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Chapter IV

BRIDGING GAPS OR WIDENING DIVIDES: INFRASTRUCTURE DEVELOPMENT AND STRUCTURAL TRANSFORMATION

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IV

A. Introduction

The last chapter recognized that building a digital infrastructure has to be a key part of any strategy to help developing countries grasp the benefits of emerging digital technologies. It also suggested that the strong scale and network effects exhibited by that infrastructure can give rise to economic rents and warned that leaving its provision to corporate interests rather than giving a lead role to public policy would probably skew outcomes in ways that would be neither inclusive nor sustainable, particularly in developing countries.

This concern reflects an older and wider discussion on the link between infrastructure and development. There is consensus among economists and economic historians that infrastructure has often been at the centre of the transformative shifts in the economy over the last 250 years, beginning with the canal network in Britain as its industrial revolution got under way. There is also broad agreement that many of these capital-intensive infrastructure projects – highways, airports, harbours, utility distribution systems, railways, water and sewer systems, telecommunication systems, etc. – have exhibited scale and network effects that engage both the public and private sectors in a variety of complicated financial, economic and political interactions. What is less clear is the best way to manage those interactions, the precise channels through which large infrastructure projects can help generate sustained development, whether the benefits derived match the costs incurred and, perhaps most difficult, whether those benefits and costs are shared in ways that generate inclusive outcomes.

In the face of such uncertainty, it is not surprising that numerous growth accounting exercises have failed to generate conclusive econometric results from the introduction of infrastructure variables, while myriad case studies have pointed to a disconnect between the microeconomic performance of infrastructure projects and their macroeconomic promise (see box 4.1). Nor is it surprising to find that many successful infrastructure programmes were as much the product of political ambition – "bold endeavours" as Felix Rohatyn (2009) put it – as careful public accounting and cold statistical calculation. Indeed, Albert Hirschman, in his seminal study titled *The Strategy of Economic Development* published exactly 60 years ago, was right in describing large-scale infrastructure planning as "a matter of faith in the development potential of a country or region" (1985: 84).

On that metric, the Washington Consensus, which has shaped much development policy thinking over the last 40 years, has shown little faith in the potential of developing countries. Infrastructure lending by the World Bank, which was its original rationale, dropped precipitously beginning in the 1970s, as its focus shifted to other forms of lending that concentrated on economic adjustment measures, good governance and social safety nets, rather than building infrastructure. However, this trend has been reversed in recent years (see figure 4.1).

The revival of interest in infrastructure reflects, in part, a growing acceptance in many advanced economies, since the 2008 financial crisis, given that such spending can have positive short- and long-term impacts on growth and, therefore, an important role in tackling secular stagnation (Summers, 2016). It is also a recognition of the central role that large infrastructure projects have played in the remarkable growth and poverty-reduction story that has unfolded in China. Indeed, the high ranking of China (relative to its income level) in the McKinsey Connectedness Index seems to indicate the faith placed by its leadership on infrastructure-led growth, including building a strategic advantage in the emerging digital economy

BOX 4.1 What do empirical studies tell us?

Aschauer's influential work (1989) found evidence for the widely accepted wisdom that "roads lead to prosperity" (see also Deng, 2013). Looking at the economy of the United States from 1948 to 1985, he concluded that infrastructure investments led to productivity increases, finding that a 10 per cent rise in infrastructure stock over time was associated with a 4 per cent increase in productivity. The study even showed that the converse also held: declining infrastructure investment from 1970 to 1985 was responsible for declining output per capita over the same period in the United States. These findings triggered a spurt of empirical research examining the contribution of infrastructure to growth. One strand has looked at the effects of aggregate infrastructure stocks and service flows on per capita GDP. This includes a majority of the macroeconomic studies, which look at expansion paths of per capita sectoral stocks with per capita GDP, thereby identifying countries that are outliers in terms of infrastructure investments in middle- and low-income regions (Ingram and Fay, 2008). Another strand has examined the effects of specific kinds of infrastructure interventions on growth and poverty reduction, usually focusing on particular geographical areas, enterprises or sectors (Straub, 2008).

However, there is still a lot of ambiguity on both conceptual and empirical fronts (see Estache, 2006; Estache and Garsous, 2012; Bom and Ligthart, 2014). The theoretical framework linking infrastructure and growth remains weak; and as Straub (2008) notes, a majority of the studies lack a clear hypothesis to be tested. As a result, although several studies after Aschauer (1989, 1990) focused on questioning the cause–effect relationship between infrastructure stocks and growth (see Gramlich, 1994), and the question of spurious correlations due to non-stationarity of data or missing variables (Holtz-Eakin, 1994), there is still a great deal of controversy on the direction and magnitude of the growth-enhancing effects of infrastructure (see Lakshmanan, 2011; Deng, 2013).

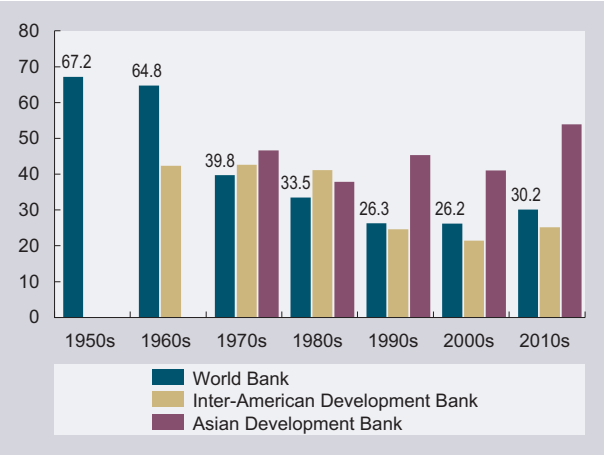
Empirically, the first critical issue is the measurement of infrastructure itself, as there continues to be no unified definition of the term (Cassis et al., 2016). Many studies measure infrastructure in terms of an investment flow or stock (public capital), or a single physical asset (Calderón and Servén, 2010; Lakshmanan, 2011; Deng, 2013), and consider the impact of one or the other kinds of infrastructure on growth (water, electricity, transport, or a combination thereof). But given that infrastructure investments are relatively heterogeneous in nature, and some forms of infrastructure (roads and telecommunications) have a greater impact on productivity than others (such as airlines), the scope of the study becomes an important issue in assessing findings and their relevance to the wider debate (Bröcker and Rietveld, 2009; Melo et al., 2013). Furthermore, macro- and microstudies often result in contradictory findings. This is because the most direct impacts of infrastructure on growth are obtained at the province or state level where network effects of infrastructure investments and indirect benefits are most evident, whereas in some cases, at the macro level expansion of infrastructure has been found to be associated with lower growth, for reasons that are not well explored.

A second issue that affects empirical comparisons relates to inadequacies in the data on infrastructure (Elburz et al., 2017). Infrastructure is a result of both public and private investment, with private investment ranging between 25 per cent to 70 per cent of total infrastructure investment in different countries. But since data on infrastructure are scant and typically do not provide a comprehensive total of private and public investments, public infrastructure is used as a proxy in a large number of studies, thereby potentially leading to undercounting of total infrastructure stocks of countries in existing empirical analyses. This problem is exacerbated by the fact that many countries have not maintained reliable public infrastructure investment figures until recently, which creates issues around comparability.

Third, infrastructure stock figures might not really convey the level of services offered, because there can be large differences between the quality and quantity of infrastructure services offered (Straub, 2008), especially in developing countries. Hence, existing estimates do not capture the efficiency of infrastructure and service quality, which is a very important determinant of growth.

In a widely accepted study, Calderón et al. (2011) estimated that a 10 per cent rise in infrastructure assets can directly account for an increase in GDP per capita of between 0.7 per cent and 1 per cent. But in general, the variability in the data used and its relevance to the central question of infrastructure's impact on growth, the model specification, the econometric methodology and the treatment of non-stationarity and causation, are all causes for inconclusive results. These data difficulties also make it hard to arrive at methodologies to compare and contrast the experiences of countries in promoting growth through increases in stock in infrastructure. Straub (2008: 22) reviewed 64 empirical studies linking infrastructure to growth to find that very few of them actually addressed the question directly and systematically.

FIGURE 4.1 Multilateral development banks: Finance for infrastructure as proportion of total banks' finance
(Percentage)



Source: UNCTAD secretariat calculations, based on banks' annual reports.
Note: Infrastructure includes energy, transportation and telecommunications. Values are averages for each decade, based on banks' annual commitments from both concessional and non-concessional windows. World Bank: includes International Bank for Reconstruction and Development and International Development Association only. Inter-American Development Bank: the 1960s are the average over 1967–1969. Asian Development Bank: based on figures available from 1971.

(Woetzel et al., 2017). Many other developing countries are keen to understand how China managed this process and to replicate its success.

Multilateral financial institutions, including new institutions from the South such as the Asian Infrastructure Investment Bank and the New Development Bank, have begun scaling up support for infrastructure investment in developing countries. There are also several international initiatives – such as the Belt and Road Initiative in China and the (much smaller) infrastructure plan for Africa from Germany – that have put infrastructure investments at their centre. Meanwhile, international institutional investors, ever on the lookout to strengthen their financial portfolios, seem keen on infrastructure as an asset class, since it offers a steady return on investment profile. All this chimes well with the 2030 Development Agenda, constructed around a series of ambitious goals and targets, which together add up to a massive infrastructure programme on a global scale; the Addis Ababa Action Agenda agreed at the Third United Nations Conference on Financing for Development in 2015, has reinforced this ambition.

But even as more resources have been made available for infrastructure projects, the scale of the financing challenge has, if anything, become more daunting. The World Bank has acknowledged this in its call to scale up efforts "from billions to trillions" to meet the 2030 Agenda and proffered a new framework to meet this challenge involving an enhanced role for the private sector through public–private partnerships, blending and de-risking techniques. This has focused the infrastructure debate on the "bankability" of projects (discussed in section D). While this focus has, no doubt, helped to raise awareness of the infrastructure challenge, it misses or, worse, sidelines, some key questions from a developing-country perspective beginning with how infrastructure can actually become a real force for structural transformation, raising productivity across sectors and activities, and creating a more virtuous development circle. Posing that question leads naturally to a series of related questions that policymakers from developing countries have begun to ask:

- How should they seek to channel new financing possibilities in the most effective and sustainable ways?
- How should they approach new initiatives coming from specific lead countries (such as the Belt and Road Initiative in China) and from regional arrangements?
- What are the important considerations to bear in mind when entering into specific financing deals for new infrastructure?
- What are the possible threats and how can they be avoided?

This chapter addresses the role of infrastructure in the process of structural transformation as its central question. It draws, in part, on the framework provided by Hirschman to make planning and programming activities more effective, in the face of the uncertainties, constraints and tensions inherent in the development process. Recognizing that development planning is a "risky business", Hirschman stressed the importance of sequencing and experimentation to establish the right balance between what was then commonly called "social overhead capital" (public infrastructure) and directly productive activities (private investment) (Hirschman, 1958: 83). Beginning from his description of development strategy as "diversified investment in the general growth of the economy rather than growth of one specific activity" (Hirschman, 1958: 85), the chapter proposes that crowding in private investment as part of an unbalanced growth strategy offers a useful framework

within which to consider infrastructure investments in many of today's developing countries (Hirschman, 1958: 93). It seeks to show how public infrastructure investments can help to break the "interlocking vicious circles" (Hirschman, 1958: 5) that impede development and to help generate the kind of linkages that are key to structural transformation.

Building such linkages is neither an automatic nor a linear process. The growth effects of infrastructure depend on where infrastructure investments take place, and how these investments are planned, executed and sequenced. The links between infrastructure and transformation are best forged when infrastructure projects are clearly designed and placed as part of a wider development strategy that recognizes and actively fosters the positive feedback loops between infrastructure, productivity and growth. Indeed, throughout history from the development of Western Europe and the United States up until the recent cases of successful industrializers of East Asia, infrastructure development has been firmly tied to broader strategic objectives and institutional changes. These experiences provide an effective counter to the bankability approach, since they show that development strategies are not best pursued through emphasis on individual projects determined solely by criteria of financial viability. The alternative requires a more holistic approach, that includes projects based on developmental criteria, and which may not be financially viable in the short run.

