

Chapter 10

Financing Infrastructure

Justin Yifu Lin and Yan Wang

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Chapter 10

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The world is committed to achieving the 17 Sustainable Development Goals (SDGs) by 2030. Nearly 3 years since the onset of the coronavirus disease (COVID-19) pandemic and amid the ongoing war in Ukraine, the repercussions of both crises – disruptions to supply chains and regrouping of countries – are in evidence around the world. The fallout is exacerbating a large divergence in development due to the uneven recovery from the health crisis, looming stagflation, and the global climate crisis. In the longer term, the outlook for emerging market and developing countries (EMDCs) remains dampened by the lasting legacies of the pandemic – the erosion of skills from lost work and schooling, a sharp drop in investment, higher debt burdens, and greater financial vulnerability. Progress in achieving the SDGs has been derailed in many countries.

Economic development is a process of structural transformation, and infrastructure is essential for facilitating this transformation. This paper attempts to address the issues of how to overcome inadequate financing for infrastructure and what resources and institutions should be relied on in the post-pandemic era. Section 1, drawing on the conceptual framework of new structural economics, highlights the importance of development starting at home, i.e., based on a country's endowments and comparative advantages. Section 2 discusses the critical role of infrastructure for development. Section 3 addresses the challenges of building new and green infrastructure, new sources for infrastructure financing, multilateralism and coordination, the role of patient capital (or ultra-long-term capital), new national and development banks and funds, and new instruments such as real estate investment trusts (REITs). Section 4 concludes with proposals.

1. Infrastructure and Structural Transformation

Modern economic development, featuring a constant increase in productivity and per capita income, is a process of continuous structural transformation, including the upgrade of industries from traditional agriculture to manufacturing and further to services (Kuznets, 1966). In the process, both infrastructure and institutions require improvements in line with the needs of industry to make the application of specific technology feasible and to reduce the transaction costs of organising the production and market exchange (Lin, 2011). Developing countries have the potential to grow faster than developed countries due to the advantages of backwardness (Gerschenkron, 1962).

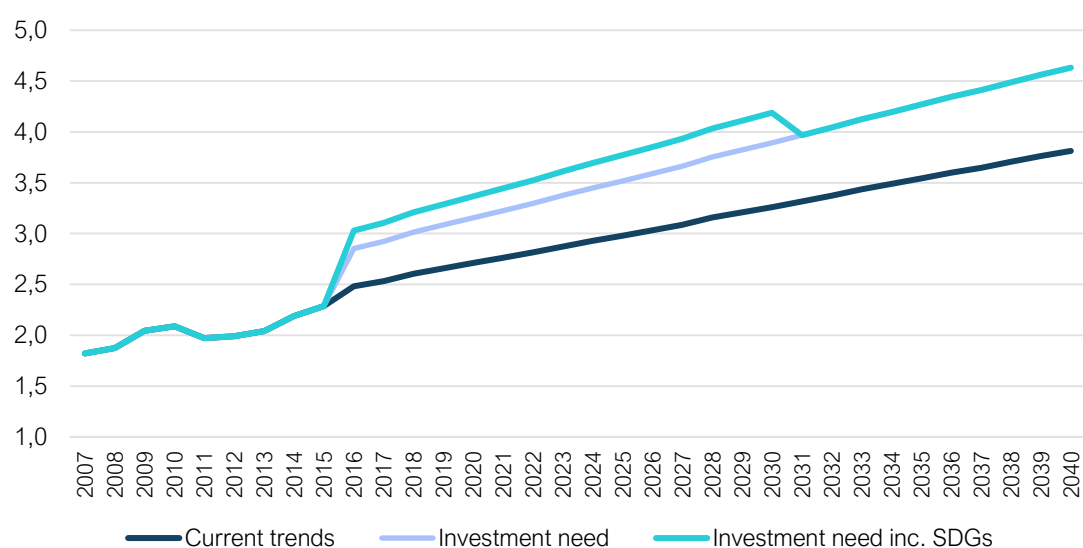
Irrespective of the development stage, each country has comparative advantages in certain sectors. The failure of development in a country is most likely caused by bottlenecks in soft and hard infrastructure, whereby a country's comparative advantages remain in a latent state and its enterprises fail to be competitive in the domestic and international markets due to high transaction costs. If development assistance is used to help remove the infrastructure bottlenecks of structural transformation in developing countries, the recipient countries should be able to tap into the potential of advantages of backwardness, grow faster than developed countries, and provide the material conditions to achieve many of the SDGs. Otherwise, the assistance will not be effective despite the best intentions of the partner country or institutions. Most development assistance to developing countries from multilateral and bilateral development institutions is used for humanitarian purposes (e.g., health and education) and improvements in governance (e.g., transparency, law, democracy, and the business environment). Such projects fall largely into the category of improving soft infrastructure. The hard infrastructure bottleneck remains the major obstacle to development in developing countries.

