13 Lessons and Reflections

At the beginning of this book, we mentioned that the development of PPI has been a process of constant interaction with policymakers. Thus, a large portion of the research questions we have addressed in each chapter stems from real-world problems that decision makers around the world are currently facing. Consequently, as we have learnt from these experiences, we have ensured that PPI is not only an academic programme but also that it offers an accessible toolkit to potential users. Thus, in this final chapter, we would like to provide the reader with three reflections about PPI and its potential to make a difference in the real world. These lessons and reflections are extremely timely as, near the publication of this book, the United Nations will be revising the progress towards the SDGs and providing advice on best practices to its member countries. First, we synthesise the results found throughout the book and their implications for sustainable development. Second, we elaborate on systematic guidelines for deriving policies from the various analyses presented throughout the book. Third, we discuss the technical capabilities needed to adopt PPI and advocate for the training of computational social scientists. Overall, with this chapter, we want the reader to take home several thoughts beyond technical analyses and question current practices and norms in socioeconomic policymaking. Our final goal, in the end, is to provide insightful ideas and helpful tools so that everybody can obtain significant benefits.

13.1 LESSONS LEARNT

The empirical chapters of this book provide the reader with a better understanding of the short- and medium-term evolution of the SDGs when governments implement policies in terms of budgetary

https://doi.org/10.1017/9781009022910.018 Published online by Cambridge University Press

allocations across established programmes. In particular, from our simulation analyses, we can learn several lessons referring to the following topics: (1) the 2030 Agenda for the SDGs is overambitious, even without considering the obstacles created by the Covid-19 pandemic; (2) there are heterogeneous responses to budgetary increments at the country, SDG, and indicator levels; (3) structural bottlenecks hinder progress in many development indicators; (4) there is a governance trap that handicaps advances in less-developed economies; (5) there is an empirical aid–development link, but it is a complex one; (6) there are critical indicators (accelerators) that, when well funded, can generate synergistic macro-level development; (7) remittances can help, in the short term, to alleviate socioeconomic deprivation; (8) regional development can be fostered through the use of better tools for the allocation of the federal transfers. Next, we summarise some of the book's results that relate to these issues.

1. **The 2030 Agenda Is Overambitious**
   Starting with the conditions that prevailed in 2020, our study indicates that many expected gaps would remain open by 2030 for several countries and development indicators, even if Covid-19 had not occurred.[1] If one assumes, in a baseline scenario, that the average historical budget during the 2000 to 2021 period remains constant in real terms until 2040, the expected development gaps would remain open across countries of all kinds (developing and developed) and regions. Likewise, our results suggest that there is a wide disparity in expected gaps across indicators and countries. When taking averages at a country-group level, we obtain the following expected gaps across indicators: the West with an 8.3% gap, Eastern Europe and Central Asia with 11.2%, East and South Asia with 14.8%, Latin America and the Caribbean with 18.4%, MENA with 26.0%, and Africa with 41.5%.
2. **Responses to Budgetary Changes Are Heterogeneous**
   The fact that development gaps will not be completely closed by 2030 does not mean that all indicators and countries' progress are rigid. Rather, the response of development indicators to changes in a country's budget

[1] We define an expected gap as the percentage of the established goal that remains unfulfilled for a specific indicator and country for 2030.

https://doi.org/10.1017/9781009022910.018 Published online by Cambridge University Press

varies considerably between SDGs and nations. One way to measure potential impact is through the number of years saved (or lost) to reach the established goals through increments (or reductions) in the budget. Through contrafactual simulations, we analyse the impact of budgetary changes of different sizes and signs. This allows us to detect the existence of diminishing marginal returns when budgets become larger, and sharp increases in convergence time (i.e., time-saving becomes negative) when public funding falls.

For example, we observe, for the average country in Latin America and the Caribbean, that the largest impact of budgetary increments corresponds to SDG 13 ('climate action'), while the smallest one corresponds to SDG 8 ('decent work and economic growth'). In contrast, for the average country in the West, an augmented budget produces the largest impact on SDG 5 ('gender equality') and the smallest one on SDG 1 ('no poverty'). In general, time savings fluctuate between 0 and 25% across country groups. Although savings above or close to twenty years are rare, they occur with budget increments of nearly 50% (SDG 13 for Africa and LAC; SDG 17 for MENA; SDG 5 for the West; SDG 15 for East and South Asia).

