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Infrastructure Investment and Finance in the Global South: The Public-Private Paradox

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December 2023

Abstract

While the public sector is traditionally the sole provider for much of infrastructure, the pendulum is shifting in light of the enormous investment gap. Across the Global South, public utilities and planning agencies are engaging with the private sector to help bridge the gap. What are the key sources of infrastructure investment across countries in the Global South? Specifically, what is the magnitude of public sector financing in the context of rising private participation? What macro factors underscore the volume of investment from either sector? These are the research questions motivating this research, which focuses on the five infrastructure sectors in the Global South and its various regions. Following a historical synthesis of the changing balance of public and private provision, the paper first outlines recent patterns of private participation in infrastructure. A unique dataset on infrastructure investment in the transport sector draws from the World Bank PPI database and the International Transport Forum data. Using this dataset, a regression analysis includes key macro-level predictors for private sector financing and overall investment, to untangle the public-private paradox. Key results point to the importance of effective governance and controlling external debt.

Keywords: investment infrastructure, public-private partnerships, Global South

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Introduction

Much has been written about the role of infrastructure: besides its function of raising the productivity of labor and capital, infrastructure contributes to the welfare of people and places. Its provision is a lengthy process of financing, construction, and maintenance that involves a multitude of players. Each year, Global South countries invest hundreds of billions of dollars in new infrastructure, with sizeable portions in transport, energy, telecommunications (also labeled as ICT, information and communications technology), water and sewerage, and municipal solid waste. Nonetheless, there remains chronic underinvestment in infrastructure, the so-called investment gap, estimated at about $1 trillion each year globally by the World Economic Forum (WEF 2014a).

Traditionally, the public sector is the sole provider for much of infrastructure. Given the enormous investment gap, however, the landscape is shifting. Across the Global South, public utilities and planning agencies are engaging with the private sector to help bridge the gap. Decentralization of public infrastructure provision and the restructuring of incentives are important catalysts in the introduction of new financing mechanisms. Increasingly, private participation, often through global networks, is seen as the key to filling the shortfalls in infrastructure financing. With the onset of financialization – transforming an illiquid asset into a liquid form – global owners and operators also play a growing role in the governance of infrastructure projects (Torrance 2018), and how infrastructure is financed is instrumental in understanding its uneven provision both socially and spatially (O'Brien et al. 2019). Distinct from public investment in infrastructure, private funding borrowed from equity investors and lenders needs to be repaid, though the process of full recovery may take many years.

Such recent developments raise critical questions. What are the key sources of infrastructure investment across countries in the Global South? Specifically, what is the balance of public sector financing in the context of rising private participation? What macro factors may underscore the dominance of investment from either sector? These are the research questions driving this research, which focuses on the five infrastructure sectors in the context of the Global South and its various regions (unless otherwise noted). Key sources of information are drawn from the World Bank Private Participation in Infrastructure (PPI) database and the International Transport Forum (ITF) datasets. The subject of study in this paper generally is confined to low- and middle-income countries, as classified by the World Bank and referred to as the Global South. Following a synthesis of the historical and conceptual contexts is an overview of recent trends in infrastructure investment and particularly PPI in its regional and sectoral distribution. Next is a regression analysis of the key predictors for private sector financing and overall investment, in an effort to untangle the public-private paradox.

The Public-Private Paradox: Historical and Conceptual Contexts

The public-private paradox has historical roots, particularly in the industrialized countries from which contrasting patterns have emerged in the modern era. In the late 19th and early 20th centuries in the U.K and U.S., gas, water, canals, trolleys, highways, and electricity were mostly provided privately. By 1890, 57 percent of the waterworks in the U. S. were owned by private companies (World Bank 1999). Services were often provided under long-term franchise contracts between municipalities and private firms, primarily for financing reasons because cities lacked capital and national subsidies were limited. By the early 19th century, London had been served by private water companies for over 200 years and eight companies were operating in the city at the end of that century (Tynan 2002).

Over time, however, dissatisfaction with private providers increased (Foreman-Peck 1994, World Bank 1999). Complaints centered on the lack of coverage in outlying areas, high prices, poor quality, and political corruption. In the case of water, increasing volume of wastewater began to pollute local sources but private companies were reluctant to mitigate. Contracts also proved hard to regulate, and courts of law found it difficult to cope with the complex regulatory problems (Shugart 1998). At the same time, rising incomes led to a much greater homogeneity in demand for such services as gas, water, sanitation, and electricity, negating one advantage of small niche providers.

Considerations of scale, similarity in demand, regulatory deficiencies, and technological changes together led to a major shift to ownership and production of services by public or regulated semi-autonomous public agencies in the U.K and, to a lesser extent, in the U.S. Since the mid-20th century, the dominant model for the provision of basic infrastructure and services has been one in which the public sector has assumed primary responsibility for planning, provision and regulation. When executed well, this broad mandate, exclusive control and centralized management can theoretically yield economies of scale for networked services. However, when run poorly, the problems generated are equally severe (World Bank 1999).

Under this public sector model of infrastructure provision, there are common features in financing (see Table 1). In industrialized countries, borrowing by local governments is widely used as a key method because of the capital-intensive nature of much infrastructure, especially in terms of up-front costs. Most such borrowing is directly from a functioning capital market and relies on a system of municipal bond rating. Excluding borrowing, local taxes are the most important source, counting on average a 40 percent share (Bird 2004, Chan 1998). More

recently, in the context of climate change, some locales have begun to consider dedicated taxes to increase the level of funding for climate projects (e.g., Bay Area Restoration in counties around San Francisco), although this remains a small fraction (World Bank 2018). What follows local taxes are grants and subsidies, and other sources including user charges. Although the situation in the Global South varies substantially, local property taxes dominate the revenue structure, and loan financing tends to be a small source. Given the general lack of local capacity, intergovernmental transfer are common as well, constituting a major revenue source across the Global South (World Bank 2018). Land value capture, increasingly practiced worldwide but still small in overall magnitude, is predicated upon the concept that governments should be able to reap at least part of the increase in land value as a result of infrastructure projects and reinvest these funds in services.