Infrastructure investment is necessary for a country to diversify and upgrade its industries. Empirical studies have shown that there is a great need for infrastructure investment, and that public investment multipliers in low initial public capital countries are significantly higher than in high initial public capital countries (ADB, 2017; Fay et al., 2019; Izquierdo et al., 2019).

Figure 10.1 shows a projection that global infrastructure investment needs will reach US\$94 trillion by 2040 to keep pace with profound economic and demographic changes and to close infrastructure gaps. It also forecasts a global infrastructure investment gap of about US\$15 trillion, which is equal to a 16% infrastructure investment deficit. In addition, to achieve universal household access to drinking water and electricity in line with the SDGs, a further US\$3.5 trillion is needed, widening the gap to about US\$18 trillion. Closing the global investment gap will require annual infrastructure investment to increase from the current level of 3.0% of global GDP to 3.5%. Meeting the SDGs will require this to increase further to 3.7% by 2030.¹

¹ Previous studies by other sources show similar magnitudes to the Global Infrastructure Hub estimates. For example, the Asian Development Bank estimates infrastructure investment needs during 2016–2030 to total US\$26 trillion (in 2015 prices) or US\$1.7 trillion per year in 25 selected economies and subregions of Asia (ADB, 2017). The African Development Bank estimates the continent's infrastructure needs to total US\$130 billion–US\$170 billion per year, with a financing gap of US\$68 billion–US\$108 billion (AfDB, 2018). The Inter-American Development Bank calculates an infrastructure financing gap of US\$150 billion per year in Latin America and the Caribbean.

Figure 10.1: Global Infrastructure Needs, 2007–2040



SDG = Sustainable Development Goal.
Source: Global Infrastructure Hub, 2018.

Table 10.1: Infrastructure Investment Gap, 2016–2040 (US\$ trillion)

Scenario	Asia	Europe	Americas	Africa	Oceania
Gap without meeting the SDGs	4.6	2.0	6.5	1.7	0.2
Additional investments needed to meet the SDGs	1.6	<0.1	0.3	1.6	<0.1
Gap including meeting the SDGs	6.1	2.0	6.8	3.3	0.2
% change in gap	34%	1%	5%	97%	6%

SDG = Sustainable Development Goal.
Source: Global Infrastructure Hub (2018).

The financing gap may have been widened further due to below-average growth stemming from three crises of the Financial Crisis in 1997–1988, the Global Financial Crisis (GFC) in 2008–2009, and the current economic crisis in 2019–2021 due to COVID-19, and the predominance of short-term thinking from creditors' points of view (Table 10.1).

2. Infrastructure: Core Capital for Facilitating Development

Infrastructure is essential for people's lives operation of the economy, and facilitation of structural transformation. In addition, critical public assets have intrinsic value to country or sovereign stakeholders. Mazzucato (2018) argues that value is "in the eye of the beholder", and stakeholder values are often higher than or deviate from the shareholder value". Infrastructure in operation not only generates cash flow and jobs but should also be able to leverage public and private

investment, just like the equity capital of a firm in an initial public offering. ‘Capital begets more capital’ has been supported by previous studies.²

The role of government in creating value by building infrastructure has often been neglected. For instance, as voices from the Global South have increasingly lamented, evaluations of debt sustainability – such as the International Monetary Fund–World Bank Debt Sustainability Framework for Low-Income Countries (IMF, n.d.) – have tended to focus narrowly on liabilities, without taking adequate account of the asset side of the public sector balance sheet. They have given too much weight to foreign exchange reserves and other liquid cash flows, from the angle of creditors seeking repayment, but not much weight to fixed public assets as indispensable assets for people’s livelihoods and development.