3. **Structural Bottlenecks Hinder Sustainable Development**
Just as there are indicators that respond well to expenditure changes, there are others that do not. Thus, we need to explain the reasons behind the insensitivity of these indicators. With PPI, we can infer the presence of structural factors that make government spending ineffective. We refer to these long-term factors as idiosyncratic bottlenecks because they are specific to individual policy issues. In other words, the computational model distinguishes whether an indicator's poor performance results from underfunded policies or idiosyncratic bottlenecks. Identifying idiosyncratic bottlenecks is not only a matter of poor sensitivity but also relates to a bad historical performance of the associated indicator.

Our simulations indicate potential idiosyncratic bottlenecks in the six groups of countries. The case of East and South Asia is particularly salient in this regard. Concerning indicators, SDG 9 ('industry, innovation, and infrastructure') stands out as the most prominent host of potential bottlenecks despite having fewer indicators than other SDGs. On the contrary, there are no bottlenecks in SDG 8 ('decent work and economic growth') in any of the six groups.

We also find out that countries in Latin America and the Caribbean do not present structural bottlenecks in programmes associated with poverty, although this is a prevalent issue. Consequently, their poor performance in this issue seems to be related to a lack of funding. With our flagging system for policy advice, we can specify which bottleneck deserves closer attention from policymakers. With a yellow flag, we classify indicators with positive growth but whose development gaps remain wide open, even when having substantial resources. We discover that yellow flags are the most common bottlenecks, and red flags are the least frequent in all country groups; MENA and East and South Asia have none.[2] Likewise, orange flags are relatively more common in MENA and Eastern Europe and Central Asia, whereas they are very infrequent in the West and African groups. Accordingly, policymakers should pay attention to revising programmes in policy issues with red and orange flags (i.e., bottlenecks with negative trends) to avoid unnecessary expenses.

4. **Governance Traps Are More Abundant in Less Developed Economies**
Aggregate correlations in cross-country studies indicate a strong negative relationship between the rule of law (RoL) and corruption. However, empirical evidence of country cases shows that improving public governance rarely dampens corruption. We deploy PPI to explain this paradox by producing within-country variation in the RoL through increments in the budget devoted to this issue. Our simulations indicate that exogenous increases in the relative participation of RoL expenditure generate a nonlinear relationship with corruption. In other words, the reallocation of public funds towards programmes associated with the RoL helps to curb corruption up to a certain point. Afterwards, the reduction of funding in other programmes offsets the previous improvements or, in some cases, even incentivises more corruption.

In the real world, changes in the quality of the RoL do not happen in isolation from other policy issues. Quite the opposite, policies across multiple development dimensions are implemented in parallel. Hence, we analyse a policy landscape in which expenditure changes in the RoL happen along with modifications in the total government budget. Using

[2] As a reminder, we use an orange flag to classify indicators with a negative trend that can be reversed with sufficient funding but cannot close the associated development gap. Then, we use a red flag when they show a negative trend that cannot be reverted with public funding.

https://doi.org/10.1017/9781009022910.018 Published online by Cambridge University Press

PPI, we produce rugged landscapes that represent this policy space, one for each country. Such surfaces quantify the uncertainty of corruption outcomes related to the two channels of government expenditure: (1) relative changes to RoL expenditure and (2) changes in the overall budget. This setting implies that a government facing a more rugged policy landscape has more problems in selecting the proper policy mix. For this reason, countries experience difficulties in undertaking speedy institutional development.

Our results indicate that countries in the West tend to exhibit smoother policy landscapes, which enables a virtuous cycle between enhanced development and improvements in the RoL. Due to a negative relationship between a country's development and the roughness of its policy landscape (i.e., difficulties in avoiding undesirable policy outcomes), we assert that there is a governance trap. That is to say, the worse the state of development of a country, the easier it will get trapped in underdevelopment. Precisely, we observe this situation in many African countries since their progress is severely limited. At the same time, they present a more uncertain environment (relative to more developed economies) to select policies conducive to fostering public governance.

