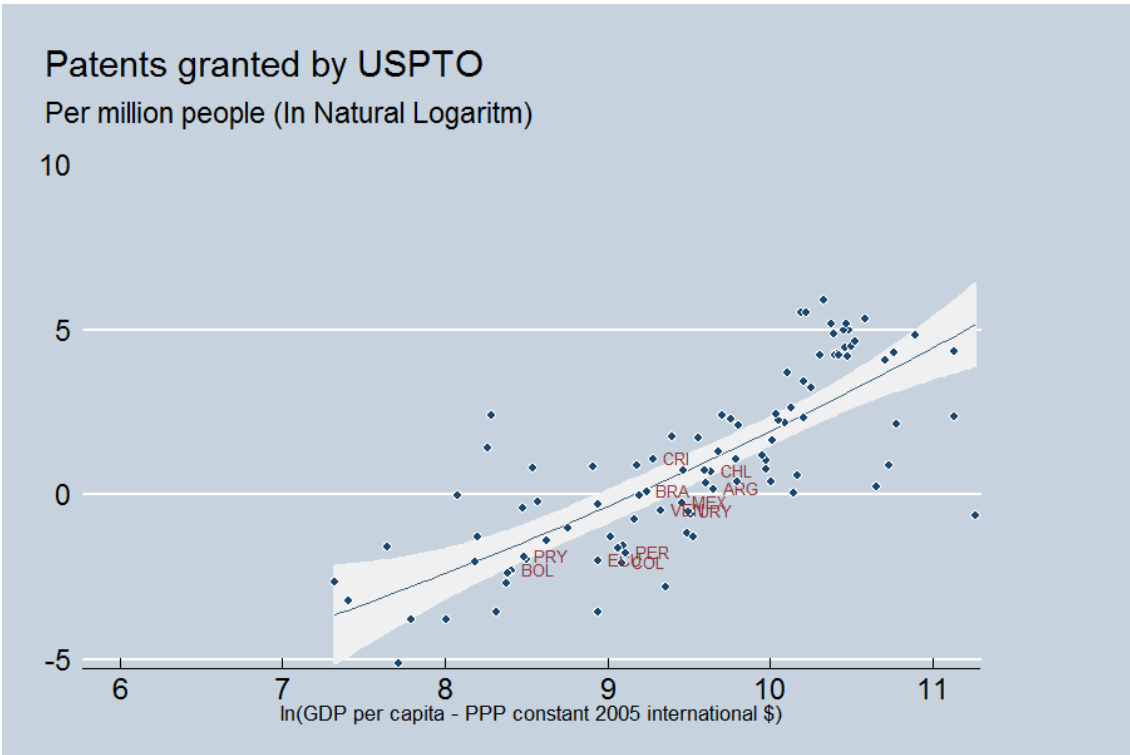
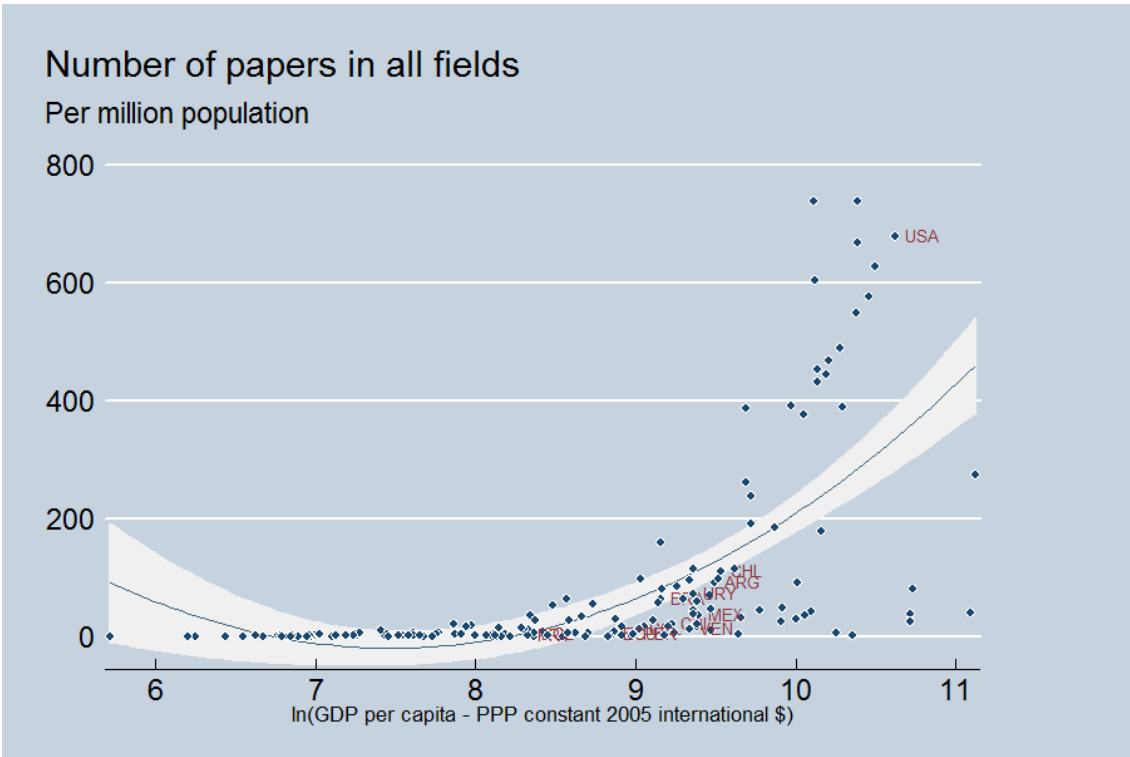
Index



