11 Accelerators and Systemic Bottlenecks

Along with the 2030 Agenda of the Sustainable Development Goals, the United Nations has promoted two closely related concepts in the policymakers' toolkit: *accelerators* and *bottlenecks*. Broadly speaking, accelerators are policy issues that, if their associated policies are well-funded, can catalyse overall development (i.e., across multiple policy dimensions) via indirect effects. In contrast, bottlenecks refer to policy issues that, if their associated policies are poorly funded, can obstruct the development of other policy issues. Both concepts are part of official discourse and policy literature (e.g., Garmer, 2017).

Regarding bottlenecks, we have already studied one type in Chapter 7 and established that the quantitative literature lacks appropriate methods. The situation is even direr for accelerators, because this concept is more recent and not treated formally. For example, these two terms are often confused with the ideas of synergies and trade-offs. That is to say, with policies that complement each other (i.e., present positive feedback) or that block each other (i.e., present negative feedback), respectively. The lack of precise definitions precludes a proper quantitative treatment of accelerators and bottlenecks. Ultimately, this limits the possibility of identifying accelerators and bottlenecks and prevents the proper usage of policy strategies that either exploit or mitigate their effects.

In this chapter, we view the identification of accelerators and bottlenecks as a problem of estimating indirect effects *at a systemic level* (i.e., with the help of a network of interdependencies). To differentiate these bottlenecks from those analysed in Chapter 11 (idiosyncratic bottlenecks), let us refer to the bottlenecks analysed in this chapter as *systemic bottlenecks*. From a short-term

perspective,[1] public funding is one of the main drivers for indicators to exert third-party effects, either direct or indirect. Thus, we need to embed both concepts in the context of the expenditure–development relationship.

To formalise the distinction between accelerators and bottlenecks, we have to conceptualise them in terms of controlled budgetary experiments. In this sense, we identify an accelerator by performing counterfactual expenditure increments on a particular policy issue while leaving the remaining policy issues with their original budgets. Under this setting, comparing the performance across non-intervened issues with their levels in the baseline scenario provides valuable information to determine an accelerator. In other words, a policy operates as an accelerator if receiving more funding improves indirectly the performance of other development dimensions when the latter does not receive additional budgetary resources.

In contrast, a policy can be conceived as a bottleneck when the removal of funding indirectly hinders the performance of other policy issues, even when these issues keep receiving financial resources. Identifying accelerators and systemic bottlenecks would be extremely challenging under a dependence account of causation (see Chapter 2), as it would require observational data on 'natural' experiments for each development dimension. Thus, PPI offers significant benefits as a viable method to formalise and quantify these concepts when the only option available is to use synthetic data.

The empirical study of bottlenecks and accelerators demands a new conceptualisation, a specific simulation strategy, and more granular data than used so far in the book. Thus, in this chapter, we introduce a dataset linking expenditure, at the level of SDG targets, to specific development indicators within those targets for the 2008–2020 period. Such linkage is not one-to-one, as there are multiple indicators per target, and there may also be indicators classified into

[1] In which policies and government programmes are already working and not experiencing substantial alterations.

several targets. Nevertheless, PPI is well equipped to handle such a nuanced data structure. Next, let us briefly introduce some of the literature discussing these concepts and then develop our analysis.

11.1 ACCELERATORS, BOTTLENECKS, AND THEIR EMPIRICAL QUANTIFICATION

Since the concept of bottlenecks is more widespread than that of accelerators, let us begin by discussing the former. The idea of a development bottleneck is well ingrained in the economic development literature. Under the traditional conception, an underdeveloped sector or a malfunctioning policy obstructs economic performance – usually measured in terms of growth. For example, the theory of the Big Push (Rosenstein-Rodan, 1943)[2] asserts that some countries can develop only when different economic activities make substantial investments in a synchronised manner. Presumably, these sectors are interrelated in a production chain and operate under economies of scale. For instance, the railroad industry might not have flourished without large investments in steel production and coal mining. Although trains and their railroad lines create a demand for these inputs, the latter industries are only profitable when their large production reduces unitary costs.

Another example comes from macroeconomics and the research programme known as growth diagnostics. According to this proposal, financial, economic, or governance constraints can prevent the successful implementation of policy reforms. Because a comprehensive package is always politically unfeasible, it is indispensable to identify bottlenecks (i.e., malfunctioning policies) so that selected interventions can ignite growth in a developing country (Hausmann et al., 2008a,b; Rodrik, 2009). In growth diagnostics, the discovery of these policies is highly contextual, and one's ability to find them resides in the idea that bottlenecks produce the scarcity of some critical resources. Hence, prices – or shadow prices – of specific factors

[2] See also Murphy et al. (1989) for a mathematical model.

(e.g., credit, education, infrastructure, public governance) should be used as guides to establish reform priorities.

These two examples illustrate the relevance of bottlenecks and offer an idea of the needed methodological requirements to proceed with their study. That is to say, these examples show troublesome complications in identifying bottlenecks and their empirical quantification. For instance, the presence of highly contextual settings and the absence of data that accounts for the interrelationships between policies. In the case of the Big Push, the bad experiences of industrial policies and state planning in Africa and Latin America are well known. Thus 'picking winners' under a solid empirical basis becomes challenging. In the case of growth diagnostics, there are multiple limitations. First, if many policies are involved when selecting priorities, the amount of expert knowledge required to inform such selection becomes excessive, even in logistic terms.[3] Second, price distortions make difficult the identification of binding constraints. Hence, non-price signals need to be employed instead (e.g., the extent of the informal market), but it is not an easy task to estimate such signals. Like many other development frameworks, growth diagnostics provides a narrow view of development that focuses solely on economic growth, ignoring the multidimensionality and complexity of sustainable development.

The idea of development accelerators is more recent and has become a common discussion in the SDG literature. Authors usually conceive accelerators as policies that catalyse overall development without conveying what 'overall development' entails (e.g., all SDGs, only some, or only a few). Typically, studies in this line of research construct a network of interdependencies between indicators,[4] and attempt to identify policy issues with positive links and a high degree of centrality. High-centrality nodes are interpreted, in some studies,

[3] It is neither cheap nor time-feasible to gather experts in every policy dimension regularly.

[4] Some works on SDG networks are Blanc (2015); Allen et al. (2016); Zhou and Moinuddin (2016); Pradhan et al. (2017); Weitz et al. (2018); Allen et al. (2019).

as accelerators and, hence, their authors advocate their promotion. For example, based on these studies, some analysts would argue that promoting public governance could produce collateral benefits in a wide variety of policy issues: economic and financial infrastructure, health, poverty alleviation, reductions in gender inequalities, protection of the ecological environment and so on a so forth. We have already warned the reader, in Chapter 3, about the potentially misleading conclusions of these studies and the dangers of shaping policies according to their results only.

Let us highlight some of the main analytical drawbacks to the approaches undertaken in the literature on accelerators. First, as discussed in Chapter 3, networks of indicators or SDGs cannot be causal. Thus, one cannot expect that by fostering a node, those connected to it through outgoing links will exhibit improvements.[5] Second, not all the nodes in a network relate to government programmes that receive public funding. Therefore, some nodes or indicators cannot be directly intervened (e.g., GDP, income distribution), despite having positive spillovers. For this reason, it is necessary to differentiate between instrumental and collateral indicators. Third, macro-level interventions usually imply injecting more public funds. Accordingly, analysts should explicitly consider how to distribute such funds across multiple policy issues. Failing to do so could lead to trivialising the budgetary allocation problem; something that, as we have shown in Chapter 8, can lead to development traps.