5. **Aid Is Effective in Promoting Development**

With the help of PPI, we have resolved a major paradox in the aid-effectiveness literature. This paradox consists of poor or ambiguous evidence on the impact of aid flows at an aggregate level (e.g., on GDP growth), but strong evidence in favour at the project or sector level. In our study, we show that aid exerts a positive impact on the development of two-thirds of a sample of 146 recipient countries during the 2000–2013 period, especially in countries located in Africa and East and South Asia. Although a significant number of countries in the dataset receive large amounts of aid as a proportion of government spending, our results indicate that there is no strong relationship between the amount of aid received and its effectiveness.

We produce country-level estimates and develop an impact metric that can account for non-linear changes in the average performance of indicators. This allows us to measure the impact of aid at different levels of aggregation: per indicator, SDG, and country. Accordingly, we argue that aid exerts a positive impact across several SDGs and country groups, except for emerging economies in the OECD. Moreover, when looking at average impacts in indicators across countries, we find that 52 (out of 74) indicators exert a statistically significant impact. Aid seems to be effective in several indicators across many SDGs: 'zero hunger' (SDG 2), 'good health and well-being' (SDG 3), 'quality of education' (SDG 4), 'clean water and sanitation' (SDG 6), 'affordable and clean energy' (SDG 7), 'sustainable cities and communities' (SDG 11), and 'partnerships for the goals' (SDG 17). In contrast, aid weakly influences the progress of indicators in other SDGs: 'decent work and economic growth' (SDG 8), 'industry, innovation, and infrastructure' (SDG 9), 'reduced inequality' (SDG 10), 'life below water' (SDG 14), and 'life on land' (SDG 15). Because context matters, the latter impacts can vary when measured at the country level, as suggested by additional PPI estimates.

6. **Well-Funded Programmes Induce System-Wide Development**
   Once network interdependencies enter into the explanation of sustainable development, the discovery of systemic effects becomes a relevant issue. A policy becomes an accelerator when receiving more funding generates advances in other development dimensions. It operates as a systemic bottleneck when reducing its funding hinders progress in other issues. With a simulation strategy that modifies the level of government spending observed in the empirical data (in each policy issue), we test the existence of systemic bottlenecks and accelerators using a novel disaggregated dataset. Using 75 SDG targets and 138 development indicators, we check if an increased (or decreased) government expenditure on a certain target produces indirect impacts on indicators that are unrelated in budgetary terms.

   In our results, we find that these indirect effects are of a second order of magnitude when compared to the impact of direct expenditure interventions. This outcome is, to a large extent, a consequence of including only short-run linkages between indicators in the network of interdependencies. We also identify many SDG targets that operate as systemic bottlenecks (20) and accelerators (33). Seventeen of these indicators have a dual role, which implies that budgetary changes might either harm or foster the performance of other indicators. Accordingly, policymakers should promote, financially, those targets identified as accelerators since they tend to produce systemic impacts on Mexico's development. However, identifying accelerators is not a trivial task that can be done with back-of-the-envelope calculations. For instance, since there is a weak correlation between the network centrality of a target and its impact metric, network analysis is not an adequate guideline for making budgetary decisions, as analysts frequently suggest. That is to say, the network metric is inadequate because it disregards the other features underlining the expenditure–development relationship; it is rather a descriptive tool.

7. **Remittances Alleviate Socioeconomic Deprivation**
In Mexico, like in other countries from the Global South, poverty is measured through a comprehensive framework that includes economic well-being and a set of socioeconomic rights (access to education, health services, nutrition, social security, and quality housing and related services). The presumption behind this formulation is that individual and collective forms of development do not improve when a population is deprived of these rights. With PPI, we explore how socioeconomic deprivation has evolved through the influence of government spending, international remittances, and the domestic income of households located in deciles 1 to 5 of the income distribution (approximately 15 million). For this analysis, we make use of a unique dataset of 37 development indicators associated with monetary measurements of poverty and socioeconomic rights, household expenditure classified by income decile and type of expense, yearly data on remittances, and a highly disaggregated dataset of government spending for the 2008–2018 period.