Blanchard (2022:8) argues that, theoretically, “Debt becomes unsafe when there is a non-negligible risk that, under existing and likely future policies, the ratio of debt to GDP will steadily increase, leading to default at some point”. And there is no magic number or one-size-fits-all threshold. The time has come to reform the Debt Sustainability Framework to distinguish between debt due to effective (not wasteful) infrastructure investment and debt due to financing government consumption and pensions. It is time to incorporate considerations for public assets and liabilities, using public sector net worth as a comprehensive measure for debt sustainability.

Further, the rate of economic growth depends on whether the infrastructure bottleneck for industrial upgrading and technological innovation is eliminated (Annex). While GDP indicates how much monetary income or output a country produces in a year, wealth also covers the value of the underlying national assets, including the natural endowments, produced capital, and infrastructure that form or unleash a country’s comparative advantages. As such, asset mapping and wealth accounting provide essential insights into a country’s prospects for maintaining and increasing its income over the long term.

3. Infrastructure Financing and the New Instruments

Infrastructure projects are usually lumpy, risky, and long-term; and require a large amount of financing. They have a huge environmental impact, and take a long time, sometimes several decades, to see returns. We support all the calls for international coordination for building more and better infrastructure, especially those in the past 2 years. In addition, we would like to make these recommendations.

3.1 Building digital and low-carbon infrastructure for resilience and sustainability

In light of the heightened risks of climate change and extreme weather in the post-pandemic era, when the development priority shifts from the containment of COVID-19 to sustainable development, the nature of infrastructure itself must be transformed to focus more on low-carbon and green infrastructure. This infrastructure must be consistent with the Paris Agreement and

² For instance, Thomas Piketty’s *Capital in the 21st Century* cogently illustrates this point using massive tax return-based data sets (Piketty, 2014).

nationally determined contributions (NDCs). It should focus on agriculture, rural development, regional connectivity, and risk mitigation for climate change. Policymakers should rethink their plans for infrastructure, prioritising resilience, and risk mitigation.

In addition, the G20 should call for building high-quality ‘smart, digital, and innovative’ infrastructure, and age-ready cities (Das et al., 2022). The new infrastructure should not only meet basic needs, but also serve as the digital basis for technology advancement in industry, as well as the needs of a rapidly ageing population. Building new infrastructure has recently become a top development priority for all countries – industrialised as well as EMDCs.

3.2 Financing challenges and new sources of finance

Building new and green infrastructure will be expensive and require a large amount of financing. But some of the new and low-carbon infrastructures can be profitable and can be financed by green finance funds, sovereign wealth funds (SWFs), and the private sector via public–private partnerships (PPPs). It is critical to engage more actors, including the private sector, bilateral development agencies, and multilateral development banks (MDBs), with a view to blended financing. Given the long-term nature of the investments needed, all participants need to embrace the concept of patient capital (Lin and Wang, 2017b; Kaplan, 2021). Real patient capital is hard to come by: the limited amount comes from MDBs, regional and national development banks, SWFs, public wealth funds (PWFs), and state-sponsored green investment funds.

Too little attention has been paid to public assets financed and constructed by other countries’ infrastructure investments jointly with host countries. Infrastructure projects completed under bilateral and South–South cooperation form part of the host countries’ public assets and generate huge externalities that benefit all other sectors and investors (Wang and Xu, 2022). Connectivity has been created across the region and between the region and the rest of the world. In the meantime, these infrastructure investments have increased local employment and reduced illegal immigration to developed countries.