The performance of the model has been uneven. Particularly in low-income countries, the public sector has not come up to expectations. This, together with reform efforts in the wave of decentralization, has spurred a significant comeback of private provision, starting in the late 20th century. By then, a profound cultural and political change was taking place in Europe as partnerships between the private and public sectors to fund and operate infrastructure projects were set to take off. Triggered by the public expenditure constraints of the Euro limiting the ability of countries to borrow for infrastructure, the change also reflected a stronger ability to regulate compared to the situation in the late 19th century (World Bank 1999). Elsewhere around the world, the role of the private sector also has become increasingly prominent, primarily as an avenue to fill the infrastructure investment gap (Rao 2018).

Table 1. General Patterns of Infrastructure Finance by Public Sector at Local Levels

Global North	Global South
Borrowing from capital markets (municipal bonds)	Local taxes (e.g., property tax)
Local taxes (e.g., property tax)	Grants (e.g., intergovernmental transfer, dedicated climate or green funds, official development assistance)
Grants & Subsidies (e.g., federal agencies)	Borrowing
User fees, land value capture	Others (e.g., user fees, land value capture)

Sources: Chan 1998, World Bank 2018, and Wu 2018.

Note: Aggregate data for each type of finance are not available across the two broad regions.

There are myriad ways the private sector affects infrastructure, from competitive procurement processes to service delivery and to long-term financing. Infrastructure is even being considered a new asset class on capital markets. Private participation may take the form of direct investment, leases, operation contracts, and private public partnership (PPP). In general, it is defined as the private sector providing some form of upfront investment, as either equity or debt, and receiving cash flow over time from the asset (WEF 2014a). There are variations of financing vehicles across different sectors of infrastructure, and investment levels may respond to global financial fluctuations.

Relying on private infrastructure providers and increasingly through project financing, PPPs are not without constraints. Historically, the majority of project financing debt globally has been funded by banks. This is especially the case in the Global South where bond and securitization markets are less developed. But after the 2008 financial crisis, banks, particularly those in OECD countries, are less able to offer longer-term lending for infrastructure projects. Bond finance in new projects also has come to a halt because of the financial crisis (Della Croce and Yermo

2013, Inderst and Stewart 2014). Consequently, policy-makers have been looking for potential alternative sources of infrastructure financing from the private sector.

The rise of institutional investors is noteworthy in this context. Chief among them are pension funds, Insurance companies, sovereign wealth funds, investment funds (e.g., mutual funds), private equity, and endowments (Wu 2015). On the side of institutional investors, the search since the turn of the 21st century has been towards new sources of longer-term, inflation-protected investments. Infrastructure stands out, along with other so-called alternative assets such as real estate and commodities. The increase in socially responsible investing also has raised demand for what are seen as ethical projects including "green infrastructure" such as renewable energy (Della Croce and Yermo 2013, WEF 2014a).

Matching investment demand and institutional investors (or private investors in general), however, has been elusive. This is particularly the case in the Global South (Wu 2015). For instance, between 1995 and 2016, about half of private investment in transport – US$1.35 trillion in constant 2014 purchasing power parity terms – were in OECD countries. China, India and Brazil counted for more than 60 percent of total such investment in non-OECD countries (ITF 2018). For instance, the vast majority of institutional investors concentrate their investment in their home markets, i.e. in OECD countries. One set of key barriers has to do with general government support, including the lack of long-term political commitment, regulatory instability, fragmentation of the infrastructure space across multiple levels of government, and the lack of project pipeline. Other barriers include lack of appropriate financing vehicles, limited investment and risk management expertise, and lack of appropriate data and investment benchmarks for illiquid assets (Inderst and Stewart 2014, World Bank 2013).

On the more positive side, domestic institutional and private investors are a potentially growing source of capital in the Global South. These countries in general face a substantial opportunity to develop their non-state investor sectors since their financial systems are largely bank-based (OECD 2011, Sharma 2013). The first wave of such investors in infrastructure began in the 1990s in countries such as Korea, Malaysia, and Chile (Inderst and Stewart 2014). Over time, pension fund experience with domestic infrastructure has become widespread in Latin America, while Asia and other regions have seen limited exposure.

Recent Trends in Infrastructure Investment

In light of the large investment gap, the general estimate is that infrastructure spending of 4.5 percent of national GDP in combination with another 2.7 percent in maintenance could enable low- and middle-income countries to stay on track in development (Foster et al. 2022). However, reliable information on how much governments are actually investing in infrastructure is sparse, hindering efforts to estimate the balance of public and private investment across regions and sectors. A limited number of studies have attempted to overcome this barrier by constructing analyses based on approximation.

A World Bank study, using PPI data in 2017 and a purpose-built dataset of state-owned enterprises (SOEs) and public sector-funded projects (SPI), shows infrastructure investment continued to be very much a public sector endeavor (World Bank 2019). Confined to investment channeled through project vehicles with more than 80 percent of public ownership, instead of all infrastructure projects (hence not representative of the entire stock of public investment), the study finds that 83 percent of such investment involved government entities and SOEs. SOEs' role was particularly significant worldwide. The estimate also includes the public proportions of investment in the 2017 PPI projects. The region of Latin America and the Caribbean (LAC)

experienced a lower level of public investment (about 60 percent), compared to other regions. In ten countries, private investment eclipsed the public sector, including Cambodia, Mongolia, the Philippines, Ghana, Jordan, Egypt, Turkey, Colombia, Brazil, and Mexico. Across the board, infrastructure investment was heavily concentrated at the national level. Among the six world regions, East Asia and Pacific (EAP) scored the single largest amount of infrastructure investment (both PPI and SPI), more than doubling any other region. Most prominently, China along accounted for 60 percent of all EAP SPI and Indonesia at 24 percent.

In the same year, almost the entirety of investment went to just two infrastructure sectors: transport (50 percent) and energy (45 percent), which also saw the dominance of SPI (57 percent in either sector). However, private sector presence was quite pronounced in renewable energy, counting for 95 percent in wind, 85 percent in solar and 79 percent in waste-to-energy projects. It's worth noting that these high proportions tended to be driven up by a few large projects; in this case, projects in Brazil, China and Mexico. In the transport sector, public investment was pronounced in railway (92 percent), road (85 percent) and airport (84 percent) projects, whereas the private sector invested mainly in ports (50 percent). The dominance of the public sector in the water sector is similar (over 90 percent). As for types of projects across all sectors, the number of SPI projects distributed almost equally in greenfield (52 percent) and brownfield (48 percent), whereas greenfield projects far outpaced brownfields for PPI projects (84 percent v. 16 percent). A useful distinction is between greenfield and brownfield projects: the former refers to new construction or the development of new infrastructure while the latter existing infrastructure assets already operating and frequently with a demand history (WEF 2014a). Overall, SPI relies more on equity financing (59 percent) than debts, while PPI is largely debt financing (70 percent) (World Bank 2019).