The chapter is organized as follows. Section B situates the discussion on infrastructure and development by tracing it historically, providing a taxonomy of different types of infrastructure and how they can contribute to a virtuous development circle in the context of unbalanced growth. Section C maps recent estimates of infrastructure needs and raises some concerns about meeting those needs primarily as a question of the bankability of projects. Section D offers some elements for planning infrastructure investments, which it sees as key to growth promotion. Section E concludes.

B. Infrastructure matters: Conceptual issues and historical lessons

Physical and social infrastructure has always been at the centre of discussions in developing countries, beginning with the crude colonial imperative of extracting and exporting natural resources at minimum cost, in the commodity-based value chains that developed during the nineteenth century. Programmes to achieve minimum standards of nutrition, health and education made a brief appearance in the interwar period as a philosophy of "colonial trusteeship" sought to deflect growing social discontent (Arndt, 1987: 27–29). But it was only during the Second World War and the subsequent struggle for political independence and local control over natural resources that a more serious discussion on infrastructure and development was launched. Given the ideological currents of the time, that discussion was strongly shaped by an emerging development narrative focused on overcoming "market failures", seen as endemic in infrastructure provision, and requiring government involvement through public utilities (power, telecommunications, water, etc.), public works (highways, dams, irrigation, etc.) and public transport systems (railways, ports, airports, etc.). Infrastructure was again the focus of attention, but from an opposing perspective, in the 1980s, as talk of "government failures" accompanied the sharp neoliberal policy turn. At that time, privatization became the instrument of choice to boost efficiency, along with measures to enhance private participation in infrastructure provision by making it more profitable. This included – in a sense coming full circle – tying infrastructure to the right business environment to enable participation in global value chains. The 2030 Agenda has once again broadened the debate with a more ambitious infrastructure agenda.

Underpinning all these twists and turns is the abiding question of whether, and if so how, infrastructure programmes can help to trigger and sustain a virtuous circle of growth and structural transformation. Answering this requires unpacking the term "infrastructure" to consider the requirements, implications and consequences of different types of infrastructure creation.

1. Types of infrastructure

Infrastructure encompasses a broad category of goods and services that involve investments in both the social and physical stock of capital. Definitions of the term by development economists have been less than precise (Ingram and Fay, 2008: 301). Hirschman, for example, employing the umbrella term "social overhead capital", defined infrastructure as those "basic services without which primary, secondary and tertiary productive activities cannot function" (1958: 83), and provided or heavily regulated by public agencies. He further distinguished a "hard core" of transportation and power (characterized by technical indivisibilities and a high capital–output ratio), from a softer group of more traditional public goods such as health and education.

The tendency to identify infrastructure with "public goods" is somewhat misleading (as the defining characteristics of non-excludable and non-rival often do not apply)[1] but does serve as a reminder of the tendency to underinvest in their provision, since the strong presence of externalities can give rise to free-riding behaviour and drive a wedge between their social and private returns. This tendency, as Hirschman recognized, is particularly acute in developing countries. While individual projects associated with softer infrastructure are often smaller compared to harder projects such as in energy or transport, the difficulties of excluding some users and their non-rival nature means they are likely to be provided at less than full cost to users. Therefore, they have usually relied on significant and continuous public sector financing. Moreover, while recognizing the potential long-term benefits of these types of infrastructure spending in terms of productivity, innovation and employment creation, it can be difficult to measure these benefits in the short term, making them vulnerable to political expediencies and budgetary pressures. This is the case with health and education services, particularly in those areas heavily dependent on intangible investments (such as in R&D and skills), which may not require large sunk costs but do require ongoing investments to maintain and improve the services provided.

In many cases, however, infrastructure services, particularly those of the harder variety, are both rivalrous in consumption and excludable in access and cannot, therefore, be considered as public goods in the strict sense. However, externalities persist, and other market failures complicate their delivery. In particular, significant scale economies, large sunk costs and long gestation periods make for both natural monopolies and strong complementarities, whereby the effectiveness of investment in one sector depends on investments in others. This is particularly the case where infrastructure provision is closely linked to networks. These characteristics are found mainly in the energy, water, public transport and telecommunications sectors, although variations exist within sectors, across countries and over time.[2] These are, moreover, the sectors that have traditionally been seen as having a more direct impact on economic growth and structural transformation.

Networked infrastructure services can be delivered through hybrid systems with varying degrees of state ownership and regulatory oversight. This makes their provision a matter of policy choice and contestation. In addition, technological changes have an impact on the provision of such infrastructure, including through a shift to less capital-intensive techniques and increased competition (Markard, 2011; Torrisi, 2009; Kasper, 2015).

This is certainly the case with the power system, comprising energy generation, transmission and distribution. Electricity generation has historically relied on conventional fossil fuels and involved large centralized power stations. Transmission and distribution are responsible for moving electricity from power stations to users. Promoting such a system, from generation to delivery to the end users, requires long-term investment in large-scale projects; it also involves risks and uncertainty and therefore requires detailed planning (Markard, 2011). But its provision dramatically increases both economic productivity and quality of life. In rural areas, access to affordable energy can boost farm productivity because of its uses in pumping water for irrigation, mechanization, agricultural processing and post-harvest storage. Developing a domestic energy industry has multiple benefits, because of jobs created in system maintenance and repairs, billing and administration, and power plant operation and distribution, in addition to backward linkages and new domestic markets (UNCTAD, 2017). Positive feedback effects are created as energy provision supports transportation and information and communication technologies (ICTs), which in turn assist in energy generation and distribution.

Like energy, transportation infrastructure (roads, railways, airports, seaports, bridges, waterways and

tramways) calls for large-scale investment projects and long gestation periods, although smaller, localized projects with shorter execution periods are also possible. The design of transportation systems shapes social transformations, and how populations and businesses settle and interact (NCE, 2014; Atack et al., 2010). The choice of transport systems, their scale and their spread, matters considerably for structural transformation as well as other economic and social impacts. This is already evident in most developing countries, many of which are still dealing with the legacy of colonial choices in developing transport systems, since these typically emphasized connecting the locations of cash-crop production or extraction of natural resources with towns and ports for export. More widely diffused transport connectivity, by contrast, can assist in more broad-based growth. For example, in road construction, investing in secondary roads in rural areas has been found to have wide-ranging positive impacts and higher benefit-to-cost ratios than investments in highways (United Nations, 2016). Rural roads that increase connectivity for rural areas obviously increase access to markets and related knowledge; they also have benefits for household income, poverty reduction and access to health care and education (Schweikert and Chinowsky, 2012). Efficient transport systems can also reduce production costs, alleviating the need to store large quantities of material and allowing large and small producers to work with just-in-time systems (Nordås and Piermartini, 2004).

The infrastructure services dealing with water provision are recognized to be crucial not just for human welfare but also for economic development. Such services and related physical infrastructure occur at multiple scales and serve urban, industrial, agricultural and rural users, as well as involving ecological considerations (Global Water Partnership, 2009). They include dams and hydropower; water supply; wastewater, sanitation and water quality; storm water systems; irrigation and drainage; river and coastal works; pipelines and canals; and natural water infrastructure (Grigg, 2017). The particular nature of water as a basic human need, in combination with its amenability to being controlled and monopolized in different circumstances, makes public involvement in its provision both necessary and fraught. While everyone needs "access to safe water in adequate quantities for drinking, cooking and personal hygiene, and sanitation facilities that do not compromise health or dignity" (UN-Water, 2015: 37), not everyone gets it. Agriculture depends on irrigation that raises crop output and is associated with lower inequality (United Nations, 2016) and water infrastructure can reduce vulnerabilities related to food and energy security. Similarly, water is an essential input for manufacturing processes. But distributional conflicts – across locations, sectors, income categories and social groups – loom especially large in the case of water, and the manner of its provision can raise environmental concerns. Longer-term concerns about water overuse and inadequate renewal of fresh water supplies, as well as water pollution, along with the (often unintended) consequences of major water infrastructure projects (such as displacement because of dams, waterlogging and salinity through canal networks, inequality of access and so on) mean that public involvement in its provision and regulation is inevitable even when much of the infrastructure is privately provided.

An example of the strong network externalities associated with infrastructure comes from telecommunications infrastructure, which includes fixed and mobile telephony, radio and Internet systems, along with the machinery that enables information transmission, transmission lines and cables.[3] This is an area that has been dominated by private players, including network and platform operators and technology and content providers, especially as rapid technological change has enabled favourable financial returns (Czarnecki and Dietze, 2017; ADB, 2017; Henckel and McKibbin, 2010; Serebrisky et al., 2015). In addition to facilitating communications in general, such infrastructure is increasingly required by a wide range of activities in banking, trade and production, and has enabled new forms of economic activity to emerge. This impact tends to be higher where levels of penetration are near universal (Estache, 2010: 16), but even where penetration is low there can be many positive effects. For example, Hjort and Poulsen (2017) report that new submarine telecom cables in different parts of Africa brought the arrival of fast Internet, leading to the emergence of technology start-ups and a manufacturing sector that produces Internet-capable devices to serve the region, an improvement of supply chain coordination enhancing productivity in manufacturing and agribusiness, and the creation of jobs in the ICT sector and elsewhere. As the industry moves from traditional fixed networks to software-based network technologies, the scale of investment has been changing rapidly from being predominantly large to including smaller-scale projects (Deloitte, 2017). However, regulatory requirements in this area are complex,

involving not just the specification of standards and usage limits, but also the prevention of monopolistic behaviour, which places often serious demands on policymakers in developing countries.

2. Infrastructure and the virtuous circle of growth

Much of the development policy challenge amounts to finding ways to trigger and sustain virtuous circles of increased resource mobilization, faster capital formation, rising productivity, better jobs, higher incomes and expanding markets, both at home and abroad, enabling more resource mobilization. As discussed in *TDR 2016*, industrial development and diversification have been key to most sustained growth and development experiences. As industry – particularly manufacturing – expands, primary activity tends to become more efficient, as a result of both increased demand and the provision of capital and intermediate goods, in turn feeding industrial dynamism. The service sector also expands to complement manufacturing activities and, at higher levels of income, comes to dominate the economy.

Industrial development was central to Hirschman's idea that developing countries should pursue "unbalanced growth" with productive resources targeted at a few sectors. This was based on the belief that the resulting disruption would not only stimulate further private investment in the favoured sectors but would help promote various organizational and other capabilities whose shortage might otherwise curtail the growth process. The unbalanced growth model is based around exploiting scale economies and complementarities in favoured sectors that can induce more investment and productivity growth. Those sectors, in Hirschman's framework, have more backward and forward linkages; the former referring to provision of inputs from other activities and sectors, the latter to demand for new activities. The development policy challenge is, accordingly, about identifying lead sectors, addressing missing linkages and strengthening inter-industry and intersectoral interdependencies to boost productivity growth.

Hirschman believed that this framework would provide the best guide for the efficient sequencing of infrastructure spending, as the shortages revealed to the planning authorities would ensure that public investments in social overhead capital would complement those already under way in the private sector, thereby further boosting productivity growth. In this sequence, infrastructure would follow rather than lead the growth process. It is largely around this sequencing issue that differences between balanced and unbalanced growth strategies emerged in early development policy debates (see box 4.2). Despite these differences, there was general agreement that in most developing countries, investment in general, and in infrastructure, in particular, involves a series of non-marginal adjustments that are poorly coordinated by markets and for which planning techniques of various kinds are desirable.

There are additional ways in which infrastructure spending can drive productivity and growth. Like other government spending, infrastructure investment boosts aggregate demand, potentially sparking broader-based output growth through scale economies which feed into productivity increases. This typically leads to greater private sector investment, and by extension, also raises private demand for physical capital over a longer time-horizon (Dissou and Didic, 2013). These complementary effects on private capital formation tend to be cumulative, as infrastructure provision affords greater certainty for private industry, and the consequent increased rates of capital formation help to crowd in investments in other sectors of the economy.[4] In turn, increased productivity and rising incomes lead to higher demand for various infrastructure services. In this way infrastructure investment becomes part of the process of cumulative causation, whereby industrial expansion creates employment, incomes and demand, and leads to increased productivity (Myrdal, 1957).