11.2 DATA

11.2.1 Government Expenditure

We mentioned previously that, nowadays, it is complicated to come across datasets where a large amount of records on public spending is disaggregated at the level of government programmes and linked to

[5] In other words, when a directed link between two indicators (X → Y) is present in a network of policy issues, one cannot infer that a positive change in X will always produce a change in Y, even after controlling for a set of Z variables possibly related to Y. At least not with aggregate observational data such as development indicators.

development indicators. We have also insisted that some countries in Latin America – Mexico being one of them – are leading examples of the generation of such datasets. Here, we use the first and most comprehensive dataset with these characteristics. This dataset includes information collected by the Mexican Finance Ministry (SHCP, for its name in Spanish).

The SHCP publishes every year data on the approved (for the coming fiscal year) and the exercised (for the ending fiscal term) national budgets. These data are disaggregated into each government programme, totalling thousands of programmes. Despite their high granularity, what is most innovative about these data is that each government programme is linked to one or more SDGs and SDG targets. This matching uses a methodology that the SHCP developed in 2017 (SHCP, 2017), which has motivated many other initiatives in the open-spending community. In Guariso et al. (2023a), we discuss this method and how expensive it is, which is one of the reasons this type of data is so rare. Nevertheless, in the same article, we also show that it is possible to mitigate these costs with the help of natural language processing and other artificial intelligence methods.

In this chapter, we use the SHCP information to construct a dataset with annual exercised budgets at the level of each SDG target. Recall there exist 169 targets within the SDGs. From these targets, the SHCP identifies a subset directly affected by the national government programmes. Thus, the data consider the total annual government expenditure (per capita and in Mexican pesos) devoted to each target. Once we combine the expenditure data with the available indicators, we end up with 76 SDG targets. These are the expenditure tranches specified in the disbursement schedule of the model. Overall, the analysed period covers the years between 2008 and 2020.

11.2.2 Development Indicators

In terms of development indicators, we collect data reported by INEGI (the National Statistics Institute) to the official SDG platforms of the UN (UNSDG) and the World Bank. We categorise each of these

indicators into an SDG and a target Thus, we end up with 139 development indicators classified into 76 targets. First, in Table 11.1, we present all the targets in our dataset. Then, in Table 11.2, we show all the indicators and the main target in which they are classified. Notice that many targets in this dataset are matched with more than one indicator (e.g., 1.3, 1.5, 2.2, 2.5, 3.1, 3.2, 3.3) Likewise, most indicators are connected to a single target. However, there are a few exceptions such as 'domestic material consumption' (EN_MAT_DOMCMPT) classified into multiple targets (8.4 and 12.2). Interestingly, it is also possible to observe indicators classified in targets that belong to more than one SDG. This multiple matching means that the government expenditure devoted to different SDGs may impact the performance of such indicators.

Finally, in Figure 11.1, we show with more clarity the nuanced structure of linkages between targets and indicators. This chart gives us a detailed characterisation of the government expenditure landscape, and PPI provides an analytical framework to analyse it properly. For example, this information allows us to identify whether government spending dedicated to a specific target exerts a direct impact on several indicators, either from the same SDG or a different one.

11.3 SIMULATION STRATEGY

In Chapter 9, we discussed the impossibility of capturing systemic impacts through the traditional statistical analysis of development indicators. One of the reasons for such impossibility is that, in the short term, governments do not directly intervene indicators but rather use public funds to finance already-existing programmes designed – in principle – to impact the associated indicators. Thus, any attempt to quantify systemic effects needs to consider changes in the budgets of government programmes.

Therefore, we exploit PPI's ability to study the effect of exogenous changes in government expenditure. Here, we focus on exogenous changes produced in specific targets. A simulated intervention consists of choosing one target j and running a set of Monte Carlo

Table 11.1 *SDG targets that have corresponding indicators and budgetary data*

Target code	Target name
1.1	Eradicate extreme poverty
1.2	Reduce at least by half the proportion of men, women and children of all ages living in poverty
1.3	Implement nationally appropriate social protection systems and measures for all
1.5	Build the resilience of the poor and those in vulnerable situations
2.1	End hunger
2.2	End all forms of malnutrition
2.3	Double the agricultural productivity and incomes of small-scale food producers
2.5	Maintain the genetic diversity of seeds
3.1	Reduce the global maternal mortality ratio to less than 70 per 100,000 live births
3.2	End preventable deaths of newborns and children under 5 years of age
3.3	End the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases
3.4	Reduce by one-third premature mortality from non-communicable diseases
3.5	Strengthen the prevention and treatment of substance abuse
3.6	Halve the number of global deaths and injuries from road traffic accidents
3.7	Ensure universal access to sexual and reproductive healthcare services
3.8	Achieve universal health coverage
3.9	Substantially reduce the number of deaths and illnesses from hazardous chemicals and contamination
3.a	Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control
3.b	Support the research and development of vaccines and medicines
3.c	Substantially increase health financing

3.d	Strengthen the capacity of all countries for early warning of national and global health risks
4.1	Ensure that all girls and boys complete free, equitable and quality primary and secondary education
4.2	Ensure that all girls and boys have access to quality early childhood development
4.3	Ensure equal access for all women and men to affordable vocational and tertiary education
4.4	Substantially increase the number of youth and adults who have relevant skills
4.5	Eliminate gender disparities in education
4.6	Ensure that all youth and a substantial proportion of adults achieve literacy and numeracy
4.c	Substantially increase the supply of qualified teachers
5.1	End all forms of discrimination against all women and girls everywhere
5.3	Eliminate all harmful practices, such as child, early and forced marriage and female genital mutilation
5.4	Recognize and value unpaid care and domestic work through the provision of public services
5.5	Ensure women's full and effective participation and equal opportunities for leadership
6.1	Achieve universal and equitable access to safe and affordable drinking water for all
6.2	Achieve access to adequate and equitable sanitation and hygiene for all and end open defecation
6.4	Substantially increase water-use efficiency across all sectors
6.b	Support and strengthen the participation of local communities in improving water and sanitation management
7.1	Ensure universal access to affordable, reliable and modern energy services
7.2	Increase substantially the share of renewable energy in the global energy mix
7.3	Double the global rate of improvement in energy efficiency
8.1	Sustain per capita economic growth in accordance with national circumstances
8.2	Achieve higher levels of economic productivity through diversification
8.3	Promote development-oriented policies that support productive activities

Table 11.1 *(cont)*

Target code	Target name
8.4	Improve progressively global resource efficiency in consumption and production
8.5	Achieve full and productive employment and decent work for all women and men
8.6	Substantially reduce the proportion of youth not in employment, education or training
8.7	Take immediate and effective measures to eradicate forced labour
8.10	Strengthen the capacity of domestic financial institutions
9.1	Develop, quality, reliable, sustainable and resilient infrastructure
9.2	Promote inclusive and sustainable industrialization
9.4	Upgrade infrastructure and retrofit industries to make them sustainable
9.5	Enhance scientific research
9.b	Support domestic technology development, research and innovation in developing countries
10.2	Empower and promote the social, economic and political inclusion of all
10.7	Facilitate orderly, safe, regular and responsible migration and mobility of people
10.b	Encourage official development assistance and financial flows to States where the need is greatest
11.1	Ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums
11.5	Significantly reduce the number of deaths and the number of people affected by disasters
11.6	Reduce the adverse per capita environmental impact of cities
11.b	Increase the number of cities adopting and implementing integrated policies and plans towards inclusion
12.2	Achieve the sustainable management and efficient use of natural resources
14.4	Effectively regulate harvesting and end overfishing
14.5	Conserve at least 10% of coastal and marine areas
15.1	Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services

15.6	Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources
16.1	Significantly reduce all forms of violence and related death rates everywhere
16.2	End abuse, exploitation, trafficking and all forms of violence against and torture of children
16.5	Substantially reduce corruption and bribery in all their forms
16.6	Develop effective, accountable and transparent institutions at all levels
16.9	Provide legal identity for all
17.1	Strengthen domestic resource mobilization to improve domestic capacity for tax and other revenue collection
17.2	Developed countries to implement fully their official development assistance commitments
17.3	Mobilize additional financial resources for developing countries from multiple sources
17.4	Assist developing countries in attaining long-term debt sustainability
17.6	Enhance North-South, South-South and triangular regional and international cooperation on and access to science technology and innovation
17.11	Significantly increase the exports of developing countries
17.17	Encourage and promote effective public, public-private and civil society partnerships
17.18	Enhance capacity-building support to developing countries
17.19	Build on existing initiatives to develop measurements of progress on sustainable development

Notes: This list contains all the targets that can be matched to expenditure programmes and development indicators in the case of Mexico.

