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Investment Gaps in IDB Borrowing Countries

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Abstract

We estimate public investment gaps in a sample of developing countries using a public investment demand function. We then use GDP per capita projections, forecasts of structural transformation, and three SDG targets (poverty, infant mortality and lower secondary school completion) to predict public investment needs in 2030 among IDB borrowing countries. Our estimates suggest that in 2014 the total public investment gap of IDB borrowers was close to $170 billion (3.1 percent of the Region's GDP) and that the gap is expected to surpass $717 billion (6.3 percent of the Region's GDP) by 2030 if the SDGs were to be reached.

JEL classification: H54, H63, O16, O54
Keywords: Investment gaps, Latin America, SDG

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1 Introduction

At the Rio+20 conference, which took place in Rio de Janeiro in June 2012, Member States called for a prioritization of the sustainable development agenda. The conference eventually led to the 2015 UN Sustainable Development Summit and to the launch, on January 1st 2016, of the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs).

Achieving the SDGs will require improved policies and governance and higher levels of public and private investment. Estimates of annual financing needs for meeting the SDGs range between $1.5 and $2.5 trillion. This note contributes to the discussion by estimating public investment gaps for a large sample of developing and emerging market countries and by describing a simple methodology for incorporating SDGs target in these gap estimates. The note also presents a detailed discussion of investment gaps in IDB borrowing countries.

We start by assessing public investment demand in a sample of developing and emerging economies and then compute the public investment gap in each country as the difference between estimated public investment demand and observed public investment. Next, we use our model and GDP projections to forecast investment gaps up to 2030. Finally, we use the relationship between public investment and selected SDGs (i.e. poverty ratios, child mortality rate under the age of 5, and lower secondary school completion), to assess the public investment needed to reach these targets.

As there is evidence that public investment is a driver of economic growth (Abiad et al. 2016), policies that promote public investment can deliver high returns in terms of economic development.[1] Peter Drucker famously stated that what gets measured gets done. Hence, measuring public investment gaps is necessary for implementing policies aimed at closing these gaps. Quantifying the current and future needs for public investment can also help international financial institutions predict future demand, and target lending to countries that need it the most. We also

[1] Public investment has both direct and indirect effects on economic growth. The indirect effects are linked to the complementarities between public and private investment (Dreger and Reimers, 2016). There, however, also authors that found that public investment crowds out private investment (Afonso and St. Aubyn, 2016).

show that public investment can promote equitable growth by helping eradicate extreme poverty, reducing child mortality, and promoting education, as requested by the SDGs.

We find that public investment gaps vary significantly across regions. While the East Asia and Pacific region overinvests to the tune of 5.5 percent of GDP, all other developing regions display large investment gaps. In Latin America and the Caribbean, the investment gap was above 3 percent of GDP in 2014 and expected to reach 4.4 percent of GDP in 2030. If we factor in the public investment needed to eradicate extreme poverty, as requested by the SDGs, the 2030 public investment gap among IDB borrowing members reaches 5 percent of GDP or $524 billion. If we were to add the resources needed to reach the targets for child mortality under the age of 5 and secondary school enrollment in 2030, the gap would reach 5 percent of GDP or $566 billion. If we were to add to the poverty target, the infant mortality and the lower secondary completion targets, the gaps would reach 6.6 percent of GDP or $717 billion.

We are aware that there are issues with data quality and with our empirical methodology. One key problem has to do with the measurement of public investment. In measuring investment, we normally assume that every dollar spent will increase the value of the capital stock (investment is often referred to as "gross fixed capital formation"). This assumption might be less realistic for public investment, especially in countries with poor institutions, high corruption, and low bureaucratic quality (Pritchett, 2000). The second issue relates to the endogeneity problem and to our ability to measure the "demand" for public investment. We discuss this issue in Section 3 below. These caveats notwithstanding, our estimations are useful in providing a benchmark and in guiding policies to promote greater public investment, especially in countries with large public investment gaps.

We are not the first to assess public investment needs and their associated investment gaps. To estimate investment demand, we build on Fay (2000), Fay and Yepes (2003), and Ruiz-Nuñez and Wei (2015) but, unlike these authors, we focus on total investment expenditure rather than estimating separate demand equations for different types of infrastructure. By focusing on total investment expenditure, we can obtain direct estimates of the monetary value of investment demand without the need of making assumptions on the unit cost of different infrastructure

projects.

The launch of the Millennium Development Goals in 2000 led to a wave of "needs assessment" for MDG investment areas (UN Millennium Project 2005, MDG Africa Steering Group 2008, Bourguignon et al. 2008) and similar assessments have also been developed for the SDGs (for a review, see Schmidt-Traub and Sachs, 2015). These studies are difficult to compare and aggregate because they propose different country coverage, methodologies and assumptions and mix quantitative estimates with expert assessments (see Schmidt-Traub, 2015 for an attempt to aggregate different SDG estimates). Our methodology is instead purely quantitative and uniform across countries. It can thus be a useful complement, albeit not a substitute, to needs assessments based on expert judgment.

The reminder of the paper is organized as follows. Section 2 provides descriptive statistics on private, public and total investment and capital stocks across developing regions as well as among individual IDB borrowing countries. In section 3 we present the empirical methodology used to estimate public investment gaps, and present the estimates for current and projected public investment gaps. Section 4 describes the methodology used to predict the public investment needed to reach the selected SDG targets and provides estimates by region and IDB borrowing countries. Section 5 focuses on the role of the IDB. Section 6 concludes.

2 Investment and capital stock in developing countries

The average capital stock of Latin American and Caribbean countries (LAC) declined from nearly 250 percent of GDP in 1990 to 190 percent of GDP in 2010 and recovered slightly to 200 percent of GDP over 2010-15 (Table 1, all averages are weighted by GDP measured in 2000 PPP US dollars).[2] This nearly 20 percent decline is in contrast with what happened in the East Asia and Pacific (EAP) region, where the capital stock increased from 180 percent of GDP in 1990 to over

[2] By LAC we mean IDB borrowing members: Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Trinidad and Tobago, Uruguay and Venezuela. For data sources, see Data Appendix.

250 percent in 2015. While in 1990 Latin America was the developing region with the largest capital stock-to-GDP ratio, by 2000 it had been surpassed by both EAP and Eastern Europe and Central Asia (ECA). By 2015 LAC ranked second, lagging 20 percent behind EAP where investment rates remained high throughout the period.

More in general, the decline in capital stock observed in Latin America and the Caribbean over 1990-2015 is not at odds with the trends in ECA, Middle East and North Africa (MNA) or Sub-Saharan Africa (SSA). In fact, in 2015 the average capital stock ratio in LAC was similar to the developing country average, which stood at around 205 percent. In terms of the median country, however, the decline in the capital stock in the LAC region was more pronounced than that observed in other regions. In 2015, the LAC median capital stock was the second lowest among developing regions.

Table 1: Total Capital Stock to GDP ratio (%)

Region	1990	2000	2010	2015
Mean				
EAP	182	222	226	253
ECA	188	235	161	158
LAC	246	217	191	200
MNA	217	175	167	186
SAS	156	158	159	168
SSA	235	205	158	167
Median				
EAP	190	221	222	220
ECA	126	167	167	166
LAC	193	196	170	166
MNA	230	203	174	218
SAS	144	152	148	157
SSA	212	211	183	199

Source: Authors' calculations using IMF's Investment and Capital stock dataset where capital stocks and GDP are measured in 2000 PPP USD dollars. All averages are weighted by GDP. East Asia and Pacific (EAP), Middle East and North Africa (MNA); Eastern Europe and Central Asia (ECA); Latin America and the Caribbean (LAC), South Asia (SAS) and Sub-Saharan Africa (SSA)

In terms of private capital-to-GDP ratios, in 2015 LAC was the region with the highest average (Table 2). However, East Asia and Pacific has been catching up rapidly. Its private capital stock-to-GDP ratio increased from 79 percent in 1990 to 134 percent in 2015, while the private capital stock-to-GDP ratio of the LAC region decreased from 165 percent to 138 percent. If this trend continues, EAP will soon surpass LAC. While the average private capital stock-to-GDP ratio of the LAC region is much larger than in ECA, MNA, South Asia (SAS), and SSA, all regions have similar medians that oscillate between 104 percent and 112 percent of GDP.

The LAC region performs particularly poorly in term of public capital. In 2015, the average public capital-to-GDP ratio in LAC (Table 3) was only 62 percent: 40 percent smaller than the ratio

observed in MNA (a region with a large public capital stock and a small stock of private capital); half the average ratio in the EAP region (which has high private and public capital), and even smaller than the average ratio in SSA. Only SAS and ECA show lower levels of public capital.

Table 2: Private Capital Stock to GDP ratio (%)

Region	1990	2000	2010	2015
Mean				
EAP	79	97	106	134
ECA	147	177	115	112
LAC	165	144	131	138
MNA	92	81	80	87
SAS	74	86	101	112
SSA	140	122	95	101
Median				
EAP	79	109	117	112
ECA	82	118	110	112
LAC	135	128	116	109
MNA	63	65	93	104
SAS	79	90	104	105
SSA	108	110	94	105

Source: Authors' calculations using IMF's Investment and Capital stock dataset where capital stocks and GDP are measured in 2000 PPP USD dollars**.** All averages are weighted by GDP.

Table 3: Public Capital Stock to GDP ratio (%)

Region	1990	2000	2010	2015
Mean				
EAP	103	124	120	120
ECA	41	58	45	46
LAC	81	72	59	62
MNA	124	94	86	100
SA	82	72	58	56
SSA	95	83	63	66
Median				
EAP	51	60	66	65
ECA	35	50	44	45
LAC	66	59	58	62
MNA	109	81	80	94
SAS	59	64	55	52
SSA	77	94	74	87

Source: Authors' calculations using IMF's Investment and Capital stock dataset where capital stocks and GDP are measured in 2000 PPP USD dollars**.** All averages are weighted by GDP.

Over 1990-2015, both public and private capital stocks declined in the LAC region. However, public investment declined more rapidly than private investment. As a consequence, the average share of public capital stock over total capital declined from 33 to 31 percent between 1990 and 2015 (Table 4). While LAC's share of public capital in total capital is much smaller than the share observed in MNA, EAP or even SSA, the public capital share in LAC is similar to the end of 2015 shares in SAS and ECA. However, these two regions

Table 4: Public Capital Stock/Total Capital Stock (%)

Region	1990	2000	2010	2015
Mean				
EAP	57	56	53	47
ECA	22	25	28	29
LAC	33	33	31	31
MNA	57	54	52	53
SAS	52	45	37	33
SSA	40	41	40	40
Median				
EAP	27	27	30	30
ECA	27	30	26	27
LAC	34	30	34	37
MNA	47	40	46	43
SAS	41	42	37	33
SSA	36	45	41	44

Source: Authors' calculations using IMF's Investment andCapital stock dataset where capital stocks and GDP are measured in 2000 PPP USD dollars**.** All averages are weighted by GDP.

had different trends. SAS has a declining share of public capital because private capital grew very rapidly and ECA has an increasing share of public capital because private capital declined rapidly during the period.

High public investment shares in East Asia and low public investment shares in Latin America are partly driven by outliers (Table 3, bottom panel). The median Latin American country has a public investment share, which is lower than the MNA and SSA medians, but well above the medians of EAP, ECA, and SAS.

The large deviation between the average and median measures for the Latin American capital stock suggests that there is substantial dispersion and skewness in the cross–country distribution of this indicator. Figure 1 provides total capital stock-to-GDP ratios for LAC countries in 1990, 2000, 2010, and 2015.