Infrastructure investment can simultaneously address supply-side constraints and thereby raise the productivity of other activities (Straub, 2008; Estache and Fay, 2009). Insofar as this reduces costs and improves the durability of private capital investment, it also enables the private sector to spend less on maintaining its own capital, releasing resources for other productive investment. Infrastructure provision that promotes social inclusion – such as better housing and improvements in health, education, sanitation and nutrition – enhances labour productivity in addition to promoting social welfare (Serebrisky, 2014). At low levels of existing infrastructure, the growth-enhancing and social-inclusion effects of new infrastructure investment tend to be even greater (Straub, 2008).[5]

Conversely, low or insufficient infrastructure can handicap enterprises by increasing production costs

BOX 4.2 Balanced versus unbalanced growth

The central issue in the early debates on development policy was how to shift from a resource-dependent to an industrializing economy with a diversified production structure. Industrialization was understood to be an inherently dynamic process, thanks to the presence of increasing returns (both at the firm and sectoral levels), complementarities (on both the supply and demand side), learning economies and various other externalities that if successfully exploited could drive productivity growth and support job creation.

The problem, recognized by most economists, was that in developing countries these features also introduced a large wedge between the private and social returns from investments, making the market an inefficient mechanism for mobilizing and allocating the required resources. Accordingly, the state would have to be involved in connecting the investment and industrialization processes in developing countries. The question was how and where it should make that connection.

For balanced growth theorists such as Paul Rosenstein-Rodan, Ragnar Nurkse and Tibor Scitovsky the major constraint on productive investment was on the demand side. Small markets in most developing countries produced uncertainty about the expected returns on investment and made it difficult to achieve scale economies, thereby choking off the accumulation process and closing down an industrial growth path before it could really get started.

The solution outlined by Rosenstein-Rodan (1943) was a coordinated investment programme (which Nurkse called "a big push") across several industries, to guarantee a sufficient level of aggregate demand to make those investments viable. In particular, expansion of light industries providing consumer goods seemed the most promising option as these could provide local demand for each other's output; and a large-scale and integrated infrastructure programme was seen as the ideal way to break the constraint on self-sustaining growth because it would both stimulate local demand and lead to lower production costs (Nurkse, 1953). Moreover, complementarities across the investments in electricity generation, transport, communications, etc. implied that these too should be organized as an indivisible block if their full benefits were to be realized. The resulting development strategy combined centralized infrastructure planning with infant industry protection and, in the process, introduced a whole range of new planning techniques (shadow pricing, linear programming, etc.) to help manage the subsequent growth trajectory.

Early criticisms of the balanced growth model raised concerns that, given an inelastic supply of factors in many developing countries, it might be prone to inflationary pressures. Also, its emphasis on consumer goods industries seemed to ignore the opportunities for economies of scale in the production of capital and intermediate goods and the potential of tapping into export markets (Fleming, 1955; Sheahan, 1958). Still,

(related to transport, logistics and storage), render products that would otherwise be competitive as uncompetitive, limit access to markets and make rural production unprofitable (Escribano and Guasch, 2005, 2008; Donaldson, 2010; Escribano et al., 2010). Indeed, countries that have experienced stalled industrialization or premature deindustrialization (see *TDR 2016*) have tended to have inconsistent trajectories of infrastructure investments, that have been inadequate overall and sometimes pulled the economy in other directions. In India, for example, several studies have noted that underinvestment in infrastructure required for manufacturing sector (Ghosh, 2012; Simon and Natarajan, 2017) has constrained private investment. By contrast, the rise of information technology services and digital products was possible in India because the conditions for the expansion of telecommunications and broadband networks were relatively less costly for the government to deliver on a wide scale (Douhan and Nordberg, 2007). In several natural resource-rich developing countries, infrastructure investments have pulled the economy in the direction of resource extraction, at the expense of other productive activity.

The resulting infrastructure gaps then become constraints on supply. For example, Mesquita Moreira et al. (2013) found that high transportation costs were associated with falling exports in Chile and Peru, while Escribano et al. (2010: 8) showed that poor infrastructure in Africa increased transport and energy costs for local firms, with severe consequences for manufacturing productivity and competitiveness. Allcott et al. (2016) found that power shortages reduced Indian manufacturing revenues and producer surpluses by almost 10 per cent. When countries have adequate electricity provision with few or no power outages, producers do not need to have costly

with the focus firmly on economies of scale, these disagreements were mainly empirical matters relating to the scope for coordinated expansion.

Picking up on both the inelasticity of supply and the importance of capital goods industries, Hirschman (1958) presented a starker contrast between a balanced and unbalanced growth model. Like the balanced growth theorists, he recognized that externalities could disrupt any desired investment sequence. However, for Hirschman growth was always, everywhere and necessarily, an intrinsically uncertain and uneven process – marked by rapid advances in some sectors followed by catching up in others. This made the principal challenge for policymakers the search for complementarities across industries rather than scale economies.

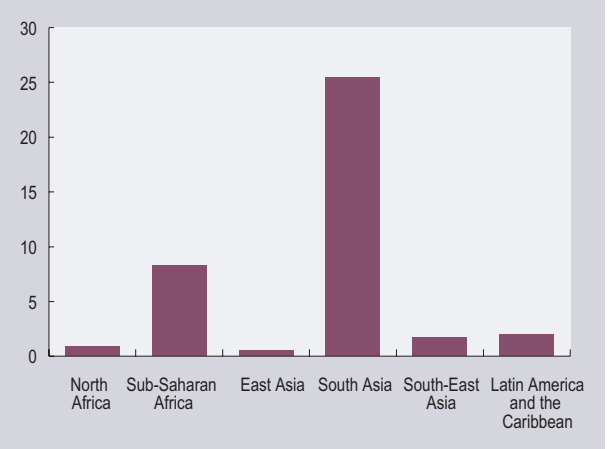
Comparing development to "an endlessly spinning cobweb", he contrasted a big push with a sequential progression of promoting and then reducing "tensions, disproportions and disequilibria", using profits and losses as the metric for identifying disequilibria and the means to induce subsequent investments (Hirschman, 1958: 66). "[A]t each step, an industry takes advantage of external economies created by previous expansions, and at the same time creates new external economies to be exploited by other operators" (Hirschman, 1958: 67). The role of the state planner is to assess whether productive private investment or infrastructure investment will induce the most progress in other industries, through creating excess capacity or shortages. Hirschman introduced the concept of (backward and forward) linkages as the mechanism for simultaneous and progressive expansion in both domestic demand and supply and to better identify the sectors to focus on. This made input–output tables, rather than aggregate demand, Hirschman's policy framework of choice. Since he was unconvinced that most developing countries had the capabilities to undertake big centralized investment programmes, he offered a more pragmatic approach to infrastructure planning that would help break the "interlocking vicious circles" of underdevelopment (Hirschman, 1958: 5). This would occur by allowing infrastructure ("social overhead capital") to lag behind in an investment sequence beginning with productive private investment primarily in the capital goods and intermediate goods sectors (see Hirschman, 1958: 83).

Arguably, the contrast between the two approaches was oversold at the time, as Streeten (1959) recognized and Hirschman (1961, 1987) later accepted. Both approaches were concerned with investment planning and both (albeit to different degrees) recognized that expanding output ahead of demand would give rise to further complementary investments and innovations. This was particularly true of infrastructure investments, given the significant indivisibilities those involved. Indeed, the two theories began with the challenge of a divergence between social and private returns, employed much the same conceptual framework – indivisibilities, externalities, increasing returns, complementarities in supply and demand – and acknowledged a central role for the state. This turns the discussion of investment planning, including with respect to infrastructure, into a matter of empirical detail about where scale economies are located and the political economy question of whether or not the developmental state has the requisite institutional capacities to pursue larger- or smaller-scale projects.

backup generators. Power outages are a particularly acute problem in South Asia and sub-Saharan Africa, as indicated in figure 4.2 by the average number of outages suffered by firms in a month. It has been estimated for sub-Saharan Africa alone that continuous energy supply would accelerate growth by two percentage points per year.[6]

In what follows, we consider whether unbalanced growth through infrastructure investments can really help countries to move to a strong growth trajectory. The historical experiences considered below suggest that they were certainly significant in many success stories. However, even within a framework of unbalanced growth, there are at least two additional issues to keep in mind (Myrdal, 1970). First, some of the supply-side limitations that are common in many developing countries, such as scarcity of skills or the absence of the institutions required to mobilize and

FIGURE 4.2 Number of electrical outages in a typical month



Source: UNCTAD secretariat calculations, based on *World Bank Enterprise Surveys: What Businesses Experience* database. Available at: http://www.enterprisesurveys.org/data/exploretopics/infrastructure (accessed 7 March 2018).

coordinate resources, have to be addressed directly through industrial policies of one kind or another. Second, in addition to expanding the "right" investments, it may also be necessary to restrict certain kinds of private investments and production that pull the economy into unforeseen and undesired directions. In the absence of such disciplining mechanisms, it is also likely that public investments, including in infrastructure, will be captured by certain private interests, with their potential development impact reduced or lost altogether.

3. Historical experiences

While infrastructure can boost productivity growth through a variety of channels, its contribution to sustaining a virtuous development circle does not occur in an institutional or policy vacuum. The gains that infrastructure brought during the industrial revolution, first in England and then in continental European countries, were not only the result of long-standing investments spanning decades or even centuries; they were often built on clear policy visions that placed infrastructure at the centre of nation-building efforts. Indeed, the later industrialization began, the more conscious those efforts appear to have become, given the larger investment push that was usually required to achieve catch-up (*TDR 2003*, *2016*).

As Haldane (2018) has noted, the series of successful transformation episodes that have sustained an unprecedented ratcheting up in living standards over the past 250 years have all tended to involve the interlinking of infrastructure, innovation and institutions in ways that have not only supported higher rates of capital formation but also responded to the economic and social disturbances that accompany such episodes. For example, structural change in Britain between 1760 and 1860 was not simply the fortuitous product of technological breakthroughs and entrepreneurial endeavour, but rather the intertwining of a series of industrial, agricultural and demographic changes. The private capital behind these changes was often on a relatively small scale but more significant investments were needed in physical and social infrastructure to ensure the required linkages across the newly emerging activities and to support businesses, workers and society buffeted by these changes. This was particularly true for the turnpikes, canals and railways that accompanied Britain's rise as a global economic superpower. Britain gained an advantage from the early streamlining of legislative procedures for infrastructure projects and the fact that these projects could be effectively implemented and managed at a regional level, reflecting its pattern of spatially unbalanced industrial development, through ad hoc initiatives among interested private actors. National initiatives only emerged later to better coordinate existing projects in line with the demands of a more sophisticated and integrated national economy.

In Europe, the French architect Michel Chevalier was one of the first to envision a scheme for a multi-country infrastructure network at the heart of efforts to end poverty and conflict in Europe. Conceived in 1830, Chevalier's impressive plan[7] was for a grand European transport system to connect the entire continent with rails, roads and shipping routes, whereby railway lines spanning over 60,000 km would traverse from the Mediterranean, the Black Sea and the Caspian Sea (through northbound lines), linking them to eastbound destinations of Flanders at the North Sea via Warsaw, Vilnius, Riga and St Petersburg to the Russian Pacific (Högselius et al., 2015; Drolet, 2015). He believed that enhanced connectivity between regions would encourage trade, commerce and industrialization in Europe and the Ottoman Empire, and that this was the only way to foster political harmony. This vision tied "public works" (as infrastructure was then known) intimately with the economic, political and industrial progress of Europe at the time. The essential features of this plan were indeed adopted by France as well as a number of European countries that became independent between 1830 and 1871, including Belgium, the German Empire, Greece, Italy, Serbia and Romania; and it even led to cross-country multilateral initiatives for infrastructure expansion (Ambrosius and Henrich-Franke, 2016). Many of these countries saw railways as a means for industrial transformation, with the result that the European railway network expanded from 1,865 miles to over 215,000 miles between 1840 and 1913 (Ambrosius and Henrich-Franke, 2016: 44).