Sources: Sustainable Development Goals.

Table 11.2 *Development indicators*

Target code	Indicator code	Indicator name
1.1	SI_POV_DAY1	Proportion of population below international poverty line (%)
1.2	SD_MDP_MUHC	Proportion of population living in multidimensional poverty (%)
1.3	per_sa_allsa.cov_pop_tot	Coverage of social safety net programs (% of population)
1.3	per_si_allsi.cov_pop_tot	Coverage of social insurance programs (% of population)
1.5, 11.5	VC_DSR_GDPLS	Direct economic loss attributed to disasters (current United States dollars)
1.5, 11.5	VC_DSR_AFFCT	Number of people affected by disaster (number)
1.5, 11.5	VC_DSR_MORT	Number of deaths due to disaster (number)
1.5, 11.5	VC_DSR_MMHN	Number of deaths and missing persons attributed to disasters (number)
1.5, 11.5	VC_DSR_PDAN	Number of people whose damaged dwellings were attributed to disasters (number)
1.5, 11.5	VC_DSR_PDYN	Number of people whose destroyed dwellings were attributed to disasters (number)
1.5, 11.5	VC_DSR_PDLN	Number of people whose livelihoods were disrupted or destroyed, attributed to disasters (number)
1.5, 11.b	SG_DSR_SILS	Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies (%)
1.5, 11.b	SG_DSR_SILN	Number of local governments that adopt and implement local DRR strategies in line with national strategies (number)
1.5, 11.5	VC_DSR_AGLH	Direct agriculture loss attributed to disasters (current United States dollars)
1.5, 11.5	VC_DSR_HOLH	Direct economic loss in the housing sector attributed to disasters (current United States dollars)
1.5, 11.5	VC_DSR_CILN	Direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters (current United States dollars)

1.5, 11.5	VC_DSR_CHLN	Direct economic loss to cultural heritage damaged or destroyed attributed to disasters (millions of current United States dollars)
1.5, 11.5	VC_DSR_DDPA	Direct economic loss to other damaged or destroyed productive assets attributed to disasters (current United States dollars)
2.1	SN_ITK_DEFCN	Number of undernourish people (millions)
2.2	SH.STA.STNT.ZS	Prevalence of stunting, height for age (% of children under 5)
2.2	SH.STA.OWGH.ZS	Prevalence of overweight, weight for height (% of children under 5)
2.2	SH.STA.MALN.ZS	Prevalence of underweight, weight for age (% of children under 5)
2.3	AG.YLD.CREL.KG	Cereal yield (kg per hectare)
2.5	ER_GRF_PLNTSTOR	Plant breeds for which sufficient genetic resources are stored (number)
2.5	ER_RSK_LBREDS	Proportion of local breeds classified as being at risk as a share of local breeds with known level of extinction risk (%)
3.1	SH_STA_BRTC	Proportion of births attended by skilled health personnel (%)
3.1	SH_STA_MORT	Maternal mortality ratio
3.2	SH_DYN_IMRTN	Infant deaths (number)
3.2	SH_DYN_MORT	Under-five mortality rate, by sex (deaths per 1,000 live births)
3.2	SH_DYN_NMRTN	Neonatal deaths (number)
3.2	SH_DYN_IMRT	Infant mortality rate (deaths per 1,000 live births)
3.2	SH_DYN_MORTN	Under-five deaths (number)
3.3	SH_TRP_INTVN	Number of people requiring interventions against neglected tropical diseases (number)

Table 11.2 *(cont)*

Target code	Indicator code	Indicator name
3.3	SH_TBS_INCD	Tuberculosis incidence (per 100,000 population)
3.4	SH_DTH_NCOM	Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease (probability)
3.4	SH_STA_SCIDEN	Number of deaths attributed to suicide, by sex (number)
3.4	SH_DTH_NCD	Number of deaths attributed to non-communicable diseases by type of disease, and sex (number)
3.5	SH.ALC.PCAP.LI	Total alcohol consumption per capita (litres of pure alcohol, projected estimates, aged 15+)
3.6	SH.STA.TRAF.P5	Mortality caused by road traffic injury (per 100,000 people)
3.7	SP_DYN_ADKL	Adolescent birth rate (per 1,000 women aged 15–19)
3.8	SH_ACS_UNHC	Universal health coverage (UHC) service coverage index
3.9	SH.STA.POIS.P5	Mortality rate attributed to unintentional poisoning (per 100,000 population)
3.a	SH.PRV.SMOK.FE	Prevalence of current tobacco use, females (% of female adults)
3.b	SH_ACS_DTP3	Proportion of the target population with access to 3 doses of diphtheria-tetanus-pertussis (DTP3) (%)
3.b	SH_ACS_MCV2	Proportion of the target population with access to measles-containing vaccine second-dose (MCV2) (%)
3.b	SH_ACS_PCV3	Proportion of the target population with access to pneumococcal conjugate 3rd dose (PCV3) (%)
3.c	SH.MED.PHYS.ZS	Physicians (per 1,000 population)
3.d	SH_IHR_CAPS	International Health Regulations (IHR) capacity, by type of IHR capacity (%)
4.1	SE_TOT_CPLR	Completion rate, by sex, location, wealth quintile and education level (%)
4.2	SE.PRE.ENRR	School enrollment, preprimary (% gross)

4.3	SE.TER.ENRR	School enrollment, tertiary (% gross)
4.4	SE.TER.CUAT.BA.ZS	Educational attainment, at least bachelor's or equivalent, population 25+, total (%) (cumulative)
4.4	SE.SEC.CUAT.LO.ZS	Educational attainment, at least completed lower secondary, population 25+, total (%) (cumulative)
4.4	SE.SEC.CUAT.PO.ZS	Educational attainment, at least completed post-secondary, population 25+, total (%) (cumulative)
4.4	SE.SEC.CUAT.UP.ZS	ducational attainment, at least completed upper secondary, population 25+, total (%) (cumulative)
4.4	SE.TER.CUAT.MS.ZS	Educational attainment, at least master's or equivalent, population 25+, total (%) (cumulative)
4.4	SE.TER.CUAT.DO.ZS	Educational attainment, doctoral or equivalent, population 25+, total (%) (cumulative)
4.5	SE.ENR.PRSC.FM.ZS	School enrollment, primary and secondary (gross), gender parity index (GPI)
4.5	SE.ENR.TERT.FM.ZS	School enrollment, tertiary (gross), gender parity index (GPI)
4.6	SE.ADT.LITR.ZS	Literacy rate, adult total (% of people aged 15+)
4.c	SE.PRM.ENRL.TC.ZS	Pupil-teacher ratio, primary
4.c	SE.SEC.ENRL.TC.ZS	Pupil-teacher ratio, secondary
4.c	SE.TER.ENRL.TC.ZS	Pupil-teacher ratio, tertiary
4.c	SE.PRM.TCAQ.ZS	Trained teachers in primary education (% of total teachers)
4.c	SE.SEC.TCAQ.ZS	Trained teachers in secondary education (% of total teachers)
5.1	SG.LAW.INDX	Women Business and the Law Index Score (scale 1–100)
5.3	SP.M18.2024.FE.ZS	Women who were first married by age 18 (% of women aged 20–24)