Another more recent study (Foster et al. 2020) draws from a different source, the World Bank's Public Expenditure BOOST database. There are several estimation and comparison issues associated with using this source. Nonetheless, the study is useful in highlighting discernable trends. First and foremost, developing country government investment in infrastructure has been low and declining, since 2010, ranging from 1 to 2 percent of GDP. A level substantially lower than earlier estimates by the World Bank (Fay et al. 2019), though methodological difference may be at work. But a level closer to the World Bank 2017 study, in which the combined share for all regions was 1.8 percent of GDP (World Bank 2017). Specifically, public sector funding has dominated roads infrastructure, and few countries have been able to tap PPI (Foster et al. 2020).

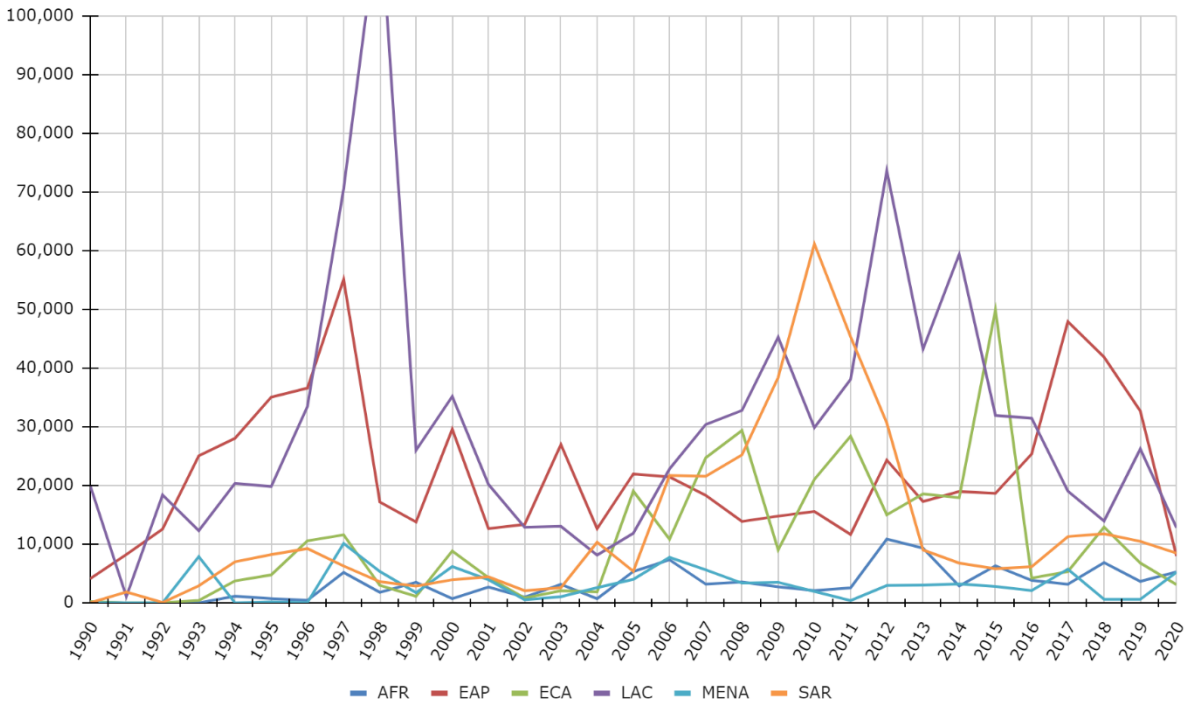
Zooming in on PPI by region

The World Bank PPI database includes projects owned or managed by private companies in low- and middle-income countries (as classified by the World Bank) or the Global South that have reached financial closure. Private parties have at least a 20 percent participation in the project contract, except for divestitures, which are included with at least 5 percent of equity owned by private parties. Projects in the database do not have to be entirely privately owned, financed or operated. Some have public funding as well. Countries are classified into six regions (East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, South Asia, and Sub-Saharan Africa). The countries are reviewed every 5 years in order to maintain continuity in the data. The database focuses on sectors in infrastructure with high capital costs – traditionally provided by the public sector – and includes transport, energy, ICT, water and sewerage, and municipal solid waste.

Generally, PPI is defined as the private sector providing some form of upfront investment, as either equity or debt, and receiving cash flow over time from the asset (WEF 2014). There are variations of financing vehicles across different sectors of infrastructure, and investment levels may respond to global financial fluctuations (Wu 2020). A particular type of PPI, PPP projects range from service and management contracts, brownfield (aka concession with private entity taking over management), greenfield, to divestiture (private entity buys equity stake in public infrastructure).

Overall, the magnitude of PPI has fluctuated in the 30 years on record (see Figure 1). While projects can take multiple years to complete, the investment is marked for the year when financial or contractual closure is achieved. The periods of 1997-98 and 2007-2015 experienced higher volumes of PPI, with each year at more than US$100 billion. A downward trend took place after 2015, with annual investment continuing to dip and reaching only about US$43 billion in 2020, the lowest level in three decades except for the first three years (1990-1992). It's plausible that the onset of COVID-19 might be at the root of this.

Figure 1. PPI by Region, 1990-2020 (Investment in US$Million at 2010 constant price)



Source: Own analysis and conversion to 2010 constant price, based on World Bank PPI Database (http://ppi.worldbank.org/).

Notes: AFR = Sub-Saharan Africa, EAP = East Asia and Pacific, ECA = Europe and Central Asia, LAC = Latin America and Caribbean, MENA = Middle East and North Africa, and SAR = South Asia.