In the United States, the development of transport (notably railway) stimulated several industries such as iron, steel and timber; encouraged financial enterprise by promoting private investments into these sectors and railway construction; and contributed directly to the generation of national income through the provision and expansion of interregional and local transportation services (Jenks, 1944, 1951; Pereira et al., 2014; Shaw, 2014). Rohatyn (2009) provides examples of bold public moves on infrastructure in

the United States over two centuries that transformed the country and its economic potential:

- the construction of the Erie Canal, which opened a water route to the west;
- Lincoln's support for the transcontinental railroad, which transformed the country and enabled vast new cities to emerge;
- Land Grant colleges that started in the mid-nineteenth century, which dramatically expanded access to higher education;
- the Homestead Act of 1852, which enabled the westward expansion of population and settlement;
- the construction of the Panama Canal in the early twentieth century, which enabled ships to pass between Atlantic and Pacific oceans and effectively sealed the hegemony of the United States in the region for the next century;
- the Rural Electrification Administration of the Franklin D. Roosevelt government, which brought electricity to the rural United States with all its attendant benefits;
- the GI Bill (Serviceman's Readjustment Act of 1944), which provided free college education and low-interest home and business loans to all veterans with more than 90 days in uniform, thereby creating a secure domestic market;
- the interstate highway system created by Eisenhower's Federal Aid Highway Act, which revitalized the economy and modernized the United States.

As Rohatyn notes, the benefits extended far beyond the purely economic: "Canals, roads, highways, schools, electrical power grids – it was this extensive and innovative infrastructure that made life in the United States more comfortable, more egalitarian and more secure" (2009: 221).

An important feature of the evolution of infrastructure development in these countries was the gradual but increasing significance of public control. While early systems in nineteenth- and twentieth-century Europe and the United States were often entirely private or a mix of public and private (with some significant public investment exceptions), from the late nineteenth century onwards there was a gradual public takeover of responsibility, supported by broader national visions of "municipal socialism" in Europe and "progressivism" in the United States (Marshall, 2013).

The experience with railway expansion in the United States during the second half of the nineteenth century is particularly instructive. In the first phase, extensive state involvement was essentially through subsidies, regulations, legal privileges, military protection, etc. as part of an early public–private partnership model. This enabled the rapid development of a transcontinental network, but also gave rise to financial speculation, market concentration and inefficiencies, business failures and political corruption. The public control that followed, particularly during the time of the New Deal, made it possible for governments to integrate spatial planning at the national, regional and local levels; and enabled an integrated approach to development, whereby infrastructure investments and maintenance were closely coordinated with national economic goals and requirements.

As it became evident with time that infrastructure provision calls for coordination, institutional frameworks to govern infrastructure emerged at the national level, which sought to centralize control with national authorities so as to plan and develop infrastructure integrating spatial, economic and temporal perspectives. Governments began to use bilateral and plurilateral agreements to achieve some level of standardization. As the coexistence of state-run and private rail lines in much of continental Europe, the United States and Britain led to clashes between private and public infrastructure systems (Cootner, 1963; Shaw, 2014), combinations of competitive and cooperative development structures were developed across road transport, telecommunications and postal services (Ambrosius and Henrich-Franke, 2016; Nerlove, 1966).

While the links between development and infrastructure spending appear to have grown closer in the late industrializing economy of the nineteenth century, triggering a virtuous circle augmented by increased international trade, those links were a good deal more tenuous for many developing countries. Indeed, the new communication technologies of that era, railways, steamships and telegraphs, created a global infrastructure network that led to growing income gaps as many developing countries were locked into a vicious circle of increased trade, weak diversification and low productivity growth (*TDR 1997*; Pascali, 2017). In many of the colonized countries, this same infrastructure shaped a highly uneven internal economic landscape: many developing countries inherited city planning or transport and port networks that were built for other purposes,

TABLE 4.1 The role of infrastructure in industrialization of the Republic of Korea

Industrial policy phase	*Key infrastructure investments*
1960–1970: First five-year development plan, along with policy to promote exporters across sectors such as iron, silk and fishing.	Development of the Seoul–Busan Highway and the Busan Port for exports; construction of power plants to support iron and steel and other core sectors; investment in primary education.
1970–1980: Accelerated industrialization with focus on promoting large exporting sectors, including textiles, plywood, iron ore and electronics.	National land development plan; investments in the Seoul Metro, Honam Highway, Yeongdong Highway and industrial complexes, nuclear power plants to support energy needs for industry.
1980–1990: Rationalization and restructuring, with focus on upgrading products and processes, especially in textiles, electronics, iron and steel products, footwear and ships.	A slowdown in aggregate infrastructure investment; targeted investments to build the regional energy supply system; strengthening of secondary and tertiary education and expansion of national R&D programme to support expansion of high technology sectors.
1990–2000: Transition to a knowledge-based economy, with focus on semiconductors, automobiles, computers and ships.	Expansion of transportation facilities, such as the Incheon Airport and high-speed railway system; information highway and e-government projects; further increase in public investment in higher education.

Source: Bang, 2003.

like natural resource exports, rather than developing a vibrant domestic market, and are still having to address the resultant inadequacies and imbalances (Rodney, 1973; Cooper, 1993). The globalization experience in the nineteenth century serves as an important reminder that simply expecting a combination of new technology, infrastructure spending and trade to deliver sustainable and inclusive growth is not borne out by the historical record.

Only after the Second World War were some developing countries able to establish their own virtuous circle linking infrastructure, industrialization, trade and economic growth. In the Republic of Korea – a prime example of manufacturing-led industrialization after the Second World War – the confluence of technological advance, export promotion, investment and capital accumulation was linked not only to favourable external conditions but also to multi-annual plans from 1962 to 1992 that set out targets and allocated resources for investments in social overhead capital. Infrastructure investment was a key element of these plans (see table 4.1), to the extent that between 1960 and 2002, it amounted to 14 per cent of GDP on average (Bang, 2003).[8]

Similarly, in China over the past three decades, the emphasis on infrastructure had the purpose of creating and enabling high-linkage sectors that were critical for generating growth (Holz, 2011). After the Asian crisis of 1997–1998, the Chinese Government increased public infrastructure investment rapidly to stimulate domestic demand and promote economic growth, and these were the underlying reasons for the increase in public infrastructure investment after the 2008 crisis as well. Public infrastructure investment grew in real terms at an average annual rate of 25 per cent over 1997–2010 (Zhang et al., 2013: 91).[9] This was instrumental in creating two distinct types of external economies. First, consistent infrastructure investment resulted in reduction in costs for private sector activity and enlargement of the market, as dispersed and fragmented pockets of small demand were converted into larger markets of effective demand. The expansion of public infrastructure and profitability of private activities raised wages and promoted consumption, while backward linkages led to private investment in new sectors. Second, public investment in strategic sectors created vertical economies in the intermediate stages of production, leading to possibilities of forward linkages between such activities and other lagging sectors to promote growth through "returning" economies (Sutcliffe, 1964).

In both the Republic of Korea and China, infrastructure investments were sequenced according to the needs of the industrial sectors. This is similar to the successful cases of industrializers in the nineteenth century, such as Europe and the United States, where targeting infrastructure investments according to sectoral needs was planned and coordinated so as to avoid bottlenecks that slow down national

and regional growth. This also meant that, despite increasing participation of the private sector, the reins of infrastructure planning and coordination were firmly with the government, to ensure the appropriate balance between national economic, social, urban and environmental goals.[10] This strategy implicitly recognized the strong intertemporal dimension, since building infrastructure that promotes structural transformation requires long-term coordination, spanning several decades (Shi et al., 2017).

C. Infrastructure in developing countries

1. Needs and gaps

In the past several years, multilateral financial institutions, private consultancy firms and international experts have provided estimates of infrastructure investment needs, for both developed and developing countries, based on current and medium-term requirements. Table 4.2 summarizes some recent estimates for (mainly) economic infrastructure investment at the global level and by sector, which suggest annual needs ranging from $4.6 trillion to $7.9 trillion.[11] This range includes estimates using both baseline and low-carbon scenarios. The baseline scenario assumes that current growth will continue into the future, while the investment needs for addressing climate change hinge heavily on the concept of sustainable infrastructure.[12]

The large variation (over $3 trillion) across estimates, is because of differences in methodologies, data sources and the types of expenditures considered.[13] All of these calculations involve a wide array of assumptions about future infrastructure demand, prices and technological change. For obvious reasons, all such estimates of future needs for infrastructure investment have problems related to coverage, assumptions and methodologies. There is lack of clarity about the definition of infrastructure and types of investment considered, as well as lack of comprehensive data on current infrastructure investment. The assessment of needs based on quality indicators and the use of expected GDP growth and elasticity of infrastructure investment to growth are problematic.

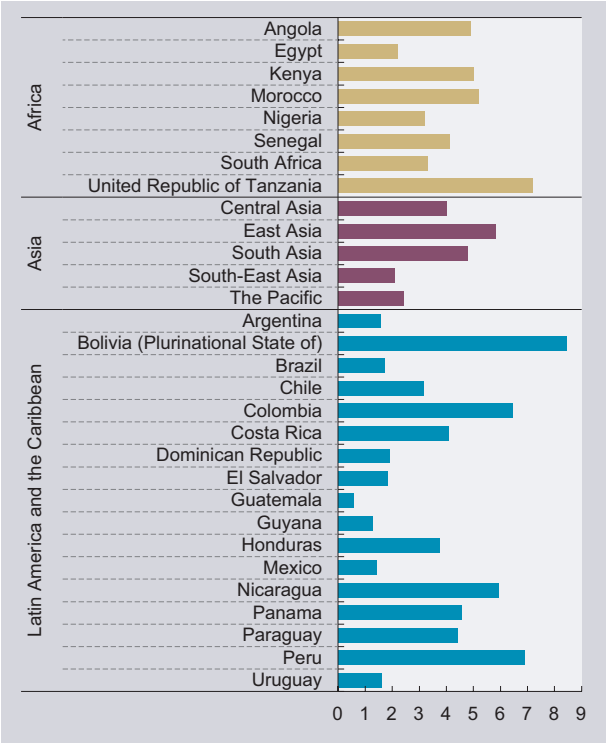
Few estimates use any calculation of minimum required infrastructure stocks, which are considered more pertinent for low-income countries in need of rapid catching up. The emphasis on a "top-down" approach based on the use of global models is to the detriment of a "bottom-up" assessment of needs based on country-specific circumstances and specific long-term development strategies. The lack of a network perspective fails to take full account of the interdependencies between sectors and types of infrastructure. In addition, rapidly changing technologies make the task of producing accurate estimates

TABLE 4.2 **Infrastructure investment needs at the global level, annual 2015/16–2030**
(Trillions of 2015 dollars)

	Annual total needs for "core" infrastructure[a]	*Annual total needs (baseline scenario)*	*Annual total needs (low-carbon scenario)*[b]	*Selected sectors (baseline scenario)*		
				Power and electricity T&D	*Transport*	*Telecoms*
OECD (2017a)	4.9	6.3	6.9	0.7	2.7	0.6
Bhattacharya et al. (2016)	5.4	7.9	.	1.5	2.0	1.0
Woetzel et al. (2016)	3.3	4.6–6.0	.	1.0	1.2	0.6
NCE (2014)	3.8	6.4	7.0	0.7	1.0	0.5

Source: OECD, 2017a: tables 3, A and 4.
a "Core" infrastructure investment includes power and electricity transmission and distribution (T&D), transport (roads, rail, airports and ports), water and sanitation, and telecommunications. Total infrastructure includes, in addition to "core" infrastructure, primary energy supply (coal, oil and gas) and energy efficiency.
b Under the low-carbon scenario, investment in low-emission, climate-resilient infrastructure is taken into account in order to limit the rise in global temperature to 2°C by the end of the century.

FIGURE 4.3 Current infrastructure investment, selected subregions and economies
(Percentage of GDP)



Source: UNCTAD secretariat calculations, based on ECLAC (2017), AfDB (2018: 80), ADB (2017) and Heathcote (2017).

