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Trends and Challenges in Infrastructure Investment in Developing Countries

Daniel Gurara, Vladimir Klyuev, Nkunde Mwase and Andrea F. Presbitero

The paper builds on work done together with Xin Cindy Xu and Geoffrey Bannister as part of the IMF report on "Macroeconomic Development and Prospects in Low-Income Developing Countries – 2016" (IMF, 2017). The paper is part of a research project on macroeconomic policy in low-income countries supported by the U.K.'s Department for International Development (DFID). The views expressed in IMF Working Papers are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, IMF management, or DFID. We would like to thank LIDC country teams for providing survey responses; our colleagues across the Fund as well as at the World Bank Group and the OECD for sharing data and information; Rupa Duttagupta, Chris Lane, Seán Nolan, Zeine Zeidane and two anonymous referees for insightful comments. We also thank Rujun Joy Yin and Sibabrata Das for outstanding research assistance.

1. Introduction

1 Since infrastructure investment is widely recognised as a crucial driver of economic development, while the quality, quantity and accessibility of economic infrastructure in developing countries lag considerably behind those in advanced economies, scaling up infrastructure investment is widely seen as a key pillar in national development strategies in low-income developing countries (LIDCs).[1] In fact, in recent years, many developing countries have been scaling up infrastructure investment, mostly through public spending, but also with a growing participation of the private sector. The growth dividend and the distributional effect of this investment push cannot be taken for granted, as past experiences suggest (see Section II), and many challenges lie ahead: infrastructure gaps are still large and bridging those gaps will require tackling several problems, in terms of additional financing and project selection and implementation.

2 This paper reviews infrastructure investment in LIDCs, focusing on the last 15 years, which have been characterised by a rising importance of non-official financing flows. Our main objective is to provide a multi-faceted picture of infrastructure development in LIDCs, covering the evolution of several physical indicators of infrastructure, the role of public and private sectors in delivering infrastructure, and its financing, including traditional and new sources.[2]

3 In the absence of consistent and comparable data on infrastructure investment, and since infrastructure in LIDCs is typically provided by the public sector and accounts for a large part of its capital spending, we start by analysing trends in public investment. Then we look at the concurrent evolution of public saving and debt, tracing the main sources of financing for public investment. Beyond that, the paper takes stock of infrastructure investment via Public-Private Partnerships (PPPs), as well as official development financing and syndicated bank lending. Limited data availability prevents us from presenting a comprehensive quantitative picture of the modes of delivery and financing of infrastructure in LIDCs. To partially overcome this constraint, we introduce a unique dataset on infrastructure investment in LIDCs—based on the results of a survey of IMF country teams—which collects novel information on public investment in infrastructure (including its sectoral distribution), obstacles to investment scaling-up, reliance on PPPs, sources and terms of financing for major projects, and other aspects of infrastructure investment for a subset of LIDCs. We believe that the use of several complementary datasets allows us to shed new light on some key issues related to delivery and financing of infrastructure investment. In addition, selected case studies illustrate experiences with public infrastructure provision (Ethiopia), private provision (solar micro-grids in Kenya), and PPPs (hydropower in Lao PDR).

4 The paper is organised as follows. The next section sets the stage by selectively reviewing the empirical literature on the economic effects of infrastructure, pointing out potential downside risks in terms of growth dividend and distributional effects. Section III provides an overview of the evolution of various measures of quantity and quality of infrastructure in LIDCs since 2000, making clear that infrastructure in LIDCs lags behind that in emerging markets on a number of dimensions. Section IV explores trends in infrastructure investment and financing over the last 15 years. It starts by looking at public investment and saving, taking advantage of broad availability of these indicators. It then zeroes in on public investment in economic infrastructure using survey data. The rest of the section covers private participation in infrastructure provision, the role of official development finance, and cross-border syndicated bank lending for LIDC infrastructure. Section V considers challenges to improving infrastructure further—as would be required to attain Sustainable Development Goals (SDGs). The last section concludes.

2. Infrastructure and Economic Development

5 Infrastructure investment is a key component of the 2030 Development Agenda.[3] However, the interest around infrastructure is not new (Rosenstein-Rodan, 1943). Since the 1990s there has been a wide body of literature looking at the possible development gains from investing in infrastructure (World Bank, 1994). The economic importance of infrastructure investment has been analysed both at project and macro levels. At a

project level, the focus is on the social cost-benefit of infrastructure projects and their implied internal rate of return (see Marcelo et al., 2016, for example). The social cost-benefit analysis often tries to account for negative externalities. At a macro level, the impact of infrastructure investment is analysed using aggregate production function with the assumption that infrastructure is complementary to other inputs in the production function (see Aschauer, 1989; Gramlich 1994). The macro literature shows that improvements in infrastructure could raise productivity, stimulate private investment (Cavallo and Daude, 2011), and facilitate domestic and international trade (Bougheas et al., 1999; Vijil and Wagner, 2012), thereby promoting sustainable growth (Esfahani and Ramírez, 2003; Agénor, 2010; Calderón and Servén, 2010).

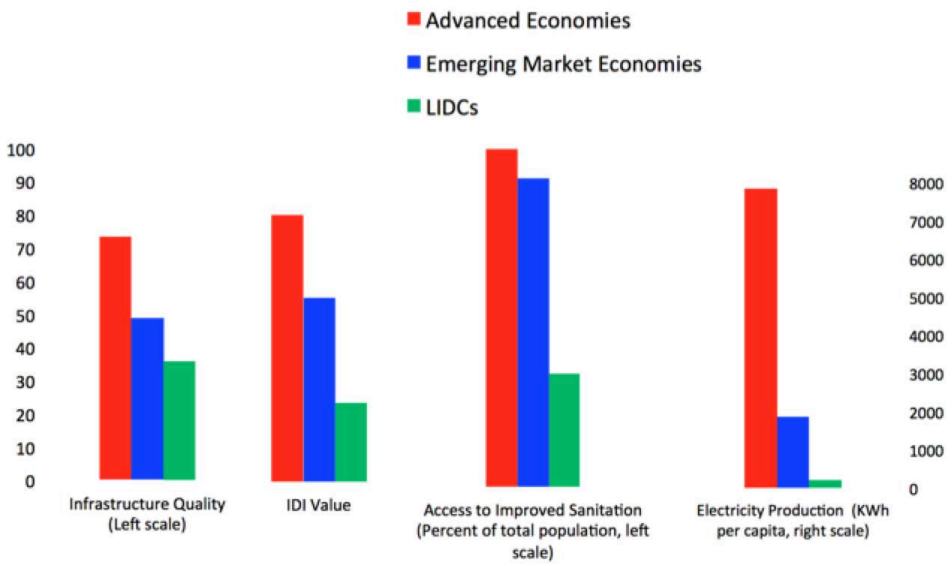
6 Public investment is often used as a proxy for infrastructure investment because of paucity of data. However, public investment could be a poor proxy as it is composed of economic and social infrastructure spending as well as government investment on state owned enterprises. In addition, the link between spending and infrastructure build up could be very weak in cases where public investment efficiency is low due to poor project selection, non-transparent procurement processes, and corruption (Pritchett, 2000; Tanzi and Davoodi, 1997). In a recent contribution, Calderón et al. (2015) constructed a synthetic physical infrastructure index to precisely estimate the productivity impact of infrastructure. Their estimate shows that a 10 per cent increase in infrastructure provision increases output per worker by about 1 per cent in the long run.

7 Some recent analyses use detailed data on transportation networks to look at their impact on economic activity and they generally find consistent results. Focusing on transportation investments in Africa since 1960, Jedwab and Storeygard (2016) show that increased market access has a positive effect on city growth, favouring urbanisation. An interesting strand of literature looks at the historical experience of colonial Africa and India to shed light on how infrastructure investment shapes economic activity. The analysis of railroads in Ghana and Kenya shows that infrastructure investment can produce long-term economic gains by reducing trade costs and integrating markets, potentially transforming the economic landscape in poor, remote regions with high trade costs (Jedwab and Moradi, 2016; Jedwab et al., 2017). Similar findings have been shown for colonial India, where railroads decreased trade costs and interregional price gaps and increased interregional and international trade as well as real income level (Donaldson, 2018). The historical impact of railroads on the American economy is also consistent with a positive impact of infrastructure investment on market integration and economic development (Donaldson and Hornbeck, 2016).