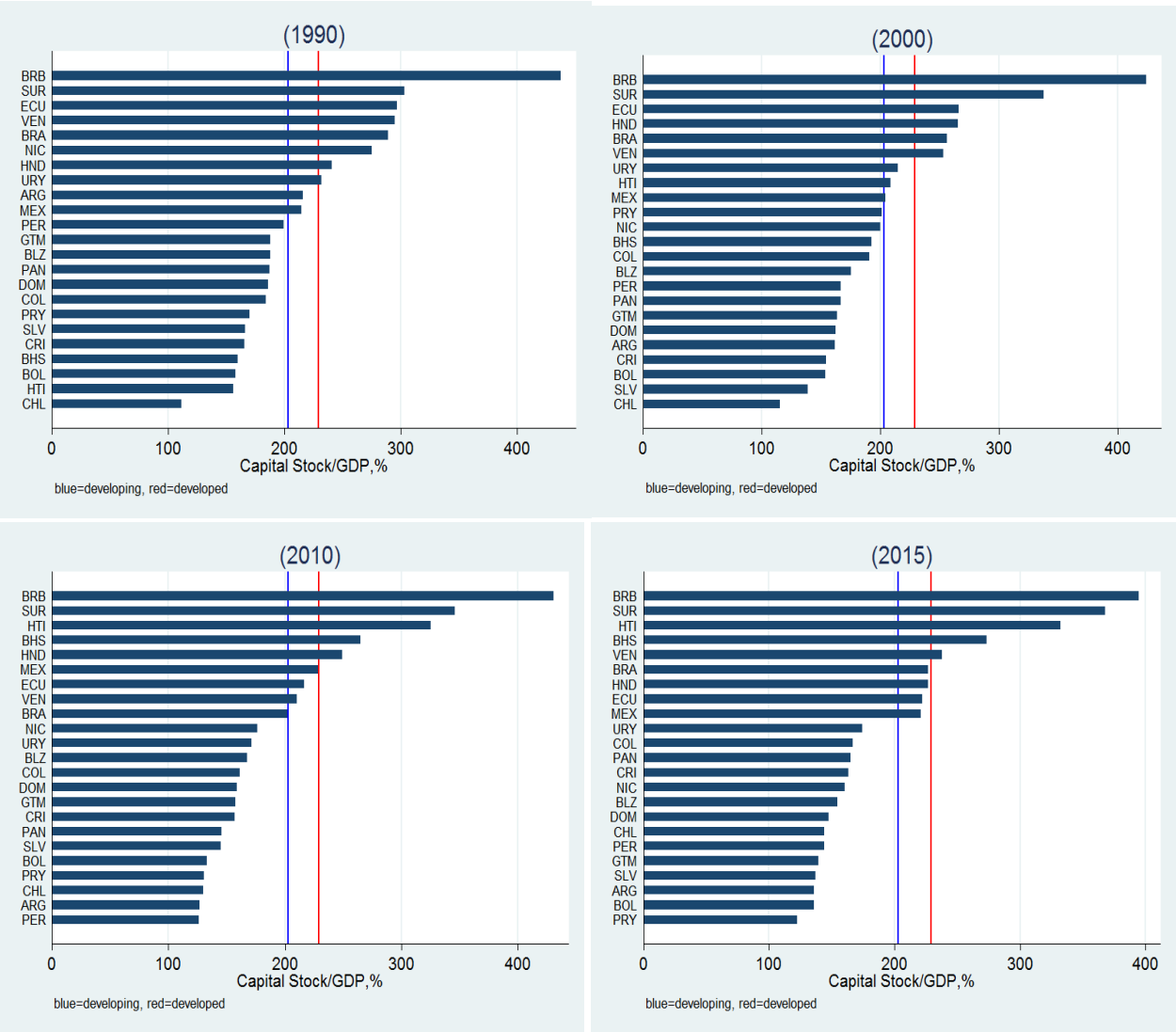
In 1990, 13 countries in the region (out of 23 for which data is available) displayed a total capital stock-to-GDP ratio below the developing country average (the blue line in Figure 1). By 2000, 15 countries in the region had capital stock-to-GDP ratios below the developing country average.

In 1990, 8 countries in the region exhibit a capital stock-to-GDP ratio above the advanced economies average (the red line in Figure 1). By 2015 only five countries had a capital ratio above that of the average advanced economy. Among these five countries, there are two high-income small Caribbean countries (Bahamas and Barbados), one middle-income small Caribbean country (Suriname), one low-income country (Haiti), and only one of the largest seven economies in the region (Venezuela). As to the large countries in the region, Brazil and Mexico had capital stock to GDP ratio above the developing country average; and Argentina, Chile, Colombia, and Peru low capital stocks.

Figure 2 confirms that public capital explains the relatively low capital stock-to-GDP ratio in the LAC region. The average developing country has a public capital-to-GDP ratio of about 90 percent; the average in LAC is just above 60 percent (Table 2). In 2015, only 5 countries in the

region (Barbados, Venezuela, Ecuador, Haiti, and Mexico) had a ratio of public capital-to-GDP above the developing country average. Public capital ratios were especially low in two of the region's three largest economies (Argentina and Brazil). Contrary to what was observed for the total capital stock-to-GDP ratio, the average public capital stock to GDP ratio in developed countries is smaller than the average ratio for developing countries.

Figure 1: Total Capital Stock to GDP ratio by LAC country (%)



Source: Authors' calculations using IMF's Investment and Capital stock dataset.

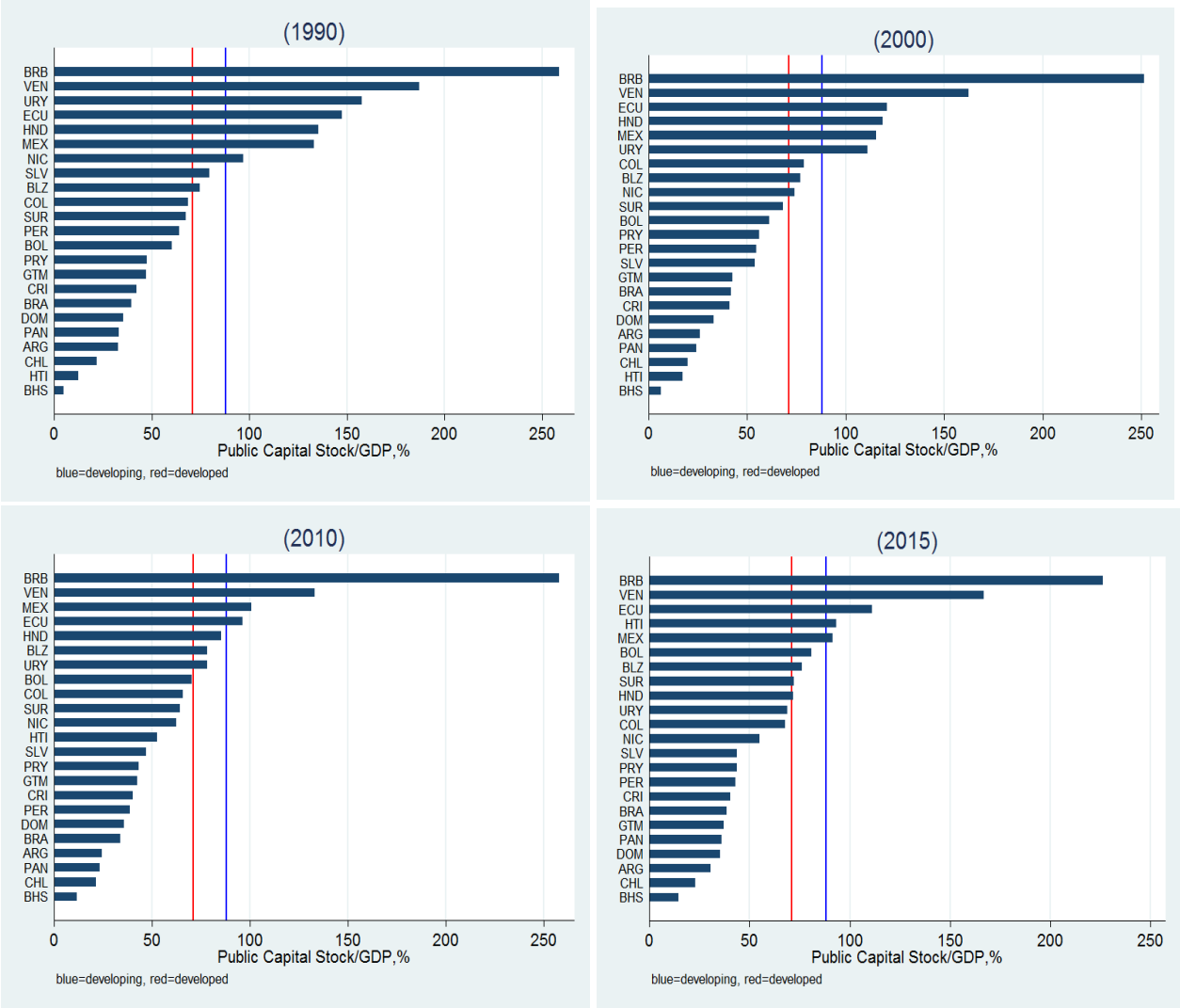
As for public capital stock-to-GDP ratios, most LAC countries are below the developing country average, even though the average LAC country has a ratio that is slightly above the average for the developing country group as a whole. This is because the median LAC country has a ratio

that is a lower than the LAC average and the developing country averages. Caribbean countries tend to be at the top of the distribution in terms of private capital-to-GDP ratios. Venezuela, instead, which was at the top of the distribution in terms of public capital stock and total capital stocks, is at the bottom of the distribution in terms of private capital-to-GDP ratio. The same is true, although to a lesser extent, for Bolivia whose very low private capital stock is only marginally compensated by its stock of public capital. Argentina moved from having one of the largest private capital stocks in 1990 to the bottom half of the distribution in 2015.

The share of public to total capital stock in LAC countries tends to be below the average for developing countries at 43 percent (Figure 4). In 2015, only Venezuela, Bolivia, Barbados, Ecuador, and Belize had a share that was above the developing country average. Eleven out of the twenty-four LAC countries in our sample have a share of public capital that is lower than the average share among developed countries. This group includes some large countries such as Argentina and Brazil.

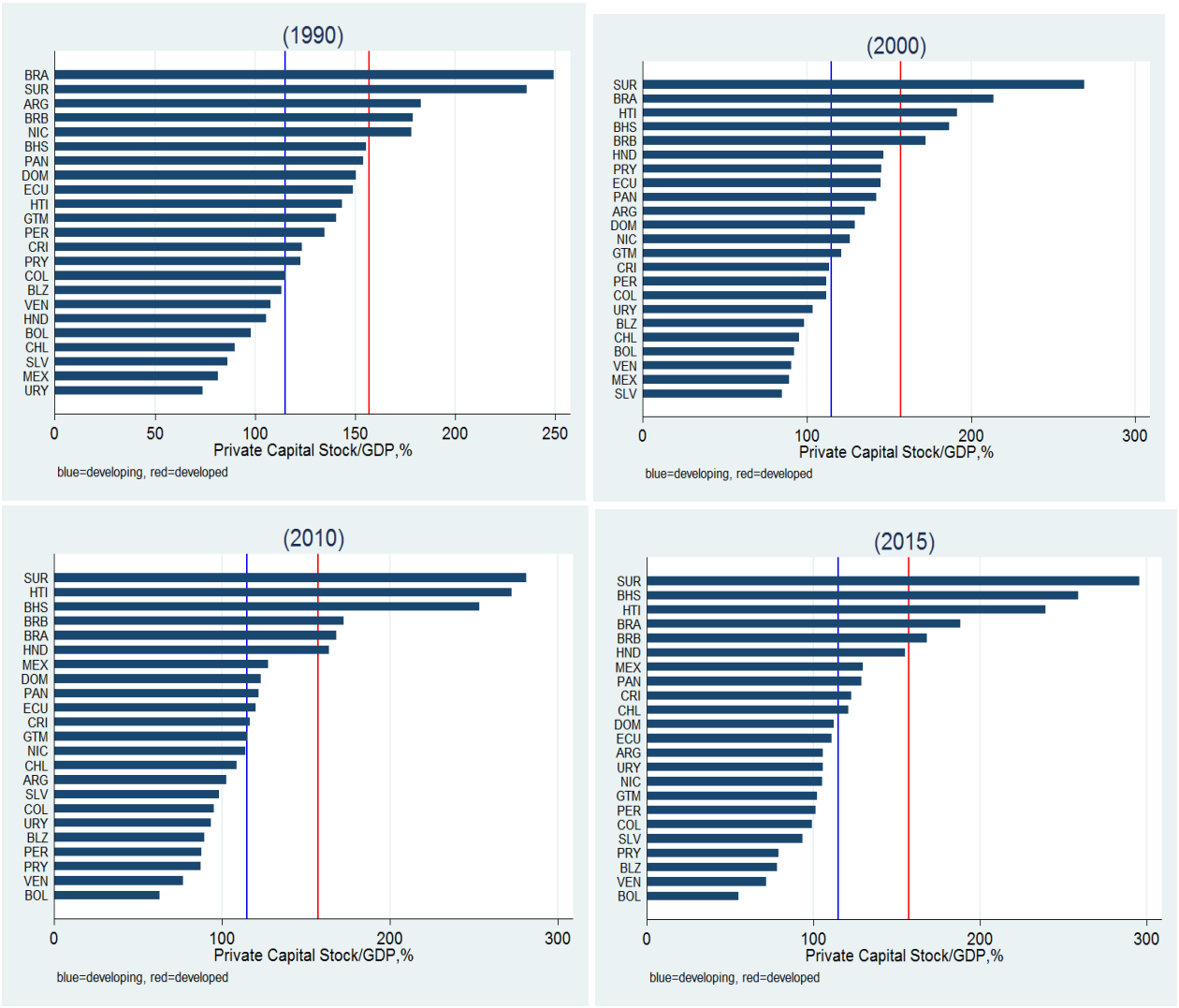
The three largest countries in the region present interesting cases. Brazil's low public capital share is driven by a large private capital stock (the largest in the region if small Caribbean countries are excluded, Figure 3) and a small public capital stock (in the bottom 30 percent of the regional distribution). Argentina's, private and public capital are below average, but public capital is even smaller than private capital, putting the country near the bottom of the distribution of the share of public capital. Finally, Mexico has above average public and private capital ratios, but a relatively higher public capital ratio.