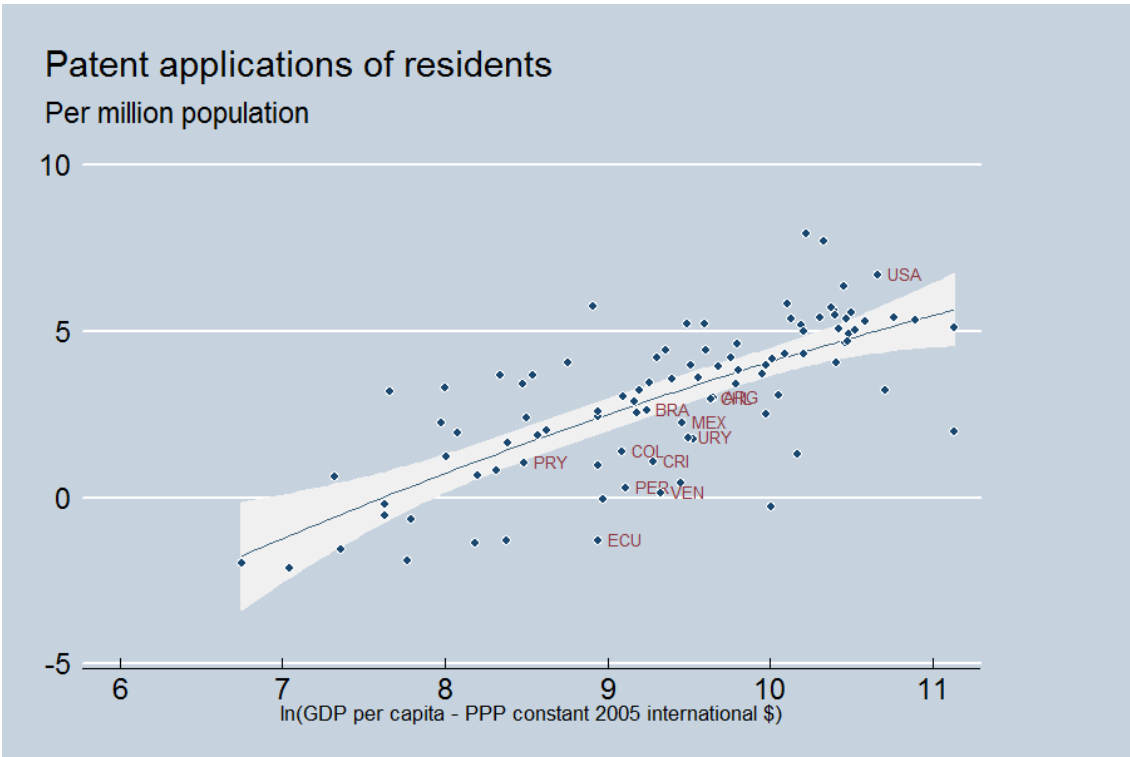
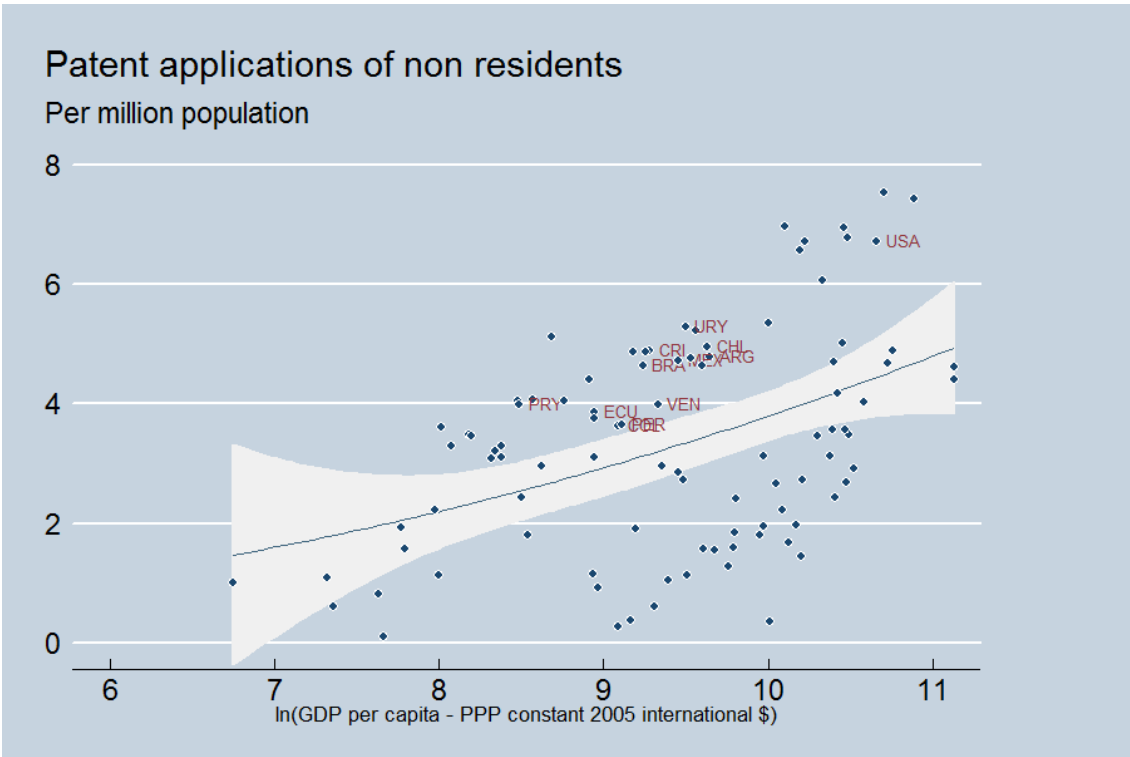
## Research and development expenditure