8 Increased access to essential infrastructure services could reduce inequality, foster inclusion and support poverty reduction efforts (Calderón and Chong, 2004; Calderón and Servén, 2010). Micro-level evidence shows that the distributional effect of infrastructure investment could vary. For instance, Khandker et al. (2009) look at road improvement projects in Bangladesh and find overall positive effects on output and poverty reduction. They also show that the poorest households are those benefiting the most. Similarly, Jedwab and Storeygard (2016) point to the importance of taking the local context into consideration, given the evidence of heterogeneous effects of transportation investments in Africa—which seem to favour small and remote cities. The evaluation of programs of infrastructure rehabilitation in Georgia and Vietnam

also shows positive average effects, with some evidence of a stronger effect on the poor (Lokshin and Yemtsov, 2005; Mu and van de Walle, 2011). Duflo and Pande (2007) look at large public infrastructure investments—specifically, dams in India—and find a bleaker picture as poverty, in the aggregate, rises. Moreover, they point out significant distributional implications, as agricultural productivity increases in downstream districts, which benefit from irrigation, but not in those where dams are built, where construction activities causes loss of agricultural land and expose the population to diseases, resulting in higher poverty rates[4]. Similarly, the extensive highway network built in China since the 1990s has complicated spatial effect on economic activity, with winners and losers. Large cities in the centre of a dense regional highway network grow faster and specialise in business services and manufacturing, while the hinterlands grow more slowly, and become relatively more specialised in agriculture (Baum-Snow et al., 2017). This points to the importance of anticipating distributional effects of infrastructure projects and planning offsetting measures if such effects are expected to be negative.

Figure 1. Selected Infrastructure Indicators (Median, latest available year between 2013-2017)



Note: Infrastructure quality (index: 1-7) and IDI value (0-10) were rescaled to range 0-100 (100= maximum quality).

Sources: Authors' elaboration based on World Bank World Economic Forum and UN data; ITU (2017); United and IMF staff estimates.

9 Even though the empirical literature indicates that infrastructure investment could deliver long-term gains, some historical experiences suggest caution. For example, in the 1980s, a wave of public-financed infrastructure investment delivered poor results in terms of short and long run economic growth, mostly because of cost overruns, corruption and poor maintenance (Arezki et al., 2017; Warner, 2014). After this negative experience, and following market liberalisation policies, the private sector started playing a more prominent role in financing infrastructure investment, partly through PPPs (see Hammami et al., 2006). However, in many developing countries this resulted in high construction and maintenance costs (Estache and Fay, 2007). Thus,

public investment effectiveness and efficiency are not always assured and need to be achieved through appropriate institutions and policies.

3. Infrastructure Development

10 The quality, quantity and accessibility of economic infrastructure in LIDCs lag considerably behind those in advanced and emerging market economies along many dimensions, from electricity generation to access to sanitation and access and use of ICT services, with the gap particularly large in the power sector (Figure 1). Firm-level data compiled by the World Bank as part of the Enterprise Surveys (World Bank, no date) confirm the presence of large gaps in access to electricity, water and transportation infrastructure, and indicate that such gaps are an actual constraint on real economic activity (Table 1, top panel). The percentage of firms in LIDCs that identify access to electricity and transportation as a major constraint to their business activity is, respectively, 43 and 24 per cent. By contrast, the same percentages are 32 and 18 per cent, respectively, in emerging markets (EMs). Focusing on access to electricity, it is interesting to observe that 74 per cent of firms in LIDCs experience power outages—compared to 53 per cent in EMs. Furthermore, the average firm in LIDCs experiences 11 power outages per month, which implies a cost of 7.1 per cent of annual sales. In contrast, in EMs firms have to deal with 4.3 power outages per month, which cost 3.4 per cent of annual sales.

11 Data on physical infrastructure show that there has been a sharp improvement in most LIDCs over the past fifteen years. This change has been broad-based across country groups, although frontier economies have shown faster accelerations and, on the contrary, changes in fragile states have been less perceptible. A few countries—particularly Vietnam—stand out with impressive performance across a range of indicators.

12 Progress has not been uniform across sectors, partly because differences in the regulatory frameworks and institutional quality across sectors and countries could impede private investment (Banerjee et al., 2006; Cubbin and Stern, 2006). Information and communication technology (ICT) has expanded dramatically, with the number of Internet servers growing from near zero in 2005 to the average of 6 servers per million people in 2015. Electricity generation per capita has increased by 57 per cent on average, with over 300 per cent increase in a few countries, such as Bhutan and Vietnam.[5] Access to improved water and sanitation facilities rose on average by around 20 per cent from 2000 to 2014. On the other hand, improvements in transport infrastructure have been relatively minor, even though transportation is typically the largest item in LIDC capital budgets. Firm-level data from the World Bank Enterprise Survey confirm these trends, as the share of firms identifying electricity and water insufficiencies as major constraints to their business activity sharply decreased over the last decade, while almost no progress is observable on transportation infrastructure (Table 1, bottom panel).

Table 1: Infrastructures and Economic Activity

Countries:	AEs	EMs	LIDCs

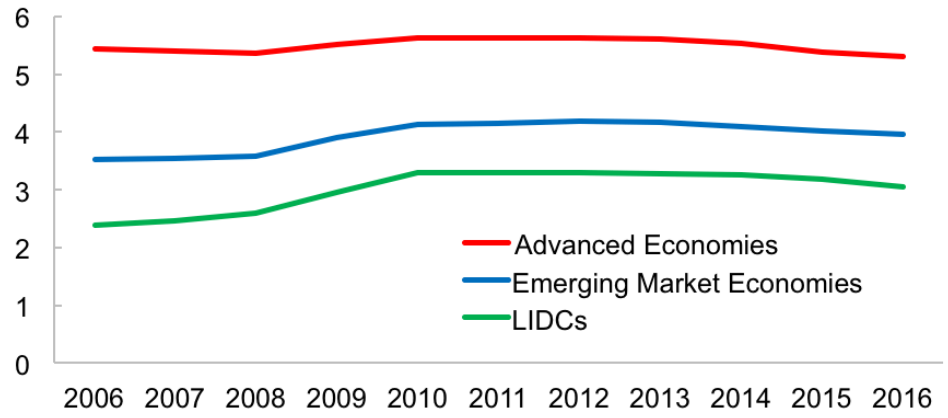
Percentage of firms:			
identifying electricity as a major constraint	14.6	26.3	39.3
experiencing water insufficiencies	4.6	12.8	22.1
identifying transportation as a major constraint	9.2	15.0	22.1
number of surveys	33	165	114
Change in the percentage of firms:			
identifying electricity as a major constraint	-7.2	-10.5	-9.4
experiencing water insufficiencies	-2.7	-2.3	-5.4
identifying transportation as a major constraint	-6.7	-2.5	-0.1
number of survey pairs	6	48	41

Note: The top panel reports simple averages of all available country-representative surveys, over the period 2006-2016, by country groupings. The bottom panel reports changes between the most recent survey and the first one, starting in 2006. Then, the initial and final year changes because of data availability. Only countries with at least two surveys since 2006 are considered.

Source: World Bank (no date), *World Bank Enterprise Surveys.*

13 Progress notwithstanding, the quantity and quality of infrastructure in LIDCs continue to lag. Despite significantly faster growth, electricity generation capacity in LIDCs—even in frontier markets—remains considerably lower than in emerging markets (9344.5 GW vs. 141065 GW on average in 2015, according to the UN database). Furthermore, electricity supply is also less reliable (see Table 1). Road density also lags behind (0.18 vs. 0.4 km of road per 100 km^2 of land area), although the gap is smaller. Mobile phone penetration made huge strides from near zero in 2000 to 72 per 100 people in 2014, but was still significantly lower than 118 per 100 people in EMs. Survey-based measures about the quality of national infrastructure compiled by the World Economic Forum (Schwab, 2016) show a noticeable improvement in perceived infrastructure quality in LIDCs in the second half of the 2000, but no progress for the median LIDCs since 2010, leaving a large gap with advanced and emerging market economies (Figure 2).

Figure 2. Perceptions of Infrastructure Quality (Index, 1-7)



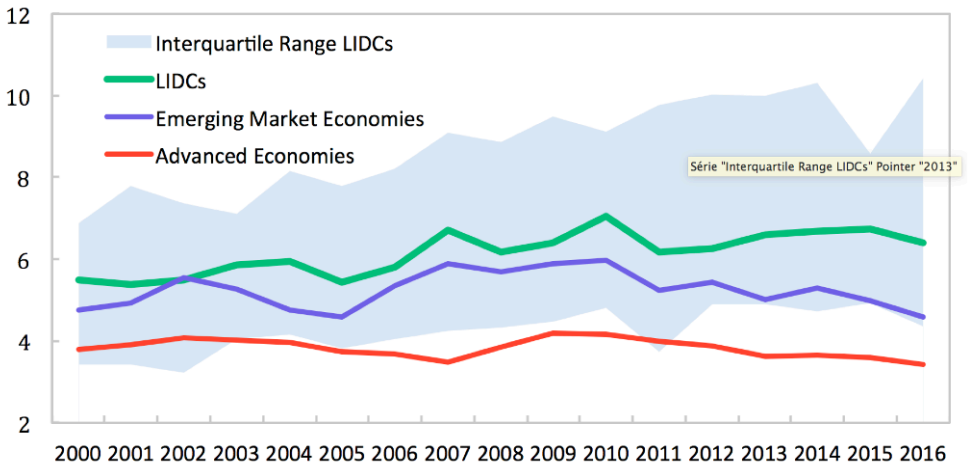
Source: Schwab (2016).