Table 11.2 *(cont)*

Target code	Indicator code	Indicator name
5.4	SL.FAM.WORK.FE.ZS	Contributing family workers, female (% of female employment) (modelled ILO estimate)
5.4	SL.FAM.WORK.MA.ZS	Contributing family workers, male (% of male employment) (modelled ILO estimate)
5.5	SG_GEN_PARLN	Number of seats held by women in national parliaments (number)
6.1	SH.H2O.BASW.ZS	People using at least basic drinking water services (% of population)
6.1	SH.H2O.SMDW.ZS	People using safely managed drinking water services (% of population)
6.2	SH.STA.ODFC.ZS	People practising open defecation (% of population)
6.2	SH.STA.BASS.ZS	People using at least basic sanitation services (% of population)
6.4	ER_H2O_STRESS	Level of water stress: freshwater withdrawal as a proportion of available freshwater resources (%)
6.b	ER_WAT_PART	Countries with users/communities participating in planning programs in water resources planning and management, by level of participation (3 = High; 2 = Moderate; 1 = Low; 0 = NA)
7.1	EG_EGY_CLEAN	Proportion of population with primary reliance on clean fuels and technology (%)
7.1	EG_ACS_ELEC	Proportion of population with access to electricity, by urban/rural (%)
7.2	EG.ELC.RNEW.ZS	Renewable electricity output (% of total electricity output)
7.2	EG.FEC.RNEW.ZS	Renewable energy consumption (% of total final energy consumption)
7.3	EG_EGY_PRIM	Energy intensity level of primary energy (megajoules per constant 2011 purchasing power parity GDP)
8.1	NY.GDP.PCAP.KD.ZG	GDP per capita growth (annual %)
8.10	FX.OWN.TOTL.ZS	Account ownership at a financial institution or with a mobile-money-service provider (% of population aged 15+)

8.10	FB.CBK.BRCH.P5	Commercial bank branches (per 100,000 adults)
8.2	NV.AGR.EMPL.KD	Agriculture, forestry, and fishing, value added per worker (constant 2010 US$)
8.2	SL.AGR.EMPL.ZS	Employment in agriculture (% of total employment) (modelled ILO estimate)
8.2	SL.IND.EMPL.ZS	Employment in industry (% of total employment) (modelled ILO estimate)
8.2	SL.SRV.EMPL.ZS	Employment in services (% of total employment) (modelled ILO estimate)
8.2	NV.IND.EMPL.KD	Industry (including construction), value added per worker (constant 2010 US$)
8.2	NV.SRV.EMPL.KD	Services, value added per worker (constant 2010 US$)
8.3	IC.BUS.NDNS.ZS	New business density (new registrations per 1,000 people aged 15–64)
8.4, 12.2	EN_MAT_DOMCMPT	Domestic material consumption, by type of raw material (tonnes)
8.5	SL.UEM.TOTL.ZS	Unemployment, total (% of total labour force) (modelled ILO estimate)
8.5	SL.EMP.WORK.ZS	Wage and salaried workers, total (% of total employment) (modelled ILO estimate)
8.6	SL.UEM.NEET.ZS	Share of youth not in education, employment or training, total (% of youth population)
8.7	SL.TLF.0714.ZS	Children in employment, total (% of children aged 7–14)
9.1	IS_RDP_FRGVOL	Freight volume, by mode of transport (tonne-kilometres)
9.1	IS_RDP_PFVOL	Passenger volume (passenger kilometres), by mode of transport
9.1	IS_RDP_PORFVOL	Container port traffic, maritime transport (twenty-foot equivalent units [TEUs])
9.2	NV_IND_MANFPC	Manufacturing value added per capita (constant 2015 United States dollars)
9.4	EN.ATM.CO2E.PP.GD	CO2 emissions (kg per PPP $ of GDP)
9.4	EN.ATM.CO2E.PC	CO2 emissions (tonnes per capita)
9.5	GB.XPD.RSDV.GD.ZS	Research and development expenditure (% of GDP)

Table 11.2 *(cont)*

Target code	Indicator code	Indicator name
9.b	NV.MNF.TECH.ZS.UN	Medium and high-tech Industry (including construction) (% manufacturing value added)
10.2	SI_POV_50MI	Proportion of people living below 50% of median income (%)
10.7	SM_DTH_MIGR	Total deaths and disappearances recorded during migration (number)
10.b, 17.2	DT.ODA.ODAT.CD	Net official development assistance received (current US$)
11.1	EN.POP.SLUM.UR.ZS	Population living in slums (% of urban population)
11.1	SP.URB.TOTL.IN.ZS	Urban population (% of total population)
11.1	SP.URB.GROW	Urban population growth (annual %)
11.5	VC_DSR_CDAN	Number of damaged critical infrastructure attributed to disasters (number)
11.5	VC_DSR_HFDN	Number of destroyed or damaged health facilities attributed to disasters (number)
11.5	VC_DSR_EFDN	Number of destroyed or damaged educational facilities attributed to disasters (number)
11.5	VC_DSR_BSDN	Number of disruptions to basic services attributed to disasters (number)
11.5	VC_DSR_ESDN	Number of disruptions to educational services attributed to disasters (number)
11.5	VC_DSR_HSDN	Number of disruptions to health services attributed to disasters (number)
11.6	EN_REF_WASCOL	Municipal Solid Waste collection coverage, by cities (%)
12.2	NY.GDP.TOTL.RT.ZS	Total natural resources rents (% of GDP)
14.4	ER.FSH.AQUA.MT	Aquaculture production (tonnes)
14.4	ER.FSH.PROD.MT	Total fisheries production (tonnes)
14.5	ER.MRN.PTMR.ZS	Marine protected areas (% of territorial waters)
15.1	AG.LND.FRST.ZS	Forest area (% of land area)
15.6	ER_CBD_SMTA	Total reported number of Standard Material Transfer Agreements (SMTAs) transferring plant genetic resources for food and agriculture to the country (number)

16.1	VC_VOV_ROBB	Proportion of population subjected to robbery in the previous 12 months, by sex (%)
16.2	VC_HTF_DETVFL	Detected victims of human trafficking for forced labour, servitude and slavery, by age and sex (number)
16.2	VC_HTF_DETVOP	Detected victims of human trafficking for other purposes, by age and sex (number)
16.2	VC_HTF_DETV	Detected victims of human trafficking, by age and sex (number)
16.5	IC.FRM.BRIB.ZS	Bribery incidence (% of firms experiencing at least one bribe payment request)
16.6	GF.XPD.BUDG.ZS	Primary government expenditures as a proportion of original approved budget (%)
16.9	SP.REG.BRTH.ZS	Completeness of birth registration (%)
17.1	GC.TAX.TOTL.GD.ZS	Tax revenue (% of GDP)
17.11	NE.EXP.GNFS.ZS	Exports of goods and services (% of GDP)
17.17	GF_COM_PPPI	Amount of United States dollars committed to public-private partnerships for infrastructure, million USD nominal
17.18	IQ.SCI.OVRL	Statistical Capacity score (Overall average)
17.19	IQ.SCI.PRDC	Periodicity and timeliness assessment of statistical capacity (scale 0–100)
17.3	BX.KLT.DINV.WD.GD.ZS	Foreign direct investment, net inflows (% of GDP)
17.3	BX.TRF.PWKR.DT.GD.ZS	Personal remittances, received (% of GDP)
17.4	DT.TDS.DPPF.XP.ZS	Debt service (PPG and IMF only, % of exports of goods, services and primary income)
17.6	IT_NET_BBNDN	Number of fixed Internet broadband subscriptions, by speed (number)

Notes: The first column shows the codes of the targets associated with the indicators, whose codes and names are described in the second and third columns, respectively. Notice that one target can be matched with several indicators.
Sources: INEGI, UNSDG, and World Bank SDGs data.