Two world regions are clearly the front runners: Latin America and the Caribbean (LAC), and East Asia and the Pacific (EAP) (see Figure 1). Over the three decades, LAC is the home for about 37 percent of the Global South total, whereas EAP accounts for 27 percent. In contrast, the Middle East and North Africa (MENA) and Sub-Saharan Africa (AFR) each accumulates less than 4 percent. South Asia (SAR) stands at 15 percent and Europe and Central Asia at 13 percent. The downward trend since 2015 discussed above, however, generally has not plagued EAP and SAR regions (except in 2020) – China and India are the primary drivers of continued PPI during this time.

The outstanding records of LAC and EAP in engaging the private sector is a reflection of the institutional sophistication in select countries in the regions. Specifically, this refers to an effective legal and policy framework, which can provide value-for-money for the government, and provide a conducive environment for the private sector to invest and operate for the long term (Wu 2015). Developed countries are nearly exclusively those identified as having the most sophisticated legal, policy and institutional frameworks towards PPI, while Global South countries have historically had less developed PPI marketplaces (Deloitte Research 2006, Siemiatycki 2013). For instance, between 1984 and 2008, globally over half of all transportation PPPs were carried out in just eight countries: Spain, the U.K., India, China, Mexico, Brazil, Australia, and the U. S. At a regional scale, Western Europe, South East Asia, Australasia, and Latin America were particularly active in using PPPs to deliver transportation projects. Overall the proliferation of PPPs has been supported by the implementation of institutional arrangements explicitly favoring this model of project delivery (Siemiatycki 2013).

During the early 21st century, a growing share of all PPI projects were carried out in emerging economies. Aside from the aforementioned implementation of legal and policy frameworks, steps were taken to engage capital financing. The best example is Chile, which graduated from a middle-income to high-income country in 2012. It represented one of the most attractive environments in the world for private investment in infrastructure, particularly successful in developing local bond markets to support relatively long-term issuances by infrastructure companies. Its investment environment and risk profile resembled those of OECD countries (Wu 2015). Chile's initial concessions law enabling private sector investments in infrastructure was passed in 1991, with the first project completed in 1995. Between 1995 and 2008, investments totaling nearly US$11.5 billion across 55 projects were completed (Ministry of Public Works

2009). Chile also demonstrated a long-term effort with its highway network, beginning a process of privatizing construction in the 1990s, auctioning off sections of highways to concessionaires, and contracting out projects on a build-operate-transfer basis (Walsh, Park and Yu 2011).

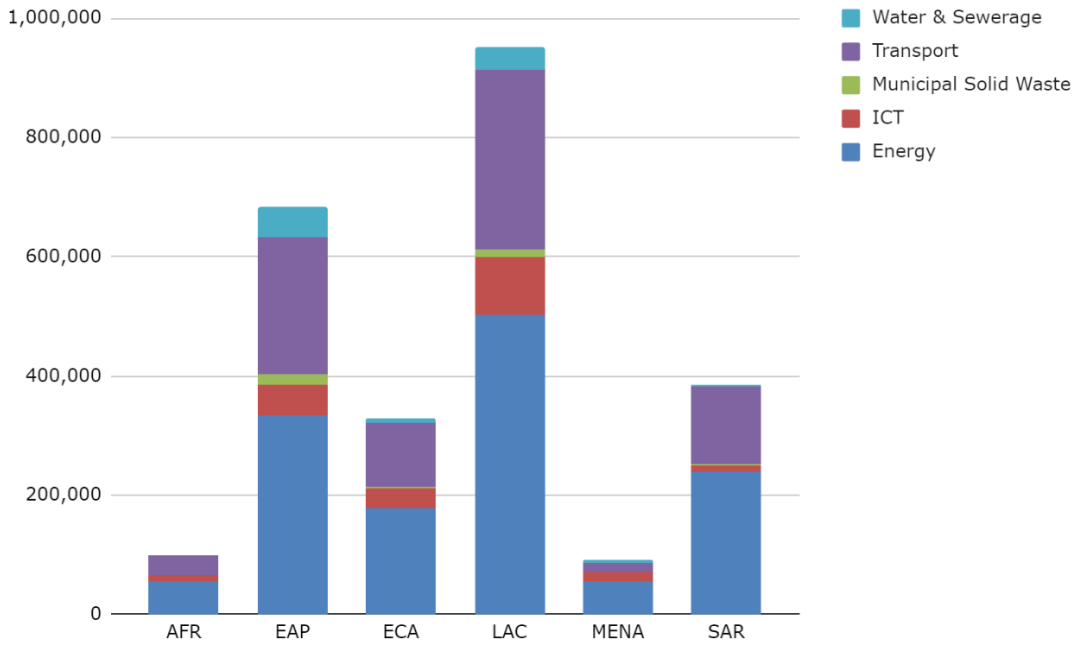
In EAP, while China is a large recipient of PPI, it is still at an early stage of developing the institutional sophistication for engaging the private sector and the country's infrastructure space continues to pose risks, in the form of regulatory, currency, demand, and general business risks (Siemiatycki 2013, Wu 2020). In fact, compared to Brazil and India, total investment in PPI projects in China has been smaller during the period of 1990-2020, despite its much larger national economy. First introduced in the late 1970s, the central government began to apply PPI schemes at a larger scale in the 1990s, especially for water, power, and road projects (Cheung and Chan 2011). The rollout of several national policies followed, in order to guide private investment in public utilities that was tapped to meet increasing demand for more and better infrastructure. In 2014, a set of new central directives were issued to encourage PPI, for at least two reasons: the high level of debt among local governments and the substantial investment local governments require for infrastructure (Wu 2020). Based on the analysis of World Bank PPI data, significant portions of private investment in China's infrastructure in the last two decades are South-South investment and domestic in origin. Private providers are especially common in water, power, and road projects.

Types and sectoral distribution of PPI

In terms of investment volume across the five infrastructure sectors, energy projects are clearly the frontrunner in all regions, followed by transport (see Figure 2). This echoes the World Bank study that has deconstructed the 2017 PPI data to distinguish between public and private investment (World Bank 2019). The sectorial breakdowns are actually quite consistent by the

income levels, with more transport investment in lower middle-income countries (though still less than the energy sector). PPI in the energy sector covers electricity generation, transmission, and distribution, as well as natural gas transmission and distribution. Recently, renewable energy projects have been growing fast, but the scale of these projects tends to be smaller than conventional power projects. They are interesting to investors as part of larger, and conscious, shifts by some Global South countries toward lower-carbon sources of energy.