4. Infrastructure Investment—Delivery and Financing

4.1 Public Investment and Saving

14 Analysing infrastructure investment in developing countries is a challenging task due to the lack of systematic and comparable data. It is generally recognised, however, that the public sector provides the bulk of infrastructure in these countries. In addition, as we show in Section 4.2 for a limited sample of countries, investment in economic infrastructure constitutes a large share of total public investment so that the latter can serve as a reasonable proxy for the former, notwithstanding the limitations discussed in Section 2. Thus, we start our analysis by examining trends in public investment.

15 Figure 3. Public Investment: 2000-2016 (Median and interquartile range, percentage of GDP)

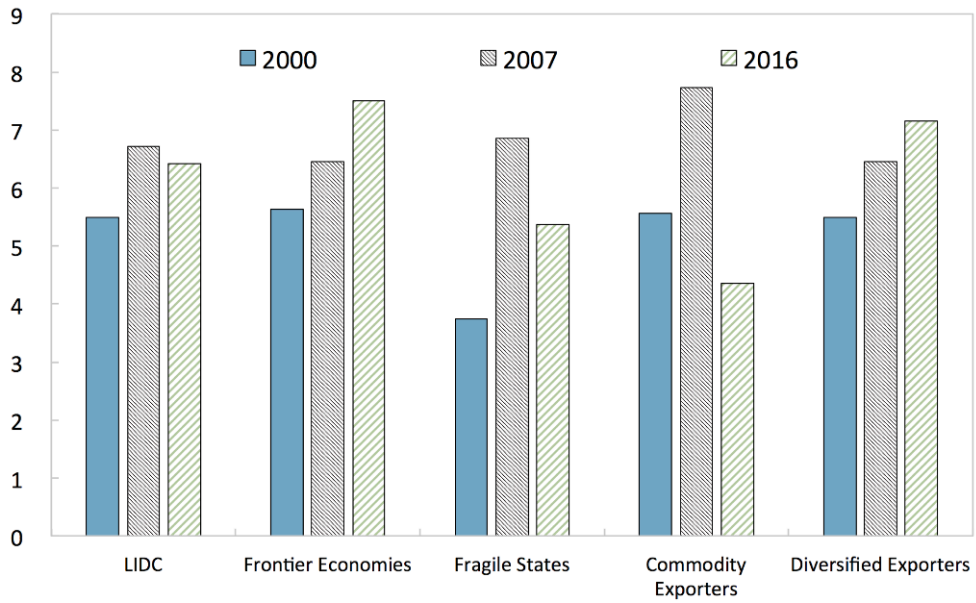


Sources: Authors' elaboration based on IMF, *World Economic Outlook data*; and IMF staff estimates.

16 Public investment in LIDCs is higher as a percentage of GDP than in emerging and advanced economies and has followed a general upward trend since 2000, first surging before the Global Financial Crisis (GFC) and then picking up again until 2015.[6] By contrast, trends in emerging markets and advanced economies had been downward sloping in the 2010s. Median public investment in LIDCs rose significantly from 5.5 per cent of GDP in 2000 to a peak of 7.1 per cent of GDP in 2010. Following a temporary slowdown in 2011, public investment picked up again and stood at 6.7 per cent of GDP in 2015, before declining to 6.4 per cent in 2016 (Figure 3).[7] As documented in the previous section, this scaling-up has resulted in a broad enhancement of economic infrastructure in LIDCs, although this relationship is far from tight and exhibits significant variation across countries and sectors. Moreover, a large gap still remains compared to emerging and advanced economies.

17 The wide variability in the public investment-to-GDP ratio across countries indicates a variety of experiences. Public investment trajectories differed somewhat across LIDC groups, particularly after the GFC. In the pre-crisis period, the scaling-up of public investment was common to most countries, which benefited from a favourable global environment, rising commodity prices, and debt relief under the HIPC and MDRI initiatives, among other factors. In particular, commodity exporters expanded public investment more than other countries as they benefited from a large terms-of-trade improvement. These trends diverged in recent years, with public investment falling in commodity exporters as a decline in commodity prices led to fiscal pressures, while diversified exporters recorded a further small increase from the pre-GFC peak (Figure 4).

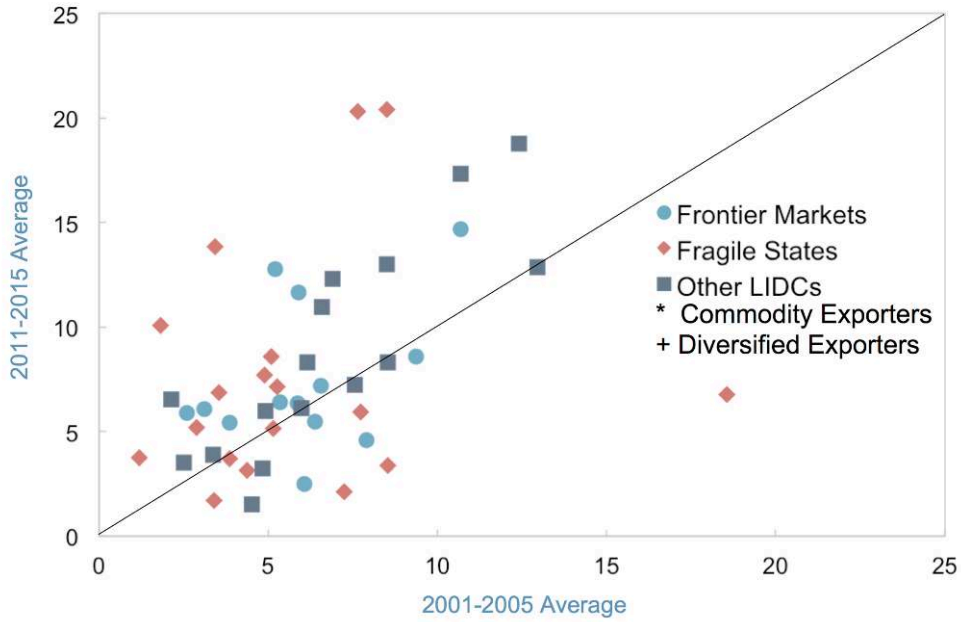
Figure 4. Public Investment in LIDCs by Sub-groups (Median, percentage of GDP)



Sources: Authors' elaboration based on IMF, *World Economic Outlook* data; and IMF staff estimates.

18 Diversity is notable not only between but also within groups. In every category, one can find examples of countries that achieved or maintained high public investment levels and examples of those that failed to do so. A large majority increased the public investment-to-GDP ratio in the 2011-2015 period compared to 2001-05 (Figure 5).[8]

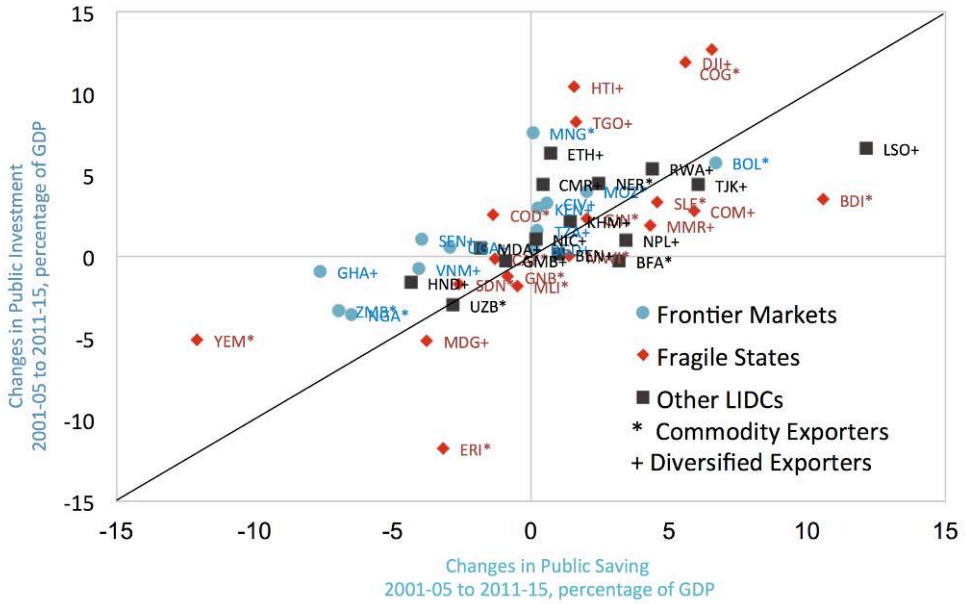
Figure 5. Public investment/GDP in LIDCs



Sources: Authors' elaboration based on IMF, *World Economic Outlook data*; and IMF staff estimates.