Figure 2: Public Capital Stock to GDP ratio by LAC country (%)



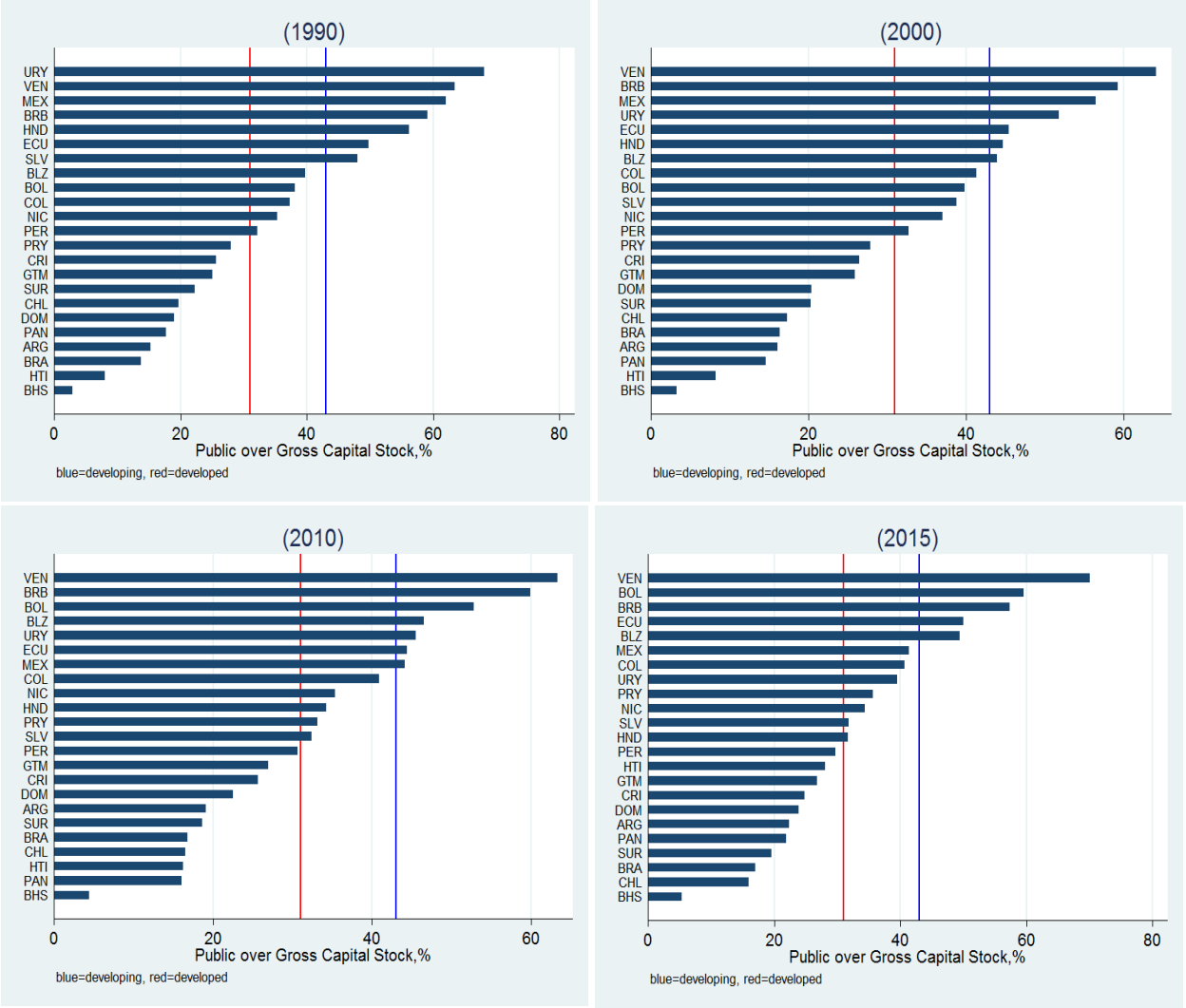
Source: Authors' calculations using IMF's Investment and Capital stock dataset.

Figure 3: Private Capital Stock to GDP ratio by LAC country (%)



Source: Authors' calculations using IMF's Investment and Capital stock dataset.

Figure 4: Share of Public Capital Stock in Total Capital Stock by LAC country (%)



Source: Authors' calculations using IMF's Investment and Capital stock dataset.

Tables 5 to 8 reproduce Tables 1 to 4 but for investment flows. They show regional patterns similar to those described above. However, contrary to the capital stock that has been declining in LAC over the last three decades, total investment-to-GDP ratios have increased from of 14 to 19 percent (Table 5). In fact, investment increased in most developing regions (the exception is ECA where investment collapsed in the 1990s) and throughout the period the total investment-to-GDP ratio in LAC was similar to that observed in most developing regions. The exception is EAP, which, by 2015, had a total investment-to-GDP ratio twice as large as that of LAC.

Table 5: Total Investment-to-GDP ratio (%)

Region	1990	2000	2010	2015
Mean				
EAP	22	26	36	37
ECA	23	13	14	15
LAC	14	17	19	19
MNA	13	13	20	19
SAS	16	17	24	22
SSA	12	13	18	18
Median				
EAP	18	20	22	24
ECA	13	13	16	18
LAC	14	16	18	20
MNA	18	14	21	20
SAS	14	15	18	19
SSA	13	13	18	19

Source: Authors' calculations using IMF's Investment and Capital stock dataset where capital stocks and GDP are measured in 2000 PPP USD dollars.

Table 6: Public Investment-to-GDP ratio (%)

Region	1990	2000	2010	2015
EAP	9	14	14	11
ECA	3	2	3	3
LAC	4	3	4	4
MNA	5	4	8	7
SAS	6	5	6	4
SSA	4	4	5	5
EAP	6	6	7	6
ECA	2	3	3	4
LAC	3	3	4	4
MNA	5	3	6	5
SAS	6	4	4	5
SSA	4	4	5	6

Source: Authors' calculations using IMF's Investment and Capital stock dataset where capital stocks and GDP are measured in 2000 PPP USD dollars.

Table 7: Private Investment-to-GDP ratio (%)

Region	1990	2000	2010	201
Mean				
EAP	13	12	22	26
ECA	19	10	11	12
LAC	10	14	15	15
MNA	8	9	11	11
SAS	10	12	18	18
SSA	9	9	12	13
Median				
EAP	14	13	15	17
ECA	10	10	11	13
LAC	9	13	13	15
MNA	7	8	12	12
SAS	8	12	14	15
SSA	8	8	13	12

Source: Authors' calculations using IMF's Investment and Capital stock dataset where capital stocks and GDP are measured in 2000 PPP USD dollars.

Table 8: Public Investment/Total Investment (%)

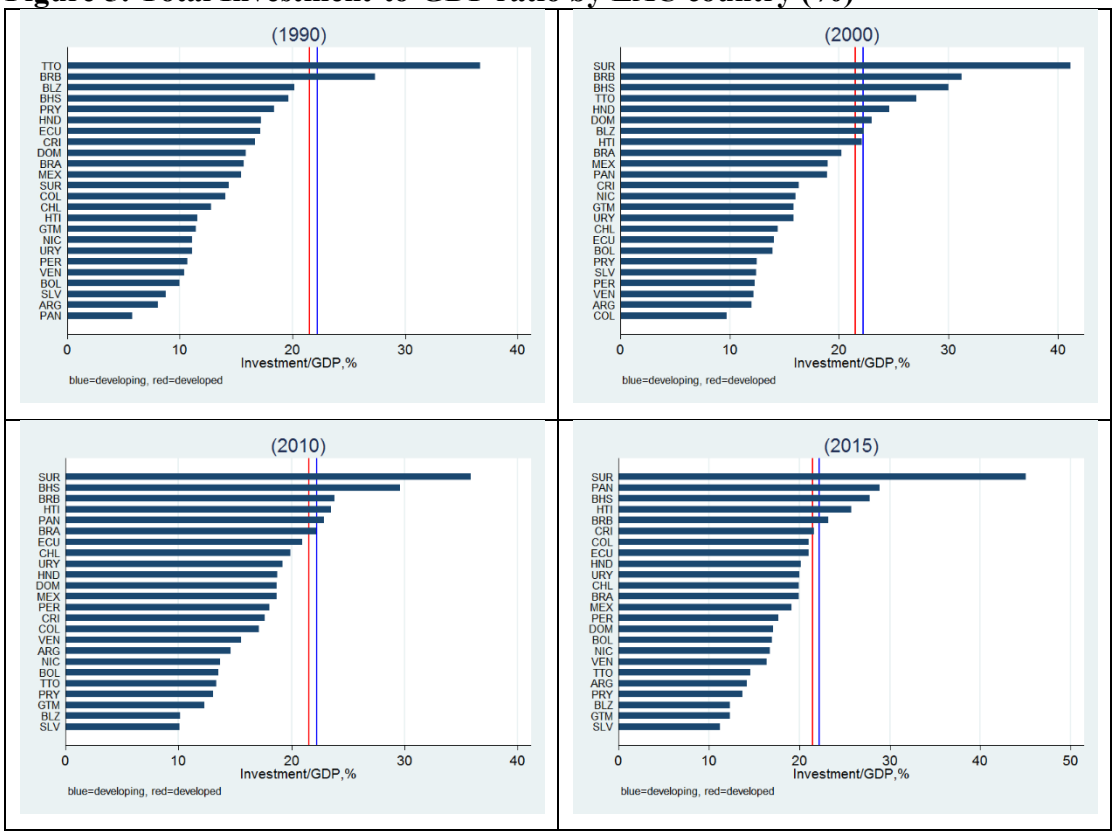
Region	1990	2000	2010	2015
Mean				
EAP	40	53	39	29
ECA	15	20	21	21
LAC	30	18	21	20
MNA	40	32	43	40
SAS	39	27	25	20
SSA	29	30	30	28
Median				
EAP	32	31	33	25
ECA	19	20	22	22
LAC	19	20	21	20
MNA	29	23	29	23
SAS	40	28	22	24
SSA	31	31	29	31

Source: Authors' calculations using IMF's Investment and Capital stock dataset where capital stocks and GDP are measured in 2000 PPP USD dollars.

In terms of public investment-to-GDP ratios, the patterns are again similar to the ones observed for the stock of public capital. Investment rates remained relatively stable during the period and LAC is the region with the second lowest public investment-to-GDP ratio (after ECA, Table 6). The share of private investment in GDP increased throughout the period from 10 percent in 1990 to 15 percent by 2015 (Table 7) confirming that it is private investment that drove the

increase in total investment in LAC between 1990 and 2015. The average country in LAC has a private investment-to-GDP ratio that is similar to that of other regions. The exception, again, is EAP where the private investment-to-GDP ratio is 11 percentage points (corresponding to 60 percent of the investment ratio in LAC) larger than in LAC.

Figure 5: Total Investment-to-GDP ratio by LAC country (%)



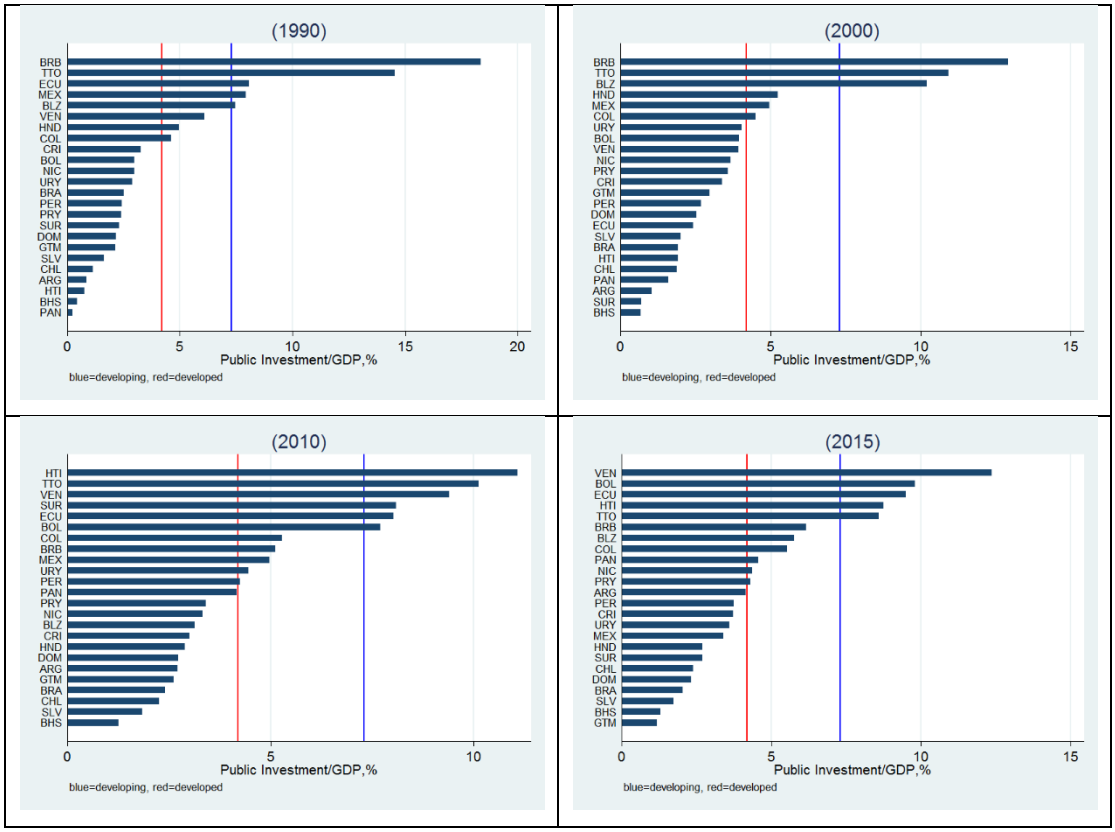
Source: Authors' calculations using IMF's Investment and Capital stock dataset.

LAC's share of public over total investment declined by a third between 1990 and 2015 (Table 8). In 2015, the share of public investment over total investment in MNA countries was twice the LAC share and EPA and SSA had average shares at least one third larger than that of LAC. ECA and SAS had instead shares of public investment in total investment similar to LAC's average.

Within LAC the patterns in terms of investment flows are also similar to the ones observed for capital stocks (Figures 5-8). In 2015, all but five LAC countries (Panama, Bahamas, Barbados,

Haiti and Suriname) had a total investment-to-GDP ratio that was below the developing country average of about 20 percent of GDP (the blue line in Figure 5).