Our results indicate that private sources of expenditure are more relevant than government spending in explaining the observed advances in economic well-being and socioeconomic rights. In particular, the outcomes show the importance of households' remittances in abating poverty not only because of its economic influence but also because it highlights an additional channel for interconnections between economies. Furthermore, these results make it clear that income shocks can severely harm social progress, and that governments have to implement compensatory measures through focalised public spending. This approach can be very fruitful because, once their income falls, households do not cut spending uniformly. This is especially the case when these cuts take place in items whose reduction entails long-term negative consequences, such as education and health services. We find that poverty and nutrition rights experience large impacts during an income shock since private funding is critical to sustaining the performance of the associated indicators. This outcome makes indispensable the application of additional funding in government programmes that can directly contain the downturn in socioeconomic rights and indirectly exert an influence through spillover effects.

8. **Adequate Rules for Federal Transfers Foster Regional Development**
PPI recognises that several policies promoting the SDGs reside at the subnational level. Hence, it provides evidence-based support for local policymaking and the design of rules for implementing fiscal federalism. In particular, the intricacies of spillover effects and multidimensional development across regional entities make the consequences of fiscal-coordination formulas unpredictable and the implications of expert advice nebulous. Therefore, our simulations are useful for studying how federal transfers can boost subnational development; especially when combining the model with a heuristic optimisation algorithm. These analytical tools help to discover 'optimal fiscal regimes' when allocating federal transfers across SDGs. With a unique dataset of 103 social, economic, and environmental indicators for the 32 states of Mexico, we study how 'fiscal contributions' impact regional development.

   Our results indicate that fiscal contributions matter for multidimensional development. The impacts of these contributions on the SDGs are substantial since our estimates are around 25%–45% on average (depending on the states' development cluster). Then, through prospective analyses, we show that it is possible to obtain additional impact gains with the implementation of 'optimal fiscal transfers'. First, our results show a misallocation of contributions if one assumes that the federal government's objective is to maximise average progress across all SDGs and states. Second, we obtain different allocation regimes (i.e., contributions granted to each state) depending on which SDG determines the federal government's objective function.

13.2 FROM ANALYSIS TO POLICY GUIDELINES

Development planning and the proposal of annual budgets are two critical tasks in the public administration of every government in the world, both at the national and subnational levels. Unfortunately, there are not enough analytical tools designed to answer the different questions raised when undertaking these policymaking endeavours.

https://doi.org/10.1017/9781009022910.018 Published online by Cambridge University Press

Among all possible questions, two are essential: How to allocate the budget across different policy issues to achieve multiple goals in a given period? Which government programmes do not work as expected despite receiving sufficient public funds?

Traditionally, when producing planning exercises, many governments use simple heuristics (e.g., benchmarking) to compare their current situation with the gold standard set by exemplary countries, provinces, or regions. For the design of the annual budget, governments tend to rely on plain extrapolation heuristics. Sometimes, governments also employ microsimulation techniques or computable general equilibrium models when technocrats are available. These tools help to assess the impact of different fiscal changes (e.g., value added tax modifications) and budgetary profiles.

However, from our perspective, analytical tools that address the complexity of social systems are necessary for providing more grounded answers to these questions. A planning exercise with solid financial backing has to begin with four postulates already mentioned in different chapters of this book. First, it is necessary to recognise that development is a multidimensional phenomenon that combines economic factors with a component of social inclusions and another of environmental sustainability. Second, it is important to recognise that different policy issues and goals involve interdependencies, making it necessary to better understand spillover effects. Thirdly, it is critical to acknowledge the existence of inefficiencies in the policymaking process due to a misalignment of incentives between policy designers and the bureaucrats implementing government programmes. Fourth, it is indispensable to be aware that budgetary policies can only exert short- or medium-term impacts, and that these effects are limited due to long-term structural constraints.

To elaborate on the methodology of Policy Priority Inference, we resort to a vision (complexity theory) and an analytical framework (agent computing). The former conceives development as an emergent property in which numerous and complex interactions between policies and officials of the State apparatus can generate a wide variety of development paths. The latter appeals to computational modelling to integrate a network of policy issues with a set of vertical and horizontal mechanisms capable of establishing a public expenditure–development link, enabling causal inference. In other words, PPI can establish an explicit connection between budgetary profiles and the stochastic dynamics of development indicators through a model that allows for causal assessments. Under this framework, causal inference is enabled by artificial counterfactuals that meet the conditions of 'what if' scenarios.