Note: *Asia*: Current infrastructure includes the following Asian subregions and economies: Central Asia (Armenia and Georgia), East Asia (China, Mongolia, the Republic of Korea and Hong Kong, China), South Asia (Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka), South-East Asia (Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam) and The Pacific (Fiji, Kiribati and Papua New Guinea), all for the year 2011. *Africa*: Current infrastructure investment expenditure in the year 2015. Countries included are: Angola, Egypt, Kenya, Morocco, Nigeria, Senegal, South Africa and United Republic of Tanzania. *Latin America and the Caribbean*: Figures are based on InfraLatam database. Current infrastructure investment is from year 2015. Countries included in the figure are: Argentina, Bolivia (Plurinational State of), Brazil, Chile (2014 expenditure), Colombia, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru and Uruguay (2013 expenditure).

particularly hard, since they would inevitably change future costs and needs (Woetzel et al., 2016: 13).[14] Insufficient inclusion of infrastructure needs for climate change adaptation and mitigation results in more modest estimates (Estache, 2010; Bhattacharya et al., 2016; Schmidt-Traub, 2015; OECD, 2017a, 2017b).

These shortcomings raise doubts about both accuracy and comparability across different estimates. Despite all this, international institutions and experts have reached the conclusion that investment needs are very large, especially when compared with current investment levels (OECD, 2017b). For developing countries, UNCTAD estimates investment needs of $1.6 trillion–$2.5 trillion per year between 2015 and 2030, against current actual investment of $870 billion.[15] An earlier study by Bhattacharya et al. (2012) projected needs in developing countries to be between 6 per cent and 8 per cent of GDP by 2020, against an actual investment level of 3 per cent in 2012.[16] In Latin America and the Caribbean (LAC), ECLAC (2017) estimated infrastructure investment needs at 6.2 per cent against an actual spending of 3.2 per cent of the region's GDP in 2015.[17] In Africa, projected needs are said to be in the order of 5.9 per cent of the region's GDP over the 2016–2040 period, against current trends at around 4.3 per cent (AfDB, 2018: figure 3.7; and Heathcote, 2017: 28).[18] In Asia, both current and projected investment needs over the years 2016–2030 have been estimated at around 5 per cent of GDP (ADB, 2017). These regional evaluations are not perfectly comparable, since they are produced by different organizations drawing on their own methodologies and data sources.

There are large regional and intraregional variations in current infrastructure investment, as indicated in figure 4.3. In Africa, Ethiopia and United Republic of Tanzania spend well above 5 per cent of GDP on infrastructure, while Nigeria and South Africa (the region's two largest economies) have expenditures of just above 3 per cent and Egypt just over 2 per cent. In Latin America, the regional average is, to a large extent, influenced by low infrastructure expenditure in the region's larger economies, with Argentina, Brazil and Mexico spending less than 2 per cent of GDP in 2015. A few small economies such as Guyana, Trinidad and Tobago, and Uruguay also spend less than 2 per cent of GDP on infrastructure. In contrast, Andean countries such as the Plurinational State of Bolivia, Colombia and Peru spend above 6 per cent, followed closely by smaller economies such as Nicaragua, with expenditure of nearly 6 per cent in 2015. In Asia, at one extreme, East Asia spent 5.8 per cent of its GDP on infrastructure in 2011, but this subregional average was dominated by China, which showed infrastructure expenditure of 6.8 per cent of GDP over 2010–2014. At the other extreme, South-East Asia spent just 2.1 per cent, as the economies hit by the East Asian financial crisis of 1997 (such as Indonesia, Malaysia, the Philippines and Thailand) experienced significant declines in public spending as a proportion of GDP that have not fully recovered thereafter (ADB, 2017: 28–30). Therefore, while on the whole Asia invests more and Africa and

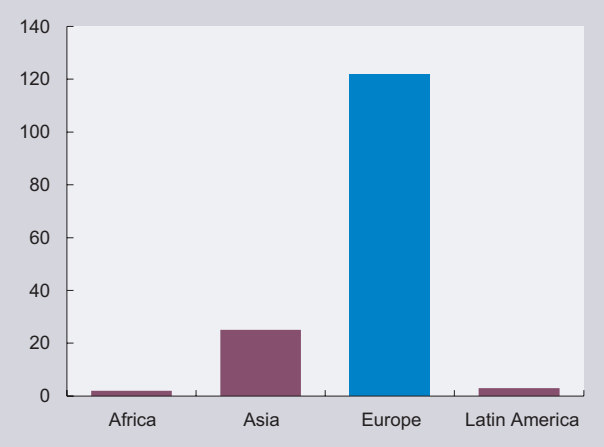
Latin America invest less in infrastructure development, no clear patterns emerge within regions, even in terms of country size or per capita income.

In sectoral terms, Heathcote (2017) indicates that in Latin America there will be a strong concentration of transportation needs in the coming decades (between the years 2016 and 2040), as these have been relatively neglected, while the energy sector seems to be scoring better (Fay et al., 2017: 9–10). In Africa, the biggest infrastructure deficit is thought to be in the energy sector (AfDB, 2013: 3, 2018), although even here, transport stands out as the sector with the largest financing needs over the coming decades (see figure 4.3). In Asia, the largest financing needs are estimated to be in the energy sector, followed by transport.

Another way of estimating infrastructure needs is to look at absolute gaps in existing stock of infrastructure according to various indicators. Road density per square kilometre is a very rough indicator of the development of transport infrastructure, and it must obviously be seen also in the context of terrain, population density and other ecological considerations. Nevertheless, figure 4.4 points to truly shocking differences between Europe and the developing regions, while within Asia (which shows slightly better levels) there are large differences between East Asia and most of the rest of the continent. This confirms the overall logistical problems that are very much a reflection of the overall state of infrastructure as expressed in figure 4.5, whereby most developing regions are still on average able to meet just above half of the performance standards in the United States.

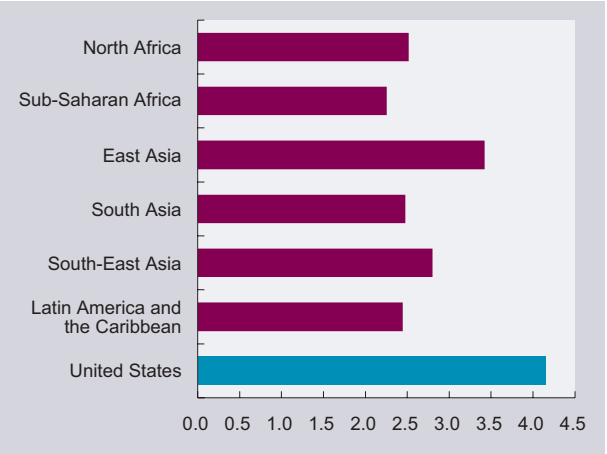
Figure 4.6 indicates the still-huge gaps in access to energy, in terms of the proportion of the population with access to electricity and clean cooking fuel. Clearly, massive investments will be required in sub-Saharan Africa and Asia to approach anything like the coverage already achieved in advanced economies; and the challenge is made even greater by the large absolute populations in both regions.

FIGURE 4.4 Paved road density
(Km of paved road per 100 km² of land area)



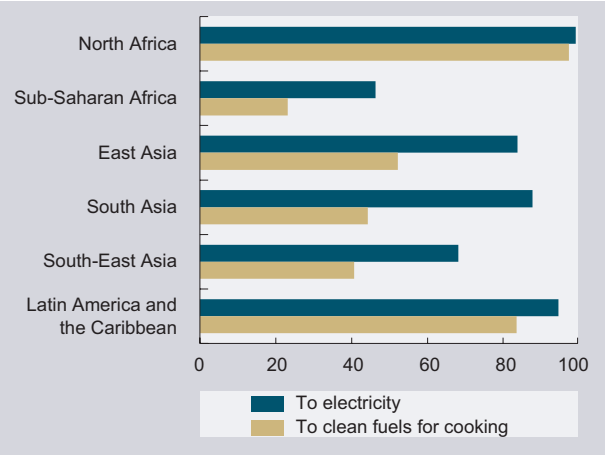
Source: AfDB, 2018: table 3.3.

FIGURE 4.5 Logistics performance index, 2016



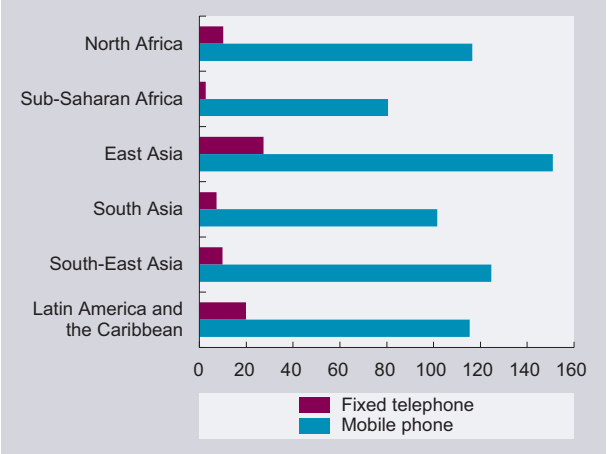
Source: World Development Indicators database, Logistics Performance Index surveys, conducted by the World Bank in partnership with public and private institutions engaged in international logistics.
Note: Respondents evaluated the quality of infrastructure related to trade and transport (e.g. ports, railroads, roads, information technology), assigning values from 1 (very low) to 5 (very high).

FIGURE 4.6 Energy access, 2016
(Percentage of total population)



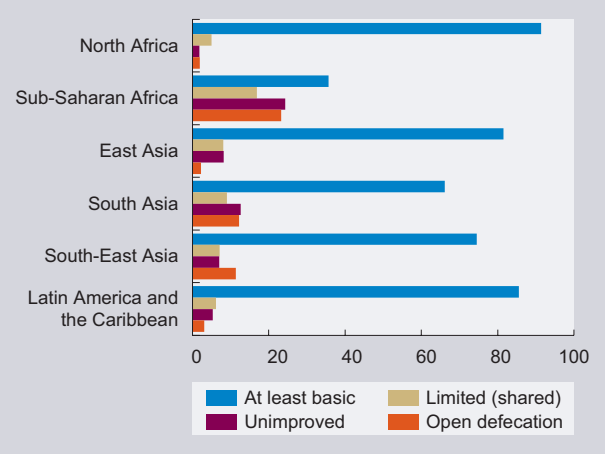
Source: UNCTAD secretariat calculations, based on World Development Indicators database.

FIGURE 4.7 Telephone access and use, 2016
(Subscriptions per 100 people)



Source: UNCTAD secretariat calculations, based on World Development Indicators database.

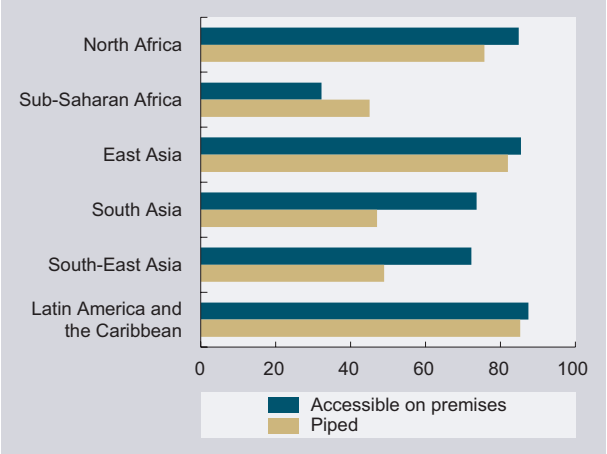
FIGURE 4.9 Sanitation facilities access, 2015
(Percentage of total population)



Source: UNCTAD secretariat calculations, based on WHO/UNICEF database (July 2017 update).

Telephone connectivity (whether through landline or mobile telephony) was seen in the previous chapter to be essential for taking advantage of new digital technologies. However, figure 4.7 indicates that, despite the significant recent expansion in such connections, there are still gaps in most developing regions. Meanwhile, access to infrastructure that is seen as essential for social and human development indicates even larger gaps in most developing regions. Figure 4.8 shows how the majority of the population of sub-Saharan Africa and large swathes of South and South-East Asia in particular do not have access to piped water, especially within homes. Gaps are also huge with respect to basic sanitation facilities, as evident from figure 4.9.