Figure 6: Public Investment-to-GDP ratio by LAC country (%)



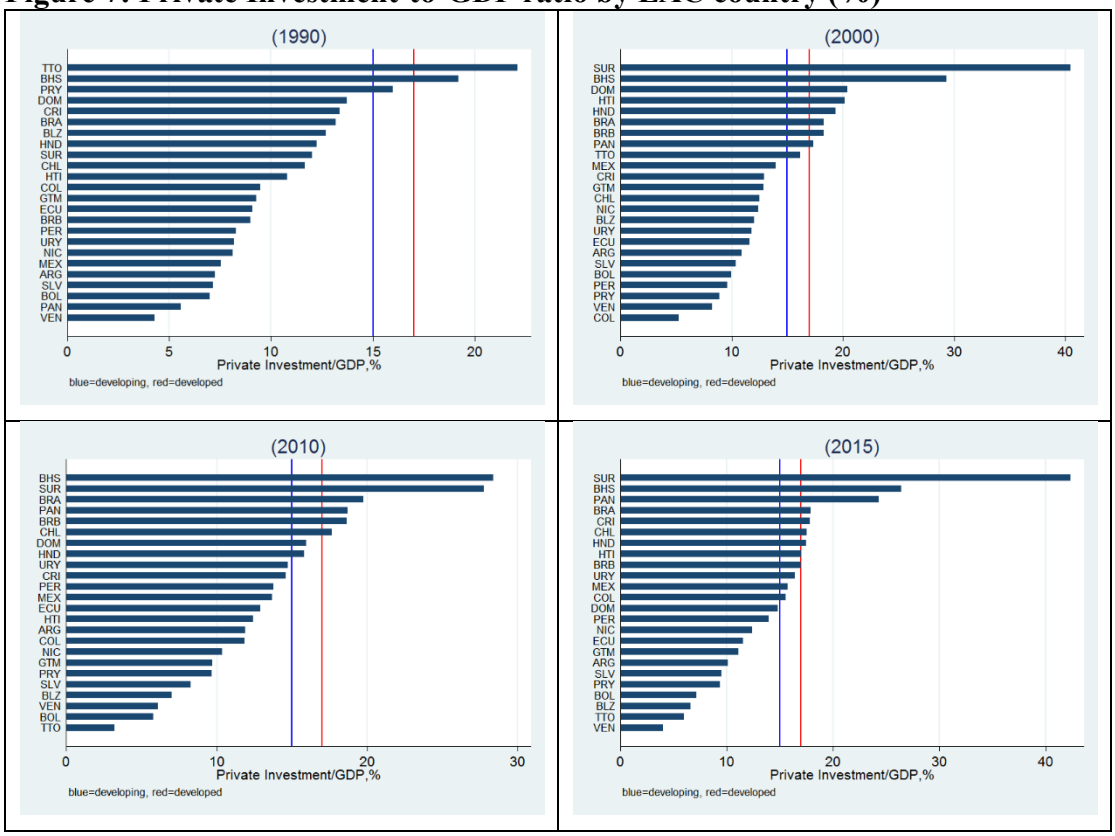
Source: Authors' calculations using IMF's Investment and Capital stock dataset.

In terms of public investment-to-GDP ratio, in 2015 there were only four LAC countries with a ratio above the developing country average: Bolivia, Haiti, Venezuela, and Ecuador (Figure 6).[3] In 2015, Guatemala, Bahamas, El Salvador, and Brazil were at the bottom of the distribution with ratios below 2 percent.

In the case of private investment, twelve LAC countries were above the developing country average in 2015 (Figure 7). Among the countries with a high share of private investment in GDP there are large countries such as Brazil and Chile.

[3] The average public investment-to-GDP ratio for developing countries tends to be larger than the average for developed countries, whereas in terms of total investment-to-GDP ratio the averages for developed and developing countries are similar.

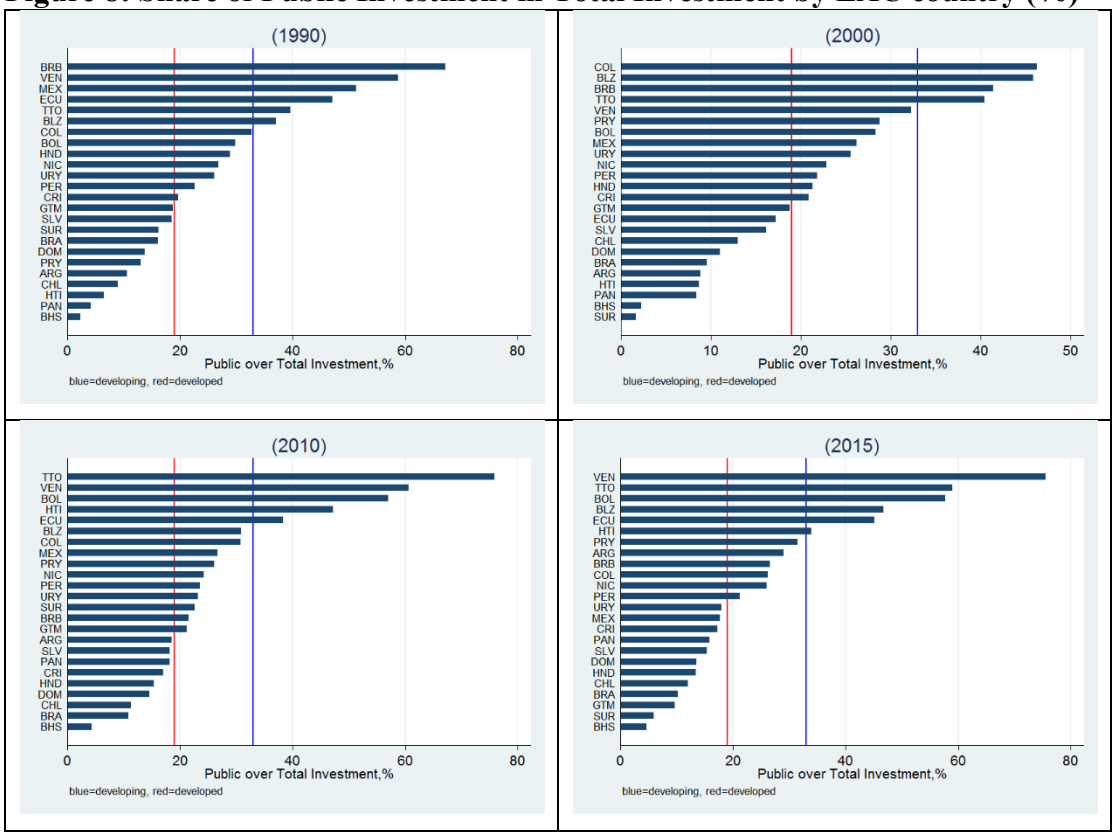
Figure 7: Private Investment-to-GDP ratio by LAC country (%)



Source: Authors' calculations using IMF's Investment and Capital stock dataset.

In 2015, only five LAC countries had a share of public investment in total investment larger than the developing country average: Venezuela, Bolivia, Belize, Ecuador, and Haiti (Figure 8). These descriptive statistics suggest that the share of public investment in total investment could be significantly increased in 18 countries in the region.

Figure 8: Share of Public Investment in Total Investment by LAC country (%)



Source: Authors' calculations using IMF's Investment and Capital stock dataset.

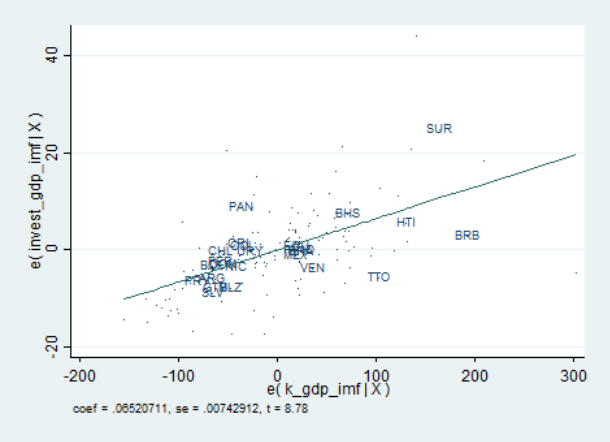
To test whether countries with a small capital stock are catching up with countries with larger ones, we regressed the investment-to-GDP-ratio in 2015 over the capital stock-to-GDP ratio in the same year. We found a positive correlation (Figure 9a) suggesting that investment is actually higher in countries with a larger capital stock (each dot in the figure is a country, LAC countries are labeled with their three-letter ISO code). The point estimate of 0.065 indicates that a 100 percent of GDP increase in the capital stock is associated with a 6.5 percent of GDP increase in the investment rate. This is about one percentage point larger than the average depreciation rate used to build the capital stock.[4] Therefore, the regression indicates that, on average, there is a small divergence. Countries with a higher capital stock invest more and the investment differential is

[4] The IMF estimates that public capital depreciation for low and middle-income countries ranges between 2.5 percent and 3.6 % and private capital depreciation for low and middle countries ranges between 4.2 percent and 8.3 percent. About two-thirds of the countries include in the regressions of Figure 6a are middle income, yielding a public capital depreciation rate of 3.2 percent and a private capital depreciation rate of 7 percent. With a public capital share of 35 percent, we obtain an average depreciation rate of 5.5 percent

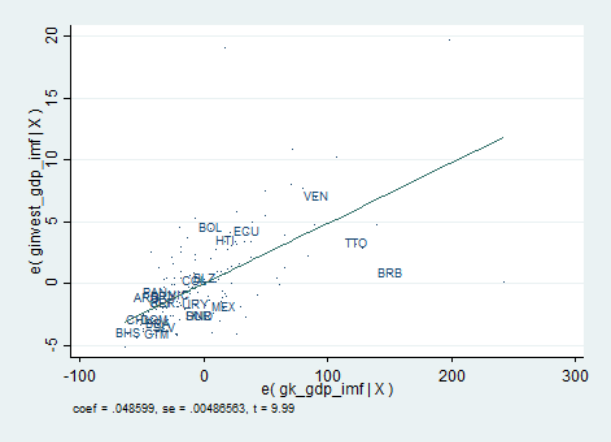
slightly larger than the depreciation differential. Countries that are above or on the regression line (such as Suriname, Panama, Bahamas, and Chile) are moving towards a higher capital stock and countries farther below the regression line (such as Barbados, Trinidad and Tobago, and Venezuela) are moving towards a lower capital stock.

Figure 9: Investment rates and capital stock

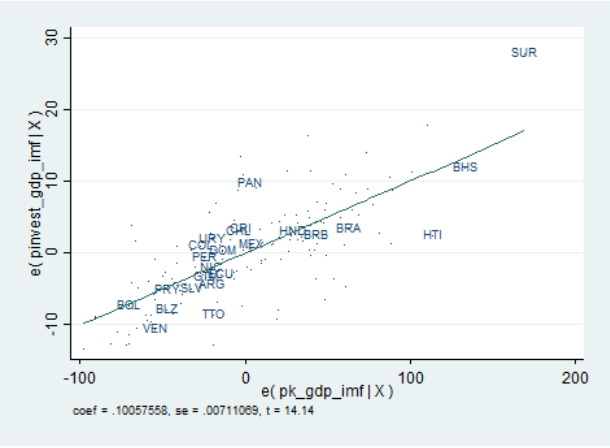
a. Total investment



c. Public investment



b. Private investment



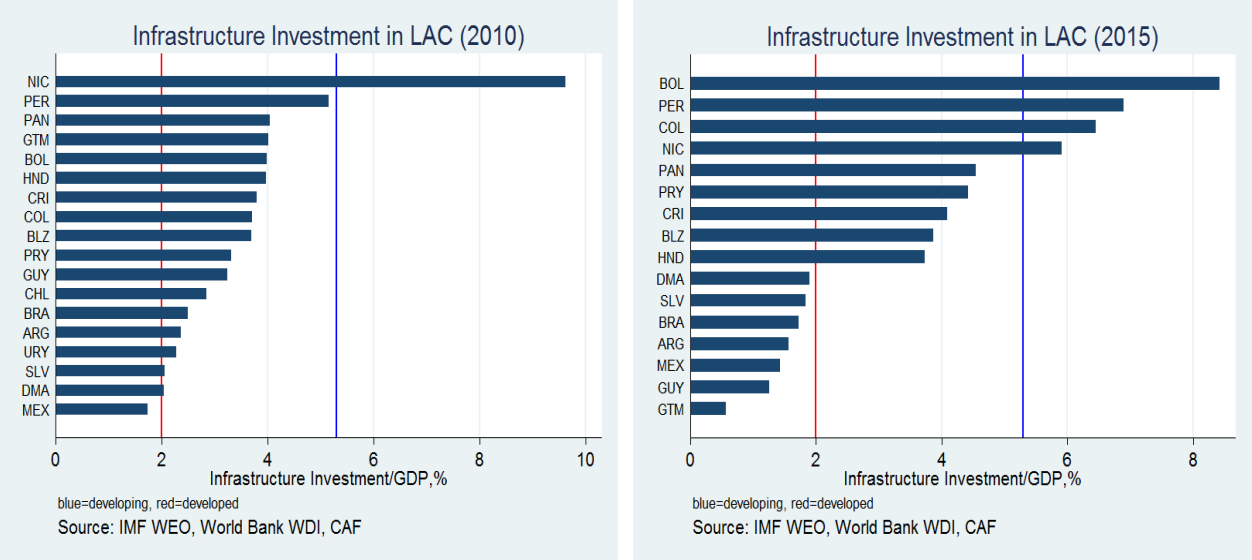
Focusing on private capital, we find a coefficient of 0.10 (Figure 9b), which is higher than the assumed depreciation rate for private capital of about 7 percent. This implies that there is divergence, as the increase in investment associated with a larger capital stock is larger than what is needed to compensate for depreciation. The figure suggests that Suriname and Panama are moving towards larger private capital and Haiti, Venezuela, and Trinidad and Tobago are moving towards a smaller private capital stock.

