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IFs analysis – Good to know before you start (illustrated by examples)

Introduction

This note describes, and illustrates by examples, some of the key features of the International Futures (IFs) model and at the same time strengths and weaknesses in its ability to deliver insights on policy guidance and acceleration. It is the hope that it will give anyone thinking of doing, or having done, an IFs analysis a better idea of what can be expected from such an analysis in terms of results and outputs, and importantly also a better idea of what kind of work/analysis and pre-conditions are required prior to using the model to ensure a good quality analysis which can confidently be used to guide policy decisions and prioritizations.

This is not a guide on how to use the model, nor a presentation of the workings of the model system. This type of information can be found elsewhere for people interested in understanding the details of the model and use it in their work.[1] BPPS SPU is of course always happy to assist in this regard.[2]

0. What is IFs, and how is it different from other UNDP integration and acceleration tools

IFs is a long-term modeling system consisting of multiple interlinked submodules[3] each representing different dimensions of development. The model is developed and maintained by the Pardee Center at the University of Denver with whom UNDP has a partnership which has resulted in the model being augmented with an SDG dashboard that lets the user track SDG impacts from interventions implemented (see section 6). A number of IFs analysis have been undertaken, and more are under way, as part of several MAPS missions and other research efforts.

IFs is the only tool in the UNDP toolbox that provides a modeling framework that ties together all dimensions of development; socioeconomic, human and sustainable. It can be used independently or as a complement to other analysis, e.g. by using the analytical outputs from applying other more "sector specific" tools to assess broader/multiple development impacts. One example could be the application of the Open Source Spatial Electrification Tool (OnSSET[4]) which supports countries on electrification planning and costing. The conclusions (electrification needs, costs and speed of grid expansion) from applying OnSSET could then be used as inputs to guide the analytical interventions in IFs.

1. How the model works in general

IFs lets the user assess impacts from interventions/changes to one dimension of development on other related dimensions of development. An intervention is implemented through one of the submodules and will carry a number of key direct or indirect links (positive or negative) to other submodules, and in some cases also feedbacks. Over time the modeling system will then reach a new (higher or lower) development trajectory compared to the trajectory under a "no-intervention" assumption, also called the baseline. This is the general workings of the IFs modeling system. The user will have to decide on the size and speed of implementation of the different interventions – the benchmarking. IFs analysis can be carried out at the national, regional or global level.

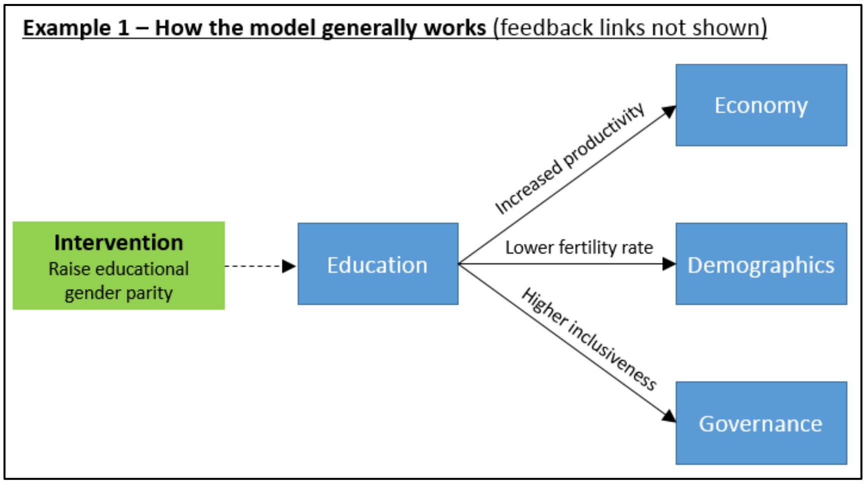
[1] For an overview of the modeling system and a quick guide to scenario analysis see: http://pardee.du.edu/wiki/Understand_the_Model for more details visit the Pardee Center's website for IFs: http://pardee.du.edu/

[2] Tasneem Mirza or Lars Jensen

[3] Some of the main submodules are; governance, international politics, education, health, agriculture, infrastructure, environment, technology, energy, economics, demographics and international politics.