Given the high debt levels, many governments have to make more out of less and use more PPPs and equity investments. They should focus on *bottleneck-releasing infrastructure investments* that maximise economic returns and generate user fees. If debt-financed infrastructure investments are solely repaid through additional tax revenues generated by these investments, amortisation of the investments is likely to be prolonged, even if the growth impact is high. Therefore, governments should seek to implement innovative financing mechanisms using public sector resources to leverage long-term private sector financing.

3.3 ‘Going beyond aid’ and moving from debt to equity

In *Going Beyond Aid* (Lin and Wang, 2017a), we proposed broadening the definitions of development finance (DF). The Organisation for Economic Co-operation and Development–Development Assistance Committee (OECD–DAC) definitions of official development assistance (ODA) and other official flows (OOFs) are a good starting point, but they need to be reformed to clarify and take into account all forms of finance aimed at supporting development. For monetary policy instruments, there are M0, M1, M2, and M3. In development finance, we can define DF1, DF2, DF3, and DF4 similarly (see below), according to the extent of ‘concessionality’ with a

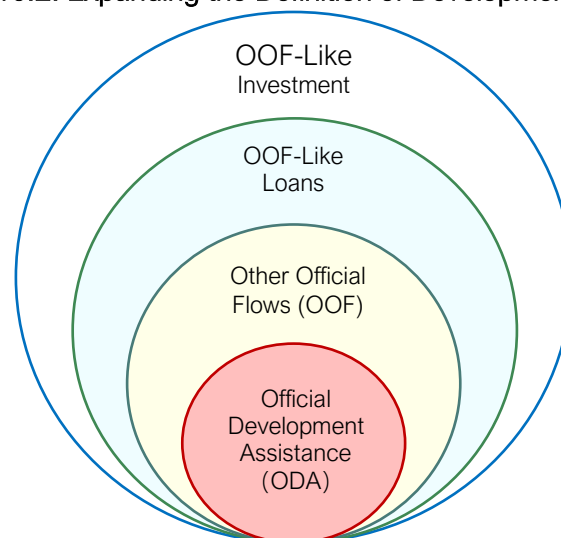
consistent benchmark market interest rate; the source (the extent of 'official' or state involvement); the destination countries (low- or middle-income developing countries); and the objectives of the financing (for economic development and welfare).

A new set of clearer definitions would facilitate transparency, accountability, and selectivity by development partners; encourage SWFs to invest in developing countries; and facilitate PPPs in developing country infrastructure.

We propose redefining development finance in the following ways (Figure 10.2):

- DF1 = ODA (as defined by the OECD–DAC, with reforms dated in 2014 and implemented in 2018).³
- DF2 = DF1+OOF, including preferential export credit.
- DF3 = DF2+OOF-like loans (non-concessional loans from state entities for development but at market interest rates).
- DF4 = DF3+OOF-like investment (equity investments by SWFs, PWFs, or development projects supported by state guarantees, or PPP projects for public infrastructure, which provide global public goods for sustainable development). The latter concept would be consistent with but different from and broader than the Total Official Support for Sustainable Development proposed by the OECD–DAC (OECD, n.d.-b).

Figure 10.2: Expanding the Definition of Development Finance



Note: The circles correspond to DF1 = ODA; DF2 = ODA+OOF; DF3 = DF2+OOF-like loans; and DF4 = DF3+OOF-like investment.

Source: Authors.

Most infrastructure finance is from the tax revenue of each EMDC, as shown by Fay et al. (2019). The amount of net ODA (or DF1 in Figure 10.2) is quite small (around US\$160 billion (OECD, n.d.-a) annually in recent years) – mainly used in humanitarian aid and not large enough for

³ For the OECD–DAC definition of ODA, see OECD (n.d.-b).

infrastructure projects. The OOFs (DF2) only included preferential export credits, usually for equipment and machinery imports. International infrastructure finance mainly relies on OOF-like loans (DF3) from MDBs and national development banks (NDBs) that can issue large and long-term loans, which are less concessional, often at market interest rates; and OOF-like investment (DF4), including equity capital for the early stages of infrastructure projects, to leverage private funds in PPP projects.