19 Some countries stand out with substantial scaling-up, with highest levels reached in Djibouti, Congo (Alter et al., 2017, discuss Congo's experience) and Ethiopia[9], which have been pursuing national development agendas centred on improving infrastructure. Public investment rose steadily in several commodity exporters, including Bolivia, Mongolia, Mozambique, Niger, and Tajikistan, until a drop in 2014-15 following a negative commodity price shock. However, in some other countries, the ratio of public investment to GDP has declined significantly over time, reflecting, for example, intensified fragility in Eritrea and Yemen, and fiscal pressures in Nigeria and Uzbekistan. A few countries have not experienced a pronounced scaling-up, but have maintained fairly high levels of public investment throughout the past 15 years. For example, Bhutan and Vietnam averaged 13 and 9 per cent of GDP, respectively, since 2000. On the other hand, in several countries, public investment has been quite low over the whole period (e.g., never exceeding 5 per cent of GDP in Nepal, primarily because of implementation capacity constraints and frequent government turnover).

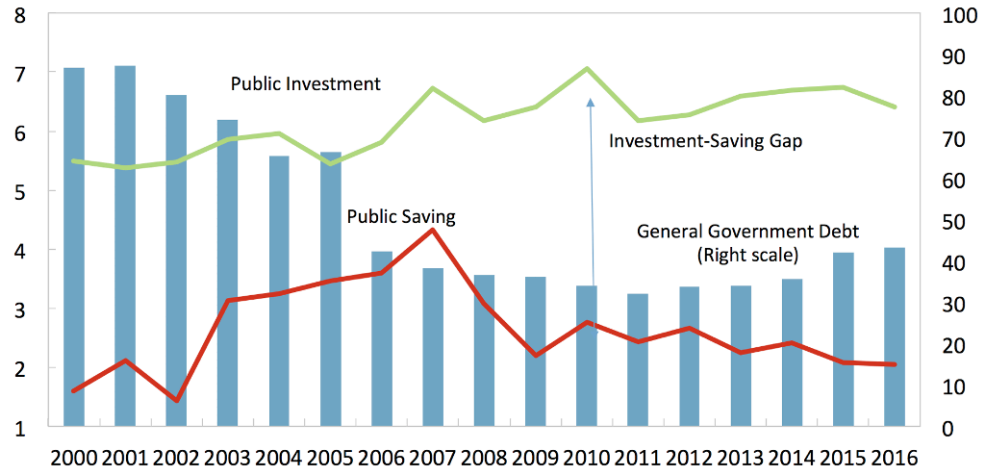
Figure 6. Changes in Public Saving and Investment in LIDCs (Percentage of GDP)



Sources: Authors' elaboration based on IMF, World Economic Outlook data; and IMF staff estimates.

20 Public saving has generally not been scaled up commensurately with the increase in public investment. Over the last decade and a half, there has been a clear correlation (with correlation coefficient of 0.68) between changes in public investment and in public saving (Figure 6). However, the former was greater than the latter in most countries, especially in most recent years.[10] As a result, the gap between public investment and saving—which narrowed just before the GFC—started widening in subsequent years, indicating increasing recourse to debt financing (Figure 7).[11] Median public saving as a share of GDP rose 2.9 percentage points between 2000 and 2007—twice as much as public investment. Median public saving declined sharply during the GFC, and, after a brief rebound, started slipping again, with the latest slide reflecting lower commodity prices. As a result, median public saving has dropped 2.4 percentage points of GDP since its 2007 peak, returning to levels from the early 2000s, even as median public investment eked out a small increase. In 2015, public investment exceeded public saving in 42 out of 46 LIDCs and the gap between median public investment and median public saving reached 4.8 per cent—the widest it has been since 2000.

Figure 7. Public Investment, Public Saving and General Government Debt in LIDCs (Median, percentage of GDP)



Sources: Authors' elaboration based on IMF, *World Economic Outlook data*; and IMF staff estimates.

21 In the most recent years, the negative public saving-investment balances have contributed to higher government debt-to-GDP ratios, following a notable drop in debt ratios in most LIDCs over the course of the 2000s, mostly driven by multilateral and bilateral debt relief initiatives (Figure 9). Fiscal vulnerabilities have increased recently, particularly among commodity exporters. Budget deficits have gone up, interest rates have risen, and local currency depreciation has increased the burden of external debt. As a result, the median general government debt ratio went up from 34 per cent in 2013 to 43 per cent in 2016.[12] In some frontier markets, rising debts are also the result of access to international capital markets: since 2010 LIDCs issued more than USD 22 billion in sovereign bonds, in many cases with the aim of using part of the proceeds to finance new infrastructures (Presbitero et al., 2016). For instance, in 2014 Ethiopia issued a USD one billion Eurobond to finance imports related to export-oriented projects such as investment in the power transmission infrastructure, sugar factories, and the development of industrial parks (IMF, 2015). More recently, in May 2017 Senegal issued its third Eurobond (USD 1.1 billion) with the intent to finance a series of infrastructure and power production projects.

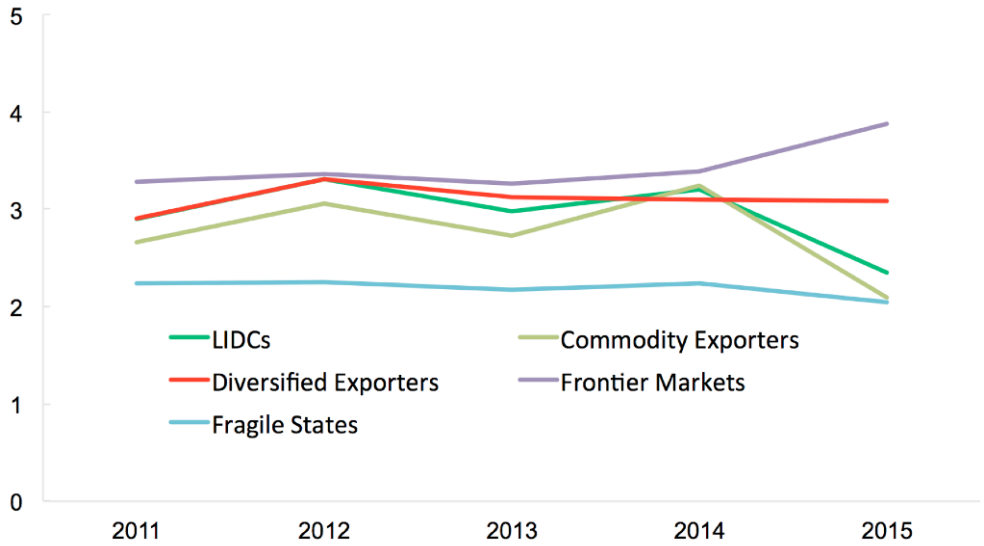
4.2 Public Infrastructure Investment

22 As noted above, internationally comparable data on infrastructure investment for a broad set of LIDCs is lacking. To fill that gap, we have conducted a survey of the IMF's LIDC country desks. Thirty-two country teams were able to provide information on public investment in economic infrastructure over the last five years, typically in consultation with the authorities.[13] Twenty-three of them had data by sector. This information offers valuable insights, even though the results should be taken with a grain of salt as quality and comparability of data cannot be assured.

23 For a median LIDC in the sample, investment in economic infrastructure accounted for about half of total public investment.[14] The median investment level stood around 3 per cent of GDP in 2011–14, but dropped below 2½ per cent in 2015 as commodity exporters were hit by falling export prices (Figure 8). Looking across country groupings, frontier

market economies had somewhat higher levels of investment, facilitated by easier access to financing and stronger economic prospects. Investment levels in fragile states were typically lower than average, likely reflecting limited fiscal space and weak institutional capacity (Collier and Cust, 2015).

Figure 8. Public Investment in Infrastructure (Median, percentage of GDP)



Sources: Authors' elaboration based on IMF staff estimates.