[4] http://www.onsset.org/

Example 1 – how the model generally works: *To target e.g. gender equality in education the user could intervene to increase female enrollment rates to match male enrollment rates in x number of years. This intervention will be done through the education submodule and will have positive impacts on a number of other variables under other submodules; economic (through higher economic productivity), demography (through a lower fertility rate) and even components of governance (through higher inclusiveness), etc. After having done this intervention the user can find an answer to questions like; How much will the intervention have added to economic growth in year x compared to the baseline? How much will population growth have fallen by year x compared to the baseline, etc.?*

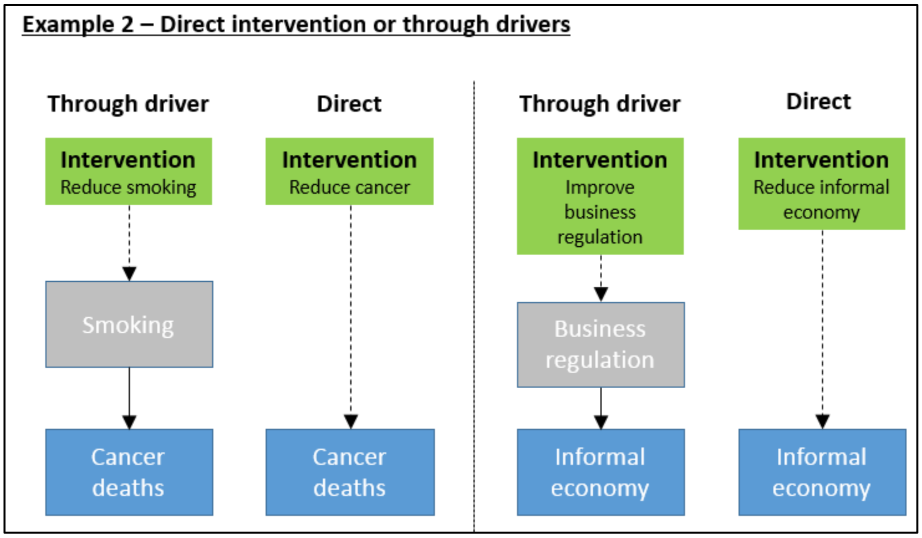


2. Interventions can be done directly or through drivers

Most key variables can be changed either directly or by making a change to one of the variable's driving variables (i.e. indirectly).[5] This has both pros and cons. On the con-side, changing a variable directly does not give the user many insights into which policy would help achieve that change. In that sense there is a limit to the model's ability to provide specific policy guidance. On the pro-side, since the model cannot realistically capture all possible relationships between variables, allowing for changes made directly is a necessary flexibility. But, such changes should of course have been motivated and analyzed "outside the model". See section 3 for an example.

Example 2 – direct intervention or through drivers: *Under the health submodule the model tracks, and the user can make changes to, different death rates, one of them being from cancer. One of the key model drivers of cancer deaths is "the smoking rate". Another example is the size of the informal economy which has as one of its key drivers "the quality of business regulation". The user can intervene through the relevant driver to reduce cancer deaths or the size of the informal economy, or he/she could just reduce the variables directly, i.e. disregarding the drivers. The latter is useful as one can think of many other policies besides policies targeting smoking or business regulation that could have an impact on either cancer or the informal economy.*

[5] Changing a variable directly is usually done by multiplying the entire result of a basic equation by a number. The default value, i.e. the value for which the parameter has no effect and to which multipliers almost invariably are set in the Base Case, is 1.



3. What policy insights can the model be expected to deliver – strengths and weaknesses

The best feature/strength of the model is its ability to *deliver insights into how multiple dimensions of development (economic, social and environmental) are integrated, and thus how changes implemented to one dimension can generate positive spillovers and/or trade-offs to other dimensions in the long-term*.

