The Alan Turing Institute

Data Challenge: Policy Priorities & AI for SDGs

Key Concepts

This document provides a brief explanation of several key concepts that have been developed throughout the Policy Priority Inference (PPI) research programme. While most of these ideas can be found in the book '*Complexity Economics and Sustainable Development: A Computational Toolkit for Policy Priority Inference*', this document also provides references to the academic articles where some of these concepts were first introduced.

The objective of this document is to provide the reader with an overview of various concepts that can be formalised and quantified through the PPI online app, without the need for a more technical explanation. The document is organised in two sections: *definitional concepts* that will help understand some of the terminology commonly used in PPI, and *analytical concepts* that are more technical and require multiple steps to be quantified.

Finally, something important is to consider that PPI requires three input datasets: (1) time series of development indicators, (2) government expenditure data across development dimensions, and (3) a network of interdependencies between the indicators. This document assumes that these three inputs are provided.

You can find a full list of publications referenced throughout in the bibliography on the final page. Alternatively, you can download all the published academic papers of PPI here.

Definitional Concepts

Sample period	The timeframe within which the data on development indicators and government expenditure has been collected.
Historical performance	The average level of an indicator during the sample period.
Instrumental policy issue	A development dimension in which there are policy instruments designed to directly impact the associated indicators. The existence of such instruments is independent of their effectiveness. Instrumental policy issues were first introduced by Guerrero & Castañeda (2020).
Collateral policy issue	A development dimension in which there are no policy instruments designed to directly impact the associated indicators. Collateral policy issues can exist because they are too aggregate to have instruments that can exert a reliable degree of control (e.g. GDP), or because the main actors driving their development are not governmental (e.g. charities, NGOs, academia). Collateral policy issues were first introduced by Guerrero & Castañeda (2020).
Development goals	The aspirations of a government (not to be confused with the priorities). Usually, these are quantified through specific values for the collected development indicators.
Interdependency network	The structure of interrelations between the development indicators. These relationships are not necessarily causal, as the dynamics of two indicators could be strongly coupled through a third (unknown) factor. Instead, this network characterises the context of a country or region by providing structural information that can be taken into account by PPI. Interdependency networks can be constructed through statistical methods or via expert opinion. Ospina-Forero et al. (2022) provide an extensive review on this topic.
Synergy	Positive links between indicators in the interdependency network.
Trade-off	Negative links between indicators in the interdependency network.
Calibration	Finding the parameters that allow the PPI model to reproduce key empirical regularities of the indicators collected during the sample period.
Retrospective analysis	Any analysis using the calibrated model that covers the sample period.
Prospective analysis	Any analysis using the calibrated model that covers periods ahead of the sample period.

Simulation run	A single run of the PPI model.
Monte Carlo simulations	A sample of independent simulation runs. Because PPI has stochastic elements, each simulation run may yield slightly different results. Hence, a Monte Carlo sample of independent runs is recommended to quantify the average outputs of the model.
Average outputs	The simulated dynamics of the indicators resulting from the Monte Carlo simulations, averaged for each indicator across the Monte Carlo sample. This is the output returned by the PPI app: one average simulated time series for each indicator.
Baseline scenario	Monte Carlo simulations (either prospective or retrospective) that are performed with the aim of using them as a reference point to measure the difference in average outputs compared to a counterfactual scenario. Typically, a baseline scenario assumes 'business as usual', for example, the same level of government expenditure as the one in the sample period.
Counterfactual scenario	Monte Carlo simulations (either prospective or retrospective) that are performed with the aim of implementing a change or intervention in the PPI input data and to measure the consequences of such a change. Typically, the consequence of the change or intervention is quantified through the difference between the average output of the counterfactual scenario and the one of a baseline scenario. Guerrero et al. (2023) provide an example on the design of a counterfactual in the context of the impact evaluation of international aid flows.
Monitoring (governance)	A feature of PPI that describes the quality of the checks and balances of the public administration regarding the usage of public resources (monetary and otherwise). This variable goes between 0 and 1, with 1 representing perfect monitoring and 0 no monitoring at all. Typically, this variable can be obtained from survey data such as the World Governance Indicators. However, the user can also devise counterfactual scenarios to study the impact of different governance frameworks, as done in Guerrero & Castañeda (2021a).
Rule of law (governance)	A feature of PPI that describes the efficacy of the punitive measures against bureaucrat agents who have been discovered being inefficient. This variable goes between 0 and 1, with 1 representing severe measures and 0 no measures at all. Typically, this variable can be obtained from survey data such as the World Governance Indicators. However, the user can also devise counterfactual scenarios to study the impact of different governance frameworks, as done in Guerrero & Castañeda (2021a).