With PPI, it is possible to inform policymaking based on evidence derived from simulations. In particular, we provide a specific answer to the first question posed at the beginning of this section since we can produce ex ante and ex post evaluations to assess the impact of different budget allocations on progress towards the SDGs. Likewise, we can offer partial answers to the second question since we can identify the indicators and government programmes that exhibit structural bottlenecks slowing down the achievement of the established goals. Yet, the reader should also be aware that with this modelling framework, we cannot assert the reasons behind the malfunctioning of a programme. Hence, our advice consists only in setting a red flag when an indicator does not respond to additional funding.

13.2.1 Workflow for Strategic Planning

Throughout the development of PPI and numerous interactions with policymaking. It became clear that the types of analyses that can be built on this framework are numerous; perhaps too many for an average technical team. Thus, we developed ways to systematise the interpretation of some of these results, guiding the analysts through steps that are conducive to policy recommendations. Here, we would like to present an example of one of these guidelines. In particular, we elaborate on a workflow for the strategic planning of SDG budgeting, and for identifying development bottlenecks.[3]

[3] We developed this workflow in Castañeda and Guerrero (2022a) during a policy project in collaboration with the UNDP.

The workflow begins by gathering information from the transformed data of the simulations. Let us describe this information-gathering process through four major steps. First, we identify the convergence to the goals in an analysis of temporary feasibility, as done in Chapter 6. Second, we detect bottlenecks through the analysis of budgetary frontiers, following the examples in Chapter 7.[4] Third, we measure the indicators' historical performance during the sample period, following Chapter 3. Fourth, we determine the necessary budgetary changes through heuristic optimisation, as done in Chapter 11. Using the information obtained in these four steps, we classify indicators in different policy guidelines that governments could pursue. The first option is to keep, in real terms, the allocated budget to the associated government programmes, as indicated in the baseline scenario (i.e., its historical trend). The second option is to adjust the budget participation of these programmes according to the indicator's sensitivity to expenditure (e.g., analysis of accelerators). The third option is to review the design and operation of the associated programmes before making any changes in their historical budget.

Let us bring together the previous steps and policy options into an integrated workflow, and present it through a diagram in Figure 13.1. This diagram is an example, and we frame it in the context of a government that is interested in achieving the SDGs by 2030 and is planning its policy priorities to start in 2021.[5] The classification process starts when government officials (i.e., budgetary and planning analysts) define which programmes affect the model's instrumental indicators. When an indicator, according to the simulation outcomes, converges to the established goals before 2030 with the baseline budget, the recommendation would be not to make any changes to the

[4] The budgetary frontier is the outcome of a hypothetical scenario where government programmes are well funded; so there are no inefficiencies and no spillover effects. For this reason, the probability of an indicator's success in each simulation period is one.

[5] This example is not exhaustive, as many similar workflows could be assembled by putting together alternative analyses presented in this book. The exact diagram that an analyst needs is a function of their interest and context.

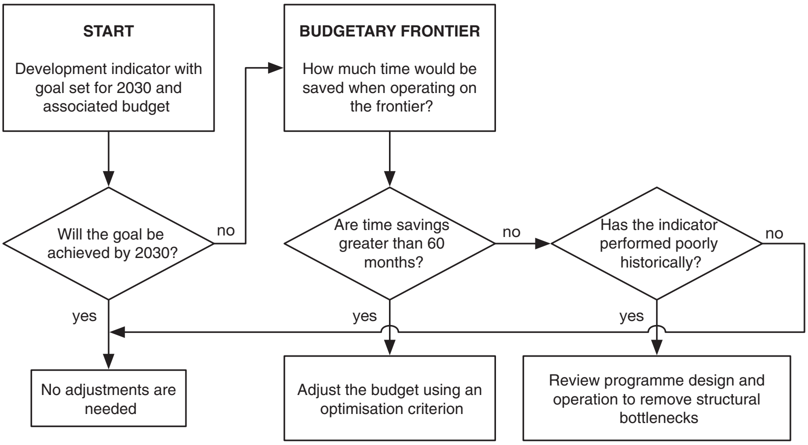

FIGURE 13.1 Workflow to specify policy guidelines with PPI.
Notes: This diagram is an illustration assuming that a government with policy plans for 2021 wants to achieve the SDGs by 2030. The criterion of saving 60 months is illustrative as well; the user can modify it according to what they consider is a sensitive response of the indicator.

expenditure trend of the associated programmes. In case they observe large open gaps by 2030, then three alternative routes are open in the workflow. Navigating these pathways requires checking time savings with the analysis of budgetary frontiers.