Previous studies have provided various estimates of G20 financing flows for sustainable infrastructure that approximate DF3 and DF4. For example, a study led by the Brookings Institution and Boston University Global Development Policy Center (Bhattacharya et al., 2019) estimated that G20 foreign direct investment flows and development finance institution flows from MDBs and NDBs to EMDCs from 2011 to 2017 for sustainable infrastructure were just over US\$1 trillion – or US\$154.8 billion per year (Table 10.2). The World Bank estimated that EMDCs need to invest (or receive investments) of roughly US\$15 trillion–US\$27 trillion per year for infrastructure from 2015 to 2030 to achieve the SDGs and meet the 2°C climate change target (Rozenberg and Fay, 2019). As a share of that estimate, the annual amount of US\$154.8 billion is just 7.4% of the midpoint of those World Bank range estimates, and just 2% of the total need estimated by the OECD and New Climate Economy (Bhattacharya et al., 2019).

Table 10.2: G20 Outflows to EMDC for Sustainable Infrastructure, 2011–2017 (US\$ billion)

Item	Total (US\$ billion)	Annual (US\$ billion)	Share of EMDC need	Share of global need
MDBs (part of DF1 & 3)	180	25.7	1.2%	0.3%
NDBs (part of DF2 & 3)	621	88.8	4.2%	1.2%
FDI (part of DF4)	282	40.3	1.9%	0.5%
Total	1,083	154.8	7.4%	2.0%

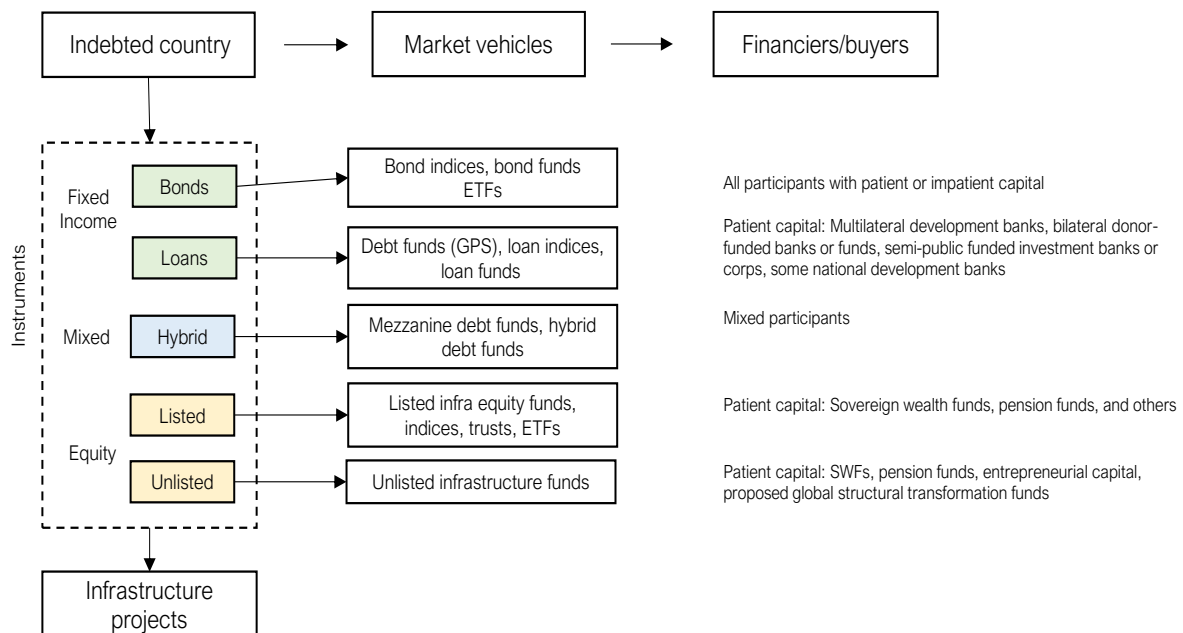
EMDC = emerging market and developing country, FDI = foreign direct investment, MDB = multilateral development bank, NDB = national development bank.

Source: Bhattacharya et al. (2019).