% of GDP





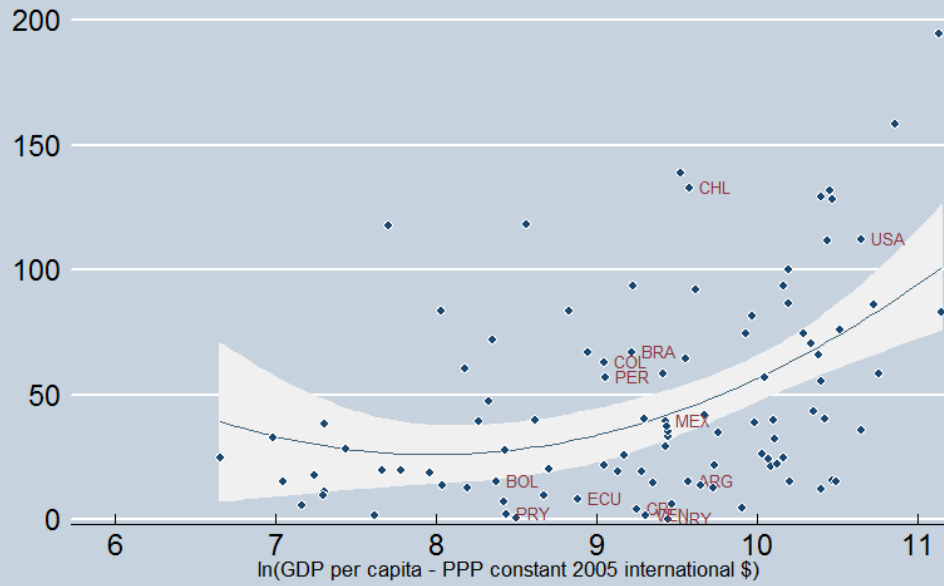




## 7. Financial Markets

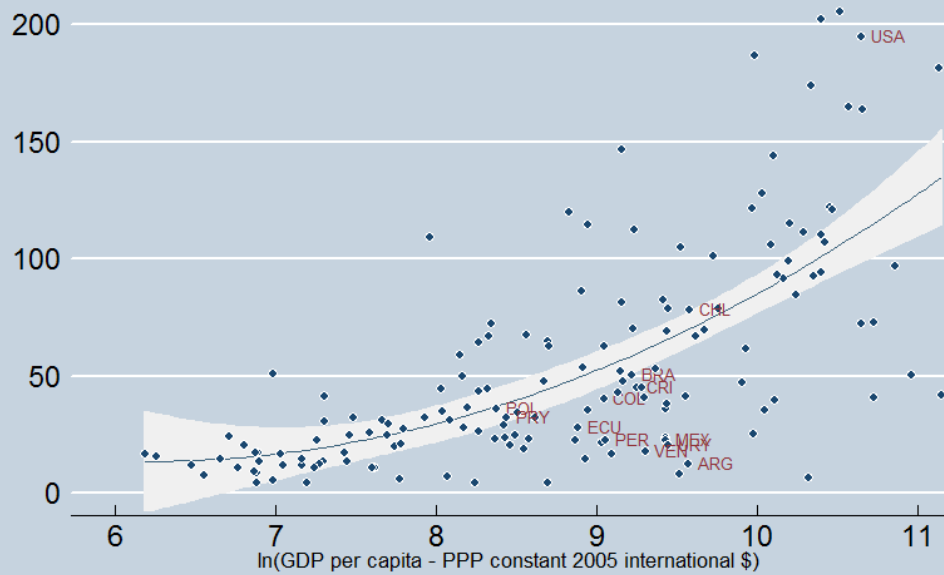
### Stock Market Capitalization

As % of GDP



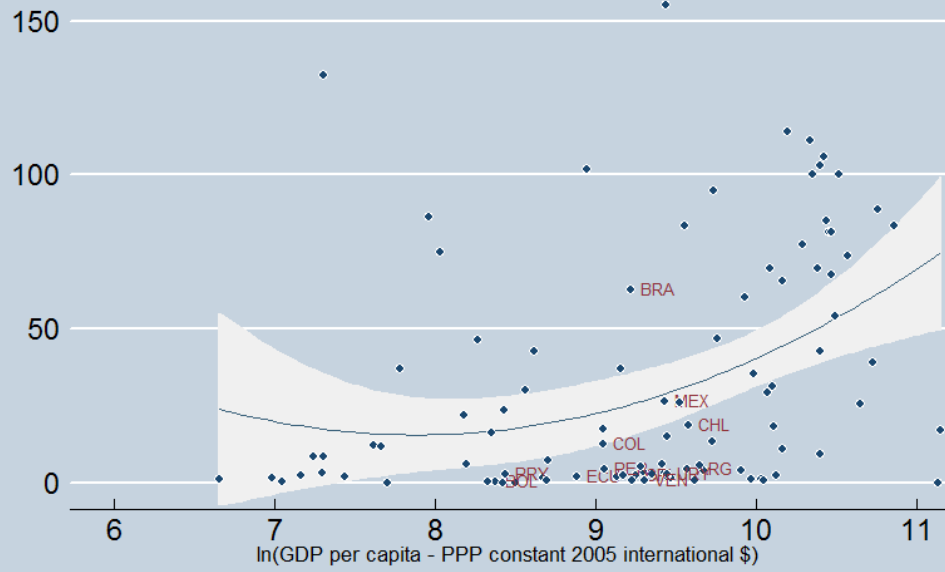
### Private Credit

By deposit money banks and other financial institutions (as % of GDP)