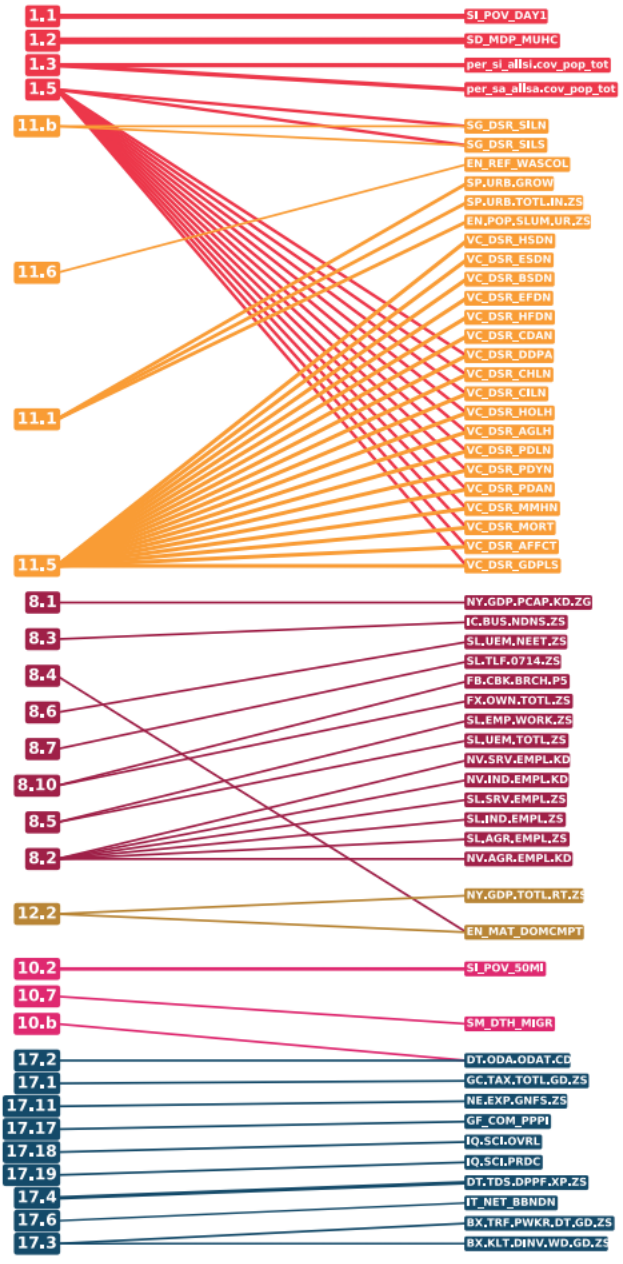

FIGURE 11.1 Budgetary links between SDG targets and indicators.
Sources: Authors' calculations with data from INEGI, UNSDG, and World Bank SDGs.

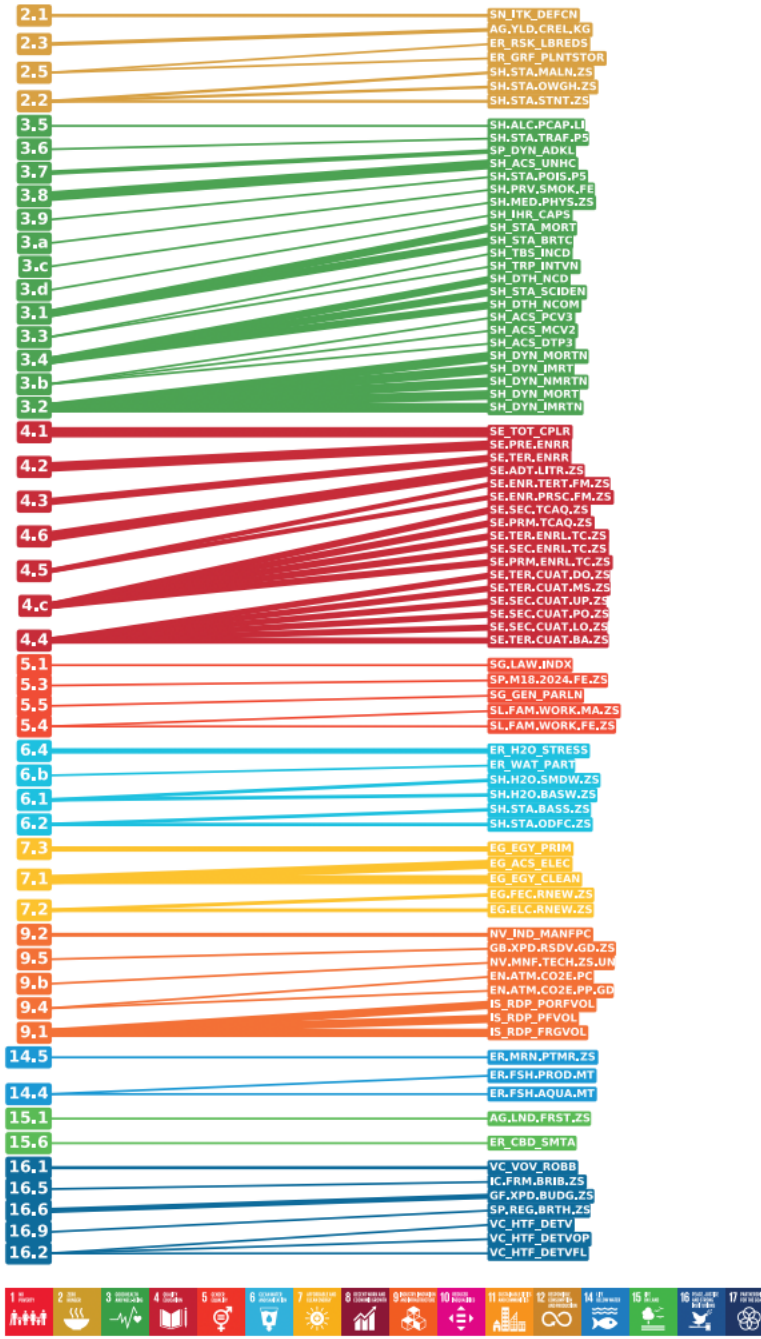

FIGURE 11.1 *(cont)*

simulations using a counterfactual budget B'_j. From these simulations, we obtain the sequence of point estimates $\bar{I}'_{i,1}, \ldots, \bar{I}'_{i,T}$ that constitute the average counterfactual time series of indicator i (as defined in Equation 4.1). Then, using the impact metric defined in Equation 9.2, we compare this counterfactual outcome against the baseline and estimate the potential impact of the intervention on i's performance. Note that, when computing the impact metric, we do so for every indicator other than those affected directly by the target's budget, That is to say, this procedure allows us to measure the indirect impacts of every target on every indicator not publicly funded by the targets' programmes. This framework captures the very essence of systemic impacts and provides a formal methodology for quantifying accelerators and systemic bottlenecks.

11.3.1 Counterfactual Budgets

Next, let us explain the simulation strategy in more detail. Recall that a systemic bottleneck manifests when a lack of funding in a particular policy issue exerts indirect negative impacts on other development dimensions. Hence, when analysing systemic bottlenecks, the counterfactual budget B'_j of the target j needs to be lower than the empirical budget. The logic is as follows: if the government reduces expenditure on a particular policy issue, this may have 'clogging' effects in the development process of some of the other policy issues.

On the contrary, recall that an accelerator appears when increased expenditure on a policy issue exerts positive indirect effects on others. Thus, if one wishes to study accelerators, the logic is similar to the strategy for systemic bottlenecks, with the difference that the counterfactual budget should be larger than the empirical budget. Here, we seek to quantify how spending more on one target leads to the improved performance of indicators across other policy dimensions.