FIGURE 4.8 Safely managed water supply access, 2015
(Percentage of total population)



Source: UNCTAD secretariat calculations, based on WHO/UNICEF database (July 2017 update).

2. The financing gap narrative

Both the historical discussion and the challenges outlined in section B point to the need for countries to have a comprehensive long-term vision that recognizes the need to coordinate across sectors, regions and timelines, along with a more targeted medium-term planned approach towards infrastructure creation. This contrasts, quite sharply, with the current approach to infrastructure investment that looks at individual projects on a case-by-case basis to ensure that they are "bankable" (assuring repayment of loans taken for such investment) and requires that all investors in such projects get adequate returns.

The current approach can be traced back to two important changes that upended the policy discussion from the late 1970s. First, the sharp ascendency of a market-friendly perspective on infrastructure that gained wide currency by the 1980s prompted the emergence of a narrower view related to measuring, understanding and improving conditions for providing infrastructure at the micro level (see e.g. Andrés et al., 2013). This approach, along with intense scrutiny of the entire public investment-driven infrastructure model, led to a widespread privatization of public

infrastructure services in the 1980s, assisted by measures to downsize state spending, reduce regulatory oversight and liberalize financial markets. In the case of the United Kingdom, the resulting reorganization was not just a transfer of state-owned business into private hands; it entailed commercialization of infrastructure sectors in an "attempt to re-engineer public institutions on a model of market exchange" (Meek, 2014: 57). This view was promoted in developing countries, in particular, through the World Bank's *Doing Business Report*.[19] Second, the process of hyperglobalization that picked up steam during the 1990s (see *TDR 2017*) further cemented these processes by promoting a global shift towards privatized infrastructure services and the financialization of infrastructure provision. Priemus and van Wee (2013) note that infrastructure no longer is just a public good, but has now become a widely popular, globally traded, asset class. The long-term, steady nature of infrastructure investments has been instrumental in endearing it to markets, making them the chosen class for institutional financial investors such as insurance companies, pension funds sovereign wealth funds and other foundations (Weber et al., 2016).

The financing gap narrative with respect to infrastructure is built around a few key points. First, estimated infrastructure investment gaps in each country (discussed above) are taken to imply a financing gap of a similar order of magnitude. Second, it is taken for granted that national public sectors in most countries are financially constrained with limited budgetary resources, face governance problems and run the risk of running into debt sustainability issues if they undertake infrastructure investments on the scale needed in the coming years. Third, given this public resource constraint, private capital, which is typically invested in short-term financial assets, should be unlocked for infrastructure projects. Fourth, for this to occur, a pipeline of "bankable" projects needs to be developed.

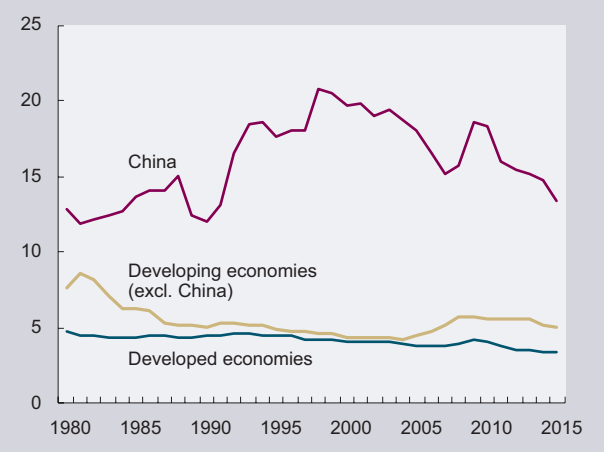
"Bankable" projects are defined as those "that provide investors with appropriate risk-adjusted returns" (Woetzel et al., 2016: 17). The standard diagnosis is that projects that fit that profile are currently scarce and the risk-adjusted returns of existing projects are too low to attract private investors. Numerous factors are pinpointed as restricting the delivery of "bankable" projects. These include low preparation capacity, high transaction costs, lack of liquid financial instruments, weak regulatory frameworks and legal opposition, along with various types of risks at the different phases of the life cycle of a project, such as: macroeconomic, political, technical and environmental risks at the phase of preparation; construction risks (overrun, cost escalation) during construction phase; and demand, operating and revenue risks (e.g. price and exchange risks; unrealized projected demand) at the operation phase (Serebrisky et al., 2015; Bhattacharya et al., 2012; Woetzel et al., 2016; G20, 2011).

In order to expand the supply of "bankable" projects, the proponents argue that new paths should be explored to enhance prospective returns and minimize risks that often arise during the life cycle of a project. To enhance returns, projects should be able to generate sufficient revenues over their life cycle, through adoption of user charges, public sector support (typically in the form of "viability gap finance") and additional funding. Proposed measures to reduce risks and uncertainties include: clear identification of actual returns and possible risks (including of default); development of governance structures to ensure approval of stakeholders, including through compensation schemes; provision of de-risking instruments such as sovereign and credit guarantees; and government mapping of long-term investment paths to reduce investors' uncertainty about the future (Woetzel et al., 2016; G20, 2011).

Other proposed measures to increase project "bankability" and thus attract private finance include the development of more liquid security exchanges, with governments acting as market makers (for instance, through issuing of equity and debt on their own infrastructure projects); and adoption of more favourable international investment frameworks, with limits on expropriation, effective compensation and binding dispute-resolution mechanisms. In addition, standardization of contractual terms is identified as important to attract funds to smaller projects, as is project pooling to reduce transaction costs and attract larger investors. Finally, supply-side constraints to additional private financing include strict pension investment rules and regulatory restrictions such as Basel III and Solvency II, which require more capital allocation for infrastructure (Woetzel et al., 2016: 23–26).

The list is long, but an important conclusion is that project "bankability" extends beyond the intrinsic characteristics of the project itself. It depends in large measure on the wider institutional and regulatory conditions in which private finance might (or

FIGURE 4.10 Trends in public investment, 1980–2015
(Percentage of GDP)



Source: UNCTAD secretariat calculations, based on IMF capital stock data set.
Note: Public investment here is General Government Investment (gross fixed capital formation).

not) be made available, such as better developed capital markets and an investor-friendly regulatory framework. In this scheme, planning is identified as necessary to create such "bankable" projects and, as the G20 puts it, "[m]ore resources are needed for project preparation… [as it] encompasses a wide range of activities that have to take place before a project can be of interest to potential financiers" (G20, 2011: 11). In line with this diagnosis, multilateral development banks are stepping in, by establishing joint investment platforms in which they provide technical expertise, capacity-building and financing instruments to increase the supply of "bankable" projects (G20, 2011; UNCTAD, 2018).

The financing gap narrative raises an important concern that is shared by the wider development community: the recognition that infrastructure development is indispensable for sustainable and inclusive growth. In many parts of the world, infrastructure investment has declined since the global crisis (Woetzel et al., 2016: 10). Public investment, which can be used as a proxy for infrastructure investment, in developed countries was at a historic low at 3.4 per cent of GDP in 2015, against 4.7 in 1980 and about 6 per cent in the 1960s. In emerging economies, it fell from above 8 per cent of GDP in the early 1980s to 4.3 per cent in 2000, recovering to 5.7 per cent in 2008 and declining again thereafter (figure 4.10). It is worth noting that the outlier in this respect was China, with impressive rates of public investment to GDP of 15 per cent to 20 per cent and associated high rates of output growth for several decades. The decline in public investment in developing countries in the 1980s and 1990s can be linked to adoption of fiscal adjustment policies in response to the debt crises and as part of structural adjustment programmes. The world as a whole is, therefore, underinvesting, and consequently creating a cumulative infrastructure gap, even though uncertainty remains as to its exact order of magnitude.

Nevertheless, the financing gap narrative has serious limitations. The first concern is with respect to the expected scale and role of private sector engagement in infrastructure development. As noted in section B, through history, domestic public financing for infrastructure development has been dominant; and experience suggests that such public sector dominance will continue even if private finance grows in the years ahead. Even today, where private finance exists, it comes in together with public funding. In Africa, domestic public finance accounts for 66 per cent of total infrastructure finance (G20, 2011: 7). In Latin America, instances in which private participation in infrastructure (PPI) occur have public finance accounting for a third of total project funding (Fay et al., 2017: 8).[20] In low-income countries, this proportion is nearly 75 per cent (G20, 2011: 10). In Asia, private investment dominates in the telecommunications sector and also has a significant presence in the energy sector, but its participation is very small in transport and virtually non-existent in water and sanitation (ADB, 2017). Thus, while private sector involvement in infrastructure investment may increase with greater supply of "bankable" projects, any rapid recovery of overall infrastructure investment in the future will critically depend on governments' capacities to carry out their leadership roles in planning and executing new infrastructure projects.

The reasons for public sector dominance in infrastructure have to do with the intrinsic characteristics of infrastructure projects. These include their long gestation periods, capital intensity, difference between private and social returns, complexity of planning and execution, the feedback loops with growth and economic development, the specificities of the countries executing infrastructure projects and the non-linear impacts of infrastructure investments (see section D). In addition, there are macro, institutional and environmental risks and uncertainties, factors that have a strong bearing on the viability and profitability of such projects. "Bankable" projects can mitigate some

of these problems when well planned and executed, but they do not eliminate them entirely. More broadly, infrastructure sectors are closely interdependent, and therefore it is critical that infrastructure development is approached systemically by the state, which is the only actor with the required political power and coordination capacity. Leaving the leadership role vacant and expecting the private sector to fill the gaps is likely to lead to an outcome in which a fragmented infrastructure landscape emerges, characterized by underinvestment, sectoral concentration of resources and persistently large infrastructure gaps.

This means that the overall development strategy should determine infrastructure planning (e.g. what scale to target, and which sectors and technologies to prioritize), and to indicate the resources required to achieve these goals. This implies a reversal of the sequencing suggested by the financing gap approach. Instead of starting with the identification of gaps between actual and needed investment for infrastructure, followed by rigid assumptions of government expenditure capacity, estimating private financing required and ending with project design strategies to attract private capital to fill in the gap, the start should be with a national development strategy. This would then be followed by a consideration of the infrastructure development needed to support this strategy, how government planning can support this process, how fiscal space may be expanded and what public–private investment mix could achieve these goals.

A second limiting aspect of the financing gap narrative is that a project is understood as "bankable" in ways that are not necessarily desirable, since the features that might make a project "bankable" may not conform to the sort of development a national government may want to pursue. For instance, to what extent will a "favourable" international investment framework, understood as a condition to make a project "bankable", rob a national government of precious space to pursue its policy goals? Or, to what extent may "bankable" projects entail trade-offs between productive and social infrastructures? Also, "bankable" projects imply de-risking by the public sector through provision of subsidies, which may erode governments' financial capacity to execute other elements of the national development plan. All this suggests that, within a clearly established national development strategy, the terms of project "bankability" should be set not by private actors but – if at all – by national governments to ensure consistency between means and ends. That is, the state should decide both what general (macro, institutional, regulatory) and specific conditions it may want to provide and what projects should be prioritized and (in case it decides in favour of private sector involvement) on what terms this should happen to ensure that private engagement is in line with national objectives.

A third problematic aspect of the financing narrative is the notion that the public sector is always and everywhere financially constrained because of restricted fiscal space and persistent or potential debt burdens, and therefore incentivizing the private sector to invest in infrastructure is the only option. To begin with, these incentives to private actors may turn out to have larger and more prolonged fiscal costs than anticipated, which would adversely affect public finances in any case. But more importantly, in reality, fiscal space and borrowing limits are not fixed, as revenues can be increased through various means and credit from the Central Bank can also play a role. This is important because public investment has the power to crowd in private investment, raising productivity, incomes and taxes. The successful historical experiences described in section B followed just such a trajectory.

Matters of legitimacy, credibility and trust are, undoubtedly, complex institutional issues when it comes to raising public revenue, but it can be argued that effective planning is just as big an issue facing many countries when it comes to the infrastructure challenge. This is considered in the next section.