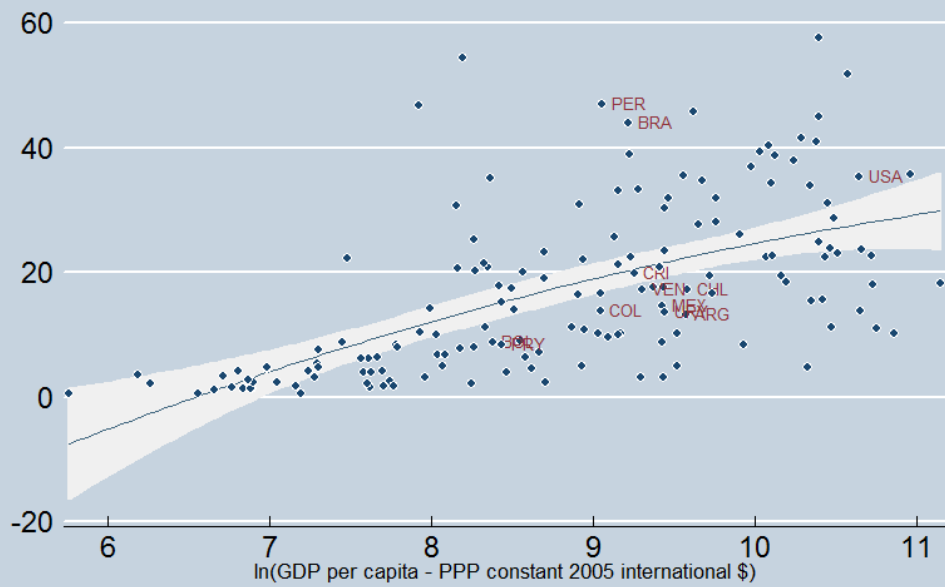
## Stock Market Turnover ratio

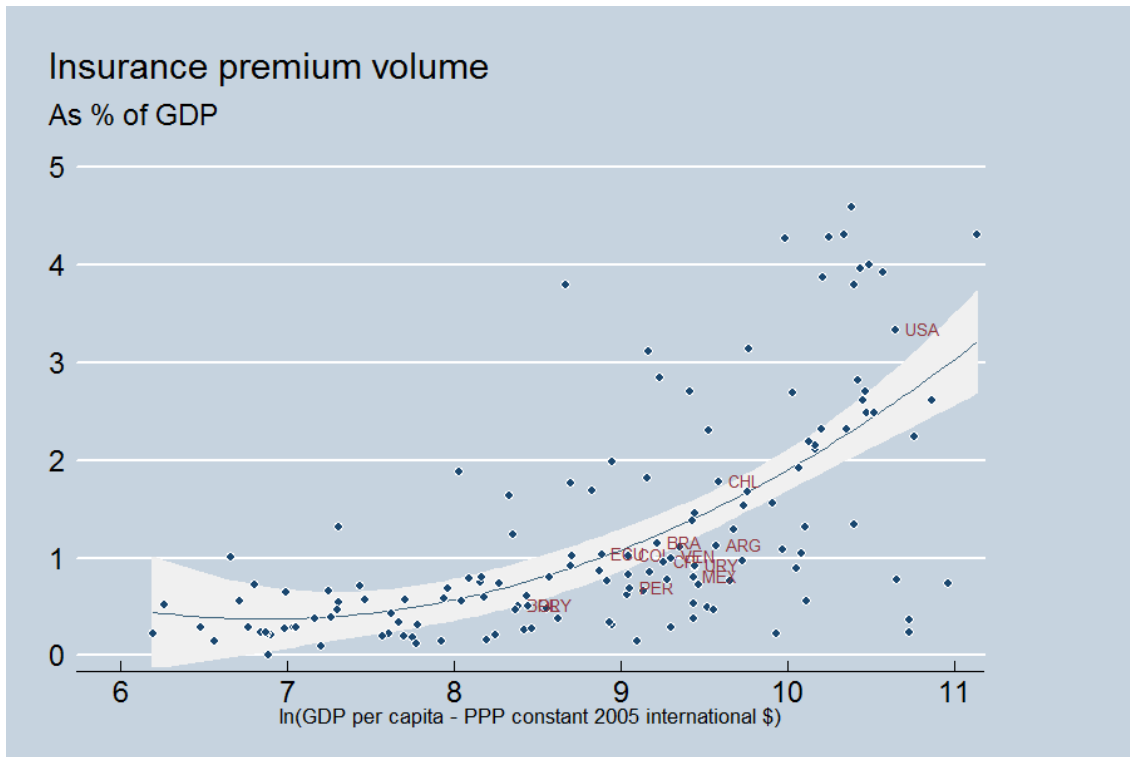
In %



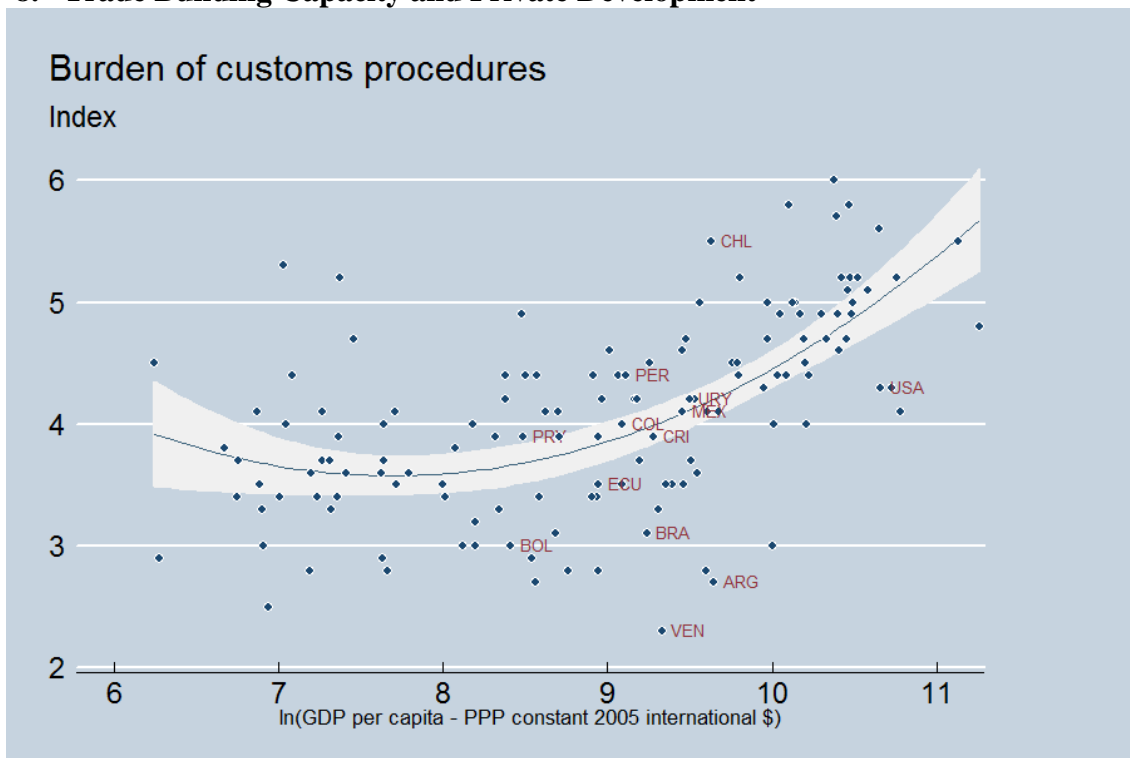