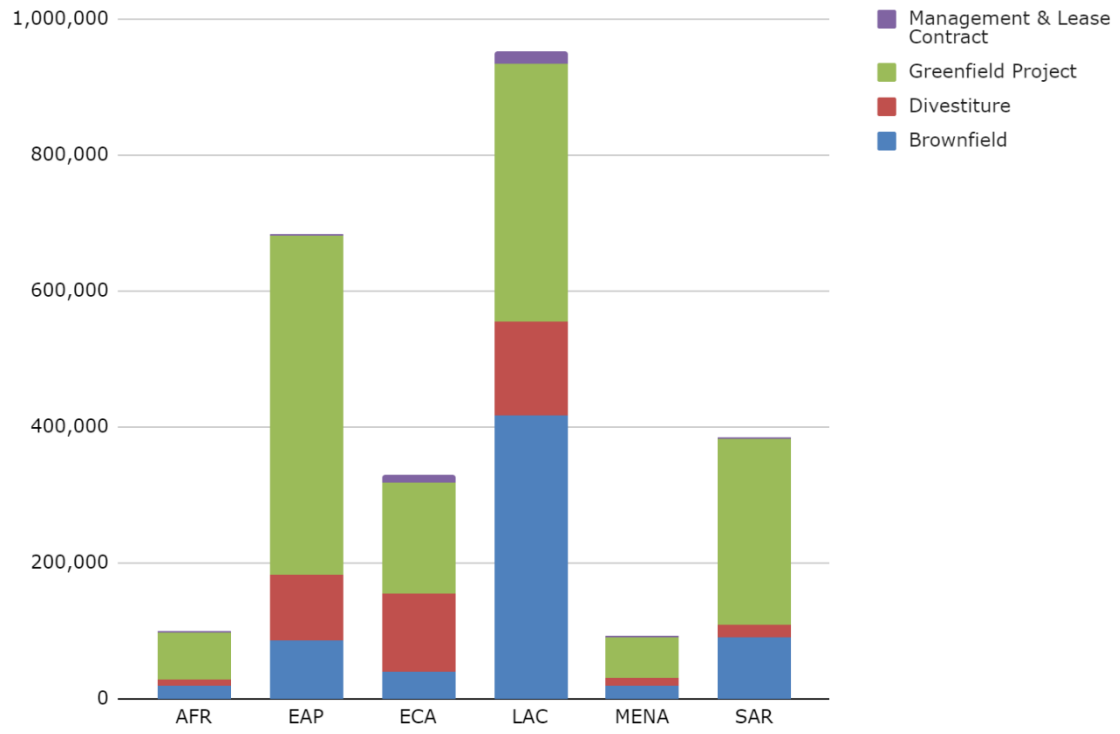
Figure 2. Sectoral Distribution of PPI by Region, 1990-2020 (US$Million at 2010 constant price)



Source: Own analysis and conversation to 2010 constant price, based on World Bank PPI Database (http://ppi.worldbank.org/).

Notes: AFR = Sub-Saharan Africa, EAP = East Asia and Pacific, ECA = Europe and Central Asia, LAC = Latin America and Caribbean, MENA = Middle East and North Africa, and SAR = South Asia.

Figure 3. Distribution of Four PPI Forms by Region, 1990-2020 (US$Million at 2010 constant price)



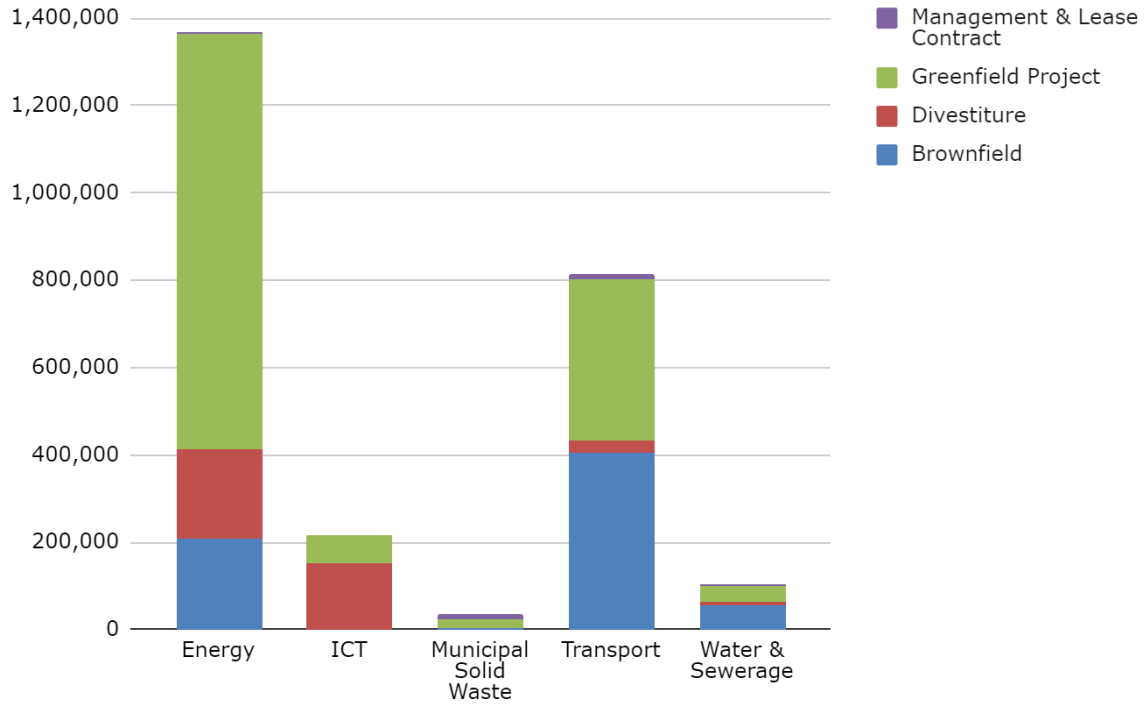
Source: Own analysis and conversation to 2010 constant price, based on World Bank PPI Database (http://ppi.worldbank.org/).