Of course, there are many ways in which one could specify a budgetary increment or decrement for the counterfactual. Thus, in this chapter, our strategy is to determine a random fraction between

0 and 1 of expenditure increments (for accelerators) and decrements (for systemic bottlenecks). The idea is to sample 1,000 random budgetary changes for each target[6] and to analyse the distribution of the impact metric. Therefore, for the analysis of bottlenecks, and given a random change rate g, we define the counterfactual budget as follows $B'_{j,g} = (1 - g)B_j$. While for accelerators, we specify the budget in the following terms $B'_{j,g} = (1 + g)B_j$.

11.3.2 *Detection of Bottlenecks and Accelerators*

Recall that the impact metric D (see Equation 9.2) captures the fraction of an indicator's baseline performance attributed to the portion of the budget removed in the counterfactual. Furthermore, it is possible to construct this metric not just for one indicator but for any subset of them. Thus, the strategy is as follows. First, we choose an intervened target j and a level of intervention $B'_{j,g}$. Then, we calculate the total impact of this intervention in all the indicators that do not belong to target j; that is $D_{-j,g}$ (because we did not intervene in the others). By building the distribution of indirect impacts $D_{-j,g}$ through the randomised expenditure decrements, we can discover bottlenecks by establishing statistical significance. Let us be even more precise through the following steps:

1. Pick a target j, compute the set of baseline simulations with budget B_j, and construct the point-estimate time series of all the indicators.
2. Set a random fraction $g \in (0, 1)$.
3. Perform a set of counterfactual simulations and construct the point-estimate time series of all the indicators.
4. Compute the aggregate impact metric on all the indicators except those linked to target j (because we are looking for indirect effects in the non-intervened indicators).
5. Repeat steps 2 to 4 1,000 times and collect the impact metrics.
6. Calculate the nth percentile of the aggregate impact metric distribution and determine if it is greater than zero.

[6] In total, we get $2 \times 1{,}000$ budgetary changes per target as we are studying both bottlenecks and accelerators.

7. When passing the test, one can infer that the target of the intervention is a systemic bottleneck. This inference holds because removing public funds produces a significant (negative) impact on the average performance of all the indicators that are not directly related to it.

Notice that, in step 6, we devise a statistical test that gets closer to the regression analysis approach, in which the statistic of interest (the regression coefficient) is a random variable. Here, the impact metric is also a random variable produced by the realisations of g (which is reasonable as scholars usually consider that the budget change rates are random). Thus, by using its distribution, we can assess if an impact of zero magnitude is feasible with a certain confidence level. We establish this confidence as one minus the nth percentile. For example, if a zero-valued impact is below the tenth percentile, it implies that the intervened target is a systemic bottleneck with a confidence level of 90%. This exercise shows that there is no single test of significance that fits all problems.[7]

For accelerators, the logic is almost identical. Here, the difference is that the budget is increased instead of decreased.[8] With this methodology, we intend to show three types of results to the reader. First, we present a list of targets that we infer as systemic bottlenecks or accelerators. In some cases, a target may be both a bottleneck and an accelerator since budgetary changes in any direction may yield significant systemic impacts. Second, we would like to show that naïve approaches such as budget size or network centrality fail to correctly identify bottlenecks and accelerators. We do this by testing whether the systemic impacts obtained through our approach correlate with any of these two features. Third, we disaggregate these results by decomposing the systemic impacts in metric $D_{-j,g}$ into a network of target-level indirect impacts. A network view of the structure of bottlenecks and accelerators provides

[7] One should be aware of the different possibilities to formulate the most appropriate test when having the capability of generating counterfactual data, as opposed to just applying off-the-shelf frameworks.

[8] Note that, here, the 'baseline simulations' are those with the increased budget in order to get the correct sign of the impact metric.

a comprehensive picture of the challenges that need to be faced when considering synergies and trade-offs during budgetary reallocations. We should add that such a formal and sophisticated picture of bottlenecks and accelerators has never been documented in the literature.

11.4 RESULTS

11.4.1 Identification of Systemic Bottlenecks and Accelerators

First, let us present the aggregate results obtained through the proposed simulation strategy. That is, using a 90% confidence level, we extract the identified systemic bottlenecks and accelerators, rank them, and display them in Figures 11.2 and 11.3, respectively. We find

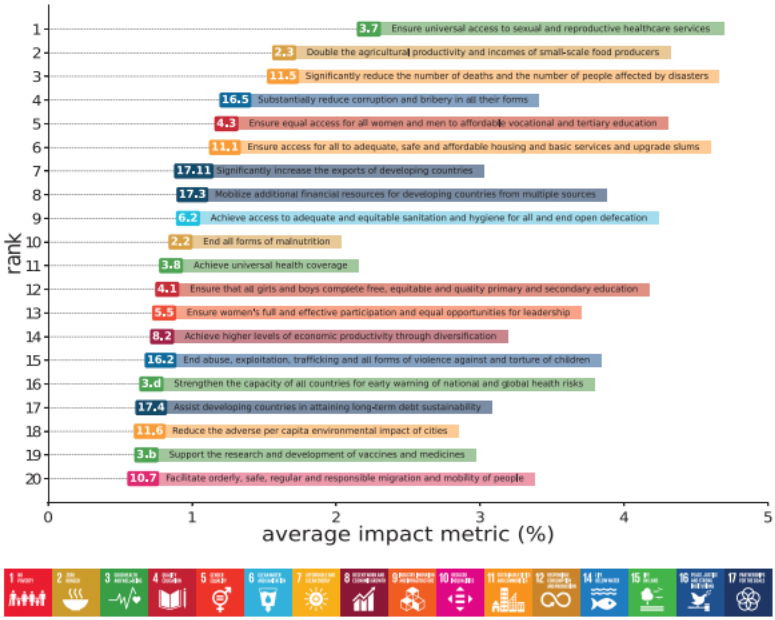

FIGURE 11.2 Systemic bottlenecks.
Notes: The reported impact metric is the mean of the distribution.
Sources: Authors' calculations with data from SHCP, INEGI, UNSDG, and World Bank SDGs.

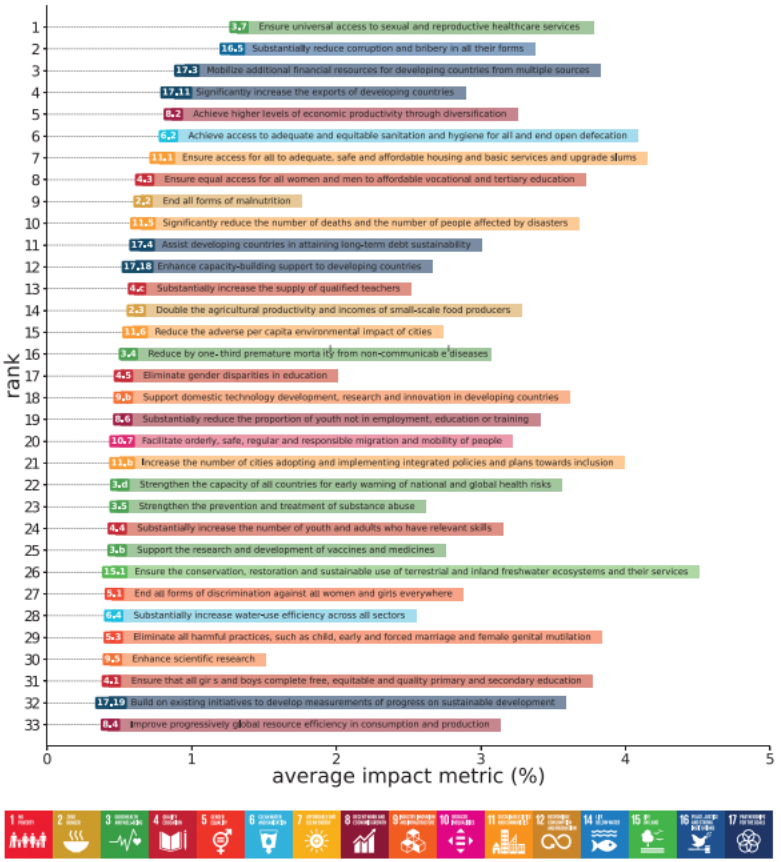

FIGURE 11.3 Accelerators.
Notes: The reported impact metric is the mean of the distribution.
Sources: Authors' calculations with data from SHCP, INEGI, UNSDG, and World Bank SDGs.