D. A framework for considering the role of infrastructure in development

A strategy of unbalanced growth, as noted earlier, assumes that there are some sectors that generate more forward and backward linkages than others and that government policy should target those sectors in terms of its efforts to mobilize, channel and manage resources and capabilities in ways that support a more virtuous growth circle. As discussed in *TDR 2016*, this implies the use of active industrial policies, mixing both general and selective measures, to support efforts to diversify and upgrade the economy. The *Report* acknowledged that this would require substantial state capacity, including the capacity to discipline recipients of support as well as to stimulate a learning economy at all levels. In both respects, it also argued that to get the most out of active policies, the developmental state should establish a meaningful dialogue with the business sector and other stakeholders but in doing so should also avoid capture of the policy and regulatory framework by specific interest groups.

This chapter has argued that infrastructure programmes should also be seen as a complementary part of such a development strategy. However, infrastructure programmes do require government to take more of a planning perspective than is the case with industrial policy. The difference is a subtle but important one, particularly as the polarized debate between balanced versus unbalanced growth has tended to pitch industrial policy and planning as being opposed.

1. Some basic considerations

It is evident from the discussion so far that the specific features of infrastructure require moving beyond a purely project-led approach based on the financing gap narrative. Far from simply focusing on "small" mechanisms that identify and remove roadblocks for economic activities, "large" mechanisms that give strategic importance to certain industries play a critical role in promoting linkages through unbalanced growth thus inducing industrialization (Hausmann et al., 2008; Holz 2011: 221). In fact, both theory and experience suggest that infrastructure's role as an inducement mechanism to industrialization is dependent on how infrastructure investments are structured and whether key feedback loops between infrastructure, growth and economic development are factored into the infrastructure planning process. Some critical considerations that have direct relevance for organizing infrastructure investments in developing countries are as follows.

a. *The impact of infrastructure depends on the kind of investment*

Some types of infrastructure (such as roads and telecommunications) have a greater impact on productivity than others (e.g. air transport or sewage). Thus, for the development of linkages, it matters which infrastructure investments are prioritized. This in turn will depend upon how the stock of infrastructure has evolved historically relative to income, the pattern and pace of urbanization, the economic and institutional structures of countries (Fay et al., 2017) as well as how the investments are likely to induce linkages with local private sector activity.

b. *The impact of infrastructure is context- and sector-specific*

The impact of infrastructure on growth is influenced by initial conditions, which explains why infrastructure development has immediate and relatively large impacts on poorer countries, as opposed to advanced countries where there is already a relatively good network of infrastructure in place (Calderón and Servén, 2014). However, even at low levels of infrastructural development, there is no guarantee that new infrastructure of the same kind will result in similar outcomes across countries or sectors. For example, although there is a link between power outages and productivity of firms, these impacts will vary between countries and sectors, depending on how acute the problem of power provision in the country is, and how dependent a sector is on continuous power provision for its production (Moyo, 2013). Similarly, even in a context of overall paucity of roads, efforts to increase connectivity through road infrastructure are likely to have the most impact when targeted to those regions where industrial activity is more easily facilitated.

c. *The impact of infrastructure is non-linear*

Greater infrastructure investment does not always lead immediately to faster growth. Since

infrastructure investment typically has significant economies of scale, it begins to have an impact on private sector productivity only after a threshold level of infrastructure investment has been reached. The relationship between infrastructure and growth can therefore take the shape of an inverted "U" curve, where at initial stages, low or no infrastructure has no impact on growth, until after a threshold where additional infrastructure will contribute to sharp rises in marginal growth, until economies reach a level of infrastructure provision that is almost complete. From that point on, additional infrastructure investments have once again low or no impact on economic growth. As an example, constructing roads will have limited effects on growth until and unless some road networks are developed. At such a point, additional roads will prompt a sharp rise in output, until a large network has been established, after which point, any more roads or maintenance expenditure can be expected to have low or no output effects (Calderón and Servén, 2014).[21]

d. *The impact of infrastructure depends on network effects within and between different kinds of investments*

All forms of modern infrastructure – transport, electricity, telecommunications and broadband – exhibit their own network effects. For instance, in the case of the Internet, the greater the number of Internet users, the greater the possibility of providing various online services. But different infrastructure investments also exhibit network effects between themselves, because achieving economies of scale in infrastructure provision is often not just a case of providing for one kind of infrastructure but also entails complementarities between several other kinds of infrastructure investments (Agénor, 2010; Jiwattanakulpaisarn et al., 2012). For example, energy to promote production in rural areas would not necessarily lead to an increase in the rate of return to enterprises in the absence of other investments, such as roads or telecommunications. Thus, the recent large-scale electricity roll-out in Rwanda did not seem to have a large impact on micro-enterprises because of additional obstacles, such as inadequate transport links, that limit their expansion (Lenz et al., 2017).

In addition to these considerations, other policy choices and macro processes also play a role in determining how infrastructure interacts with growth and productivity. This includes the pace and nature of capital accumulation, technological advancement, institutions that determine the sequencing of infrastructure investment and its interaction with production capacities, linkages that emerge between sectors over time, and eventually, trade relations and international competitiveness (see Gomory and Baumol, 2000). This reiterates the need for planning, which is elaborated upon in the following subsection.

2. The role of planning in infrastructure development

Rapid economic transformation is unlikely to occur spontaneously, and throughout the twentieth century successful countries have relied on planning by the state to "initiate, spur, and steer economic development" (Myrdal, 1970: 175), whether in centrally planned regimes, mixed economies or largely market-based private investment dominated economies. However, from the late twentieth century, planning went into decline as a state tool for economic transformation, except in East Asian economies. Recently it has staged something of a comeback, as more developing countries are discovering the long-term costs of unplanned growth.

Planning involves a wide range of choices, from what sectors to prioritize and technologies to adopt, to the degree of macro coordination of investment decisions, to the amount of resources required and how to mobilize them (Chandrasekhar, 2016). Infrastructure planning is likely to assume different forms in different contexts, so plans need to be based on economic, social and geographical realities and aspirations, rather than any pre-established blueprint to guarantee a successful outcome. The design and execution of an infrastructure plan should take into account a country's stage of development, existing infrastructure, industrial capabilities and expansion plans, urban versus rural divides, levels of policy ambition, existing infrastructure institutions and their coordination, availability of new financial, technical or other resources and the existence of political and managerial capacity for effective implementation.

Therefore, infrastructure planning that fits broadly into a national economic development strategy would include the following elements:

- a vision for the infrastructure sector in the long term in the context of the broader national industrial development strategy;

- a consistent time frame to allow for coordination of infrastructure planning with other goals of development planning;
- a life-cycle analysis that allows for feedbacks and improvements and that takes into consideration broader economic and social benefits (market access, poverty alleviation);
- flexibility to respond to possible technological forecasts and potential disruptions or to path-changing contingencies such as the need to promote green technologies as a result of climate change;
- a systemic approach that addresses sectoral interdependencies; and
- coordination between different government levels and departments.

Some models of infrastructure planning guidelines have been developed in recent years with the purpose of providing a road map to national governments.[22] These guidelines present additional aspects to those just outlined, such as:

- setting up an adequately staffed central infrastructure unit, under the supervision of the prime minister or president to ensure projects are prepared and executed;
- understanding of the current infrastructure situation and preparation of a list of gaps and deficiencies that need to be addressed;
- looking for solutions with the largest economic and social benefits while minimizing negative social and environmental outcomes;
- laying out the framework and modalities for private sector participation; and
- moving from planning to action by publishing the plan, ensuring the necessary policy changes for the selected projects and finalizing detailed project preparation.

The Infrastructure Consortium for Africa (ICA) defines project preparation as "a process which comprises the entire set of activities undertaken to take a project from conceptualization to actual implementation" (ICA, 2014: 2). But various obstacles to (and shortcomings of) infrastructure project preparation have been identified in recent years, including lack of coordination; lack of funding to cover the project preparation costs, which could be between 3 per cent and 12 per cent of total project costs; lack of institutional and human capacity for planning, project appraisal and preparation; overly rigid and myopic budgeting, which can limit multi-year costing and thus inclusion of large and long-term projects; a disconnect between decentralized project planning and overall fiscal targets and plans; and lack of a robust public investment management process to deal with the complex interplay between politics and planning (Fay et al., 2017; AfDB, 2018).

Focusing on planning more broadly, Alberti (2015) identifies further shortcomings from country case studies in Latin America, including: lack of intersectoral planning; narrow cost–benefit analysis that does not take account of project linkages or externalities and the requirements of regional or sectoral development; failures to anticipate social reactions; no penalties if a national development plan is not followed through; inadequate time for planning activities in public entities crowded out by portfolio administration time; lack of specialists to assist the public sector and poaching of human resources from the public sector during growth phases, when project preparation is needed most due to growing demand for infrastructure services. Looking at both developed and developing-country experiences with large infrastructure projects, Flyvbjerg (2009, 2007) makes the additional point that such projects tend to be characterized by cost overruns, benefit shortfalls and underestimation of risks. In his assessment, much of this has to do with perverse incentives whereby planners deliberately miscalculate costs and benefits to have their projects approved. However, this assessment is project-based and therefore appears not to include the linkages and externalities.

In the early stages of planning, some critical features for success include: clear political support from the top; better coordination between governmental agencies and departments; the recognition of sectoral interdependencies; the generation of political consensus of a kind that incorporates demands from weaker stakeholders; better staffed planning units for effective design of projects; and feasibility studies that take into account broader development benefits. In the later planning stages, a multi-year budgetary approach is necessary to reduce disruption. Procurement practices could be used as a tool to strengthen industry linkages, in addition to serving the purpose of cost reductions. Studart and Ramos (forthcoming 2019) highlight the positive role played by national development banks through their planning capacity, financial clout and available

instruments, including taking projects off the ground and contributing to the build-up of an infrastructure financing architecture with cross-party support.

It is likely that de-emphasizing the "bankability" of projects would reduce much of the complexity and costs in infrastructure planning, since the financial arrangements needed to bring the private sector on-board are unduly complicated. The costs involved are not just those of fees for banks or consultants on financial engineering, or upfront financial incentives but, equally important, the contingent liabilities that build up in the course of a project (*TDR 2016*). The latter are hard to anticipate fully, often impacting on future fiscal capacity to maintain support for infrastructure development.

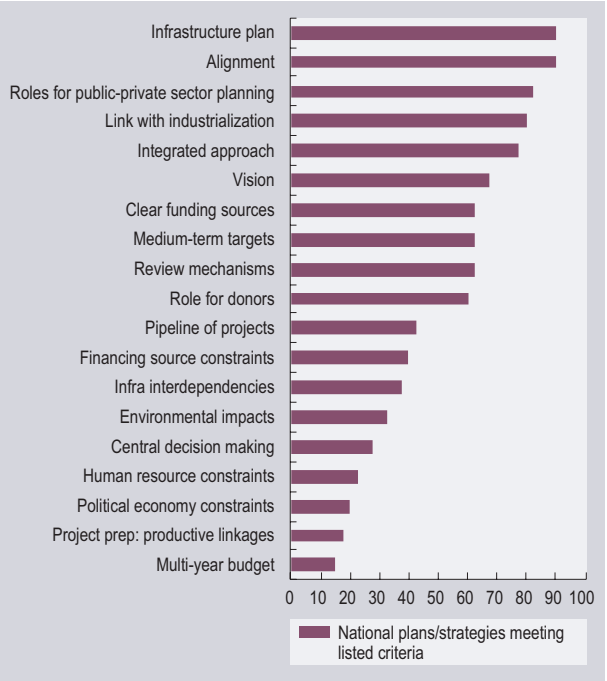
3. Experiences with national development plans: Country evidence

Since the early 2000s, many developing countries have started to prepare and publish national development plans. These initiatives do not necessarily imply that countries rigorously stick to each of their provisions, but rather indicate a vision which countries may want to pursue in terms of their national trajectories. Many countries initially produced these as a follow-up to national (or poverty-reduction) strategies under IMF–World Bank funded programmes, with uncertain government commitment or resources for effective implementation. At the same time, under the broader frameworks of the Millennium Development Goals and now the Sustainable Development Goals, these plans have evolved and in many cases appear to be taking the form of incipient, broad-based national efforts to build a coherent development strategy. Their underlying motivations seem based on the growing understanding that only through development planning will developing countries be able to accelerate growth, develop their productive capacities and achieve greater economic diversification.