The IFs modeling system contains hundreds of quantitative relationships derived from the academic literature and statistics. These relationships provide the user with important information on the key forces that help transform/shape development, and thus also an idea of what kind of policy could matter to tackle different types of development problems. One simple example is the negative relationship between access to safe water and sanitation (the infrastructure submodule) and children's health burden (the health submodule). The relationship suggests that a country with a high burden of children's health and simultaneously low access to safe water and sanitation could significantly reduce this health burden by focusing policy on expanding access.

But, as explained in section 2, the model does not include all potentially relevant relationships, and in some cases there are no specific relationship stated (no key drivers) as the academic/empirical research is considered inconclusive on such relationships. Even when the model suggests that e.g. increasing access to infrastructure is a key solution to a health problem, it does not offer any specific insights into how the country could go about expanding that infrastructure given its particular context.[6] Understanding and quantifying the relationship between infrastructure and health is the model's main contribution - not to deliver specific policy and regulatory guidance on how to expand infrastructure.

To stick with the example above; by expanding access to safe water and sanitation by say 25%, the user can then ask; How much will this have reduced the disease burden for children by year x? What will the impact be on fertility and population growth? What is the impact on stunting? Etc.

[6] Here other available tools could can be used. For electrification planning e.g. the Open Source Spatial Electrification Tool (OnSSET). Over the past few years, KTH Royal Institute of Technology together with UNDP, UNDESA, the World Bank, SEI, and other partners have been developing and promoting the use of open source, geospatial electrification toolkit that can support countries on electrification planning. OnSSET is a GIS-based tool developed to identify the least-cost electrification option(s) based on a country's available natural resources and population needs.

In that sense, the model is not highly useful in answering questions like; *"through which specific policy will a country be able to reach an objective, and at what financial cost"?* Or in other words, in most cases the model shows the user the benefits and trade-offs *"of getting there"*, not *"how to get there"*.

However, it should be noted that even disregarding the important quantitative relationships in the model which can help identify relevant policy areas, the model can still help researchers get closer to answering the "how". This is because the model provides a framework for comparing countries on different variables and their historical developments. One could e.g. think of a country that has decided to prioritize gender equality in education and labor force participation. The modeling system and database can then be used to help identify countries that have historically been at that same level of gender (in)equality (and shared other important similar characteristics also), but was able to achieve rapid progress in female education and female labor force participation rates. This would indicate to the researcher that it might be beneficial to review and find inspiration in the specific policies adopted by these other countries – i.e. essentially facilitating the identification and sharing of best-practices.[7]