The first route corresponds to a setting where structural factors do not constrain indicator advances (e.g., time savings in the budgetary frontier are more than 60 months). Thus, it is advisable to adjust the budget with the support of simulations exploring some sensitivity criteria. In the other two routes, time savings are limited (e.g., to 60 months or less). Hence, it is necessary to check the indicator's historical performance. Thus, the second route corresponds to an above-average performance, which implies that additional funding is not required. Last, the indicator's performance is relatively mediocre in the third route and does not respond to budgetary changes. In this case, the policy recommendation is to proceed with a comprehensive analysis of the associated programmes to decipher the causes behind these structural constraints.

A revision of the unresponsive and ill-performing programmes allows, among other things, detecting if budgetary resources end up diverted for personal use. Undoubtedly, this is a very relevant endeavour for fostering expenditure efficiency. However, this type of inefficiency is not part of what PPI defines as structural bottlenecks. The latter concept refers to a programme's inability to enhance development despite using the transferred public funds in its operations. Once discarding a lack of funds and resource wastage, the problem of insufficient progress might be due to an inappropriate implementation or an erroneous design. Examples of the latter are inadequate economic incentives, unresolved issues hampering collective action, conflict with other programmes, implementation in the wrong context or geographical location, and so on and so forth.[6] Therefore, with the previous commentary, we want to emphasise that PPI has the potential to identify structural bottlenecks that block development. However, the agent-computing model does not count with the data nor the required theoretical features to discover specific problems with the workings of such programmes.

13.3 A CALL FOR COMPUTATIONAL SOCIAL SCIENTISTS

The global challenge of achieving sustainable development goes hand in hand with the ability of states to perform successfully the following tasks: (1) generate and analyse data, (2) produce evidence-based policy advice, and (3) design, fund, and implement effective programmes. In each of these steps, capacity-building is key as the more complex development problems become, the more sophisticated the knowledge and technical expertise has to be for providing solutions. Thus, promoting capacity-building lives at the heart of the 2030 Agenda; and it should be part of every new technical proposal aiming to support the SDGs. For this reason, we would like to conclude this book with a reflection on the skills that social scientists and technical

[6] On the contrary, implementation problems refer to difficulties in the instrumentation of the programme, instead of how it operates.

teams in governments should acquire to exploit innovative analytical frameworks such as PPI.

Throughout the various policy projects in which we have been engaged with international organisations, and governments at the national and subnational levels, a common concern regarding the necessary skills and infrastructure to implement PPI seemed prevalent. Typical questions include: Do we need to learn how to program or to become computer scientists? Do we need to spend more time in data preprocessing in PPI than in other methods? What kind of skills should we be looking to hire in the future? Do we need to start hiring engineers instead of social scientists? Will this and similar technologies replace our analysts? Do we need a lot of computational power? Can we use PPI more resourcefully, such as re-training the staff available? In general, we can classify these questions into three groups: (1) data and computational infrastructure, (2) the government's technical teams, and (3) training future generations. In this section, we would like to discuss each category briefly and make an emphatic call for action in terms of updating the curricula of social science degrees. In this manner, new graduates could easily take advantage of emerging paradigms, such as the one on which we build PPI.

13.3.1 Necessary Infrastructure

When asked about the computational resources (hardware) needed to prepare data and deploy PPI, our short answer is that this toolkit does not require more than other analytic tools such as econometrics or system dynamics. Today, the computational power of personal computers has grown so much that PPI's model runs on computers already available in most offices of government analysts. To provide additional support on this issue, we have also developed an online app that allows the user to open the simulator on a web browser, load their indicator and expenditure data, calibrate the model parameters, and perform prospective simulations. This app works even on mobile devices such as smartphones. Moreover, we often use freely available

https://doi.org/10.1017/9781009022910.018 Published online by Cambridge University Press

cloud computing resources to give demos and training. All these resources are available from policypriority.org.