Finally, Figure 9c shows a divergence in public capital, but at a much smaller rate with respect to public capital (the regression's coefficient implies a 4.8 percent elasticity and the estimated public capital depreciation rate is 3.2 percent). Regression's results suggest that Venezuela, Haiti, and Bolivia are moving towards a larger stock of public capital and Trinidad and Tobago, Barbados, Mexico and Guatemala are moving toward lower stocks of public capital.

The IMF data used so far focus on total investment. Cross-country data on infrastructure investment from the Global Infrastructure Hub are only available for a small number of countries and start in 2010. For those countries, the pattern is similar to that for total investment. In 2015, LAC infrastructure investment represents on average 2.6 percent of GDP, well below the 5 percent infrastructure investment needs estimated by Serebrisky et al. (2015). In EAP and SSA the average is above 5 percent, 3.7 percent in SAS and 3.0 percent in MNA. Overall, LAC's infrastructure investment is much lower than in the developing world average.

The Latin American Development Bank (CAF) the Economic Commission for Latin America and the Caribbean (ECLAC) and the Inter-American Development Bank (IDB) have assembled a detailed dataset on infrastructure investment (INFRALATAM) covering 18 countries in Latin America and the Caribbean. Figure 10 corroborates our previous results, suggesting that most countries in the regions have low investment levels. Specifically, in 2015, only 4 countries in the region (Bolivia, Peru, Colombia and Nicaragua) invested in infrastructure more than the average developing economy. The figure also shows that infrastructure investment is particularly low in the Region's three largest economies (Brazil, Argentina, and Mexico).

Figure 10: Infrastructure investment by LAC country (%)



Source: Authors' calculations using INFRALATAM data.

Infrastructure quality also matters. Even if the level of total or public investment in LAC is relatively low, it may be that the quality or the efficiency of total and public investment is higher in LAC than in other regions. To check this, we use World Economic Forum data to calculate average infrastructure efficiency by region in 2014 (Table 9).[5] The first column shows the raw index and the second the index conditional on GDP per capita (these are the residuals of a regression of the infrastructure index over the log of GDP per capita).

Table 9: Infrastructure Efficiency, 2014

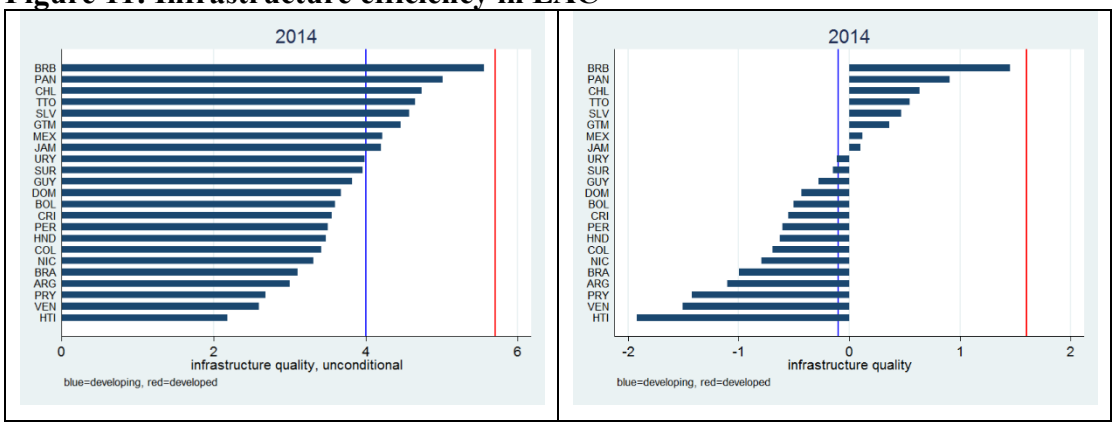
Region	Infrastructure quality 2014	Infrastructure quality conditional on GDP per capita
East Asia & Pacific	4.4	0.3
Europe & Central Asia	4.4	0.3
Latin America & Caribbean	3.5	-0.6
Middle East & North Africa	4.6	0.5
South Asia	3.7	-0.4
Sub-Saharan Africa	3.4	-0.7

Source: Authors' calculations using WEF's Infrastructure efficiency data dataset and World Bank's WDI for GDP per capita. The WEF infrastructure quality index ranges from 1 to 7. After conditioning on GDP per capita the average of the residual across all countries is equal to zero.

[5] See http://www3.weforum.org/docs/GCR2016-2017/05FullReport/TheGlobalCompetitivenessReport2016-2017_FINAL.pdf

The results suggest that infrastructure quality in Latin America is not better than in the rest of the developing world. If we exclude Sub-Saharan Africa, infrastructure quality in Latin America tends to be lower than other developing regions, with a larger difference if we control for GDP per capita. Table 9 shows that, in Latin America, investment in infrastructure lacks both in terms of quantity and quality.

Figure 11: Infrastructure efficiency in LAC



Source: Authors' calculations using WEF's infrastructure efficiency data and World Bank's WDI for GDP per capita**.** The (unconditional) infrastructure quality index varies between 1 and 7.

Within LAC, infrastructure quality varies across countries, with relatively high infrastructure quality (but still below the developed country average) in Barbados, Panama, Chile, Trinidad and Tobago, El Salvador, Guatemala, Mexico and Jamaica. The quality of infrastructure is instead low in Paraguay, Venezuela and Haiti (Figure 11). We obtain the same ranking if we condition for GDP per capita. Among South American countries, only Chile has an infrastructure quality index above the developing country average.

3 Estimating public investment gaps

In this section, we estimate investment gaps for Latin America and the Caribbean and compare them with gaps in other developing regions. As a first step, we estimate public investment demand and compare it with actual investment. Next, we project future investment demand and compare it with a business as usual benchmark. Our approach builds on the methodology of Fay (2000) and Ruiz-Nuñez and Wei (2015). These authors first estimate the demand for different types of

infrastructure by regressing the stock of existing infrastructure on lagged infrastructure stock, GDP per capita, the sectorial composition of GDP, and a set of country fixed effects. Next, they use projected GDP per capita growth to estimate future demand for infrastructure in each country and give a dollar value to these projections by making assumptions on the cost of production of different infrastructure projects. While we use a similar strategy, we recognize that there are three issues with the existing methodology.

First, estimating separate demand equations for different types of infrastructure overlooks their complementarities, for example, between access to electricity and access to sanitation. Moreover, public money is fungible and governments face a budget constraint and tradeoffs. The decision to invest in a certain type of public infrastructure requires an evaluation of its opportunity costs in terms of other types of public expenditure or, as minimum, alternative investment projects. It is also methodological complicated to back up the monetary value of investment demand from regressions that do not include the monetary value of infrastructure investment.[6] Additionally, data availability is limited. Hence, demand estimates for different types of infrastructure are based on different samples. For instance, in Ruiz-Nuñez and Wei (2015), 96 countries (for a total of 926 observations) have available data for electric generation capacity, but only 57 countries (and 107 observations) for port infrastructure.

Second, existing empirical exercises are based on a business as usual scenario as they assume that future growth is equal to projected growth. Hence, they do not incorporate the idea that countries may be trying to meet certain development goals that may require higher public investment.

Finally, there are econometric problems with the estimation of a fixed effects model in the presence of a lagged dependent variable. There is also an endogeneity problem, as it is not clear whether the estimates of Ruiz-Nuñez and Wei (2015) capture demand or supply effects.

[6] Ruiz-Nuñez and Wei (2015) estimate models for: telephones subscribers per 1,000 persons; Kilometers of paved roads per squared kilometer of land area; Kilometers of unpaved roads per squared kilometer of land area; Kilometers of rail per 1000 persons; KW of installed electricity generation capacity per capita; Percentage of households with access to electricity; Percentage of households with access to water and sanitation; Percentage of households with access to sanitation; Percentage of households with access to wastewater treatment.

In order to address the first issue, we do not estimate equations for different types of infrastructure, but we focus on total public-sector investment. This strategy allows us to use data covering up to 156 countries and provides direct predictions for investment-to-GDP ratios, which can be easily converted in dollar values using GDP data. We then compute investment gaps by comparing the estimated investment demand with realized investment.

We address the second issue by estimating the conditional correlation between public investment and an indicator of extreme poverty. Next, we use the SDG target to compute the amount of public investment necessary to close the gap between the current value of extreme poverty and the SDG goal. Finally, we add this amount of public investment to the estimated investment demand described above.

While we cannot fully address the endogeneity issue, we use the standard system GMM estimator of Arellano and Bover (1995) and Blundell and Bond (1998) to deal with problems that arise from the joint presence of country fixed effects and a lagged dependent variable. Under certain conditions, these estimators also mitigate the endogeneity problem.

3.1 Baseline

We start with a basic investment demand equation:

$$I_{c,t} = \alpha_c + \alpha_t + \beta_1 I_{c,t-1} + \beta_2 \ln(y_{c,t}) + \beta_3 \ln(A_{c,t}) + \beta_4 \ln(M_{c,t}) + \varepsilon_{c,t} \quad (1)$$

where $I_{c,t}$ is public investment over GDP of country *c* at time *t,* $y_{c,t}$ is GDP per capita*,* $A_{c,t}$ is the share of agriculture in GDP, $M_{c,t}$ is the share of manufacturing in GDP, α_c is a country fixed effect, $\alpha_t$is a year fixed effect, and $\varepsilon_{c,t}$ is an i.i.d. error term.[7] Each observation is an average for a 5-year

[7] The year fixed effects control for common shocks. The results are qualitatively identical and quantitatively similar if we exclude year fixed effects. We can introduce other control variables into Equation (1). One potential candidate is the WEF's quality of infrastructure variable that is likely to affect public investment demand. The problem with this variable is that it is only available from 2006, so once we take 5 year averages we would be left with two observations per country, which would allow us to use our preferred estimation strategy.

period (1990-1994, 1995-1999, 2000-2004, 2004-2009, 2010-2014). In principle, we have 5 observations per country. However, since the equation is estimated in first differences we only use 4 observations per country. To control for the potential spurious effect of outliers, we Winsorize all variables at 2 percent.

Table 10 reports the results of our baseline estimates for a sample of developing and emerging market countries (125 countries and 466 observations), as well as for a sample of advanced and developing countries (156 countries and 581 observations). The estimates suggest that, as countries grow in terms of GDP per capita, they need less public investment per unit of GDP. The point estimates imply that a one-percent increase in GDP per capita is associated with a decrease in public investment demand of approximately 0.4 percent of GDP. The point estimates also indicate that as countries move from agriculture and manufacturing to services they need more public investment. The structural transformation away from agriculture and into services seems to require higher public investment than moving from manufacturing to services. However, the difference between the coefficients of the agriculture and manufacturing shares is not statistically significant.

The bottom panel of the table shows that our model satisfies the standard specification tests. Specifically, the Sargan tests do not reject the overidentification restrictions and the Arellano and Bond autocorrelation tests satisfy the assumption of statistically significant autocorrelation of order 1, but no autocorrelation of order 2.[8]

Up to this point we assumed that β_2 in Equation (1) measures the causal effect of the GDP per capita on investment. This is equivalent to assuming that the GDP per capita is fully exogenous and hence uncorrelated with the residuals of Equation (1). However, this assumption is unlikely to hold as investment may have a positive effect in GDP per capita (in the standard neoclassical

[8] When we run the same specification on a sample of developed countries (31 countries and 115 observations) the Sargan and Arellano and Bond autocorrelation tests suggest that the instruments are not valid. It is also unclear that with such a small cross-section we satisfy the necessary conditions for asymptotics to be valid. In our baseline sample composed of developing and emerging market countries, we also run a specification where we include the share of private investment in GDP as a regressor. The results are qualitatively identical, and the share of private investment to GDP has a positive and statistical significant coefficient suggesting that private and public investment complement each other.

growth model an increase in investment leads to a higher steady state income). Consider, for instance a model in which public investment (I) is regressed on GDP per capita (Y):

$$I = \alpha + \beta Y + \varepsilon \tag{2}$$

where α and β are parameters to be estimated and ε is a shock to public investment. In the setup of Equation (2), a negative value of β indicates that richer countries need less public investment. This is what we find when we estimate Equation (1). Now, let us also assume that public investment has an effect on GDP per capita and that this relationship can be described as:

$$Y = m + kI + v \tag{3}$$

where m and k are parameters to be estimated and v is a shock to GDP per capita. The parameter k measures the effect of public investment on GDP per capita and is likely to be positive.