Notes: AFR = Sub-Saharan Africa, EAP = East Asia and Pacific, ECA = Europe and Central Asia, LAC = Latin America and Caribbean, MENA = Middle East and North Africa, and SAR = South Asia.

There is a clear dominance of greenfield projects, which accounts for about 57 percent of all PPI. EAP, SAR and AFR regions in particular, at about 73, 72 and 69 percent respectively (Figure 3). Equally pronounced, greenfield makes up 72 percent of all PPI in low-income countries, close to 70 percent in lower middle-income countries, and 51 percent in upper middle-income countries. In the energy sector, this share is also high, at 70 percent (Figure 4). Such projects take place in the form of BOT (build-own-transfer), BLT (build-lease-transfer), or BOO (build-own-operate). A private entity or a public-private joint venture builds and operates a new facility for the period

specified in the project contract. The private entity also takes on much of the financial and operational risk, and recoups its investments through the life of the project. In contrast, PPI in the water and sewerage sector is predominantly brownfield projects: the private entity takes over an existing facility and usually makes an improvement to it or expands it. Often a take-over of existing operations precedes the capital investment.

Figure 4. Types of PPI by Infrastructure Sector, 1990-2020 (US$Million at 2010 constant price)



Source: Own analysis and conversation to 2010 constant price, based on World Bank PPI Database (http://ppi.worldbank.org/).

Notes: AFR = Sub-Saharan Africa, EAP = East Asia and Pacific, ECA = Europe and Central Asia, LAC = Latin America and Caribbean, MENA = Middle East and North Africa, and SAR = South Asia.

The fact that two sectors – water & sewerage and municipal solid waste – have received much smaller volume of PPI than the others is largely due to the small project size on average. The water & sewerage sector, however, looks particularly promising for private investors. Across the

Global South, low sewerage coverage, inadequate treatment facilities, and low water discharge fees all have contributed to contaminated groundwater and polluted surface water. Multinational providers (e.g., Suez and Veolia) have gone into water production and distribution services, as well as wastewater treatment plants, based on the recent experience of China (Wu 2015). In some ways, sewerage is a more viable sector for investment than highways, given that demand will not fluctuate and will only increase as quality of life improves.

Untangling the Public-private Paradox

What macro or country-level factors may underscore the magnitude of infrastructure investment by either the public sector or private investment? A proper response entails systematic data that remain elusive. In this analysis, I have constructed a unique dataset on infrastructure investment, drawing from the World Bank PPI database and data available through the International Transport Forum (ITF). ITF is an intergovernmental organization with 59 member countries. Countries report total public and private investment together in the transport sector (ITF 2018). Regressing on investment volumes in select Global South countries is based on conceptual underpinnings discussed below.

There are some commonalities among PPI in the Global South that distinguish them from industrialized countries. Among them are barriers that prevent these countries from attracting private investment. Barriers that are more common than among developed countries are volatile currencies, weak financial institutions, and weak regulation (Allayannis and Weston 2000, Banerjee et al. 2006, Estache 2006, Pesso 2010, Sharma 2013). A fundamental driver of many barriers is the overarching fact that each country is unique politically, legally, bureaucratically, culturally and financially. This requires the development of expertise on the lay of the land in a given country, either by the investor in-house or by an outside investment manager. Countries

with opaque processes and risk-inducing institutions will necessarily require investors to expend greater expense and effort to acquire this information (Bachher and Monk 2013). Furthermore, the importance of institutional quality seems favorable, in that less corruption and effective rule of law are positively associated with the magnitude of PPI (Hammami et al. 2006, Sharma 2012).

Public risk is related to the role of the state in private investment (Grimsey and Lewis 2002, Ng and Loosemore 2007). It can arise from the status of regulation or from political issues. Regulatory risk depends upon the legal solidity, financial strength, and autonomy of the regulator (Sirtaine et al. 2005). If the government is unsupportive, or if it is liable to legal challenges, risk might increase (Grimsey and Lewis 2002). Various surveys have shown that investors consider unstable regulatory environments or weak rule of law as some of the main concerns when investing in infrastructure (OECD 2011, Probitas Partners 2013). For example, Walsh, Park and Yu (2011) have found that while judicial and legal reforms in Brazil were making PPPs easier to enter into, constitutional barriers, bureaucratic ignorance and political resistance remained, resulting in a far slower uptake of PPPs than was initially hoped for. Even with good regulatory frameworks, risk can be high if there is not enough commitment from the government to comply with regulations and ensure stability (Banerjee et al. 2006). For instance, the cancellation or considerable modification of a government procurement process can increase risk (Partners Group 2013, WEF 2014a). Other commonly perceived threats are danger of expropriation, the potential effects of the unpopularity of having public services produce high returns for private firms, and breach of contract.

Investments also carry financial risks. Volatile currencies can increase risk, especially when foreign capital represents a high proportion of the investment (Partners Group 2013, Sharma 2012). Other issues leading to increased risk are a higher than average inflation rate that can

translate into credit risk to lenders (Dailami and Leipziger 1998, Rao 2018) and a lack of well-functioning capital markets (Banerjee et al. 2006). Economic aspects can impact risk too. For instance, economic instability – for which inflation serves as a proxy – can increase risk by making it more difficult to estimate future demand (PPIAF 2014, Sharma 2012). Country wealth is also related to risk. Estache has found that poorer countries tend to present higher risk premiums, even when controlling for other factors (Estache 2005). Unsurprisingly, there is evidence that private investment tends to be more common in countries where market size and potential for risk diversification are large (Rao 2018, Trebilcock and Rosenstock 2015). External debt can be an indicator for soft budget constraint – providing little motivation to engage private investors – and therefore is expected to have negative effect on PPI (Sharma 2012), though there is no consensus on this nexus as Hammami et al. (2006) suggest an opposite direction. All of these factors speak to the fundamental concern of risk, and at some point, the relatively high level of risk, or inability to even adequately determine risk, will scare away investors.

A different take on the infrastructure investment gap posits that much of the world's infrastructure could in fact have its useful life prolonged considerably with better operations and management, thereby preventing the need for at least some of the anticipated investment called for in the future (WEF 2014b). This view suggests that governments are neglecting their current assets, failing to utilize existing infrastructure to the maximum potential while incurring needless costs. Furthermore, political bias leans in the direction of greenfield infrastructure that has high visibility and the potential to garner votes; brownfield infrastructure, on the other hand, requires longer-term efforts than that of shorter-term political cycles.