20 bottlenecks and 33 accelerators; because there are 76 targets in the dataset, the number of bottlenecks and accelerators is substantial. Nevertheless, not all of them have the same importance since, as indicated in these figures, their indirect impacts may vary substantially. Since these systemic effects consist of aggregated indirect impacts, it should not be surprising that their magnitudes are small compared to the direct impact values, such as those found in Chapter 9. Therefore,

to analyse them, it is convenient to interpret our estimations qualitatively (by their rank).

Notice that most bottlenecks are also accelerators (17 out of 20). For these targets, the cutting of funding may constrain the progress of others. Yet, additional funding may also help generate positive systemic effects. For these reasons, these targets represent extremely important policy issues. In so far as their funding is a necessary condition for the country's overall development.

Having a larger amount of accelerators than bottlenecks suggests that more policy issues could foster development rather than constrain it. Thus, it seems that Mexico, at least at the national level, has more options to generate positive change than obstacles. Importantly, we do not identify systemic bottlenecks nor accelerators in SDGs 1, 7, 12, and 14, at least in the short run. This result is interesting as SDG 1 is perhaps the most important goal for the national government, meaning that expecting to generate overall development (through indirect impact) by just financing anti-poverty programmes is short sighted. Instead, the government needs to take a holistic approach and intervene in a strategic set of policy issues.

Finally, we find in our simulations that SDGs 9 and 15 have some targets operating as accelerators but not as bottlenecks. This outcome implies that some policy issues in 'industry, innovation and infrastructure' (SDG 9) and in 'life on land' (SDG 15) exert a positive impact on other targets when their budget increases. However, these same issues do not exhibit indirect effects when losing public funding, suggesting that they could be more dispensable than others. This trait occurs when the government needs to reallocate funding, and those SDGs do not represent pressing issues or do not fall noticeably when receiving fewer resources.

11.4.2 Comparison against Naïve Approaches

Now let us shift our focus to approaches that have recently become popular among scholars and consultants. In these alternative perspectives, the existence of accelerators depends on the level of funding

and network centrality. More specifically, we investigate whether a significant correlation exists between the aggregate impact metric and traditional conjectures to promote development systemically. The idea of this exercise consists of assessing whether proper indirect effects could be 'picked-up' by much simpler methods. If so, one could argue that a 'back of the envelope' calculation should suffice to identify systemic bottlenecks and accelerators.[9]

First, let us discuss the comparison between the impact metric and the budget received by each target as a fraction of the total budget. Appealing to their common sense, some analysts would argue that bottlenecks are likely to occur in targets with low funding because their lack of resources constrains development among the associated policy issues. Figures 11.4a and 11.4b show scatter plots of both variables for systemic bottlenecks and accelerators, respectively. In both cases, there is no correlation that would validate this back-of-the-envelope approach. For instance, one would expect a negative correlation in Figure 11.4a since less funding should imply that the target operates more as a bottleneck. Whereas a positive correlation would be expected in Figure 11.4b since more funding propels development across several dimensions. We get the opposite correlation signs in each case. This result indicates that historically underfunded policies are not necessarily clogging development across other policy issues. Thus, an approach such as PPI – that is explicit about the expenditure development relationship – is necessary.

Next, let us repeat the same exercise as before but compare the impact metric against the outgoing spillovers of the targets in the exogenous network of conditional dependencies between indicators. Thus, we can aggregate this network at the level of each target (now nodes represent targets) such that a link from node A to B represents the average weight of all the edges going from indicators in target A to indicators in target B. With an aggregate network like this, analysts typically argue that the centrality of a target is a good signal of the

[9] But even if one would succeed, there is no guarantee these methods would work for a different dataset.

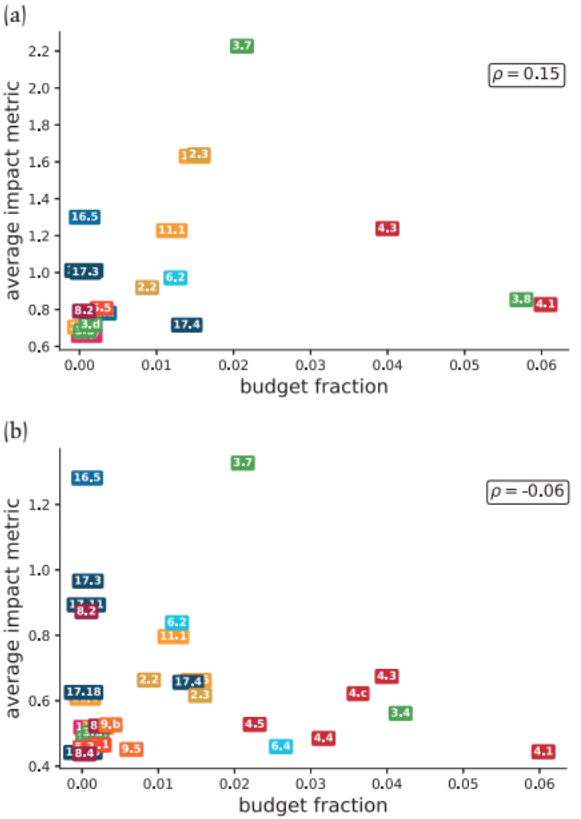

FIGURE 11.4 Weak correlation between clogging/acceleration potential and data on budgets and network centrality. (a) Bottlenecks and budget level, (b) accelerators and budget level, (c) bottlenecks and network centrality, and (d) accelerators and network centrality.

Notes: The top panels show the association between the fraction of the budget dedicated to each target and their aggregate impact metric. The bottom panels report a similar analysis but use a metric of spillovers (known as node strengths in network analysis) for each target instead of their budget fraction. We build these metrics of outgoing spillovers from the exogenous network of conditional dependencies between indicators. The boxed legend in each panel reports the Pearson correlation coefficient.

Sources: Authors' calculations with data from SHCP, INEGI, UNSDG, and World Bank SDGs.

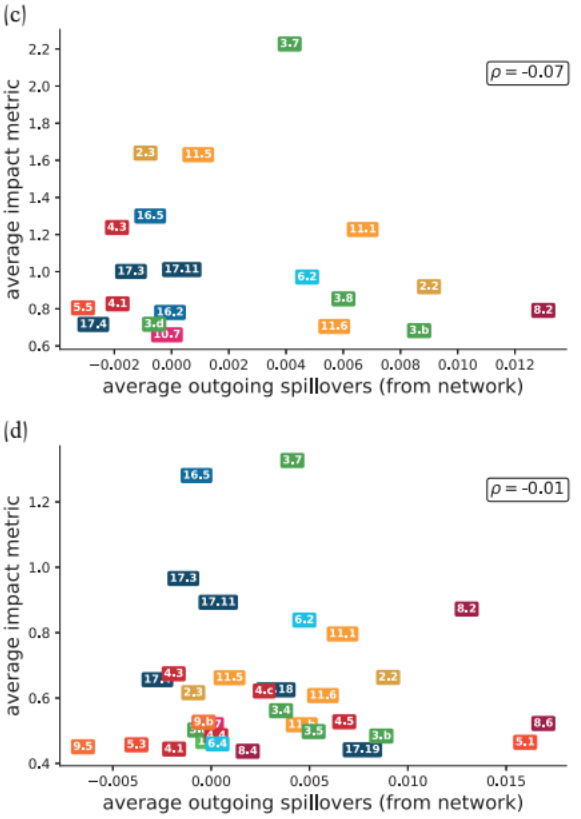

FIGURE 11.4 *(cont)*

potential creation of systemic effects. Accordingly, an indirect effect would be more likely when there are many spillover effects (outgoing links) from one target to the rest of the nodes. Our results, shown in Figures 11.4c and 11.4d, suggest that such logic does not hold since the correlations between the impact metric and the outgoing spillovers are rather weak.