3.4 New financial instruments

We propose a taxonomy of innovative infrastructure financing instruments, drawing on the OECD Institutional Investors and Long-term Investment Project. The coverage of instruments is comprehensive, spanning all forms of debt and equity and risk mitigation tools deployed by governments and economic agents. Under this framework, patient capital serves as the financier of infrastructure financing instruments with a long-term horizon. Furthermore, unlisted equity-like instruments or unlisted infrastructure funds are also better suited for patient capital than short-term debt instruments for impatient capital (such as hedge funds) that can be traded frequently (OECD, 2015; Lin and Wang, 2017b).

Figure 10.3: Taxonomy of the Financial Instruments Required for Infrastructure Finance and Patient Capital



ETF = exchange traded fund, GP = general partner, SWF = sovereign wealth fund.

Source: Based on Lin and Wang (2017b) on patient capital and OECD (2015).

A global trend of moving to green financing and equity financing is emerging. One option is to set up public REITs. Such REITs provide an investment opportunity for ordinary investors to benefit from valuable real estate, access dividend-based income and total returns, and help infrastructure development. Asset owners can monetise their qualified assets by selling and listing them through REITs and reinvesting the proceeds in new projects. The spinoff (new projects) will help originators to deleverage by recouping investments and deconsolidating liabilities. Meanwhile, improved balance sheets enhance their financing capacities for new investments. This process also revitalises existing assets by unlocking their value and turning illiquid infrastructure assets into liquid REITs that can be publicly traded.

4. Proposal for International Cooperation in a Post-COVID-19 World

In view of the huge infrastructure financing gap, the post-pandemic agenda is clear: countries must build on their endowments and tackle infrastructure bottlenecks to unleash their potential for sustainable development. With an appropriate approach to policy and financing, countries can mobilise the required resources to accelerate their growth towards sustainable, resilient, and inclusive development. This section provides proposals for international cooperation in a post-COVID-19 world to move to green financing, patient capital, and equity financing.

We support previous G20 commitments on infrastructure, especially the G20 Principles for Quality Infrastructure Investment and G20 Guidelines on Quality Infrastructure for Regional Connectivity. The upcoming G20 Summit in Indonesia should make the following proposals related to infrastructure financing:

- Prioritise infrastructure that addresses country-specific bottlenecks to structural transformation and job creation, and that is consistent with a country's NDCs and plans to achieve the SDGs, with a focus on agriculture, rural development, regional connectivity, resilience, and risk mitigation for climate change. The G20 Summit should call on all partners, including the private sector, not to finance new coal-fired power plants in any part of the world.
- The infrastructure financing gap is huge, exemplified by the Global Infrastructure Hub's estimate of the US\$18 trillion gap from now to 2040. The G20 should play a leadership role in proposing new initiatives and coordinating global efforts. One possibility is to use part of the US\$650 billion special drawing rights (SDRs) to establish a global green finance fund for green infrastructure. The newly formed Resilience and Sustainability Trust at the IMF is a good step in the right direction, albeit the size is far from adequate. In our view, the SDRs are not efficiently allocated for development.
- Strengthen G20 support for multilateralism – including the existing MDBs and funds, but also newly established MDBs, i.e., the Asian Infrastructure Investment Bank and the New Development Bank. Hundreds of new development finance institutions have been established in recent years. More new development institutions, such as Green Funds and PWFs, should be encouraged and financed.
- It is high time for the G20 leaders, the IMF, MDBs, rating agencies, and development practitioners to consider that a country's key infrastructure – such as water, electricity, transportation hubs, and telecom centres – are a country's core capital, like the tier I capital in the Basel Agreement. They should be valued favourably to support the country's viability and sustainability in the longer term, as compared to countries without these key infrastructures.
- Innovation is needed for both debt relief and green transformation. To create such a virtuous cycle, creditor countries should use tailored solutions in debt-distressed countries. These could include debt-to-bond swaps and debt-to-nature swaps, as well as asset+ based refinancing (Xu et al., 2021; Gallagher and Wang, 2020; Wang and Xu, 2022). Some of these proposals involve using SDRs for debt-to-bond swaps (Xu et al., 2021). We call on international financial institutions to take more responsibility in supporting (rather than rejecting) these innovative approaches from the Global South.