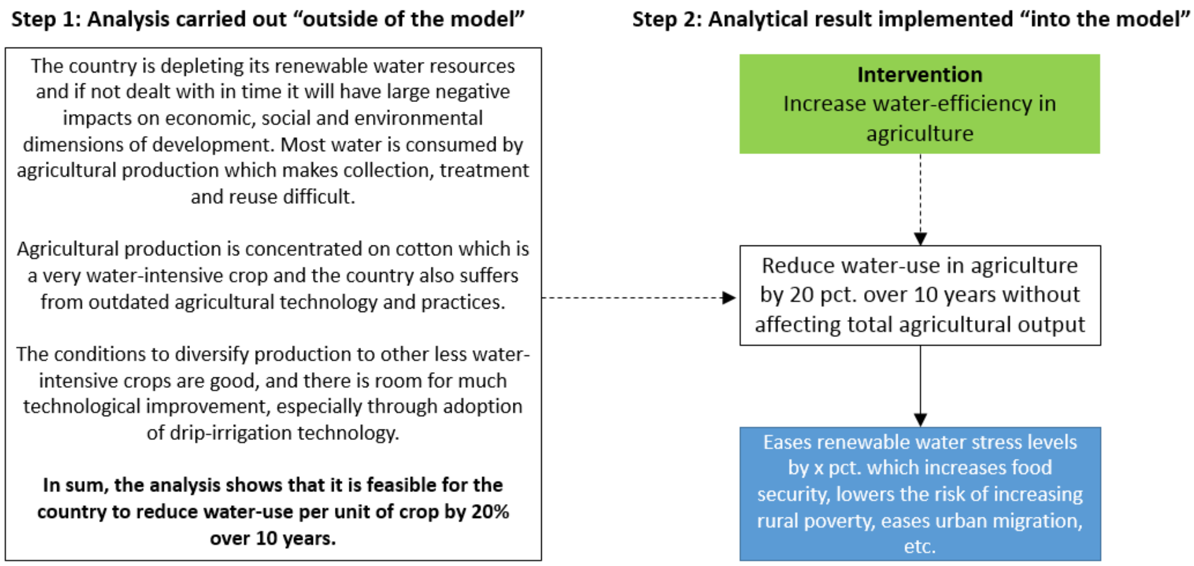
Answering the "how" will for most parts require in-depth analyzes carried out "outside of the model", results of which can then be implemented "into the model" through the relevant submodules and their variables. After doing so, the multidimensional development impacts can be assessed through the model system. Without an in-depth analysis undertaken outside of the model to guide such interventions the user often has to rely on much simpler benchmarking approaches and the main trade-off of such will be high uncertainty on whether or not they represent feasible interventions for that particular country.

The most common simple benchmarking approach is to find a country (or a group of countries' average) that performs better on the specific dimensions of development the user is interested in, and then model the interventions such that the country "catches up" to this "frontier country" in a said period of time and then assess the multiple development impacts from doing so. Alternatively, base interventions on cross-country regressions and implement e.g. a one standard deviation improvement in the variable of interest. If a country has decided on specific policy targets – e.g. to reach universal access to education or electricity by 2030 – then these can help guide interventions.

Example 3 – how to motivate an intervention: *Arriving at a feasible/realistic benchmark value for an intervention is not straightforward. It will often require inputs from an in-depth analysis undertaken "outside of the model" on the particular topic by, or in consultation with, national experts. If not, interventions might carry a too high uncertainty. To understand this, think of example 2 on cancer. If a country designs a set of policies targeted at reducing smoking (tobacco taxes, ban smoking in public areas, information campaigns, etc.) it will, if successful, also reduce cancer deaths in the model as smoking is the number one driver. But, what if the target is to reduce corruption, increase access to electricity or attract foreign investments? The policy and regulatory designs needed to reach such targets are more complex and comprehensive and likely to differ between countries, which makes it much more difficult to assess what a feasible model intervention and benchmark would look like. The box below gives an example on how a result from a sector-specific country analysis conducted prior to using the model can be used as an input to guide the model intervention.*

[7] This can be a time-consuming exercise in the model, but is something that Pardee Center hopes to be able to automate more in the future through programming, so-called "automated-benchmarking".