## Commercial bank branches

Per 100,000 adults



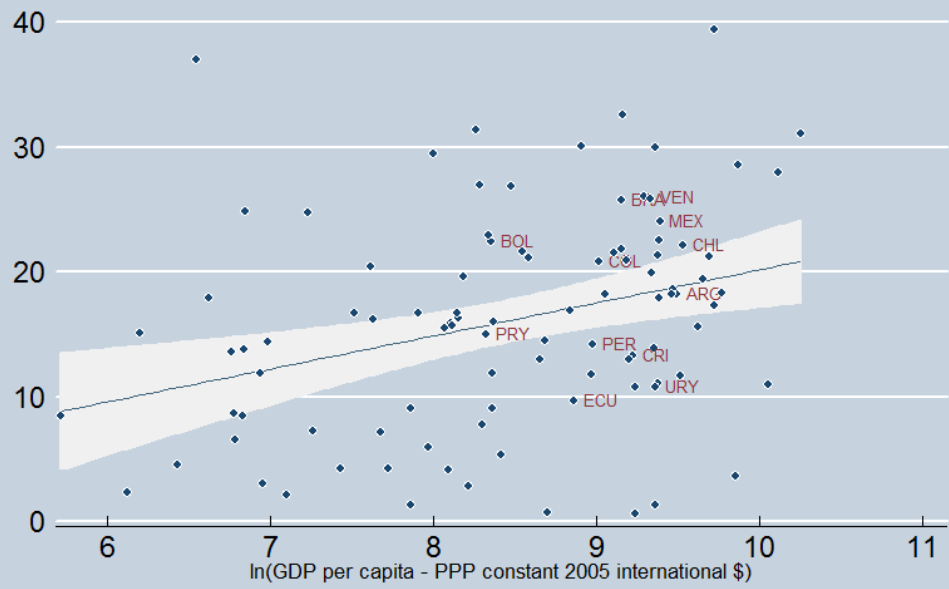


## 8. Trade Building Capacity and Private Development



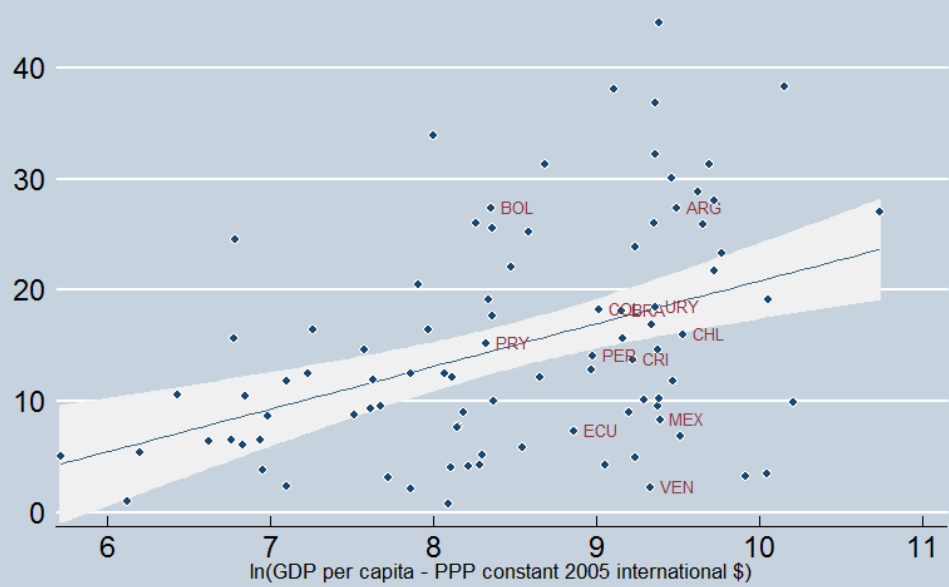