Analytical Concepts

Convergence time	The amount of time it would take to reach a set of development goals with a given level of government expenditure. Convergence may not always be possible, as some indicators may exhibit trends that diverge from the goals.
Feasibility	An assessment of how viable it would be to reach the development goals. This assessment can follow different criteria, and it is up to the user to determine which one is the most adequate. Some examples include checking if the convergence time is less than the duration of a government; if the additional resources needed to reach the goals are realistic; if a minimum number of goals would be reached given an amount of government expenditure.
Optimal budget	A distribution of government expenditure that optimises certain development outcomes, for example, minimising the convergence time or maximising the performance of certain indicators. To find the optimal budget in PPI, it is necessary to perform counterfactual scenarios with alternative budgets and compare the associated outcomes with a baseline scenario. In the PPI app, this can be achieved through trial and error by testing different expenditure distributions. Guerrero et al. (2022) provide an example on budget optimisation in the context of regional development and conditioning for different development dimensions.
Policy coherence	The consistency between the development goals and the policy priorities of the government. To quantify policy coherence, one can compare the real-world data on government expenditure against the optimal budget. Coherent policies imply that real-world expenditure looks like the optimal budget. Such similarity could be measured through a correlation coefficient, rankings of expenditure tranches, or the policy coherence index developed by Guerrero & Castañeda (2021b).

Sensitivity analysis	A study on the response that an indicator shows to a change in government expenditure. This can be achieved by constructing a counterfactual scenario where the budgetary data is modified, and the outputs are compared against the baseline. A metric commonly used in economic analysis is *arc elasticity*, which consists of calculating the following formula: $$arcElasticiy = \frac{\%\ changeInIndicator}{\%\ changeInExpenditure}$$ Here, the change is measured as the difference between the counterfactual and the baseline scenarios. The arc elasticity can be interpreted as the percentage change of the indicator as the result of one perfect change in expenditure. If this measure is greater than 1 in absolute value, we say that the indicator in question is elastic, as its response is more than proportional to the change in expenditure. An example of how arc elasticity is used in PPI can be found in Guerrero & Castañeda (2024).
Critical policy issues	Topics in which development indicators present a persistent worsening trend that cannot be reversed, even with substantial increases in government expenditure.
Frontier analysis	An assessment of the sensitivity of the indicators under a hypothetical scenario with no financial constraints. In this analysis, the user sets an extremely high budget as the counterfactual scenario. The idea is to simulate a case with unlimited financial resources to discover indicators that, even with sufficient funding, still show poor sensitivity. Such a result would be a first step in the discovery of policy issues that may require structural reforms due to the potential presence of idiosyncratic bottlenecks. Frontier analysis was first developed by Guerrero & Castañeda (2022).
Idiosyncratic bottlenecks	A structural problem that prevents indicators from performing well, even when sufficient funds are available. To detect indicators that may have idiosyncratic bottlenecks, two steps are required: (1) performing frontier analysis and (2) identifying indicators with historically low levels of development. Hence, an idiosyncratic bottleneck is most likely to exist in those policy issues that have historically poor development and do not respond to the influx of public funds. For example, they may have poorly designed programmes, or their target population may be misidentified. In these cases, it is necessary to bring domain experts to identify the idiosyncratic bottlenecks and to design relevant interventions. Guerrero & Castañeda (2022) provide examples of how to perform this analysis, and Guerrero & Castañeda (2024) develop a flagging system to categorise these bottlenecks according to their level of criticality.

Systemic bottlenecks	In contrast to idiosyncratic bottlenecks, systemic bottlenecks focus on indirect effects between policy issues. Systemic bottlenecks refer to policy issues that, if their associated policies are poorly funded, can obstruct the development of other policy issues. To detect systemic bottlenecks, we need to construct a counterfactual in which the funding associated to a specific indicator is reduced or removed. Then, we need to compare the outcome between this counterfactual and the baseline scenarios *only in those indicators that are not associated to the budget tranche that was intervened.* Hence, a policy issue is a systemic bottleneck if the reduction or absence of its associated budget affefcts indicators that are not directly linked to the intervened budgetary tranche. An example of systemic bottlenecks can be found in Chapter 11 of Guerrero & Castañeda (2024).
Accelerators	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. They are the counterpart to systemic bottlenecks and, to detect them, we need to construct a counterfactual in which the funding associated to a specific indicator is increased. Then, we need to compare the outcome between this counterfactual and the baseline scenarios *only in those indicators that are not associated to the budget tranche that was intervened.* Hence, a policy issue is an accelerator if an increase in its associated budget affects indicators that are not directly linked to the intervened budgetary tranche. An example of accelerators can be found in Chapter 11 of Guerrero & Castañeda (2024).
Policy resilience	The capacity within a policy issue to continue performing in the presence of a budgetary shock. This notion can be formalised in different ways through PPI. For example, Guerrero & Castañeda (2018) define resilient policies as those that can achieve their development goals in the presence of random reductions to their budgets. Alternatively, one could say that a policy issue is resilient if its indicators can maintain an improving trend, even when their resources are diminished.

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