Example 3 – How to motivate an intervention

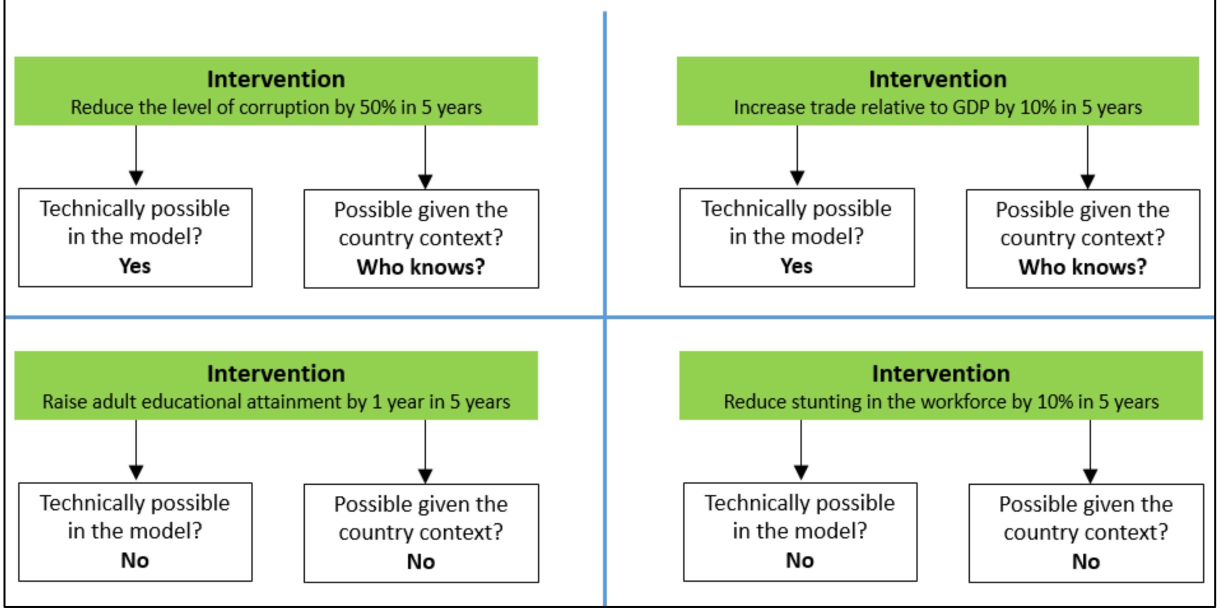


4. Immediate impact versus longer term impacts

A common conclusion from using IFs is that economic benefits of say governance improvements (or other more direct interventions to e.g. boost trade or investments) will occur more immediately – shorter waiting time – than interventions targeted at improving human capital such as health and education that will often take longer to "take a hold". This means that looking at governance improvements versus human capital improvements only till e.g. 2030 will often give the wrong impression that returns to human capital investments are relatively smaller. The conclusion is also a bit misleading for other reasons as it depends on differences in the technical modeling done under each submodule. As an example, while one can only raise educational attainment slowly in the model, large changes to most governance indicators can be implemented more or less immediately. But, who is to say how long it realistically will take for a country to reach such governance improvements? It comes back to the points made in section 3 on having the right analytical foundation to guide interventions. However, there is probably some truth in that willing and able governments that come from low levels of "quality of governance", or say poor private sector regulation, could swiftly implement reforms that would have more immediate economic impacts at relatively lower costs. The same cannot be done with many human capital interventions, and that's exactly why they should be prioritized urgently to reap the significant economic (and other) returns sooner rather than later. The same applies to most infrastructure investments. Developing, financing and constructing a large infrastructure project can take many years.

Example 4 – immediate versus slower impacts: *Two important human capital indicators are "adult educational attainment" and "stunting" as they have a high impact on economic productivity and thus economic growth. But, raising educational attainment in the adult population by e.g. 1 year will take a long time as the education submodule tracks people through stocks and flows. Adding 1 year of additional education to all graduating cohorts starting today will not have changed the "average working age educational attainment" much looking only till 2030, as most working age adults in 2030 graduated many years before the intervention/improvement and will still dominate the workforce in numbers. As we move beyond 2030 the older generation of workers will increasingly retire and a higher and higher share of the* *working age population will now have a higher educational attainment, significantly pulling up the average for every new higher educated cohort added to the workforce and every old lower educated cohort retiring. The same mechanisms are at play for stunting. Stunting takes place in yearly childhood, but will have permanent/irreversible negative impacts throughout a person's life. Eradicating stunting in all children below 5 years of age today and going forward will not have had a significant productivity effect by 2030 as most children under 5 today will not even have joined the workforce by 2030. The positive economic impacts of such an intervention will be large, but later. Conversely, the negative economic impact of not doing anything about it today will be large (and irreversible), but later.*

Example 4 – interventions that generate "immediate" economic gains vs. interventions that take longer



5. Most Interventions are "free"

The model is for most parts not suitable for producing cost estimates of interventions. However, the submodules for education and infrastructure can under some circumstances be used to produce cost estimates as they operate with unit-costs for any additional unit of infrastructure "implemented" or any additional student educated (e.g. the cost of sending one additional student through primary, secondary and tertiary levels of education).