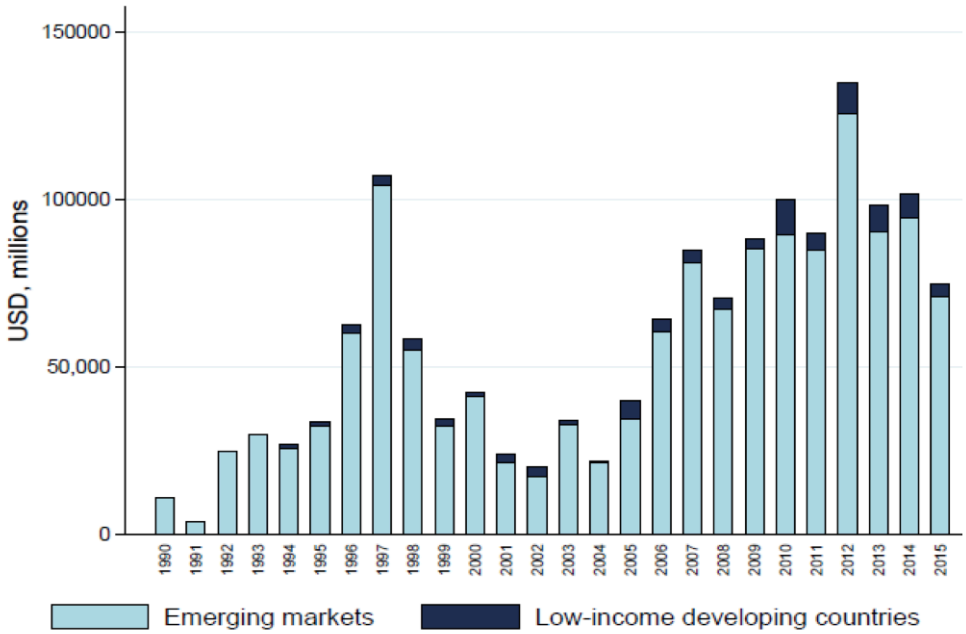
24 The transportation sector accounted for about half of total investment in economic infrastructure, consistent with what is found in other analyses (e.g., UNCTAD, 2014). Water and sanitation account for 22 per cent, the energy sector for 19 per cent and ICT for the residual 6 per cent. The relatively low share of energy is somewhat troubling, since access to electricity is frequently identified as a key constraint to development in LIDCs (see Payne, 2010, for a review of the literature, and Di Bella and Grigoli, 2016, for an application to Haiti and Nicaragua). Fairly broad private provision of ICT services has allowed governments to spend relatively little in that area.

4.3 Private Participation in Infrastructure

25 Private participation in infrastructure investment is quite limited in LIDCs. Since 2000, LIDCs accounted for 6.5 per cent of the value and 10.5 per cent of the number of Public-Private Partnership (PPP) projects in all emerging market and developing economies (Figure 9).[15] In the last five years PPP volume amounted on average to about 0.4 per cent of LIDC GDP—a ratio similar to EMs. After a sharp acceleration in the early 2010s, PPP flows have declined in the most recent years. Of the USD 43 billion in LIDC PPP projects since 2010, more than half has been invested in Asia and one third in Sub-Saharan Africa—see also the recent report by the Infrastructure Consortium for Africa (ICA, 2017) for recent data and examples of large PPP projects in Africa. Vietnam and Bangladesh have the largest number of projects (Table 2), while Lao PDR is an undisputed leader in terms of volume.[16] Public-private partnerships have also been used to finance regional projects. Across Africa there are several examples of regional infrastructure projects, especially in the energy and transport sectors (UNCTAD, 2016).

For instance, the Central Corridor is an integrated transport program across five countries (Burundi, DR Congo, Rwanda, Tanzania, and Uganda) with an investment of about USD 18 billion involving local and international actors from the public and private sectors (WEF, 2015).

Figure 9. Flows of PPPs to LIDCs and Ems



Source: World Bank (no date), *PPI Database*.

26 Private participation varies greatly across sectors (Figure 10). The telecom sector attracted considerable private participation in the 1990s, following liberalisation and technological advances, and has ultimately moved toward mostly purely private provision (particularly for mobile services), with the government's role limited to regulation and licensing.[17] There is very little purely private provision of infrastructure services outside the telecom sector, although some small-scale successful models can be found, and private sector involvement is channelled predominantly via PPPs.[18] Currently, the energy sector attracts the bulk of PPPs, with transportation a distant second, and a small share allocated to water and sanitation.[19] This likely reflects the fact that it might be easier—both technically and politically—to charge end users for electricity than for roads or water (Swaroop, 1994). The vast majority of projects are greenfield projects (87 per cent since 2000) and brownfields (8 per cent) and almost all the contracts (97 per cent) have been with the central government. There is considerable variation in the size of PPP projects, and some of them are very large, such as a coal plant in Laos with an investment of USD 3.7 billion, the expansion of the Onne port complex in Nigeria (USD 2.9 billion), and a thermal power generation project in Vietnam (USD 2 billion). Nine projects started since 2010 are valued over USD 1 billion.

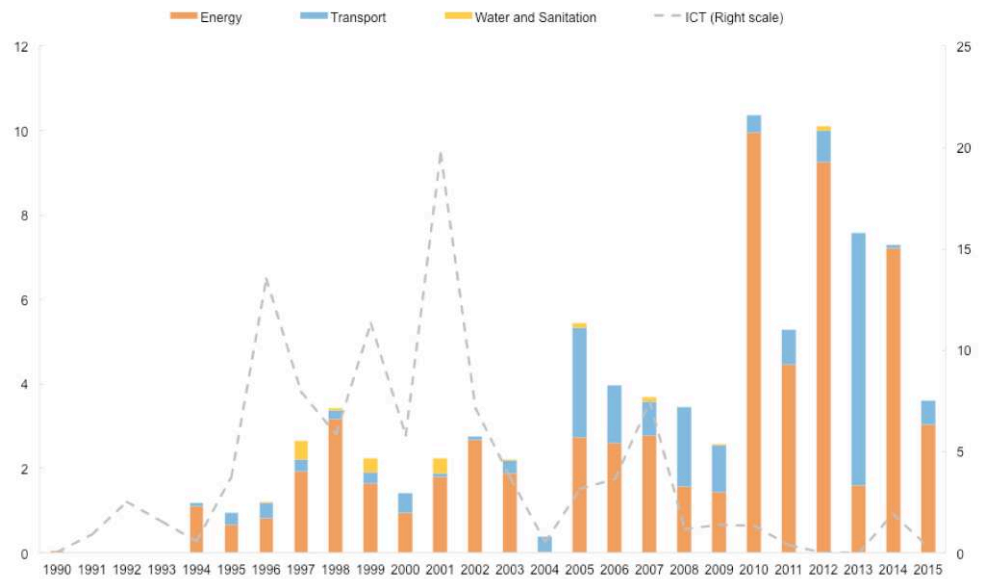
Table 2. Countries with Most PPPs, 2011–15

Ranking	Country	# PPPs	Value USD (in millions)	% of GDP
1	Lao PDR	18	8 075	15.3
2	Nigeria	5	5 812	0.2
3	Vietnam	31	5 430	0.6
4	Bangladesh	22	2 688	0.3
5	Honduras	18	2 636	2.8
6	Ghana	3	1 466	0.7
7	Kenya	7	1 358	0.5
8	Nepal	12	1 173	1.2
9	Zambia	3	1 170	0.9
10	Senegal	6	717	1.0

Sources: Authors' elaboration based on World Bank data and IMF staff estimates.

27 Multilateral development banks (MDBs) are involved in a significant share of PPPs to provide operational assistance, financial support and risk mitigation (Ruiz-Nunez and Harris, 2016). More than a quarter of the projects in LIDCs involve MDB support in the form of direct loans, syndication, equity investment, partial credit guarantees, and political risk coverage. The presence of MDBs is associated with a lower probability that a project comes under distress or is cancelled, even after controlling for a set of project-specific variables and for year and country fixed effects.[20] This likely reflects a combination of careful project selection by MDBs and the impact that MDB involvement—through a thorough preparation and a strengthened oversight—has on the quality of the project (Jandhyala, 2016).

Figure 10. Flows of PPPs Commitments in LIDCs, by sector (in billions of USD)



Sources: Authors' elaboration based on World Bank data and IMF staff estimates.

4.4 Financing for Infrastructure: Official Development Finance and Cross Border Lending

28 Official development finance (ODF) is a major source of infrastructure financing in LIDCs. Detailed data obtained from OECD show that LIDCs received nearly USD 17 billion in project finance from MDBs and OECD members in 2014.[21] While the total value of infrastructure investment in LIDCs is not known, ODF certainly covers a much larger share of investment in LIDCs than in other developing countries.[22] In this respect, the Aid for Trade Initiative disbursed over 300 billion USD since 2007—27 per cent of which was directed to least developed countries—to improve trade connectivity through ICT, physical and network infrastructures (OECD/WTO, 2017). Moreover, 87 per cent of ODF for LIDCs consisted of grants and concessional loans, in contrast to only 56 per cent for all developing countries. The bulk of the money went to public projects, with direct support to the private sector amounting to USD 0.9 billion. The share of projects in water and transportation sectors in total infrastructure ODF declined steadily since 2006, while the share of energy increased to about 30 per cent in 2014 (Figure 11).

Figure 11. Sectoral Allocation of Infrastructure ODF to LIDCs, 2006–2014 (Percentage of total)

Sources: Authors' elaboration based on Miyamoto and Chiofalo (2016) and IMF staff estimates.