The OLS estimation of β from Equation (2) is:

$$\hat{\beta} = \frac{\beta\sigma_v^2 + k\sigma_\varepsilon^2}{k^2\sigma_\varepsilon^2 + \sigma_v^2} \tag{4}$$

and the bias of the OLS estimate is:

$$E(\hat{\beta}) - \beta = \frac{k(1-\beta k)}{\sigma_v^2/\sigma_\varepsilon^2 + k^2} \tag{5}$$

Under the assumptions that $\beta k < 1$ (which is satisfied if β and k have opposite signs) and $k > 0$, the OLS estimate of β is positively biased. While our estimation strategy partly controls for this endogeneity problem by using lagged values as instruments, any violation of the exclusion restrictions (and the Sargan test is a necessary but not sufficient condition for the validity of these restrictions) is likely to lead to a positive bias in the estimation of β. Hence, the true value of β_2 is likely to be smaller than -0.46. In future research, it would be interesting to build bounds for the value of β_2 and use these bounds to build a distribution of the investment gap.

Table 10: Investment demand equation

	(1)	(2)
Lag of public investment/GDP	0.319**	0.293**
	(2.03)	(2.11)
ln(GDP per capita)	-0.426**	-0.536***
	(-2.46)	(-4.17)
Agriculture/GDP	-0.070***	-0.072***
	(-3.60)	(-4.42)
Manufacturing/GDP	-0.099***	-0.085***
	(-5.73)	(-6.15)
Sample	Developing	All
Country FE	Y	Y
Year FE	Y	Y
Observations	466	581
Number of countries	125	156
Sargan Stat.	2.177	3.187
Sargan P-Value	0.537	0.364
Arellano-Bond test for AR(1)	-2.564	-2.697
Arellano-Bond test for AR(1) P-value	0.010	0.007
Arellano-Bond test for AR(2)	-0.233	-0.660
Arellano-Bond test for AR(2) P-value	0.816	0.509

z-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

Next, we use the estimates of column 1 of Table 10 (the sample of developing and emerging market countries) to compute country-specific investment gaps as captured by the country fixed effects:

$$GAP_c = \alpha_c$$

Note that, by construction, $E(GAP_c) = 0$.[9] Hence, our gap estimate does not measure the absolute gap, but the relative investment gap. By construction, certain countries will have a positive investment gap and others will have a negative investment gap. Table 11 reports these relative investment gaps measured both in percentage of GDP and in USD dollars.

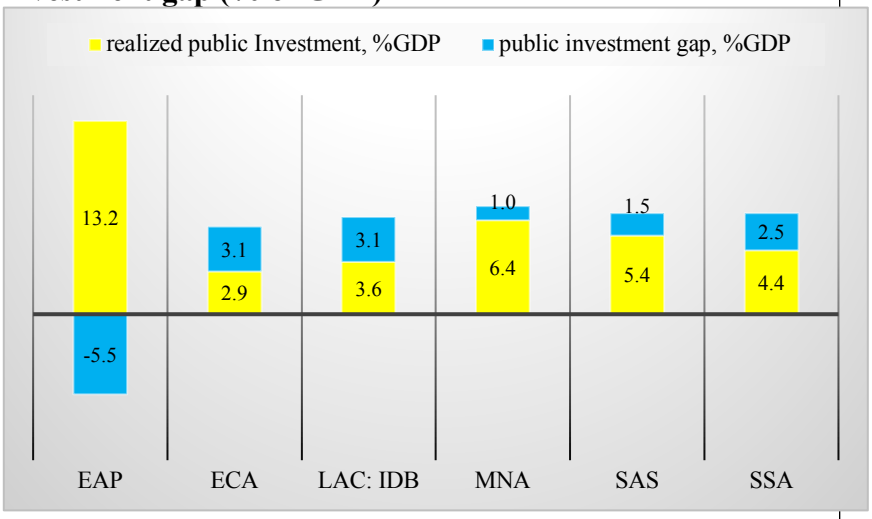
[9] As the demand equation is estimated in first differences, the fixed effects cannot be recovered directly from the estimated equation, but need to be obtained by applying the point estimates to a level equation.

Table 11: Public Investment Demand and Gaps

Region	Investment demand (% GDP)	Realized Investment (% GDP)	Gap (% GDP)	Investment demand (bill USD)	Realized Investment (bill USD)	Gap (bill USD)
EAP	7.7	13.2	-5.5	799	1367	-567
ECA	6.0	2.9	3.1	257	125	131
LAC	6.7	3.6	3.1	366	197	169
MNA	7.4	6.4	1.0	131	114	17
SAS	6.9	5.4	1.5	159	123	35
SSA	6.9	4.4	2.5	100	63	37

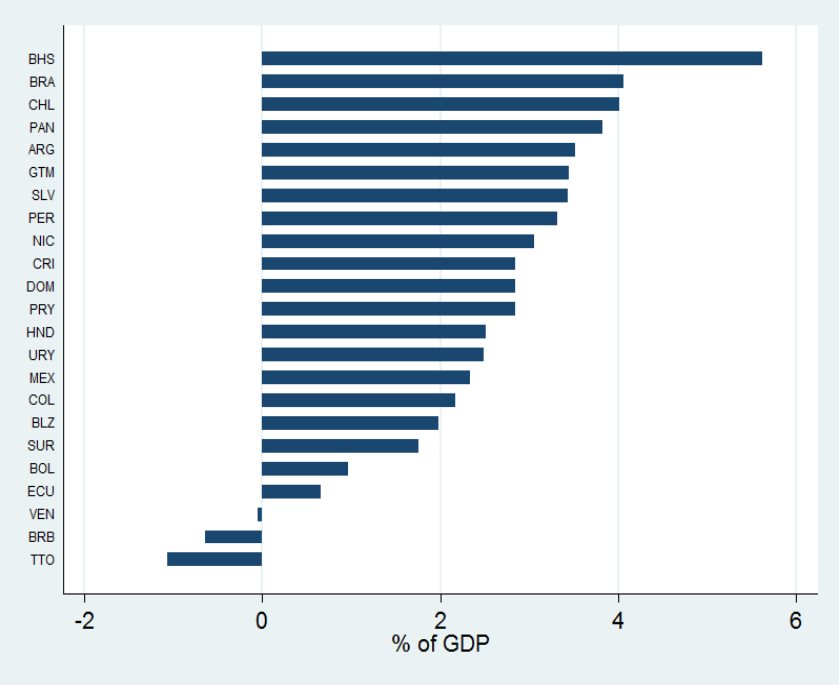
Source: Authors' calculations.

Figure 11: Realized public investment and public investment gap (% of GDP)



The East Asia and Pacific region has a negative investment gap (suggesting that in this region the public sector invests too much) and all other regions have positive gaps. LAC and ECA display the largest gap when measured both as a share of GDP and in US dollars. The gap represents 3.1 percent of GDP in both regions, equivalent to $169 billion for LAC and $131 billion for ECA. In SSA the public investment gap represents 2.5 percent of GDP or $37 billion; in South Asia 1.5 percent of GDP or $35 billion, whereas in MNA one percent of GDP or $17 billion. At the other end of the spectrum, in East Asia public overinvestment is estimated at 5.5 percent of GDP, or $567 billion. Figure 12 graphically illustrates the investment gap as the difference between actual investment and investment demand as a share of GDP for each region

Figure 12: Investment gaps in IDB borrowing countries (% of GDP)



Source: Authors' calculations. A positive gap means underinvestment.

Barbados, Trinidad and Tobago, and Venezuela show a negative investment gap (Figure 12). One of these outliers is a high-income small country and the other two are important oil and gas producers with large public investment rates (Figure 6).[10] All other countries have positive, and often large, investment gaps. The gap is higher than 2 percent of GDP in 16 countries. In Chile, Brazil, and The Bahamas the gap reaches or surpasses 4 percent of GDP.

3.2 Investment gap projections

We predict future investment needs using the estimated parameters of Equation (1) and projections for GDP growth and the shares of agriculture and manufacture in GDP. We use IMF WEO GDP forecasts up to 2022. For the 2022- 2030 period we use OECD forecast (which are available for OECD countries, Russia and China) to predict GDP in non-OECD countries. Specifically, we start by estimating country-specific correlations between per capita GDP growth in developing countries and per capita GDP growth in the US, Russia, and China and then we use these correlations and

[10] It is also worth noting that the quality of recent data in Venezuela is poor and this may lead to imprecise estimates of the gap.

OECD forecasts to predict GDP per capita in non-OECD countries. The shares of agriculture and manufacturing in GDP are predicted using their 2010-2014 trend.

Table 12: Estimated Public Investment Demand 2022

	Estimated demand		Business as usual		
	% GDP	bill USD	% GDP	Gap (% GDP)	Gap (bill USD)
EAP	6.3	1,472	13.2	-6.9	-1,613
ECA	7.3	461	2.9	4.4	278
LAC	7.7	578	3.6	4.1	308
MNA	8.5	227	6.4	2.1	56
SAS	7.2	352	5.4	1.8	88
SSA	7.9	201	4.4	3.5	89

Source: Authors' calculations.

Table 12 shows that by 2022 annual public investment demand in IDB borrowing countries will increase from its current level of 6.7 percent of GDP (corresponding to $366 billion) to 7.7 percent of GDP (or $578 billion). This increase is mainly explained by structural transformation. Projected increases in GDP per capita are likely to reduce public investment demand but, as the economy moves away from agriculture and manufacturing into services, the demand for public investment is projected to increase.

Assuming a business as usual scenario where public investment remains at its 2015 level of 3.6 percent of GDP, the public investment gap projected in 2022 reaches 4.1 percent of GDP. This implies that the annual public investment gap is expected to increase from an estimated $169 billion in 2015 (Table 11) to $308 billion by 2022. This large increase is driven by the 1-percentage point increase in the estimated share in GDP of public investment demand, as well as the projected increase in GDP by 2022.

Table 13: Public Investment Demand 2030

	Estimated demand		Business as usual		
	% GDP	bill USD	% GDP	Gap (% GDP)	Gap (bill USD)
EAP	5.5	1,927	13.2	-7.7	-2699
ECA	7.4	814	2.9	4.5	495
LAC	8.0	911	3.6	4.4	501
MNA	8.2	333	6.4	1.8	73
SAS	7.2	532	5.4	1.8	133
SSA	8.2	328	4.4	3.8	152

Source: Authors' calculations.

Longer term estimates calculated using the same approach but with GDP per capita projections obtained with the methodology explained above suggest that public investment demand in IDB borrowing countries will reach 8 percent of GDP or $911 billion in 2030 (Table 13). With a business as usual public investment scenario representing, as in 2015, an investment rate of 3.6 percent of GDP, the annual public investment gap reaches 4.4 percent of GDP in 2030 ($501 billion). This is almost three times larger than the current public investment gap of $169 billion.

4 Public Investment and the Sustainable Development Goals

So far, we estimated investment demand and investment gaps by using actual and projected data on GDP growth and economic structure. However, we did not consider the possibility that countries may try to reach certain targets as specified in the Sustainable Development Goals. In this section, we propose a methodology that could be used to estimate the level of public investment necessary for reaching some of the SDGs. We use the first target of the first SDG, which focuses on the eradication of extreme poverty (i.e., people living with less than $1.25 PPP per day).[11] We then turn to two additional SDGs and compute the additional public investment gap to achieve the reduction of child mortality under the age of 5 to 25 per thousand lives[12] and the completion of secondary school for all girls and boys.[13] .

As first step, we estimate the impact of public investment on the poverty ratio. Table 14 shows that, controlling for country and year fixed effects, GDP per capita, and the agriculture and manufacturing shares in GDP, public investment is negatively correlated with the poverty ratio.[14] If we interpret these correlations as causal (which, of course, is a strong assumption), we can use the estimates of Table 14 to back up the amount of investment necessary to reach a given poverty target, while controlling for the projected increases in GDP per capita as well as changes in agriculture and manufacturing shares.

[11] With more data, the same approach could be applied to a larger number of indicators.

12 By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce under-5 mortality to at least as low as 25 per 1,000 live births

13 By 2030, ensure that all girls and boys complete free, equitable and quality secondary education leading to relevant and effective learning outcomes

[14] GDP per capita is also negatively correlated with the poverty ratio, whereas the agriculture and manufacturing value-added shares in GDP do not seem to have a statistically significant impact on poverty rates.

Let us illustrate this procedure with an example. Consider the case of a country with a 9 percent poverty rate (which is close to the average for LAC in the period 2010-2014). The first target of the first SDG is: "By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day." The estimates of Table 14 show that, controlling for GDP per capita, a 1 percentage point increase in the ratio of public investment-to-GDP is associated with a decrease in poverty of 0.8 percentage points. They also show that, controlling for the ratio of public investment-to-GDP, a 1 percent increase in GDP per capita leads to a 0.15 percentage point reduction in poverty. Let us ignore the changes in the shares of agriculture and manufacturing value-added in GDP that are statistically insignificant. Assuming the country is projected to have an increase in GDP per capita of 50 percent by 2030, we can then predict that this will reduce the poverty rate by 6 percentage points. To fully eradicate poverty, we need a further reduction of 3 percentage points. This can be achieved with an increase in the ratio of public investment-to-GDP of 2.4 percentage points (3*0.8=2.4). We can then add this 2.4 percentage point of additional public investment needed to eradicate poverty to the investment demand projected in 2030 in Table 13. So, if the country in question had a public investment demand of 8 percentage points, achieving this specific SDG would push the projected investment demand in 2030 to 10.4 percent of GDP.