This subsection looks at national plans of 40 developing countries, elaborated from the beginning of this millennium, to assess how they fare in terms of including infrastructure plans and the extent to which they address questions of structural change, linkages and productivity growth.

Ninety per cent of all the 40 national development plans considered here contain some sort of infrastructure plan. The infrastructure plans are then assessed with respect to their vision of the country's infrastructure into the next 20–30 years, whether the plans are comprehensive or focused, which sectors are covered, and if the links to other policy objectives such as industrialization and economic diversification are clearly stated. Other aspects covered include these questions: Is there a clearly designated centralized decision-making unit or agency? Do countries identify clear funding sources and adopt a multi-year budget approach? Is the role for the private sector, international donors or agencies specified, and to what extent? Are review mechanisms present? Do the plans address specific constraints, such as in the areas of skills, resources, capacity, legislation, environmental impacts and financing sources? Is a detailed pipeline of projects provided, and life-cycle analysis of project preparation? Do projects take into account productive linkages and externalities, going beyond traditional cost–benefit analysis?

FIGURE 4.11 Infrastructure planning: Country evidence
(Percentage of total)



Source: UNCTAD secretariat calculations, based on national development plans (or strategies) of 40 countries.

Note: These countries are: *Africa*: Botswana, Burkina Faso, Chad, Ethiopia, the Gambia, Guinea, Kenya, Lesotho, Malawi, Mozambique, Namibia, Somalia, South Africa, Uganda, United Republic of Tanzania and Zambia. *Asia*: Afghanistan, Bangladesh, Bhutan, Cambodia, Fiji, Malaysia, Papua New Guinea, the Philippines, Solomon Islands, Tajikistan, Thailand, Turkey, Vanuatu, Viet Nam and Timor-Leste. *Latin America and the Caribbean*: Bolivia (Plurinational State of), Colombia, Ecuador, Guatemala, Jamaica, Nicaragua, Peru, Trinidad and Tobago, and Costa Rica.

The results of the assessment are summarized in figure 4.11. While these cannot provide evidence on implementation within countries, they nevertheless provide an indication of how extensive such national plans are, in terms of their levels of coverage and depth. Overall, plans score well in terms of vision, alignment with the broader country's strategy and links with policy goals such as industrialization or productive diversification. Most plans also identify clear funding sources and a role for the private sector in infrastructure development. However, these plans score considerably less well beyond these broad features. Less than 40 per cent of such plans address the important issue of infrastructure interdependencies, just above 20 per cent make clear references to central decision-making and only about 15 per cent include multi-year budgets. In addition, less than 40 per cent of such plans, and in some cases less than 20 per cent, address different sorts of constraints such as in the areas of skills, environmental impacts or sources of finance.

Even where assessment is more positive, such as in the areas of vision, alignment and links with industrialization/diversification goals, a more detailed reading of the plans suggests that: visions are not fully developed or really long term or do not anticipate possible challenges (of technological nature, other) or obstacles; alignment does not specify the channels through which infrastructure development may support a broader development strategy; and links with industrialization/diversification do not clearly articulate how development of certain types of infrastructure might lead to the latter, lacking description of specific linkage identification or which tools might be needed to establish such linkages.

Experiences with infrastructure development in the recent past might have been richer on the ground than the infrastructure plans surveyed convey. However, if these plans do capture the level of governments' commitment to infrastructure planning and development, then considerably more work is needed, for both more robust national infrastructure and development strategies, to ensure infrastructure development does play the fundamental role it can have in transforming developing economies.

E. Conclusion

Managing structural transformation is a big challenge at all levels of development. In part, that is because the mixture of creative and destructive forces accompanying such a transformation do not automatically translate into a virtuous growth circle while the rents that are inevitably created in the process can be captured by a privileged group in ways that clog the economic arteries and increase the dangers of a political stroke. There are already signs of this happening with the digital revolution. However, this is not inevitable and if history is any guide, public policy, including industrial policy, can help to manage more inclusive and sustainable outcomes. The chapter III set out some elements of that agenda.

This chapter has argued that structural transformation will also need to be accompanied by infrastructure planning. However, even as the funding for infrastructure has begun to recover after decades of decline, serious discussion of what is needed to effectively embed infrastructure programmes in a development strategy has not followed. Indeed, even when infrastructure has been included in national plans, there does not appear to be any clear framework for moving from ambition to implementation. This disconnect is in part the result of a singular ideological drive to limit the infrastructure challenge to a matter of project bankability, leaving it solely in the hands of finance ministries. But it also reflects a reluctance on the part of governments in developing countries to think about the challenge in a more comprehensive and integrated manner and to invest in the techniques, skills and institutional capacities required to ensure that infrastructure will not just build bridges but ensure those bridges deliver on the ambitions of the 2030 Agenda. In that respect, the chapter has suggested that the old debate between balanced and unbalanced growth provides a rich discussion for thinking about those techniques, skills and institutional requirements. The bottom line when it comes to infrastructure spending is that it is too important a development matter to be left to the sole responsibility of finance ministries. ■

Notes

1 A good is non-excludable if people cannot be excluded from consuming it because of non-payment or other criteria and it is non-rivalrous if its consumption by one person does not prevent others from consuming it.

2 According to Markard, 2011: table 3, capital intensity is judged as very high in electricity and water supply, sanitation and road transport; regulation intensity as stronger in water and sanitation; systemic importance is highest in electricity supply, railway transport and telecommunications, and public-sector dominance is found in water supply and sanitation, and railway and road transport.

3 Telecommunications infrastructure is often intertwined with digital infrastructure, but as chapter III indicated, digital infrastructure contains several additional components.

4 This is contrary to the argument made in some recent literature, that infrastructure investment can crowd out private investment (see Agénor and Moreno-Dodson, 2006, for example).

5 For instance, Africa has a power infrastructure investment backlog of over US$40 billion and the world's lowest electrification rate with around 30.5 per cent (Odey and Falola, 2017; Nyambati, 2017). So any additional infrastructure investment in electricity in Africa can be expected to have significant effects on growth, private economic activity and conditions of life.

6 *The Economist*, 2017, based on World Bank calculations.

7 Laid out in Chevalier's book *Système de la Méditerranée*, 1836.

8 The Republic of Korea's first five-year development plan (1962–1966) identified infrastructure as key to support the development of light industries, focusing on the construction of 275 km of railway and many highway projects (Ro, 2002). In the third five-year plan (1972–1976), there were comprehensive programmes to develop airports, seaports, highways, railways and telecommunications (Ro, 2002). Such coordinated infrastructure expansion continued through the subsequent decades, particularly in the 1990s to deal with the emerging extreme infrastructure congestion.

9 This can be contrasted with sluggish public infrastructure investment in India, which has held back the private sector, while in China it has lent a much-needed boost to stimulate demand (Shi et al., 2017).

10 For example, when the Republic of Korea faced additional infrastructure pressures, the Private Capital Inducement Act of the Republic of Korea was formally launched in 1994. This set out the framework conditions for private sector investment in infrastructure provision (World Bank, 2009). The Act identified two categories of investments – strategic infrastructures (roads, railways, subways, ports, airports, water supply and telecommunications) and other infrastructure projects, including gas supply, bus terminals, tourism promotion areas and sport complexes (World Bank, 2009) but the state retained its overseer role in both.

11 These figures are adjusted for sector coverage, are for the period 2016–2030 and are expressed in 2015 United States dollars. The sources are: OECD, 2017a; Bhattacharya et al., 2016; Woetzel et al., 2016; NCE, 2014. As a proportion of global GDP, these figures are in the range 4.8 per cent to 8.3 per cent, assuming global GDP grows in real terms over the years 2016–2023 according to projected rates of IMF WEO Database April 2018 and then at 3 per cent over 2024–2030. These proportions might be compared against investment estimates presented by Woetzel et al. (2016) at 3.5 per cent of global GDP in the past two decades.

12 According to the Global Commission on the Economy and Climate, sustainable infrastructure means, first, that infrastructure is socially sustainable, by: being inclusive and contributing to people's livelihoods and social well-being; and supporting the needs of the poor and reducing their vulnerability to climate shocks. Second, that it is economically sustainable, whereby it creates jobs and boosts growth but does not create unsustainable debt burdens for the government or high costs for users. And, third, that it should be environmentally sustainable by limiting pollution, supporting conservation and the sustainable use of natural resources, contributing to a low-carbon and resource-efficient economy and withstanding climate change impacts (NCE, 2016: 22).

13 Some estimates comprise only capital investment while others include expenditure on operations and maintenance as well. Some methodologies are based on sectoral analysis with consideration of use of more efficient technologies (e.g. OECD, NCE) plus a country-by-country assessment (e.g. Woetzel et al., 2016). In the case of Bhattacharya et al. (2016: 26–28), a macro-simulation is used in which current investment spending is calculated for the base year and then projections for investment requirements are obtained using assumptions on expected growth and investment rates, based on assessments of investment plans from major economies and regions.

14 According to Woetzel et al., 2016, disruptive technologies involve new technologies such as additive manufacturing, advanced automation and modular construction, and new products and services such as autonomous vehicles, drone deliveries and e-commerce, which have the potential to drastically shift the demand between different sources of energy (e.g. from fossil fuel to renewables), reduce the demand

for specific types of infrastructure (e.g. transport – roads, ports) and change how infrastructure is built, with the ultimate effect of radically reshaping the infrastructure sector.

15 These estimates of investment needs are at constant prices and comprise power, transport, telecommunications, water and sanitation; and exclude investment required for climate change. Actual investment is based on latest available year (UNCTAD, 2014: 142). Bhattacharya provides an alternative estimate for developing countries, of $3.5 trillion–$4 trillion (at 2015 dollars) per year over the period 2016–2030, against actual infrastructure investment at $2.2 trillion in 2014, with China alone accounting for $1.3 trillion (Bhattacharya et al., 2016: 21–28).

16 These figures exclude expenditures on operation and maintenance and include additional investment needed to make investments sustainable. See Bhattacharya et al., 2012.

17 Other estimates of infrastructure investment needs for the LAC region fall in the range 3 per cent to 8 per cent of GDP, against actual spending at 2.8 per cent (Fay et al., 2017: table ES1 and box table 1). Serebrisky et al., 2015, and Serebrisky, 2014, drawing on a range of studies, suggest needs of 5 per cent of GDP.

18 In United States dollar terms, the AfDB, 2018: 64, puts the infrastructure needs for Africa at between $130 billion and $170 billion a year, and a financing gap of $68 billion to $108 billion. Previous estimates, produced by the Africa Infrastructure Country Diagnostic, indicated needs of $93 billion a year in 2008, with a financing gap at $31 billion (AfDB, 2018: 64, 2013: 7).

19 That Report attempts to provide "objective" measures of business regulations and their enforcement across 190 economies and selected cities. Higher values on the index are taken to indicate "better" (usually simpler and more liberal) regulations for businesses and stronger protection of property rights, and these results have been used to influence policymakers to move towards liberalizing rules, often without appropriate recognition of the context or broader development considerations. There has been much criticism of both the choice of indicators and the manner of measurement (typically based on interviews conducted in one city of the country concerned) not just from civil society but from the Independent Panel appointed by the President of the World Bank and headed by Trevor Manuel, former Finance Minister of South Africa (World Bank, 2013).

20 This portion of public finance comes from development banks, export credit agencies and other public authorities and companies (Fay et al., 2017: 20).

21 As an example, a recent study on understanding the regional growth determinants in the European Union between 1995 and 2010 concluded that transport and telecommunications investments have a non-linear relationship with growth in the European Union countries (Sanso-Navarro and Vera-Cabello, 2015).

22 Some of these are elaborated in Bhattacharya et al., 2016; Schweikert and Chinowsky, 2012; WEF and PWC, 2012; Alberti, 2015.

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