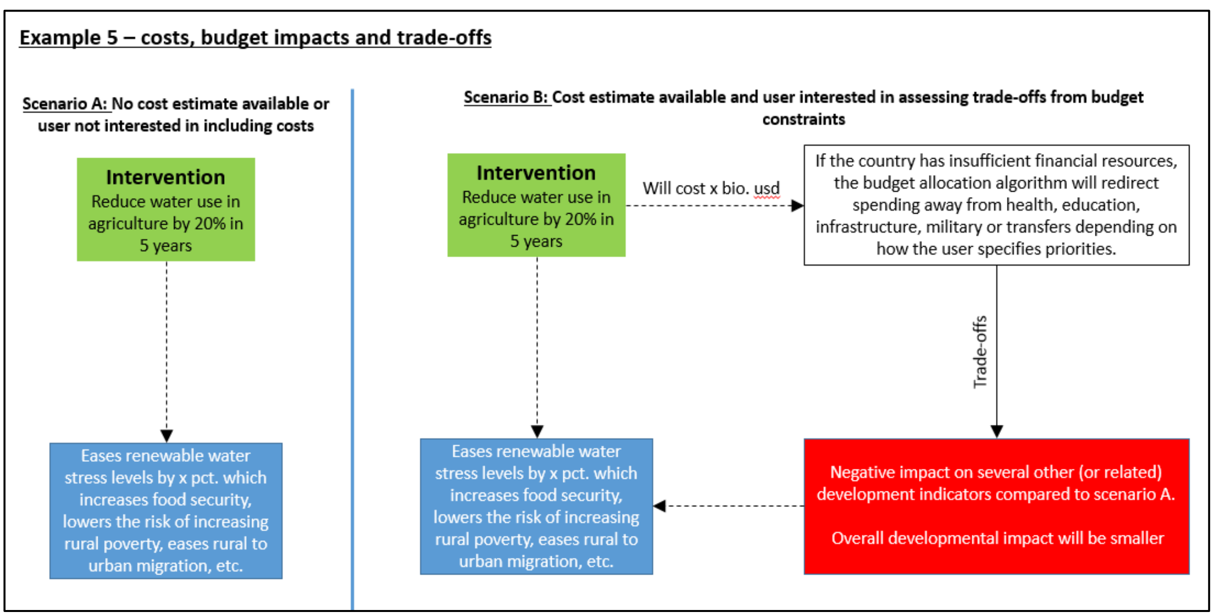
But, for the most part, if the user is interested in costing, then that estimate would have to be produced outside the model; e.g. what would be the cost of rolling out drip irrigation technology from the box in example 3 above? Or what is the cost of implementing a large governance reform? Improving business regulation? Attracting FDI? If needed, such cost estimates will most often be better produced in designated models/tools designed for that specific purpose or sector.

After having done so, the cost estimate could then be entered (exogenously) into IFs as an increase to government expenditure (through the category "other") to assess how this would affect the government's budget, and budget allocations to other spending categories; transfer payments (welfare, pensions, etc.), education, health, military and infrastructure.

In IFs any intervention that will have a budgetary impact is implemented under a "budget constraint" assumption. It means that if the user e.g. choses to prioritize investments in education through his/her interventions and the country does not have the required financial resources, the government budget algorithm will automatically re-allocate some of the spending on say health or infrastructure to education – i.e. there is a policy trade-off. Importantly, in such cases the model allows the user to decide how the budget algorithm should prioritize between spending categories, e.g. by setting education as the highest priority and military spending as the lowest, or vice versa.