## ISO certified firms

As % of total firms



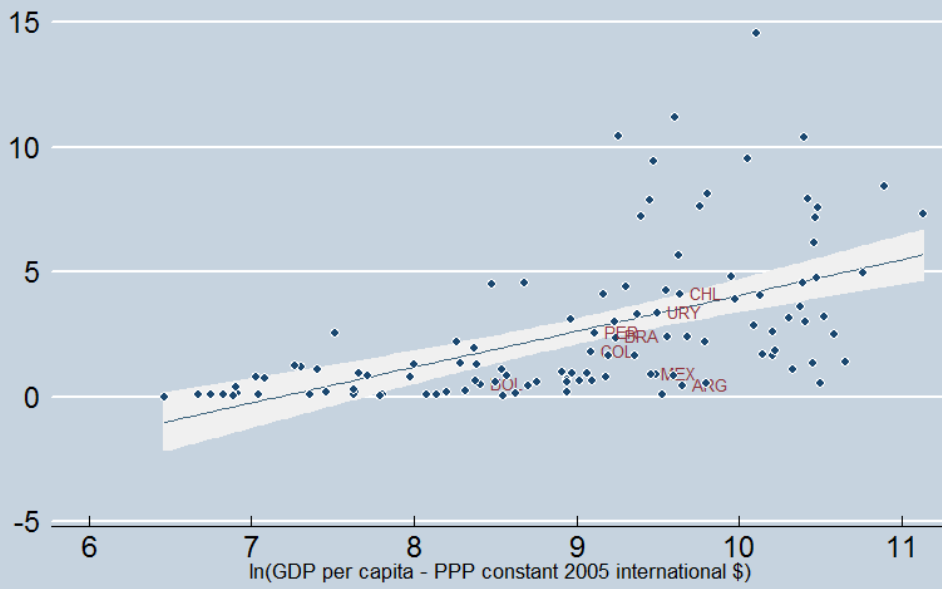
## SME exporting firms

As % of total SME firms