While the idea of network structures exerting indirect impacts is compelling, throughout the book, we have shown that it is not the only – nor the main – cause determining complex development dynamics, such as those of bottlenecks and accelerators. The conventional metrics are easy to calculate and closer to our common sense; however, they are insufficient to properly understand development problems and assess the impact of policy priorities. By construction,

our model allows us to study these systemic impacts more systematically and explicitly address the role of government expenditure. In doing so, we have learnt that other mechanisms, such as the political economy, produce different levels of efficiency across nodes, calling for holistic frameworks.

11.4.3 Disaggregation of Systemic Bottlenecks and Accelerators

To finalise this chapter, we would like to expand on the capabilities of PPI to investigate in more detail the structure of interdependencies underneath the aggregate impact metric. The reader may recall that, due to the flexibility of the impact metric, it is possible to construct it for an arbitrary set of indicators. In this case, we want to build impact metrics between pairs of targets (between their indicators) to construct a network of systemic bottlenecks or accelerators. To achieve this, we follow the next steps. As before, we focus on the example of systemic bottlenecks, while the application to accelerators should naturally follow.

1. Pick a target j and apply the steps described in Section 11.3.2 to determine whether it is a bottleneck or not.
2. If j is not a bottleneck, then move on to the next target and go back to step 1. Otherwise, move on to the next step.
3. Pick a second target $k \neq j$ and build the distribution of impact metrics of the indicators in k when j was intervened (leaving out any indicator that may be in both j and k).
4. Perform a t-test to determine if the mean impact is different from zero.
5. If the t-statistic is positive and its p-value less than 1%, draw an edge from j to k and set the impact metric as its weight.[10]
6. Repeat from step 3 until all targets different from j have been checked.
7. Repeat from step 1 until all targets have been checked.

After following the previous steps, we construct two networks of indirect impacts: one for systemic bottlenecks and another for

[10] The purpose of the t-test is to determine if the impact from j to k is positive and significant in order to obtain a sparse network. We choose this test over that for the aggregate impact metric because it allows us to obtain sparser networks, which are useful for the visualisation in this chapter. However, the reader could choose the other test and different significance levels to explore different networks.

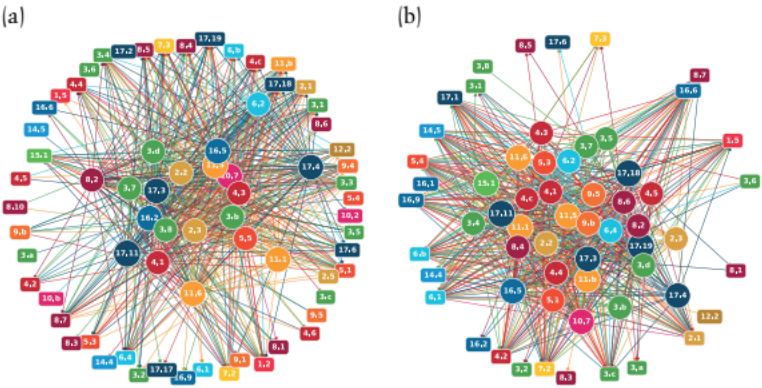

FIGURE 11.5 Networks of indirect impacts. (a) Systemic bottlenecks and (b) accelerators.

Notes: The circular nodes denote targets identified as systemic bottlenecks or accelerators according to the steps described in this section. The rectangular nodes are those targets that are affected by the circular nodes but are not bottlenecks or accelerators. The links show indirect impact relationships between circles and from circles to rectangles. We colour the edges according to the SDG of the target exerting the impact. The size of the nodes does not bare any meaning.

Sources: Authors' calculations with data from SHCP, INEGI, UNSDG, and World Bank SDGs.

accelerators. We present both networks in Figure 11.5 and lay out the nodes using a spring-based algorithm. This algorithm positions the nodes according to their mutual attraction, determined by the edge weights. Hence, bottlenecks and accelerators are placed at the centre of the network (the circular nodes), while the rest of the nodes (rectangles) are pushed to the periphery.

We can find some interesting examples of how these indirect impacts are structured. For instance, when operating as a bottleneck, target 8.2 exerts an impact on target 16.6 but not on target 1.5. From these networks, we can also learn that a specific target (e.g., 9.5) operates as an accelerator and we can recognise the targets on which the former one exerts a strong indirect influence. It is also possible to know the fraction of targets of a particular SDG that operate as bottlenecks or accelerators. For instance, five targets in SDG 4 operate as accelerators, but only two out of seven work as bottlenecks.

Generally speaking, in these networks, we can identify bottlenecks and accelerators with relative ease through eyeballing. However, there are some exceptions. For instance, target 6.2 in the bottlenecks' network and target 17.4 in the accelerators' network remain close to the periphery. The network suggests that some of these nodes play a more prominent role in clogging or accelerating development in a country. Further investigation into how these networks are structured is beyond the scope of this book. However, future research in this direction could consider a comprehensive analysis of different ways to construct these networks of indirect impacts and to find systemic bottlenecks and accelerators through consensus algorithms, for example.

11.5 SUMMARY AND CONCLUSIONS

This chapter presents two analytical innovations for prioritising policy issues. First, we formalise and operationalise the concepts of bottlenecks and accelerators so we can measure systemic effects when intervening in specific SDG targets through changes in government expenditure. We talk about a systemic bottleneck when reductions in the assigned budget of a specific target dampen the performance of other targets and their corresponding development indicators. We classify a target as an accelerator when its budgetary increments foster advances in development indicators of related targets. We support our definitions through an expenditure–performance link, which implies that systemic effects can appear when applying cuts or additions to the budget of some targets (i.e., in the set of programmes focusing on a particular group of policy issues).

Second, we use a novel government expenditure dataset with a high degree of granularity. The dataset captures thousands of government programmes and classifies them into SDG targets. No data like this has ever been used to address impact-related questions. We profit from this to show how PPI can adapt to its highly granular yet imperfect mapping between programmes and indicators.

Our simulation results are also twofold. First, the indirect effects that we estimated have one order of magnitude less than the direct effects of budgetary changes estimated in the previous chapters through the impact metric. Nonetheless, we identify a large set of targets that operate as systemic bottlenecks (20) and accelerators (33), with 17 having both traits. Therefore, we can argue that, even in the short run, a budgetary allocation in a specific set of policy issues can dampen or accelerate the improvement of related indicators. Consequently, policymakers should not see policy issues as isolated silos when deciding budgetary allocations. Rather, they should attempt to reinforce, financially, those targets that offer positive systemic effects to boost overall development.

Third, our findings indicate that the correlation between the centrality of a target – in a network of policy issues – and its impact metric is practically null. One cannot advise intervening in an SDG target by simply suggesting a potential change in its value. In real life, these interventions come either from budgetary or organisational/incentives changes. For this reason, we identify accelerators by studying systemic effects when the assigned budget – an exogenous variable – is modified. Thus, these weak correlations send a 'word of warning' on the growing practice of advocating specific policy issues of SDGs based on a data-driven system-level statistic (i.e., calculated only with a network topology).