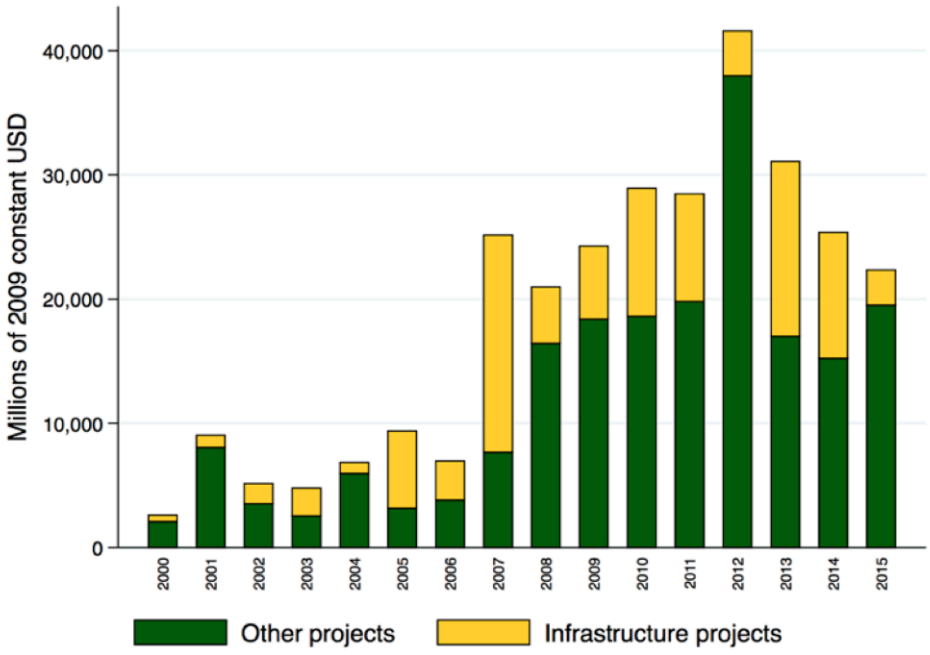
29 Some emerging donors, notably China and India, have also become important providers of infrastructure financing to LIDCs. These countries direct a considerable share of their development financing to infrastructure. China, in particular, committed billions of dollars of infrastructure investment under the "Belt and Road" initiative, an ambitious plan to boost trade and global development, strengthening the links between Asia, Europe, and Africa. According to the data on Chinese official development assistance published by AidData, between 2000 and 2014 infrastructure projects accounted for about 70 per cent of total Chinese financing.[23] Gutman et al. (2015) calculate that China contributes about 20 per cent of external finance for infrastructure projects in Sub-Saharan Africa, with most of that financing provided by China's EXIM Bank.[24] India's development financing for infrastructure is estimated at USD 1.3 billion in 2014, with most of it going to neighbouring countries, primarily for energy and transportation. There is considerable dispersion across countries in the amounts of ODF received. In 2014, for all LIDCs, the median ratio of ODF to GDP equalled 1.3 per cent, the simple average 2.0 per cent, and the GDP-weighted average 0.9 per cent. As

expected, grants accounted for the bulk of financing in fragile states, while frontier markets and commodity exporters received less ODF (relative to their GDP) than other country groups as they have a higher domestic revenue base and greater access to commercial borrowing.

30 The role of non-traditional donors has also widened with the entry of new multilateral institutions, notably the Asian Infrastructure Investment Bank (AIIB) and the New Development Bank (NDB). The AIIB focuses on supporting Asia's infrastructure needs while the NDB has a broader development mandate for BRICS and other emerging market and developing economies.

31 Infrastructure projects in LIDCs are also increasingly financed by cross-border bank lending, which generally represents a complementary source of external financing with respect to ODF. Vietnam, Uzbekistan, Nigeria, Lao PDR, Ethiopia and Kenya are the largest recipients of international syndicated loans, with MDBs participating in about one fourth of these cross-border loans. Total cross-border bank lending rose steadily in the late 2000s, peaking in 2012—when it amounted to about USD 40 billion—before falling significantly alongside the drop in commodity prices in 2014–15. A significant share of these flows is financing infrastructure projects, especially since 2007, when almost 30 per cent of cross border bank lending in LIDC financed infrastructure projects, while the share in EMs is about 22 per cent (Figure 12; see also Gurara et al., 2017 for a detailed discussion of syndicated lending to LIDCs). In terms of sector distribution, 52 per cent of infrastructure loans go to energy and utilities, 19 per cent to telecommunications, 17 per cent to transportation. This allocation points to complementarity between commercial cross-border lending and ODF, with the latter focused more on the transportation sector.

Figure 12. Cross-Border Bank Lending to LIDCs



Source: World Bank (no date), *PPI Database*.

5. Challenges and Way Forward

32 UNCTAD (2014) estimates that attaining the SDGs would require increasing spending on economic infrastructure by USD 0.8 to 1.7 trillion a year from current levels, although these numbers cover all developing countries, not just LIDCs. Various other analyses (e.g., Foster and Briceño-Garmendia, 2010 for Sub-Saharan Africa) also find large gaps between infrastructure investment needs and actual spending. Thus, despite the broad increase in infrastructure investment documented in the previous section, a strong case exists for further expansion in light of potentially high social and economic returns, even though policy makers should keep in mind the lessons from past experiences and the possible heterogeneous effects of infrastructure investment (see Section 2).

33 The path forward is not easy and the scope for increasing public investment in LIDCs is rather limited, even though the wide range of investment ratios shows that many countries may have some room for scaling up. Over recent years, public debt levels have risen, external financing conditions have tightened, and growth prospects have weakened for the LIDCs. These trends create a challenging environment for infrastructure investment. Countries with fiscal space should seek financing on the most concessional terms possible, with the support from the international community. Especially for countries where fiscal space is limited (but also for the others) there is a need to increase the efficiency of public investment—and considerable scope for it exists. The link between the amount of public investment (the input) and the quantity and quality of infrastructure in a country (the outputs and the outcomes) is not very tight and, although many factors may contribute to this variance, differences in investment efficiency are likely one of them. Several studies (Dabla-Norris et al., 2012) show that low-income countries have relatively weak public investment management institutions, and that improving those institutions could increase considerably the efficiency (i.e., the "value for money") of public investment.[25] In addition, mobilising domestic revenues and prioritising expenditures could provide more sustainable and reliable sources of development funding.

34 Petrie (2010) documented eight key elements to strengthen public investment management and thereby increase the efficiency of public investment:

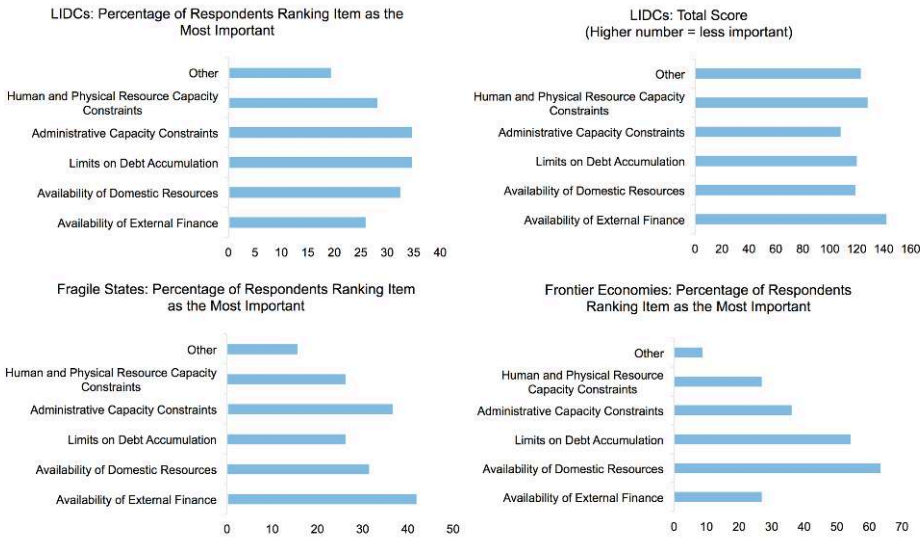
> Strategic guidance and preliminary screening: strategy documents should be specific enough, and have sufficient coherence and authority to guide public investment. Sector strategies should be fully costed, and closely integrated and consistent with medium term budgets.
> Appraisal: projects should be appraised using the full range of techniques as appropriate. There should be a comprehensive central guideline on project appraisal, including specific detailed guidance on the appraisal of PPPs.
> Independent review of appraisal: projects should be subjected to independent review.
> Project selection and budgeting: only projects that have been subject to thorough appraisal, and have been independently reviewed, should be selected for funding in the budget.
> Project implementation: there should be a strong focus on managing the total project costs over the life of each project with regular reporting on financial and non-financial progress.
> Project adjustment: specific mechanisms should be in place to trigger a review of a project's continued justification if there are material changes to project costs, schedule, or expected benefits.

Facility operation: comprehensive and reliable asset registers should be maintained and are subject to external audit.
Project evaluation: ex post evaluation framework should be in place.

35 Chile has one of the most effective public investment management systems that encompass the above key elements. All public bodies wishing to undertake an investment project must apply to the National System of Investments (SNI) at the Ministry of Planning (MoP) for funding (Ley, 2006). Every public-investment project is subject to the same cost-benefit analysis, under a set of clearly specified methodologies published by the MoP. The law mandates that the capital budget sent by the Ministry of Finance to Congress can only include projects within the SNI. This process screens out 'white elephants' (Gómez-Lobo, 2012). MoP oversees the *ex-ante* and *ex-post* appraisal of investment initiatives within the SNI. MoP is also responsible for regulating the procedures for preparing and appraising projects that apply for public funding; developing and managing an information system for all investment initiatives; developing project preparation and appraisal methodologies, including the determination of social prices, and training public officials in project preparation and evaluation (Gómez-Lobo, 2012).