To achieve the SDGs in the post-pandemic era, all countries need to know what the government owns (asset) and owes (liability), to distinguish patient capital from footloose investors, and to separate long-term (structural) and short-term (liquidity) issues. Therefore, a public asset mapping exercise could be experimented with in countries, using public sector net worth as a comprehensive measure for debt sustainability. To address the long-term structural issues,

policymakers everywhere need to work with patient capital holders such as MDBs, regional and national development banks, SWFs, PWFs, and green funds by experimenting with innovative asset+ based refinancing, REITs, and other approaches suggested above. It is essential to make a concerted effort to reinvigorate investment in both hard and soft infrastructure, expand access to vaccinations, improve digital connectivity, and invest in green infrastructure to bolster growth along a sustainable, resilient, and inclusive path for achieving the SDGs by 2030 and beyond.

Annex: How to Identify Bottlenecks⁴

To use the scarce financial resources effectively, it is essential to identify a country's infrastructure bottlenecks before the actual investment. For this purpose, we propose a method and use it to examine a panel data set of five broad indicators of infrastructure needs across all G20 and Asian developing countries from 2000 to 2017, using data sources from the World Development Indicators World Bank and GlobalEconomy.com. Our data set includes 39 countries – 16 upper middle-income countries, 19 lower middle-income countries, and 4 low-income countries. Table 10.A1 lists the countries in our data set. The following indicators are used to identify bottlenecks in infrastructure sectors: water, energy, road/rail/port transportation, telecommunications, and internet access.

Table 10.A1: Sectors and Indicators for Bottleneck Identification

Category	Indicator and Unit
Infrastructure	Infrastructure
1. Water	1. People using at least basic drinking water services (% of population), 2000–2017 (Source: World Bank World Development Indicators (WDI)).
2. Energy	2. Access to electricity (% of population), 2000–2017 (Source: WDI).
3. Road/Rail/Port/Air transportation	3. Road quality, 2006–2017; railroad infrastructure quality, 2009–2017; port infrastructure quality, 2006–2017; air transport infrastructure quality, 2006–2017, using the Borda method (Source: The Global Economy).
4. Telecommunications	4. Mobile cellular subscriptions (per 100 people), 2000–2017 (Source: WDI).
5. Internet access	5. Individuals using the internet (% of population), 2000–2017 (Source: WDI).

Source: Authors, based on the above-mentioned databases.

For each indicator and country, we first take the average value over 2000–2017 and then divide the countries into three income groups: low-income, lower middle-income, and upper middle-income. Second, for each country, we take the ranking order (percentile) of each indicator within their income group. For most of the above indicators, a higher-ranking order (percentile) indicates better access within the income group and hence a lower urgency for investment, except for the environment where a higher-ranking order (percentile) indicates worse emissions or deforestation within the income group and hence more urgency for investment.

For each country, we identify four out of five infrastructure indicators as bottlenecks. We order these bottlenecks by the level of urgency from 1 to 4. For each country, the lowest ranking

⁴ For methodology, see Lin and Wang (2017a: 124–29).