Table 14: Public investment and First SDG

Dependent variable: poverty rate (%)	
Public Investment/GDP	-0.818***
	(-3.041)
Ln(GDP per capita)	-15.106***
	(-5.635)
Agriculture/GDP	0.134
	(0.811)
Manufacture/GDP	-0.076
	(-0.366)
Country FE	Y
Year FE	Y
Observations	255

t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 15 provides the estimates of the public investment demand by region when we include the public investment needs to reach the target of extreme poverty eradication to the projected investment demand in 2030 reported in Table 13. Once we include the public investment demand needed to reach the objective of eradicating extreme poverty, IDB borrowing members will face a public investment demand that will increase from 8 percent of GDP projected in Table 13 to 8.2 percent of GDP ($934 billion). If public investment as a share of GDP remains at its 2015 level of 3.6 percent of GDP, then the public investment gap reaches 4.6 percent of GDP ($524

billion). This is not much larger the 4.4 percent of GDP ($501 billion) projected for 2030 in Table 13, which did not include this specific SDG target.

Table 15: Public Investment Demand including eradication of extreme poverty (SDG 1)

	Estimated demand (percent GDP)	Business as usual investment (percent GDP)	Business as usual Gap (percent GDP)	Business as usual Gap (bill USD)
EAP	8.7	13.2	-4.5	-1577
ECA	7.4	2.9	4.5	495
LAC	8.6	3.6	5.0	566
MNA	8.2	6.4	1.8	73
SAS	12.7	5.4	7.3	540
SSA	17.9	4.4	13.5	540

Source: Authors' calculations.

Eradicating extreme poverty does not request a large increase in public investment in LAC for two reasons. First, there is a large projected increase in GDP per capita in LAC that significantly contributes to poverty reduction, as seen in Table 14. This implies that much of the objective of poverty eradication will be achieved by the projected increase in GDP per capita, without any need for public investment to increase.

Second, the extent of extreme poverty in LAC is much smaller than in other regions. The average for the period 2010-14 for LAC countries is below 9 percent. If we exclude Haiti, which has a poverty rate above 50 percent, then the average for LAC falls to 6 percent. This is much smaller than the average for all developing and emerging market countries, which is above 20 percent. In Sub-Saharan Africa, the poverty rate is close to 50 percent and eradicating extreme poverty in that region will require a much larger increase in public investment. In this case, the investment gap increases from 3.8 percent of GDP in Table 13 to 12.6 percent of GDP in Table 15. Another region that experiences large increase in the public investment gap is South Asia, where the gap increases from 1.8 percent to 5.3 percent of GDP.

While the poverty eradication goal does not have a large effect on the Latin American investment gap, it is possible that investment gaps in LAC are affected by other SDG goals. In order to check this, we estimate the impact of public investment on two additional SDGs: child mortality under 5 years of age, and lower secondary school completion rates. Table 16 provides the regression results. The first column reproduces the results of Table 14 for poverty rates; the

second column provides results for mortality rates, and the third column for lower secondary school completion rates.

Table 16: Public Investment and SDGs

Dependent variables:	(1) Poverty Rate, %	(2) Mortality Rate, %	(3) Education Completion Rate (Lower Secondary)
Public Investment/GDP	-31.563**	-1.771***	0.436**
	(-2.514)	(-5.239)	(2.056)
Ln(GDP per capita)	-18.788***	-24.570***	16.896***
	(-4.290)	(-5.664)	(5.783)
Agriculture/GDP	0.134	1.181***	-0.252
	(0.811)	(4.778)	(-1.519)
Manufacture/GDP	-0.076	0.963***	-0.586***
	(-0.366)	(2.956)	(-2.794)
Country FE	Y	Y	Y
Year FE	Y	Y	Y
Observations	255	468	382
R-squared	0.394	0.396	0.340
Number of id	103	124	121

t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

As expected increases in the ratio of public investment over GDP is correlated with reductions in the mortality rate and increases in lower secondary education completion rates. A 1 percent increase in public investment leads to 0.18 percentage point reduction in the mortality rate, and a 0.4 increase in the lower secondary completion rate.

In order to compute the additional public investment gap needed to achieve these two additional goals, we calculate the investment need to reach each of the goals (poverty, mortality under 5, and completion of lower secondary school) by 2030 as before, and then take the maximum investment need. If public investment as a share of GDP remains at its 2015 level of 3.6 percent of GDP in LAC, then achieving all three targets would imply a public investment gap of 6.3 percent of GDP ($717 billion) (Table 17).

Table 17: Public Investment Demand and reaching three SDG targets

	Estimated demand (percent GDP)	Business as usual investment (percent GDP)	Business as usual Gap (percent GDP)	Business as usual Gap (bill USD)
EAP	8.8	13.2	-4.4	-1542
ECA	7.9	2.9	5	550
LAC	9.9	3.6	6.3	717
MNA	10.5	6.4	4.1	167
SAS	15.3	5.4	9.9	733
SSA	21.8	4.4	17.4	696

Source: Authors' calculations.

The increase in public investment needed to achieve the three SDG targets in LAC (6.3 percent of GDP) is significantly larger than the increase needed to reach only the poverty target (5 percent of GDP). This is mainly driven by the public investment needs to reach the infant mortality target as can be seen from the appendix Tables that report the public investment needs by 2030 if mortality and secondary school completion targets were to be reached separately. The public investment needed to reach the targeted reduction in infant mortality is driven the results, because the returns to public investment in achievement the infant mortality target are lower than those for secondary school completion as noted when discussing the results in Table 16. In addition, part of the explanation is due to the fact that in the region the infant mortality target is further away from its current level than in the case of secondary school completion or poverty. Note that a similar exercise can be undertaken for other SDG targets. The challenge is to find quantitative indicators that can be used to evaluate the gap.

5 Closing the Investment Gap: The Role of the IDB

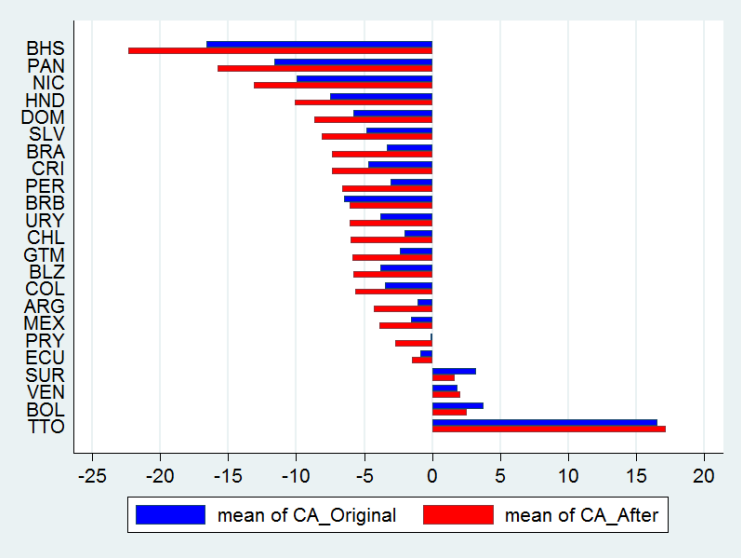
The previous sections showed that in 2015, Latin America and the Caribbean had an investment gap equal to 3.1 percent of the Region's GDP and that closing it would require an increase in investment of nearly $170 billion per year. Projections for 2030 indicate that the gap will reach 4.4 percent of the region's GDP and that closing it will entail additional investment of more than $500 billion per year: the cumulative investment gap over 2015-30 is close to $5 trillion. This amount does not include the scaling up in investment necessary to reach the SDGs. Our simple exercise shows that reaching one of the least ambitious targets (from the region's point of view) would

increase the 2030 gap by more than $20 billion and bring the cumulative gap over 2015-30 to $5.1 trillion.

To evaluate the effects the required scaling up of public investment on external and fiscal sustainability, we conduct two simple exercises. First, we assume that countries have constant saving rate and private investment. Given that the current account balance is equal to total savings minus private and public investment, we estimate the current account implications of closing the investment gap by subtracting the 2015 country-specific investment gap to the country's current account balance (we use the 2010-14 average).

Figure 13 plots the results of this exercise. The blue bars measure the average currency account balance over 2010-14 and the red bars are equal to the blue bars minus the investment gap reported in Figure 12. Other things equal, we find that there are four countries that, in order to close the investment gap, would need a current account deficit equal or greater than 10 percent of GDP. There are other 12 countries (including the Region's 6 largest economies) for which closing the investment gap would require a current account deficit larger than 4 percent of GDP.

Figure 13: Investment gaps and current account balance (% of GDP)



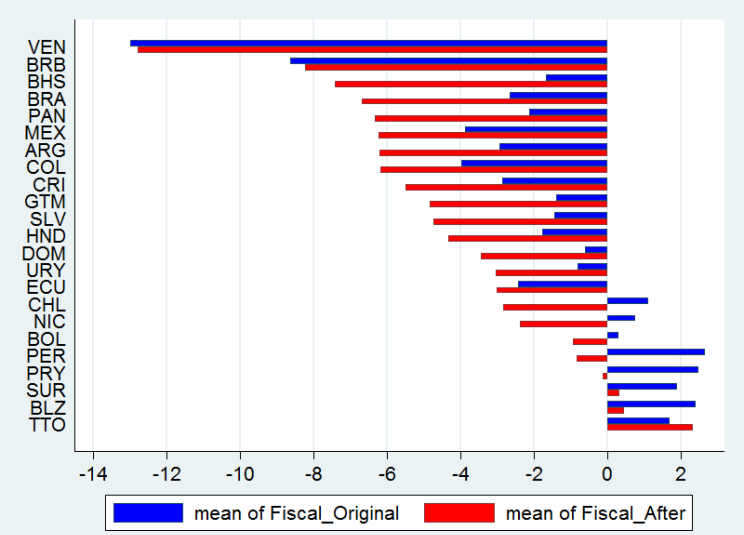
These are back of the envelope estimates based on the assumption the other things remain equal and on long run projections that are far from being problems free. However, they give an indication of the order of magnitude of the problem. It is also worth noting that these large current accounts would need to be sustained for an extended period (15 years in our estimations). Cavallo, Eichengreen, and Panizza (2017) show that large and persistent current account deficits often lead

to financial crises, high volatility, and sub-par economic growth. Hence, a systematic scaling up of public investment will require an increase in the domestic saving rate (for a comprehensive discussion of saving rates in Latin America and the Caribbean see Cavallo and Serebrisky, 2016).

We can examine the fiscal implications of closing the investment gap by conducting a similar experiment. Specifically, we assume unchanged government revenues and current expenditure and subtract from the observed fiscal balance the increase in public investment necessary to close the public investment gap.

Figure 14 shows the results of this exercise. The blue bars plot the average fiscal balance over 2010-14 and the red bars are equal to the blue bars minus the investment gap reported in Figure 12. Other things equal, we find that there are eight countries (including Brazil, Argentina, Mexico, and Colombia) that in order to close the investment gap would need to have a fiscal deficit greater than 6 percent of GDP and 4 other countries where closing the investment gap would require a fiscal deficit larger than 4 percent of GDP.

Figure 14: Investment gaps and fiscal balance (% of GDP)

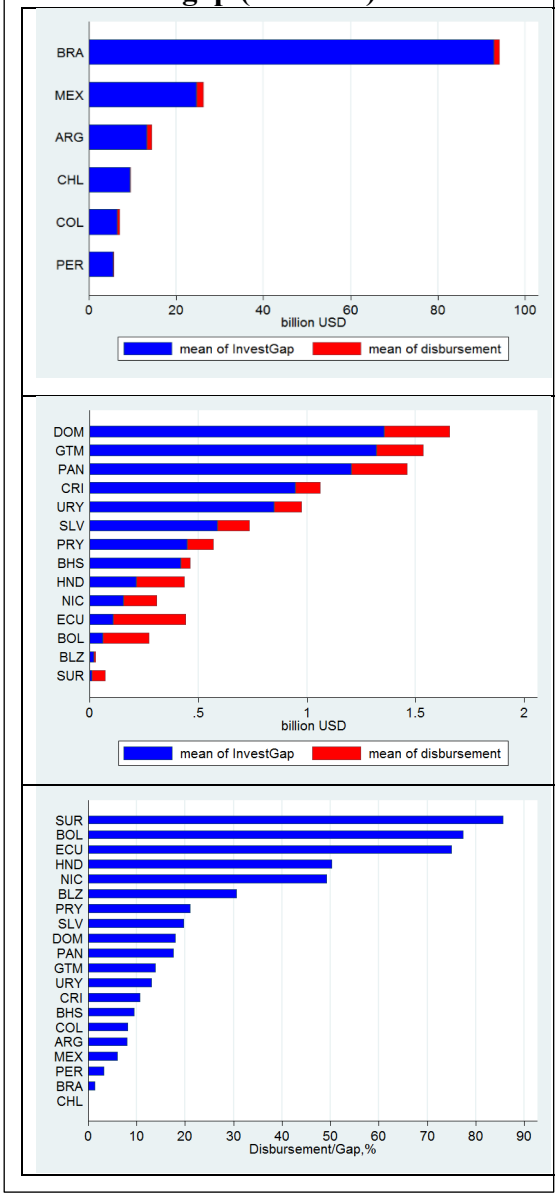


These back of the envelope estimates do not keep into account many factors (for instance, the fact that public investment can have a positive effect on growth and fiscal revenues). However, they illustrate that there are serious fiscal implications linked to closing the investment gap. All large Latin American economies would need substantial fiscal deficits (going from 7.5 percent in Brazil to 3 percent in Chile) sustained for a period of 15 years to close the investment gap.

Scaling up public investment will require fiscal reforms but also public private partnership which would allow the private sector to finance some investment projects that have been traditionally financed with public funds.