36 Even in the absence of financing constraints, absorptive capacity constraints could weaken the growth impact of infrastructure spending, as countries could not have the capacity to reap the benefit of additional investment, given that a simultaneous implementation of several investment projects would require a varied set of technical and managerial resources which cannot be expanded in the short-run (Horvat, 1958; Rosenstein-Rodan, 1961). In a seminal paper, Isham and Kaufmann (1999) show that once the ratio between public investment over GDP is too high (above 10 per cent), the increase in public investment is associated with a declining productivity of investment projects. More recently, Presbitero (2016) uses a large dataset of investment projects financed by the World Bank since the 1970s in 100 developing countries and shows that infrastructure projects undertaken in periods when public investment accelerates compared to its historical patterns are less likely to be successful, indicating the presence of absorptive capacity constraints. This suggests that it might be advantageous to scale up infrastructure investment gradually, while building capacity and strengthening institutions.

Figure 13. Key Obstacles to Scaling Up Public Investment in Economic Infrastructure

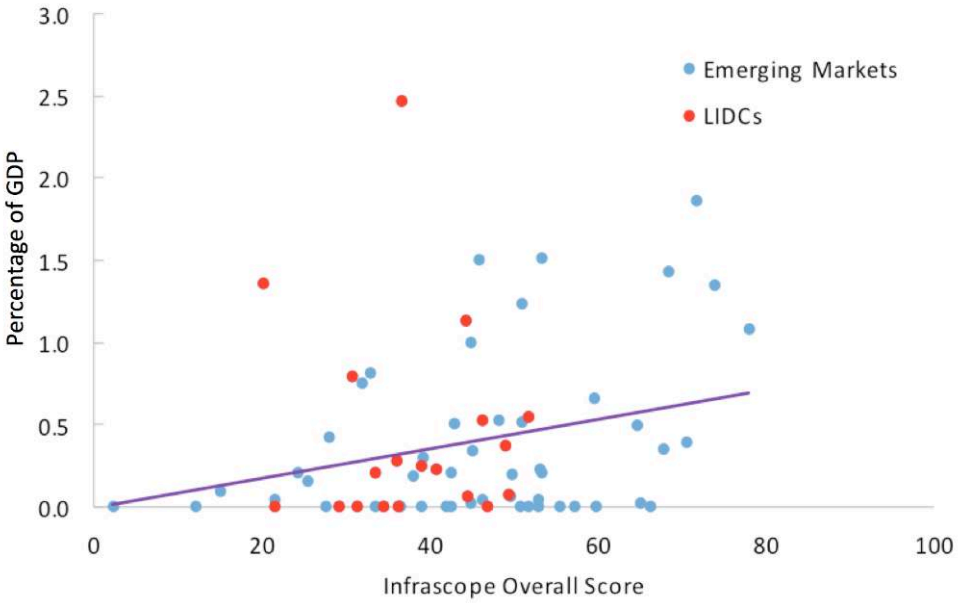


Scores ranges from 1-6 in decreasing order of importance. Based on 46 responses.
Source: IMF (2016).

37 The IMF team survey shows that indeed countries face multiple obstacles to scaling up public investment in economic infrastructure. Interestingly, no single constraint emerged as dominant in the full sample (Figure 13). Sharper results were obtained for subgroups, with fragile state desks emphasising availability of external finance and administrative capacity as key challenges, while availability of domestic resources and limits on debt accumulation were most important for frontier economies.

38 Even under optimistic assumptions about future improvements in public investment efficiency, domestic resource mobilisation, and concessional financing, the scale of the infrastructure challenge is such that tackling it is inconceivable without a significant increase in private sector participation. While over the longer run purely private provision can be expected to spread more widely beyond the telecom sector, in the near future private participation is likely to occur primarily through PPPs.

Figure 14. PPP Amount vs. Institutional Framework



Sources: Authors' elaboration based on World Bank data and IMF staff estimates.

39 The balance between public and private financing depends to a large extent on the country context and, in particular, on the institutional weaknesses that are felt most acutely, as government could be affected by limited commitment, limited accountability, limited capacity, and limited fiscal efficiency (Estache et al., 2015). Macro-fiscal implications of PPP projects could be large and expose countries to fiscal risks. Thus, a strong regulatory environment and a robust institutional framework[26] are essential to implement PPP infrastructure projects in a sustainable and efficient way, especially in developing countries, where public sector capacity constraints may be more severe (Romero, 2015). PPP use is correlated with domestic institutions, such as the rule of law and levels of corruption (Moszoro et al., 2014). In a broad sample of emerging market and developing economies, there is a positive association between PPP investment as a percentage of GDP and the Infrascope index developed by the Economist Intelligence Unit (EIU, 2010) to evaluate countries' capacity to deliver efficient and sustainable infrastructure projects (Figure 14). The average Infrascope index for LIDCs is significantly lower than the one of EMs, and the gap is particularly strong for the legal regulatory framework and for the presence of financial facilities. A heavy reliance on external financing and lags in the implementation of the PPP legal framework have been identified as key constraints for the growth of PPPs in sub-Saharan Africa (EIU, 2015). In that perspective, there is scope to improve the collaboration between local governments and MDBs in the preparation, structuring and financing of infrastructure projects, to facilitate the participation of private long-term investors—the World Bank *Global Infrastructure Facility* and the EBRD *Equity Participation Fund* are infrastructure platforms that go in that direction (Arezki et al., 2017).

40 Beyond the PPPs, the large pool of resources held by institutional investors (such as insurers, pension funds, and sovereign wealth funds)— estimated at USD 88 trillion (McKinsey Global Institute, 2016)— could be an important source of private financing of infrastructure. Investment in infrastructure is attractive for institutional investors, as they look for stable, long-term, inflation adjusted return higher than government

bonds to match their long-term liabilities. However, infrastructure investments are exposed to high market and non-market risks (Weber et al., 2016). The role of MDBs is thus crucial in de-risking infrastructure investment and crowding in private investment including from institutional investors through their various instruments[27] such as partial risk guarantee and provision of subordinate loans. The African Development Bank (AfDB) partial risk guarantee for Kenya's Lake Turkana Wind Farm Project in 2013 is an interesting example. The guarantee covered a potential delay in the construction of the transmission line by the government; off-take risks due to non-payment of monthly invoices; and termination of the power purchase agreement by the off-taker. The guarantee improved the risk-return mix and facilitated access to long-term debt and financial close for the power plant (AfDB, 2014).

41 More broadly improving infrastructure in LIDCs is subject to numerous challenges and requires a coordinated set of measures that include:

Mobilising domestic resources for public investment by increasing tax revenue and streamlining and prioritizing expenditures;[28]
Increasing access to concessional external financing;
Developing local capital markets and diaspora bonds;
Strengthening the institutional and regulatory framework to expand private sector involvement in the provision and financing of infrastructure investment, supported by multilateral development banks and development finance institutions;
Improving "value for money" in public and PPP investment projects.

6. Conclusions

42 Public investment, including in infrastructure, has broadly increased in LIDCs over the last 15 years. Despite the scaling-up, the quantity, quality and accessibility of infrastructure in LIDCs remain considerably lower than in emerging market economies. Outside the telecom sector, infrastructure services in LIDCs are primarily provided by the public sector. Private participation is largely channelled through Public-Private Partnerships, which are mostly concentrated in the energy sector and whose volume has declined recently after a sharp spike in the early 2000s. Grants and concessional loans from development partners are an essential source of infrastructure funding in LIDCs. International syndicated loans play an important complementary role in a few countries, even though lending volumes have fallen in the last two years. Data collected through a survey of IMF country teams confirm that funding constraints are a common impediment to scaling up infrastructure investment.

43 Improving LIDC infrastructure to levels consistent with attaining Sustainable Development Goals—and at the same time being able to reap the benefits in terms of growth and inclusion—requires action on multiple fronts, to avoid repeating the negative experiences of past scaling-up episodes. Governments need to strike a careful balance between supporting development outlays and maintaining debt sustainability, and financing schemes should be adapted to the institutional context. As fiscal risks limit room for debt financing, additional resources for public investment need to be sought through domestic resource mobilisation and concessional financing. Given the scarcity of resources, improving administrative capacity and investment efficiency is paramount. In addition, a major increase in private sector involvement is essential and requires concerted efforts to improve the regulatory and macroeconomic environment

as well as complementary actions by multilateral development banks to provide risk mitigation and technical assistance.