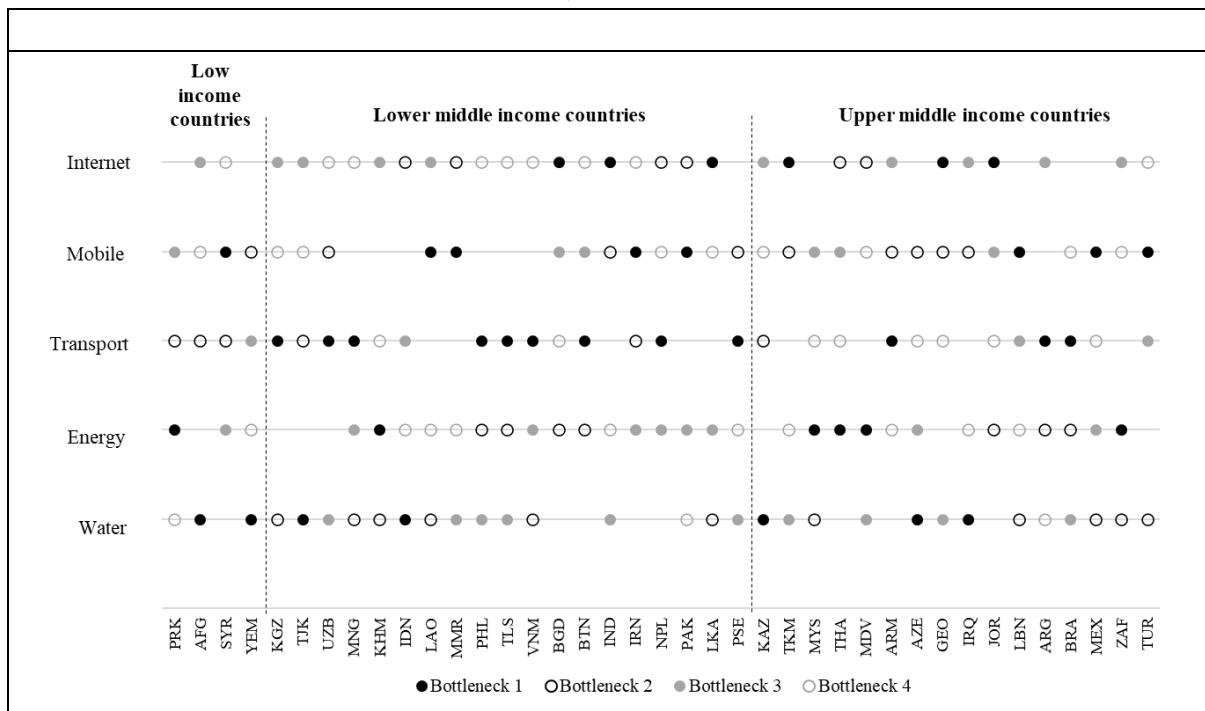
indicator within its income group is defined as ‘bottleneck 1’, i.e., the bottleneck with the greatest need, the second lowest ranking as ‘bottleneck 2’, and so on. The highest-ranking indicator for each country is not considered a bottleneck. This process can be expressed as

$$\text{Bottleneck 1 for country } i = \min(R_{i,j}), \text{ where } j = 1, \dots, 5$$

$$\text{Bottleneck 2 for country } i = \min(R_{i,-j^*}), \text{ where } j = 1, \dots, 5$$

Figure 10.A1 shows the results of the process of bottleneck identification.

Figure 10.A1: Infrastructure Bottlenecks – The G20 and Asian Developing Countries, Excluding China, 2000–2017



Note: For the methodology, see step 1 in Lin and Wang (2017a: 124–29).
 Source: Authors.

The above analysis shows that infrastructure bottlenecks are widespread, in nearly every sector of every country. In low- and lower middle-income countries, water, energy/electricity, and transport are the major bottlenecks, as bottlenecks 1 and 2, e.g., the water shortage in Afghanistan, Azerbaijan, Indonesia, Iraq, Kazakhstan, Tajikistan, and Yemen, is a number 1 priority. Energy in Cambodia, Malaysia, Maldives, Pakistan, and Thailand is urgently needed. The transport sector has been a bottleneck in lower middle-income countries such as Kyrgyzstan, Mongolia, Nepal, and Uzbekistan. Amongst upper middle-income countries, transportation problems are most apparent in Armenia, Argentina, and Brazil.

Table 10.A2: G20 and Asian Developing Countries, By Income Group

Low-income countries	Lower middle-income countries	Upper middle-income countries
Afghanistan, North Korea, Syria, Yemen	Bangladesh, Bhutan, Cambodia, India, Indonesia, Iran, Kyrgyzstan, Lao PDR, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Palestine, Tajikistan, Timor-Leste, Uzbekistan, Viet Nam	Argentina, Armenia, Azerbaijan, Brazil, China,* Georgia, Iraq, Jordan, Kazakhstan, Lebanon, Malaysia, Maldives, Mexico, South Africa, Thailand, Turkey, Turkmenistan

* China is not included in the bottleneck analysis.

Source: Authors.

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