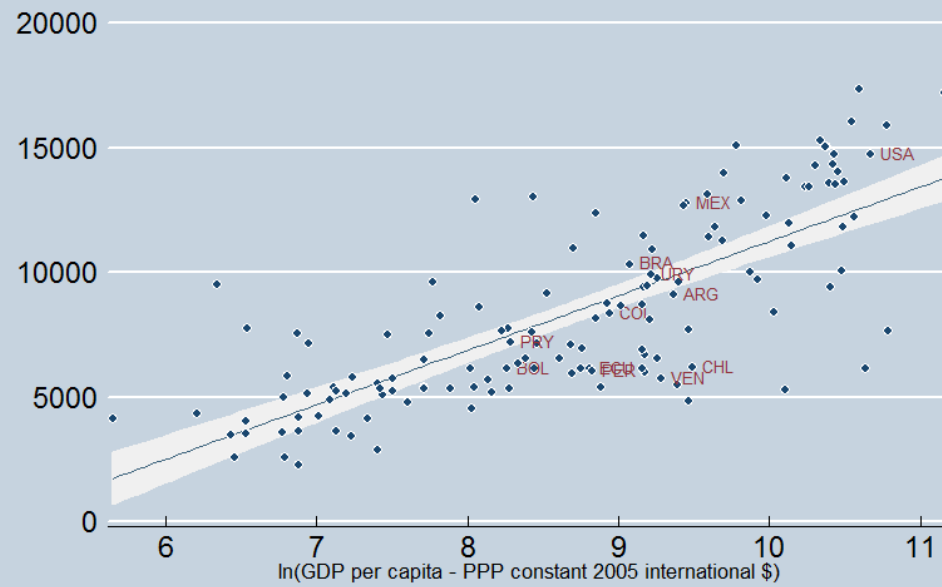
### Business entry

Per 1,000 people ages 15-64

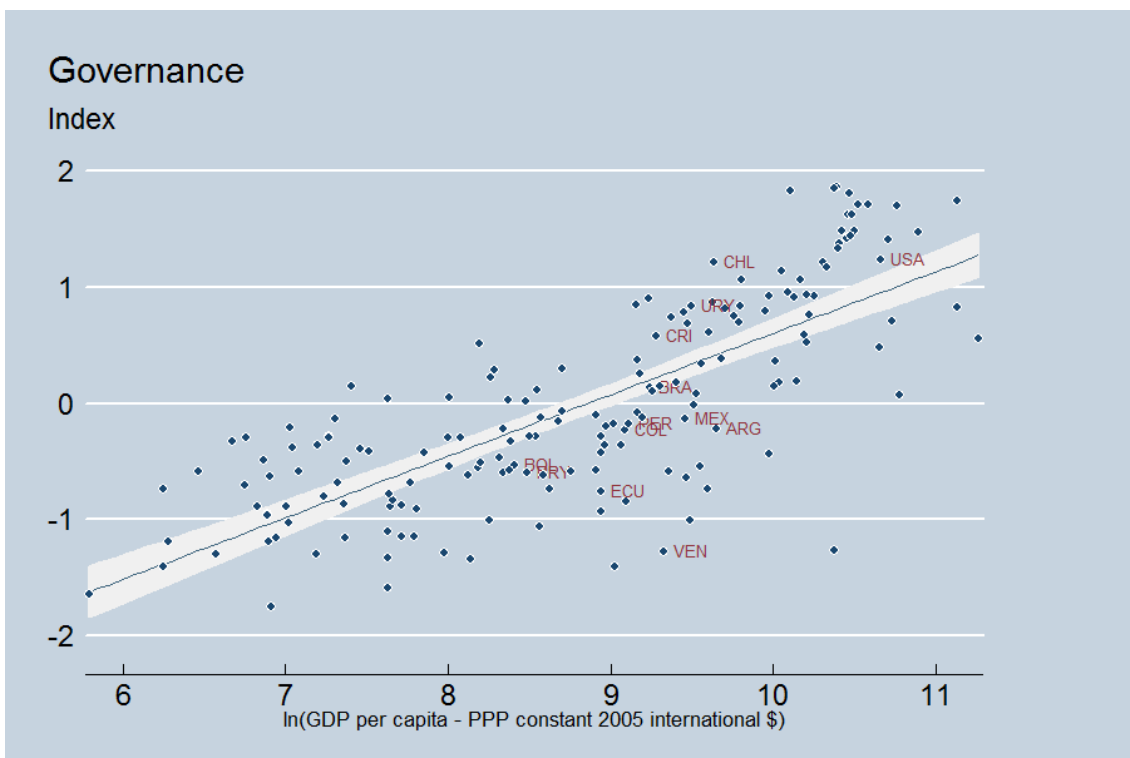
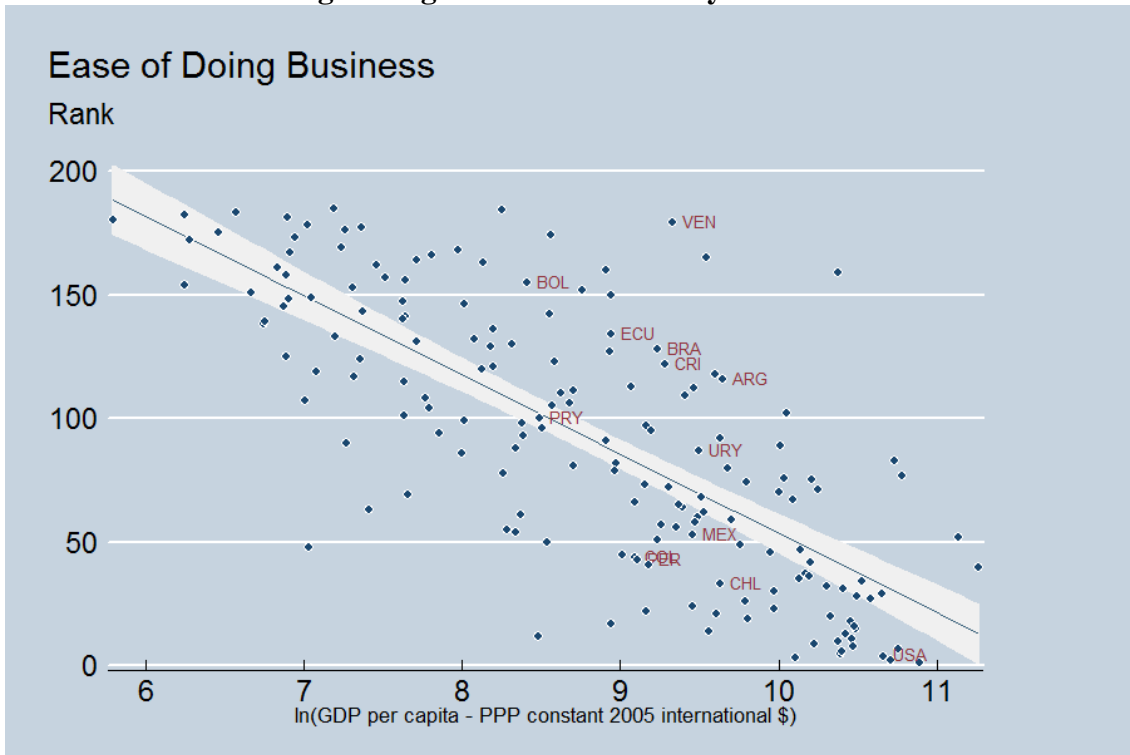