The reason why PPI's toolkit does not require more computational infrastructure than other approaches has to do with its parsimonious nature. Because we simulate agents' interactions in a parsimonious way (with few free parameters), we do not have to perform cumbersome algebraic operations such as large-scale matrix inversions (which often become a computational bottleneck in econometric methods). We designed it with these characteristics in mind to overcome the scaling limitations of other frameworks. This versatility was very important to us, as the least developed countries do not have the computational resources of nations in the Global North. Furthermore, as we have explained in the first part of this book, PPI's data-prepossessing requirements are not more demanding than those of other quantitative methods, as cleaning and normalising observations are part of the everyday workload of any quantitative social scientist.

In terms of software infrastructure, we programmed PPI's model in Python, which is one of the most popular programming languages (especially in the data science community). With each version of PPI, we have provided open source code via public repositories, such as those accompanying this book. In each project with a government, we deliver Jupyter Notebooks, which makes it easier to work with PPI, as the users do not need to worry about the nuts and bolts of the model. Their only concern should be executing functions that read the data and return the simulated outputs (in a similar fashion that one would run a regression in an econometric package). This strategy has been very successful as members of technical teams with basic quantitative skills have been able to quickly understand these materials and adopt them for their experimentation using counterfactual budgetary data. Likewise, all the required software (e.g., a Python distribution) is free and open source, and anyone can install it in popular operating systems. Yet, the online app is programmed entirely in the JavaScript language and designed to be even friendlier for the non-technical expert as it does not require any software installation other than a web browser.

13.3.2 Upgrading Skills in Technical Teams

In terms of the required skills to take full advantage of PPI, there are several points that we would like to discuss. First, as with most quantitative frameworks, skilled personnel are always beneficial for helping others to gain a deeper understanding of the tool and for performing bespoke studies. For instance, the optimisation procedure performed in Chapter 10 to analyse federal transfers requires certain modelling experience since applying heuristic optimisation involves the formulation of problem-specific strategies, which lie beyond the functions provided by PPI's libraries. Likewise, extending the model to account for remittances, as done in Chapter 12, demands programming knowledge for understanding the functions embedded in the code. While this type of proficiency would typically require an expert with capabilities that are unusual for a social scientist, we believe that the marginal cost to achieve such expertise is small. That is to say, it would cost not more than the time spent by someone wanting to understand an econometric package reasonably well.

Thus, while PPI is accessible to technical teams with an intermediate level of statistical skills, it would also be ideal to invest in computational skills to profit from the toolkit. As a first step, this objective is possible by promoting data science training through workshops or enrolling in continuous education programmes (quite common these days). As a second step, it would be convenient to hire graduates from technical fields like computer science, who can bring complementary skills to those of social scientists (a popular approach these days, especially among central banks). However, bringing people with these profiles into a government does not mean that conventional social scientists are irrelevant. Neither it implies that this AI framework will replace traditional government analyses. On the contrary, PPI relies heavily on the knowledge and field expertise of social scientists. Otherwise, it would be impossible to frame its applications properly and to support its parameterisation (as we do when defining instrumental indicators and validating the spillover network). In other words, the input of personnel with technical skills in computer and data sciences would be misplaced without the guidance of someone who understands the context under study.

Overall, we favour upgrading the level and diversity of skills within technical teams in governments. Yet, when hiring non-social-science experts, it is up to the organisation to generate synergies between the social and natural scientists. Unfortunately, this task is not always straightforward. Perhaps a more natural way to upgrade technical teams is to recruit new graduates with a mix of social studies and computational skills. Unfortunately, as of today, it is very challenging to find such a combination of skills, especially in the Global South. Even in developed nations, and despite new graduate programmes, educational gaps remain; preventing meeting the growing demand for computational social scientists by the public sector. Something that we discuss next.

13.3.3 Updating Social Science Programmes

The emerging field of Computational Social Sciences (CSS) has become quite popular in recent years. This is a very dynamic, interdisciplinary, and constantly evolving field. Thus, instead of stating a definition explicitly, we prefer to provide an illustration through Figure 13.2. What is important to note is that, contrary to various definitions provided by scholars and analysts, CSS is not just about big data or using computers and algorithms to unveil patterns. It has a deeper epistemology that relates to the usage of the term *computing*. While some of its antecedents trace back to schools of thought like cybernetics, systems dynamics, and micro-simulation, we could say that its origins as an independent discipline start with the work of Herbert Simon.