Regression Analysis

In light of the conceptual underpinnings discussed above and the availability of consistent data over time, a set of macro factors are used as predictors in estimating the private and total investment through two OLS (ordinary least squares) models (see Tables 2). The first group of predictors include global rankings (percentiles) in government effectiveness, control of corruption, political stability, and regulatory quality. In addition, the presence of anti-corruption campaign is constructed as dummy variable. The second group of predictors are proxies for measuring macroeconomic stability (GDP deflator), market size and potential for risk diversification by investors (GDP per capita), and the presence of soft budget constraint (external debt stock and total debt service).

Two dependent variables are constructed from the World Bank PPI dataset and ITF transport investment data (total of public and private investment). Both sources report transport projects in a consistent set of areas, including airport runways and terminals; railways (including fixed assets, freight, intercity passenger, and local passenger); toll roads, bridges, highways, and tunnels; and port infrastructure, superstructures, terminals, and channels. Investment volumes are converted into US$ at 2010 constant price, and ITF data from Euro to US$ first. Given the scarcity of public investment data, the transport sector reported by ITF offers the best option.

Only 13 countries, all of which are upper middle-income, are covered in both data sources for between 2001 and 2020. They are Albania, Armenia, Belarus, Bulgaria, China, Georgia, India, Mexico, Moldova, North Macedonia, Russian Federation, Serbia, and Turkey. While small in number, these countries represent some of the most active markets receiving PPI (China, India, Mexico, Russia, and Turkey). In either source, not all of these countries have data for every year from 2001 and 2020. To overcome this spottiness, 5-year sums are calculated for four time

periods: 2001-2005, 2006-2010, 2011-2015, and 2016-2020. Even so, a few countries have only one or two data points each. A total of 30 observations are eventually included in the OLS regression analysis. For the predictors, values in the first year of each 5-year time period are used.

Given the data construction for both the independent variables, their values show a wide spread (see Table 3), aside from the effect caused by country size and development level. To improve the fit of the regression models, three variables – total PPI and ITF investments and per capita GDP – are log transformed so that their distributions resemble more normally-shaped bell curves. In addition, the worldwide rankings for the first group of predictors have been converted to percentiles within the group of 30 observations (see Table 3).

Table 2. Variable Description and Data Source

Variable	Description	Theorized direction of effect	Data source
Predictors (Included in regression models)			
Government effectiveness rank (percentile)	capturing perceptions of quality of public services, quality of civil service and degree of its independence from political pressures, quality of policy formulation and implementation, and credibility of government's commitment to such policies	+	World Governance Indicators, World Bank
Control of corruption rank (percentile)	capturing perceptions of extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of state by elites and private interests.	+	World Governance Indicators, World Bank
External debt stock (% of GNI)	as proxy for presence of soft budget constraint	–	World Development Indicators, World Bank
Inflation, GDP deflator (annual %)	as indicator of macroeconomic stability	–	World Development Indicators, World Bank

Log_GDP per capita, PPP (constant 2017 US$)	as proxy to measure both market size and potential for risk diversification by investors	+	World Development Indicators, World Bank
Predictors (Not included in regression models because of multicollinearity or lack of correlation)			
Political stability rank (percentile)	measuring perceptions of likelihood of political instability and/or politically motivated violence, including terrorism	+	World Governance Indicators, World Bank
Regulatory quality rank (percentile)	capturing perceptions of government's ability to formulate and implement sound policies and regulations that permit and promote private sector development	+	World Governance Indicators, World Bank
Anti-corruption campaign (dummy)	presence of anti-corruption campaign during four time periods	+	Desktop compilation of web reporting
Total debt service (% of export)	as proxy for presence of soft budget constraint	−	World Development Indicators, World Bank
Dependent variables			
Log_ITF_Sum (US$ million in 2010 constant price)	total of public and private investment in transport sector		IFT Transport infrastructure investment and maintenance spending
Log_PPI_Sum (US$ million in 2010 constant price)	proxy to measure private investment in transport sector, as PPI projects are not exclusively funded by private sources		World Bank PPI data, excluding cancelled projects

Table 3. Descriptive Statistics of Variables

Variable	*Mean*	*Standard deviation*
PPI_Sum (US$ million in 2010 constant price)	10,793,264,999	17,252,597,353
ITF_Sum (US$ million in 2010 constant price)	327,425,178,477	975,575,189,691
Log_PPI_Sum	9.20	1.1557
Log_ITF_Sum	10.18	1.1446
External debt stock (% of GNI)	42.96	23.2532
Total debt service (% of exports)	16.59	10.6174
Inflation, GDP deflator (annual %)	9.62	10.4916
GDP per capita, PPP (constant 2017 US$)	14304	6359
Log_GDP per capita, PPP (constant 2017 US$)	4.10	0.2281
Anti-corruption campaign (dummy)	0.40	0.4983
Worldwide ranking		
Political stability (percentile)	30.55	15.5366
Government effectiveness (percentile)	48.93	13.7348
Regulatory quality (percentile)	50.77	14.1007
Control of corruption (percentile)	38.67	12.9805
Within-group ranking		
Political stability (percentile)	50.00	28.3982
Government effectiveness (percentile)	50.00	28.3956
Regulatory quality (percentile)	50.00	28.3961
Control of corruption (percentile)	50.00	28.3974

The OLS models are run with simultaneous entry, not stepwise procedures, because the latter tends to capitalize on random variations in the data. There is no problem of multicollinearity in the models since no variables display tolerance levels of less than 0.2 (see Tables 4 and 5). Initially, other predictors also were considered, including political stability rank, regulatory quality rank, presence of anti-corruption campaign, and total debt service. They are not part of the regression analysis eventually because of multicollinearity issues, except for the anti-corruption campaign dummy variable that lacks correlation with either dependent variable. As regression coefficients are unit dependent, my discussion focuses on standardized coefficients in assessing the extent to which each predictor is influential.