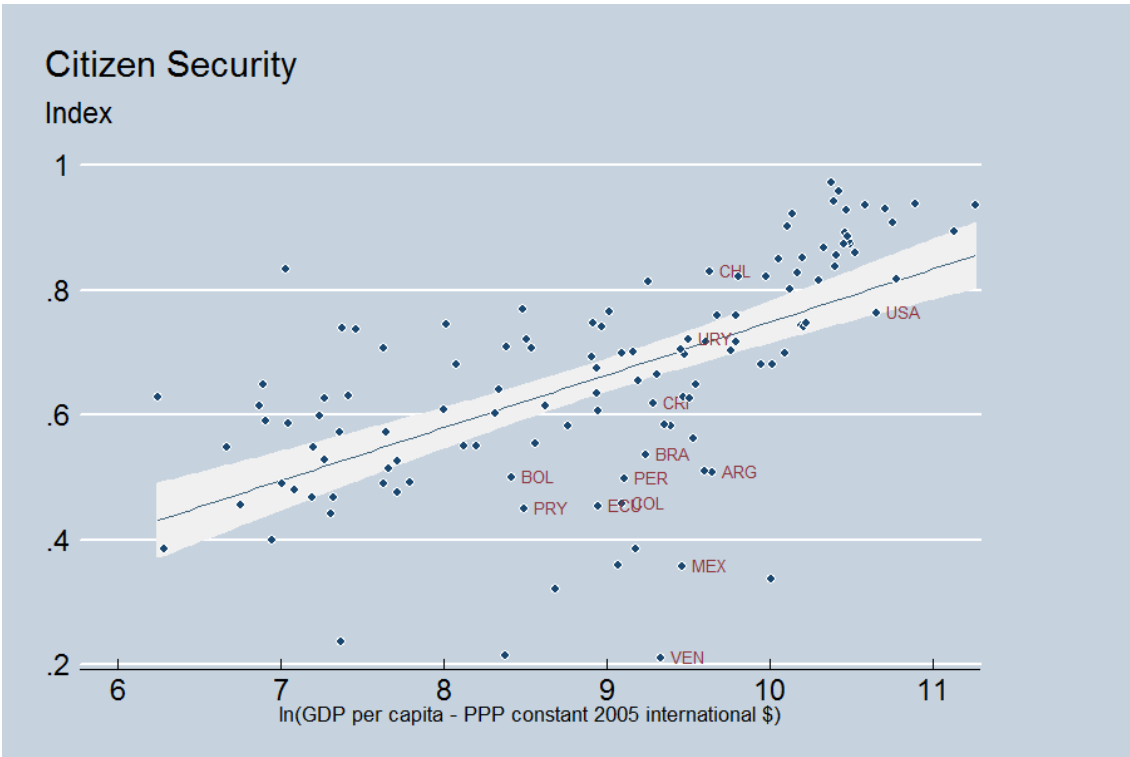
### Export sophistication measure

PPP US\$

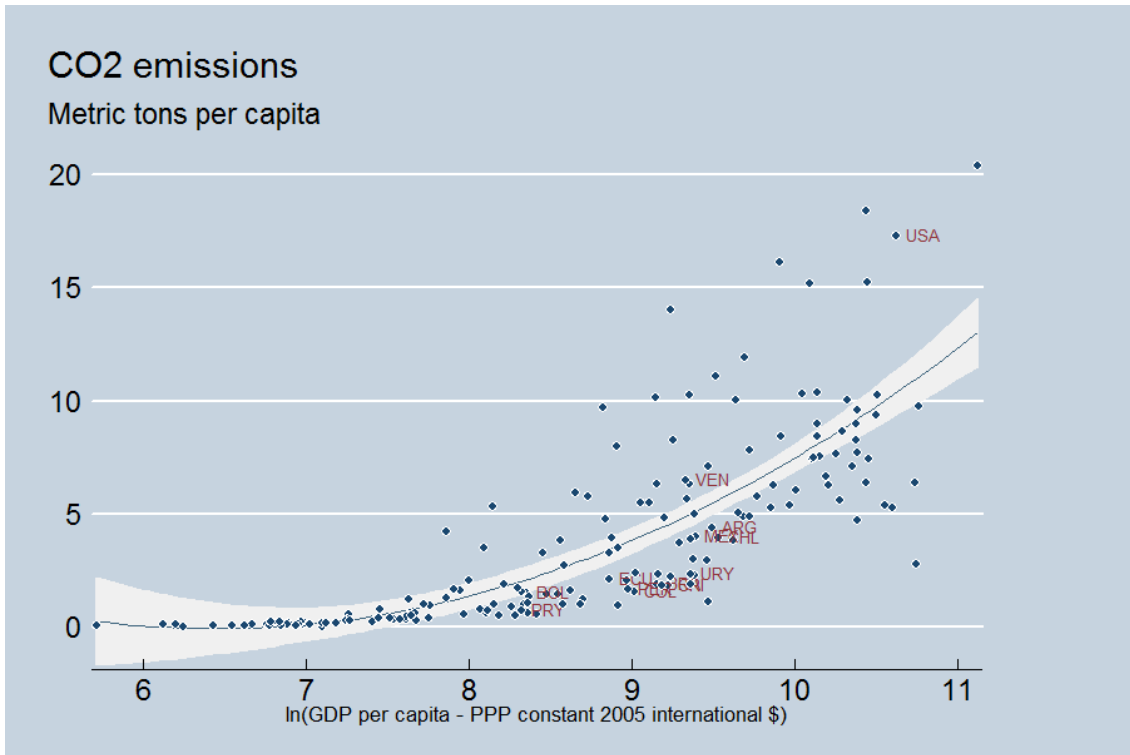


## 9. Institutional Strengthening and Citizen Security





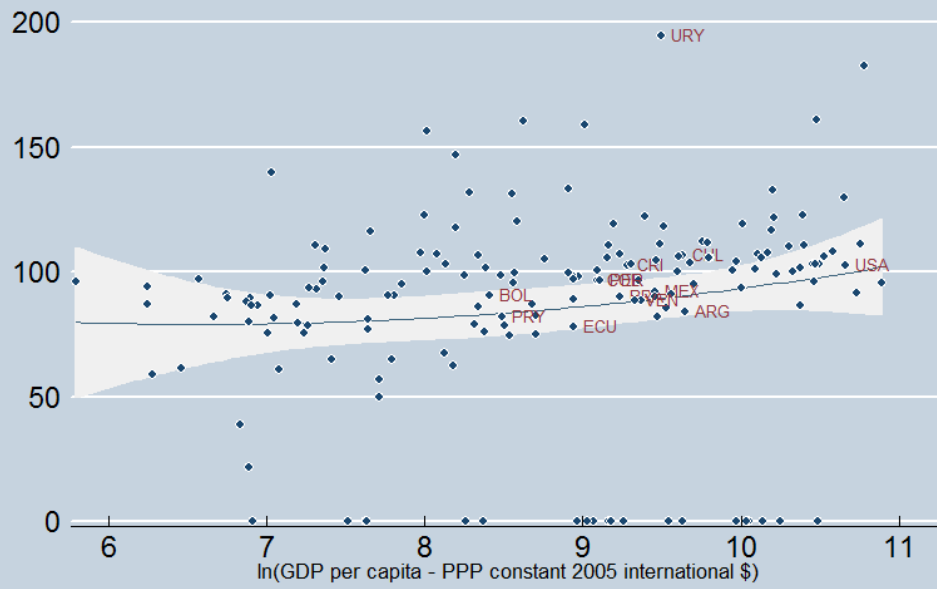
## 10. Environment





## Deforestation rate

% change in forest area vs. 1990 (1990=100)



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