This Nobel laureate in Economics was the first to systematise ideas related to agent-computing and human beings into a coherent framework to study social systems and their complexity. Through

https://doi.org/10.1017/9781009022910.018 Published online by Cambridge University Press

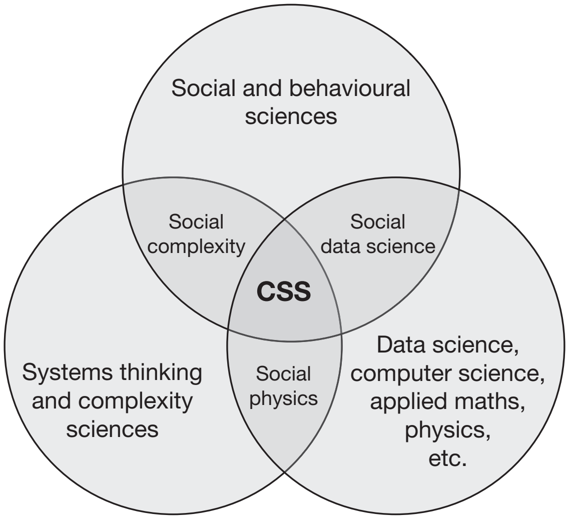

FIGURE 13.2 Computational social science and related fields.

a systemic and behavioural lens, Simon conceived computation as the process through which individuals process limited information under conditions of uncertainty (in a heuristic and procedural manner) to generate responses and interactions (as opposed to understanding computing as a number-crunching tool). Under this paradigm – traced through a series of essays on social modelling (Simon, 1957) and an integrated view of complex systems and behaviourism (Simon, 1962, 1969, 1976) – AI is conceived and implemented as a tool for understanding socioeconomic systems from a holistic point of view (i.e., from the bottom-up). For this reason, in Figure 13.2, we differentiate CSS from other popular approaches (with which it is often confused) like social data science and social physics (which includes econophysics).

As scholars who have worked in CSS for quite some time, we believe that social scientists should be, at least, familiarised with the intersection of disciplines where CSS is located in Figure 13.2. Unfortunately, many recently designed academic programmes focus on either social data science or social physics, claiming that both are

https://doi.org/10.1017/9781009022910.018 Published online by Cambridge University Press

equivalent to CSS. It is imperative to make this distinction because the former lacks a systemic view, while the latter presents extremely weak socioeconomic foundations. These two elements are critical for a better understanding of social systems and, hence, to properly embrace and advance CSS.

In particular, learning about complex systems is critical as it provides a binding theoretical framework (see Castaneda, 2021a,b for a comprehensive exposition). Often, such a framework stands in contrast to well-established assumptions on how social systems operate (e.g., aggregate economic equilibrium). In our experience, researchers who lack these foundations tend to employ computational methods to test off-the-shelf theories (rather than formulating new methods) or address the same old questions (without thinking outside of the box) by using computers only as number-crunching tools. With this, we do not mean to say that analysing pre-existing theories and questions is bad, but to recognise that advancing social science and CSS can only happen by challenging the established paradigms; and computational frameworks cannot help much in such endeavour if one always constrains research to the status quo. Thus, complexity science facilitates questioning the established social science paradigms and formulating novel solutions. As we have argued throughout the book, such critical yet formal thinking is necessary to overcome both theoretical and empirical challenges that prevent us from fully exploiting new data that are relevant to achieving sustainable development.

In summary, PPI and other computational frameworks that, in the future, will support evidence-based policymaking will require a new generation of social scientists. This type of professional will be comfortable with algorithms, programming, behaviourism, systems-thinking, and complexity; and will be prone to questioning deeply entrenched assumptions in their fields of study. Thus, updating university curricula to acquaint them with CSS will be critical during this process. Furthermore, because of the interdisciplinary nature of CSS and the provision of a rich theoretical backbone, this new generation will be better prepared to interact with other disciplines and avoid the siloed dynamics that have prevailed in many social sciences. Such cross-fertilisation is essential to properly tackling sustainable development and its complexity. Thus, with this book, we hope to contribute to this mission and plant the seed for future generations who wish to make substantive progress towards improving the well-being of society and our planet.