Table 4. Regressions on Stock of PPI (Log_PPI_Sum)

	Standardized Coefficients	*t-value*	*Significance*	*Tolerance*
(Constant)		2.388	0.025	
Government effectiveness rank (w/in group percentile)	0.396	2.239	0.035*	0.568
Control of corruption rank (w/in group percentile)	-0.048	-0.281	0.781	0.606
External debt stock (% of GNI)	-0.601	-4.145	0.001***	0.848
Inflation, GDP deflator (annual %)	0.054	0.391	0.699	0.922
Log_GDP per capita, PPP (constant 2017 US$)	0.142	1.008	0.324	0.894
Adjusted R^2	**0.484**			

The two models have produced consistent results, one on stock of PPI and another on stock of all investment in their log transformations. As discussed earlier in the paper, PPI projects often are not exclusively funded by private investment. But dissecting the private and public components of PPI data for over a period of 20 years is beyond the capacity of individuals – in fact, this is yet to be attempted at all. Thus, it's prudent to consider PPI as a proxy to measure private investment (see Table 2). In addition, all included countries belong to the upper middle-income category, essentially controlling the wealth factor. Using GDP per capita in the regression models also controls for market size and hence customers' purchasing power, all predictors recognized in the literature (Hammami et al. 2006, Sharma 2012). As such, the analysis can focus on structural factors.

One single most important and significant predictor is the variable government effectiveness rank, in a positive direction of influence. This variable captures perceptions of the quality of public services, quality of civil service and degree of its independence from political pressures, quality of policy formulation and implementation, and credibility of government's commitment to such policies. This result suggests that private investment, albeit in transport sector only in this analysis, is more prevalent in countries with accountable governments that provide higher quality

of public services and better effectiveness in policy implementation. The strong impact of the governance factor is echoed in another major study (Sharma 2012), while Hammami et al. point to a minimal role (2006).

Table 5. Regressions on Stock of Total Investment (Log_ITF_Sum)

	Standardized Coefficients	***t-value***	***Significance***	***Tolerance***
(Constant)		2.420	0.023	
Government effectiveness rank (w/in group percentile)	0.496	2.936	0.007**	0.568
Control of corruption rank (w/in group percentile)	-0.209	-1.275	0.214	0.606
External debt stock (% of GNI)	-0.555	-4.008	0.001***	0.848
Inflation, GDP deflator (annual %)	0.138	1.042	0.308	0.922
Log_GDP per capita, PPP (constant 2017 US$)	0.202	1.495	0.148	0.894
Adjusted R^2	**0.529**			

Another significant predictor is the variable external debt stock, measured as percentage of gross national income. This serves as a proxy to indicate the extent of soft budget constraints. Two schools of thought are present in the literature: one asserts PPI tends to be more common in countries with heavy debt burden as it allows the governments to consider projects otherwise unaffordable (Hammami et al. 2006), while the other finds no significant evidence to support the claim (Sharma 2012). My analysis is in agreement with the latter and further indicates a negative impact of debt burden. Back to the aforementioned finding from the World Bank study (2019) that in ten countries private investment eclipsed the public sector in 2017, a common problem plaguing heavily-indebted poor countries relates to the inability of their over-stretched public finances to support large infrastructure investment.

The fact that a consistent set of factors underscore the magnitude of both PPI and overall infrastructure investment also can serve as evidence of no effect of crowding out private interest by public funding. In contrary, it points to a virtuous cycle in which government support for the

infrastructure sector may be attractive to private investors. A key bottleneck for infrastructure development is not always capital, but a lack of viable pipeline of projects attractive to institutional investors (Wu 2015). Creating a viable pipeline of projects is fundamentally the responsibility of governments, drawing investments by demonstrating successful project implementation as well as the likelihood that the development of local expertise will pay off with future opportunities (WEF 2014a).

Private and institutional investors are more interested in a comprehensive set of opportunities than ad hoc projects, i.e. repeat opportunities instead of one-off. One way to achieve this is through the establishment of intermediaries. The basic idea is for a government entity or development bank to act as a lead investor, perhaps working in partnership with one or two other institutions, and set up a fund with professional management for private investors to invest in (WEF 2014a, Wu 2015). In essence, the intermediary would bridge the 'investibility gap' by assuming key functions. For instance, Brazil's BNDES (Brazilian Development Bank) provided loan guarantees, securities underwriting, and bond purchases, in addition to being a primary lender of long-term capital.

Conclusion

Across the Global South, the investment gap remains large in infrastructure. While the tides of private participation have seen upswings since the 1990s, matching country demand with investors has been elusive at best. Aside from a handful of emerging economies, PPI has largely taken place in OECD countries. When PPI is occurring in Global South countries, it shows a strong concentration in greenfield projects, particularly in low-income and lower middle-income countries. Among the infrastructure sectors, energy PPI has the highest concentration of greenfield investment.

Two world regions, Latin America and the Caribbean (LAC), and East Asia and the Pacific (EAP), have captured the majority of PPI. In particular, EAP region also has sustained volumes over time, unaffected by the downward trend since 2015 that plagues other regions. Secondary evidence confirms that this stems from the institutional sophistication in select countries in the two regions. Involving the private sector in partnerships requires first the modification of rules inhibiting private provision in the first place. While the experience of Chile reflects the importance of an effective legal and policy framework, the cautionary tale associated with the limited success of China in attracting PPI points to other macro factors at work.

On the side of investors, there is a prevailing concern that public finance of infrastructure tends to crowd out private investment. For instance, investors do not see a lot of value in putting funds into infrastructure in China because of so much money already coming from within the country's public coffer (which also lowers the returns). But the analysis in this research provides some evidence that this concern may not have materialized in a range of Global South countries. A consistent set of macro factors serve as predictors for the magnitude of both PPI and overall infrastructure investment, based on results from two regression models.

The results of this research further underscore the critical role of governance. Its significant effect goes hand in hand with controlling external debts. Together, they account for around half of the variance in both PPI and total investment. Global South countries with macroeconomic stability and effective public services attract more investment through PPI. This is sensible as both factors reduce the risk of infrastructure ventures, and likely indicate longer-term, positive economic prospects. The latter bodes well for countries as investors favor a comprehensive set and repeat opportunities. Practically, creating integrated project pipelines is a function that can be assumed by a government entity or development bank by being the lead investor and pulling

dispersed projects. This intermediary role is a concrete example of how public investment can be complementary of PPI, instead of crowding out.

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