The IDB can help countries in the region to close these gaps through lending and policy advice. On the policy advice side, the Bank can help countries to design fiscal reforms aimed at limiting the budgetary implications of scaling up public investment and creating an enabling environment for prompting greater private sector participation in infrastructure projects. The Bank can also help countries to develop policies that can promote domestic savings and therefore limit the current account implications of scaling up public investment (Cavallo and Serebrisky, 2016).

Figure 15: IDB disbursements and investment gap (bill USD)



On the financing side, the question is the impact of an increase in IDB lending on closing these gaps. The horizontal bars in the top two panels of Figure 15 plot the total public investment gap in 2014 for IDB borrowing countries and the red bars show the share of the investment gap that could be covered if IDB were to double its disbursements with respect to the 2010-14 average. The top panel of the figure shows that IDB disbursements are a small fraction of the total investment gap of the 6 largest countries in the Region (and these are gross disbursements, net flows would paint an even bleaker picture).

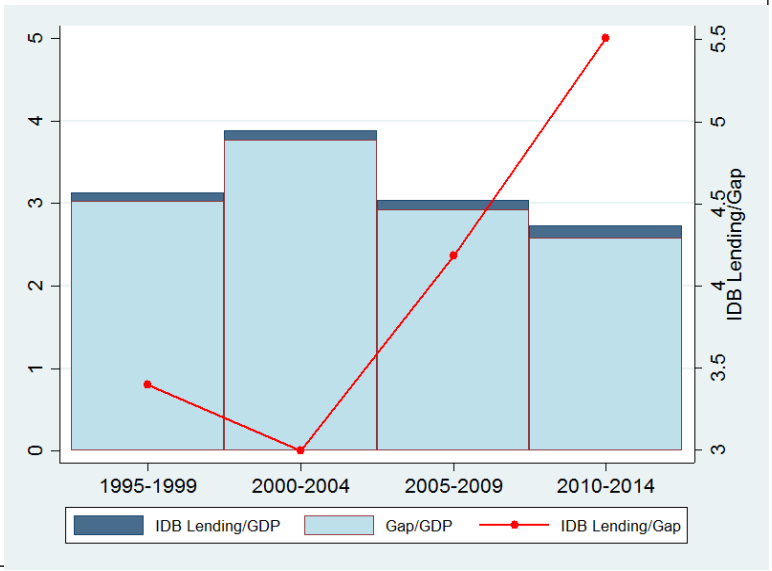
There are, however, several small and medium sized countries, plotted in the middle panel of Figure 15, for which a scaling up of IDB lending could have a significant effect in reducing the public investment gap. The bottom panel of Figure 15 shows that

there are 9 countries for which IDB disbursements are close or greater than 20 of the public investment gap. A scaling of IDB lending could have a substantial impact on public investment in these countries.

There are two ways to interpret the data of the top panel of Figure 15. The first interpretation is that the Bank cannot have any important effect in large countries and that it should concentrate its lending on small countries. The second possible interpretation is that there is a large latent demand for IDB lending. It is worth nothing that even in large countries, like Colombia and Argentina, a doubling of IDB lending could reduce the public investment gap by nearly 8 percent. Moreover, multilateral lending could contribute to closing the investment gap thanks to its catalytic role for private sector financing.

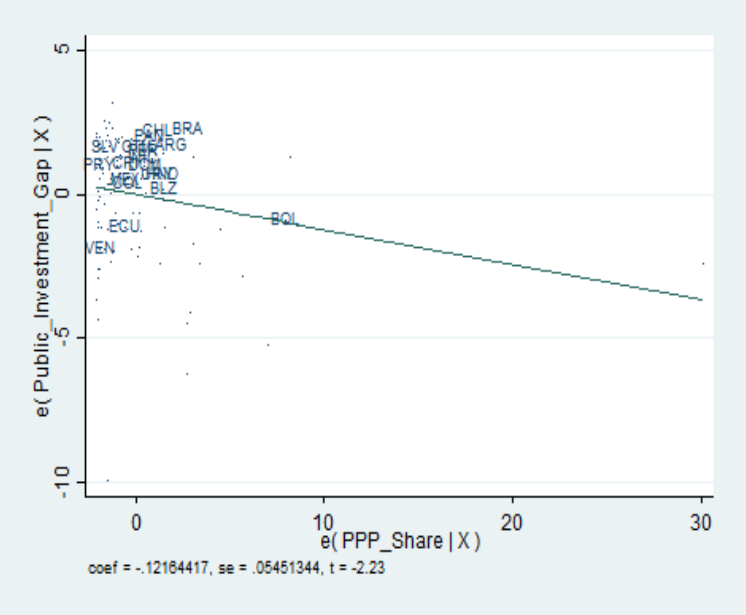
One important question from IDB's perspective is how its relative importance as a source of funds for public investment in the region has evolved across time. We have therefore computed a time-varying public investment gap by considering not only the country fixed effect (the time invariant gap), but also the error term when estimating equation (1). We then compute the share of the public investment gap in GDP, and the share of IDB lending in the public investment GAP and in GDP for four sub-periods: 1995-1999, 2000-2004, 2004-2009, 2010-2014. The results are reported in Figure 16. They suggest that while IDBs' lending is relatively small with respect to the total public investment gap, since the turn of the century its relative importance has been growing to reach 5.5 percent of the total public investment gap in 2010-2014.

Figure 16: Investment gaps and IDB lending (% of GDP) over time



One of the reasons behind the larger share of IDB lending in the public investment gap could be due to the increase in Public Private Partnerships (PPP) funding by the IDB over time. Unfortunately, we do not have access to data of IDB's funding of PPP project in the regions, but if we take overall PPP investment across countries we find a negative and statistically significant relationship between the share of PPP funding in GDP and the public investment GAP. This is shown in Figure 17, which suggests that PPP funding is indeed helping close the public investment gap, as more PPP funding tends to be correlated with a lower public investment gap.

Figure 17: Investment gaps and PPP funding



There is another dimension in which, while small in comparison to the investment gap described in Sections 3 and 4, IDB lending (and multilateral lending, more in general) can play an important role in narrowing public investment gaps. This dimension is related to the fact that official lending has better cyclical properties than private financial flows. It is thus a safer form of financing from the borrowers' point of view.

5.1 Multilateral lending is safer from the borrower's point of view

While in a closed economy investment is limited by national saving, an open economy can increase investment by tapping foreign savings. In theory, a poor country with a low saving rate but good growth prospects can build up its capital stock by running a large and sustained current account deficit. Access to the international capital market should also allow countries to smooth public expenditure across good and bad times. In fact, there are good reasons why countries may want to increase public investment during demand-driven recessions. Such a policy would reduce the cost

of building a country's capital stock (factors of productions are cheaper during recessions) while facilitating the recovery by providing a stimulus to domestic demand.

However, developing and emerging market countries have precarious access to international finance and, as they tend to lose market access during recessions, they often implement procyclical fiscal policies (Gavin and Perotti, 1997). Public investment is often the adjustment variable and losing access to international financial flows can lead to budgetary cuts which, besides deepening the recession in the short term, may also have long-term implications as these cuts tend to concentrate on public investment (Easterly, Irwin, and Servén, 2008) and infrastructure investment (Serebrisky et al., 2015).

Besides increasing the volatility of public investment, precarious access to international financial markets may also reduce a country's willingness to scale up investment by borrowing abroad during good times when financing is available. This is because, with volatile access to international finance, foreign borrowing is risky as highlighted by the economic literature on original sin and sudden stops.

External debt is often denominated in foreign currency (Eichengreen, Hausmann, and Panizza, 2007) and funding domestic investment projects that do not generate foreign earnings with foreign currency debt can lead to dangerous currency mismatches. Another risk, highlighted by the literature on sudden stops (Calvo, Izquierdo and Mejía, 2004, and Cavallo and Frankel, 2008), is that countries that rely heavily on foreign savings tend to face sudden capital flight. These sudden stops force the affected country to abruptly close its current account deficit. This outcome is usually achieved through a combination of real exchange rate depreciation and import contraction, both of which are typically accompanied by recessions, especially in the presence of foreign currency debt.[15]

[15] Because of these risks, which were at the center of the financial crises of the 1990s, many East Asia countries decided put in place policies aimed at reducing their net exposure to external debt. These policies consisted of either borrowing less or self-insuring by accumulating large foreign reserves, (Hausmann and Panizza, 2011). This was however an easy choice for East Asian countries characterized by high saving rates and no need to tap foreign markets to finance their sky-high investment rates. Things are more difficult for Latin American countries characterized by low saving rates.

While most multilateral lending is still denominated in foreign currency (hence, it does not eliminate the risks linked to the presence of currency mismatches), lending by multilateral development banks is either acyclical or countercyclical (Galindo and Panizza, 2017). It is thus better suited for financing long-term investment projects, as it is not subject to sudden stops. It is in this sense that lending by multilateral banks is a safer form of finance that can play an important role for scaling up investment in emerging and developing countries. Cavallo, Eichengreen and Panizza (2017) find that large current account deficits financed with official flows are less likely to end with a financial crisis.

One puzzling element is that in good times, when liquidity is abundant, most Latin America countries prefer to borrow from financial markets instead of borrowing from the multilaterals. The standard explanation for this behavior is that when the spread between the interest rate changed by official lenders and the rate charged by private lenders is low it is not worth to pay the higher costs in terms of compliance linked to official lending. This way of reasoning seems myopic because it does not keep into account the costs linked to the volatility of market finance.[16] In future research, it would be interesting to compare the total costs (interest rate + volatility) of market financing with the total cost (interest rate + compliance) of official financing.

6 Conclusions

This note provides a simple and transparent methodology for estimating public investment gaps in developing countries together with a detailed analysis of these gaps in IDB borrowing countries. We also develop a simple methodology for incorporating three SDG targets into our investment gap estimates (poverty, infant mortality and lower secondary school completion).

We find that in 2015 the total public investment gap of IDB borrowers was close to $170 billion (3.1 percent of the Region's GDP) and that the gap is expected to reach $501 billion (4.4 percent of the Region's GDP) by 2030. If we were to add the necessary public investment needed

[16] While it is true that when countries lose access to market finance, they can still get funding from the multilateral, the process is usually slow and emergency finance is often at a premium (in terms of both interest rates and conditionality) over regular lending facilities. Moreover, if multilaterals do not have enough demand in good times, their steady state balance sheet will remain small and hard to scale at time of crisis.

to reach the three SDGs examined, the public investment gap would reach $717 billion (6.3 percent of the Region's GDP) by 2030.

Most of the region's largest economies have gaps well above 2 percent of GDP and Brazil has a gap of 4 percent of GDP in 2015. Like all forecasting exercises, our estimates have a substantial margin of errors and should be complemented with expert assessments of gaps in specific areas.

Future research should focus on estimating confidence intervals for these predictions and on building bounds that keep into account possible endogeneity problems with the methodology described in this note. It would also be interesting to put the investment gaps on the left-hand-side of a regressions analysis and study whether country characteristics are correlated with these gaps. Potential control variables include private savings, the level of development, government balance, current account balance, fiscal and monetary policy procyclicality, and the composition of public debt. It would be also interesting to study the relationship between investment gaps and the cyclicality of public investment spending. Finally, future research could expand our methodology to alternative SDG targets.

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Data Appendix

- Investment and capital stock data comes from the IMF Investment and Capital Stock Dataset 2017. This dataset contains comprehensive and comparable data across countries on public, private and total investment, as well as capital stocks for all IMF member countries. These flows and stocks include public-private partnerships (PPPs) projects.
- Our key focus is on the public investment and the IMF dataset is comparable data across 170 countries (see Pritchett, 2000 for reasons why capital and investment flow data may not be comparable across countries). Investment and capital stock data is computed using PPP exchange rates to make them comparable across countries. This explains why the investment numbers in the new IMF dataset are a bit larger than what one may be used to observe for low-income countries.
- Data on infrastructure investment data is drawn from the Global Infrastructure Outlook (GIO). The GIO contains infrastructure data for around 50 countries from 2007 until 2015.
- The infrastructure investment efficiency data is from the World Economic Forum and it includes 170 countries from 2006 to 2014.
- GDP, GDP per capita, population, the share of agriculture value-added in GDP, and the share of manufacturing value-added on GDP come from the World Bank's World Development Indicators 2017.
- GDP forecast data until 2022 is borrowed from the IMF's World Economic Outlook (WEO) and is available for 170 countries. For GDP forecasts after 2002, we use the OECD dataset, which contains the GDP forecast for its member countries (including China and Russia) until 2060.
- Data on poverty, child mortality under 5, and lower secondary enrollment corresponding to SDG targets comes from World Development Indicators.

Appendix Tables

Appendix Table 1: Public Investment Demand including SDG infant mortality target

Region	Estimated public investment demand (% GDP)	Business as usual investment (% GDP)	Business as usual investment gap (% GDP)
EAP	6.1	13.2	-7.1
ECA	7.9	2.9	5.0
LAC: IDB	9.9	3.6	6.3
MNA	10.5	6.4	4.1
SAS	15.3	5.4	9.9
SSA	21.5	4.4	17.1

Source: Authors' calculations.

Appendix Table 2: Public Investment Demand including SDG lower secondary education completion target

Region	Estimated public investment demand (% GDP)	Business as usual investment (% GDP)	Business as usual investment gap (% GDP)
EAP	6.2	13.2	-7.0
ECA	7.9	2.9	5.0
LAC: IDB	8.6	3.6	5.0
MNA	8.7	6.4	2.3
SAS	8.1	5.4	2.7
SSA	9.3	4.4	4.9

Source: Authors' calculations.