Annex Table A1. LIDCs classification

		Frontier Markets (14)	Fragile States (28)	Developing Markets (19)
Commodity Exporters (27)	Fuel Exporters (6)	Bolivia[#] Nigeria (2)	Chad Congo, Rep.[2#] South Sudan Yemen, Rep. (4)	
	Non-fuel Commodity Exporters (21)	Mongolia[#] Mozambique[#] Papua New Guinea[#] Zambia[#] (4)	Afghanistan[2#] Burundi[2#] Central African Rep.[2] Congo, Dem. Rep.[2] Eritrea Guinea[2#] Guinea-Bissau[2#] Malawi[#] Mali[#] Sierra Leone[#] Solomon Islands Sudan Zimbabwe (13)	Burkina Faso Mauritania Niger[#] Uzbekistan[#] (4)
Diversified Exporters (33)		Bangladesh[#] Cote d'Ivoire[1,2#] Ghana Kenya Senegal[#] Tanzania[#] Uganda[#] Vietnam (8)	Comoros[2] Cote d'Ivoire[1,2#] Djibouti Haiti[2#] Kiribati Liberia[2#] Madagascar[#] Myanmar Sao Tome and Principe[2] Somalia Togo[2] (11)	Benin[#] Bhutan[#] Cambodia Cameroon[#] Ethiopia[#] Gambia, The[2] Honduras Kyrgyz Republic[#] Lao PDR Lesotho Moldova[#] Nepal[#] Nicaragua[#] Rwanda Tajikistan[#] (15)

Note: See IMF, 2014a, for the details of the classification. The number of countries is shown in the parentheses.

[1] Cote d'Ivoire is included in both the "frontier market" and "fragile state" groups.

[2] Late HIPC: completion point in or after 2007.

[#] Country with survey data on infrastructure investment.

Source: IMF (2014a)

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NOTES

1. One can distinguish between economic and social infrastructure. Recent evidence suggests heterogeneous growth effects, with possible benefits in low-income countries from re-allocating investment from economic to social infrastructure (Acosta-Ormaechea and Morozumi, 2017). Our analysis focuses exclusively on economic infrastructure: power, transportation, water and sanitation, and telecommunications facilities. For a discussion about the potential trade-offs between investing in economic and social infrastructure, see Atolia et al. (2017). We zoom in on the experience of low-income developing countries; see IMF (2014a) for the definition of LIDCs and IMF (2017) and Annex Table A1 for the current list of LIDCs as well as their breakdown into analytical categories used in this paper, such as (i) frontier markets, fragile states, and developing markets; and (ii) commodity exporters and diversified exporters.

2. This analysis complements and extends previous regional studies, such as IMF (2014b) and IMF (2016). Because of limited data availability, the short time period under consideration, and the

difficulty in having a credible identification strategy we refrain from any new analysis. Section II provides a selective review of the empirical literature on the economic impact of infrastructure development in low-income countries.

3. Enhancing infrastructure is a key component of the 2030 Development Agenda, mentioned explicitly in three of the seventeen Sustainable Development Goals (SDGs 6, "Ensure availability and sustainable management of water and sanitation for all"; SDG 7, "Ensure access to affordable, reliable, sustainable and modern energy for all"; and SDG 9, "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation") and essential for achieving many others.

4. In addition, agricultural productivity could decline in the upstream because of flood, increased salinity and waterlogging near the reservoir.

5. Consistent with the aggregate evidence, firm level data show that the share of firms that indicate electricity as a major constraint to economic activity almost halved in Vietnam between 2009 and 2015.

6. The analysis in this section is based on 47 LIDCs for which the IMF's World Economic Outlook database contains information on public investment and public saving.

7. The current median level of public investment in LIDCs is similar to that observed in the present-day EMs in the 1980s and is higher than the 1990s EM median of 6 per cent of GDP.

8. Five-year averages are used to smooth over yearly fluctuations.

9. High public investment in Ethiopia reflects the government's national development agenda with a focus on infrastructure. With this concerted effort, public investment went up from 12 per cent of GDP in 2009 to 22 per cent in 2015—among the highest levels in the world—and private investment also rose. As a result, the stock of infrastructure has increased significantly, although the impact has not been uniform. The scaling-up has benefited the economy, but concerns about debt sustainability are emerging. Despite the growth dividend of high investment (real GDP increased at an average rate of 10 per cent per year between 2010 and 2015), the ratio of public debt to GDP is on the rise.

10. Among the 33 countries where the public investment/GDP ratio increased between 2001-05 and 2011-15, public saving rose in 27, but only in 10 of them it rose enough to cover the increase in public investment. As with investment, fragile states exhibit the widest variety of changes in public saving and the extent to which those match changes in public investment.

11. The correlation coefficient between median public investment and saving is 0.74 with p-value of 0.03 for the period 2000-2007, while it is -0.16 and insignificant for the post-2007 period.

12. According to the latest debt sustainability analyses conducted by IMF and World Bank country teams, two LIDCs are currently experiencing external debt distress, 11 are at a high risk of debt distress, and 27 are at a moderate risk (IMF, 2017).

13. See Annex Table A1 for details. For some countries, coverage included only budgetary central government.

14. The correlation between public infrastructure investment and total public investment is 0.8 in this sample, providing justification for looking at cross-country differences and time evolution in the latter as a reasonable proxy for the behaviour of the former.

15. The World Bank's PPI database (Ruiz-Nunez and Harris, 2016) records total investment in infrastructure projects with private participation (but not purely private investment). Investment commitments include expenditures on facility expansion, divestiture revenues, and license or concession fees. Infrastructure refers to telecommunications, energy, transport, and water projects serving the public, including natural gas transmission and distribution, but excluding oil and gas extraction. Coverage of the telecom sector currently includes only the ICT "backbone" (e.g., fibre optic networks), but was broader in the past.

16. Lao PDR stands out as the LIDC with the largest volume of infrastructure PPPs. This can be largely attributed to the country's abundant hydrological and mineral resources and its close

relationship with Thailand, whose state-owned electricity company (EGAT) purchases the bulk of energy generated in Lao PDR.

17. Changes in methodology amplify the rise and fall in telecom PPPs in Figure 10. Coverage of the telecom sector currently includes only the ICT "backbone" (e.g., fibre optic networks), but was broader in the past.

18. Micro-grids are an example of private production and distribution of electricity. Micro-grids deliver electricity produced locally through low-voltage distribution lines. In Kenya, micro-grids under a platform pioneered by Steama.co are rapidly expanding, currently serving over a thousand households and businesses. They have attracted global players such as E.ON, the world's largest investor-owned electric utility service provider. See Annex III in Gurara et al. (2017) for additional details.

19. At the regional level, in Asia the vast majority of PPI are in the energy sector, while in Sub-Saharan Africa private participation in transport infrastructure is also common.

20. On average, about 5 per cent of the projects recorded in the PPI database are cancelled or under distress. Regression results are available upon request.

21. Multilateral support accounted for 57 per cent of ODF, bilateral for 43 per cent. The World Bank is the largest multilateral donor, and Japan is the largest bilateral one. ODF *commitments* amounted to around USD 24 billion in 2014, exceeding disbursements by a wide margin.

22. According to Miyamoto and Chiofalo (2016), ODF covers 6-7 per cent of infrastructure investment in developing countries.

23. The figures of the box are based on the AidData's Global Chinese Official Finance Dataset, Version 1.0. Retrieved from http://aiddata.org/data/chinese-global-official-finance-dataset. The dataset captures the known universe of officially-financed Chinese Official Finance projects from 2000-2014. See also Strange et al. (2017) for an extensive discussion of the data. We exclude pledges from the figure cited in the text.

24. Figures based on *realised* foreign direct investment of China show that China only accounted for around 5 per cent of global FDI into Africa in 2015 (McMillan, 2017). The same authors show that Chinese FDI in Africa is starting to diversify in terms of sector and location.

25. A related issue is a frequent failure to allocate adequate funds to maintenance (Adam and Bevan, 2014). In the IMF survey, only 40 per cent of LIDC country teams indicated that new projects included a budget for maintenance.

26. These include sound planning and project selection; strong fiscal institutions; strong legal frameworks; strong budgeting, accounting and reporting practices; and appropriate fiscal risk analysis at the project level (see IMF, 2017, Box 9).

27. See https://goo.gl/zGh2Bk for list of available instruments.

28. The potential to mobilise domestic resources in developing countries and the steps needed to realise that potential are discussed in detail in IMF (2015).

ABSTRACTS

This paper examines trends in infrastructure investment and financing in low-income developing countries (LIDCs). Following an acceleration of public investment over the last 15 years, the stock of infrastructure assets increased in LIDCs, even though large gaps remain compared to emerging markets. Infrastructure in LIDCs is largely provided by the public sector;

private participation is mostly channelled through Public-Private Partnerships. Grants and concessional loans are an essential source of infrastructure funding in LIDCs, while the complementary role of bank lending is still limited to a few countries. Bridging infrastructure gaps would require a broad set of actions to improve the efficiency of public spending, mobilise domestic resources and support from development partners, and crowding in private investment.

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