Depending on the purpose of the analysis the user can also decide to switch-off any budgetary impacts. In that case the cost of the intervention will be tracked outside the model's government budget, but not impact its size and allocation. This is useful if the user is interested in assessing the benefits of an intervention under the assumption of no "trade-offs".

Example 5 – costs, budget impacts and trade-offs: *This example builds on the example in box 3. Say that the "external" analysis carried out on the country's agricultural reform program has produced a cost estimate for diversifying agricultural production and expanding drip irrigation infrastructure which will ultimately lead to the overall goal of reducing water stress levels. As IFs allows the user to make changes to water-efficiency, but has no cost estimates for doing so, the user could chose to either 1) ignore this externally produced cost estimate and just implement the improvement to water-efficiency and assess the different development impacts in the model – this is scenario A in the box below 2) implement the water-efficiency improvement AND the externally produced cost estimate as an increase to government expenditure and then assess the different development impacts in the model – this is scenario B in the box below. Under the latter approach, and if the additional expenditure means that the government will hit its budget constraint, this will come with some trade-offs as e.g. reductions in expenditure on health or education (at least in relative terms).*



6. How the model incorporates the SDGs

There are 169 SDG targets and 232 indicators 93 of which are categorized as Tier 1.[8] Most indicators do not translate one-to-one into IFs, but in total 94 different IFs measures which are either precisely an SDG indicator or a proxy for an SDG indicator can be calculated and tracked in the model under 14 different goals. As there are oftentimes several alternative proxies for the same indicator, the net number of SDG indicators calculated and tracked in IFs is 48 – i.e. 48 SDG indicators are tracked through 94 different measures.

Example 6 below shows the SDG dashboard for SDGs 1 and 3 for a country. SDG target 1.1 states; *"By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day"*. The associated indicator 1.1.1 is; *"Proportion of population below the international poverty line, by sex, age, employment status and geographical location (urban/rural)"*. As evident IFs has two measures for this indicator denominated "indicator 1.1.1a and 1.1.1b" depending on whether one would like to measure poverty at the $1.25 or $1.90 threshold.[9]

Example 6 - SDG indicators and targets			
********************** Goal 1: POVERTY **********************	2015	Baseline 2030	Target 2030
Indicator 1.1.1a - Percentage of population below $1.25 (2005$ PPP) per day; Lognormal	41.54	35.18	3
Indicator 1.1.1b - Percentage of population below $1.90 (2011$ PPP) per day; Lognormal	44.28	37.18	3
Indicator 1.2.1a - Percentage of population below $2 (2005$ PPP) per day; Lognormal	72.94	59.82	36.47
Indicator 1.2.1b - Percentage of population below $3.10 (2011$ PPP) per day; Lognormal	72.83	59.72	36.42
Indicator 1.a.1a - Transfers as % of total government expenditures	23.62	26.33	
Indicator 1.a.1b - Transfers as % of GDP	4.674	5.441	
Indicator 1.a.1c - Transfers in Billion $	2.024	6.441	
Indicator 1.a.2a - Percentage of total government spending on essential services (education; health)	30.68	32.54	
Indicator 1.a.2b - Government spending on essential services (education; health) as % of GDP	6.071	6.725	
Indicator 1.a.2c - Government spending on essential services (education; health) in Billion $	2.629	7.96	
********************** Goal 3: HEALTH **********************			
Indicator 3.2.2 - Infant mortality rate in deaths per thousand newborns	42.09	30.23	12
Indicator 3.3.1a - HIV cases as percentage of population	2.784	1.875	0
Indicator 3.3.1b - AIDS death rate as percentage of population	0.0854	0.0325	0
Indicator 3.3.3 - Malaria death rate per thousand	0.2985	0.1619	0
Indicator 3.4.1a - Cardiovascular disease death rate per thousand	0.8113	0.8618	0.5435
Indicator 3.4.1b - Cancer death rate per thousand	0.417	0.4549	0.2794
Indicator 3.4.1c - Digestive disease death rate per thousand	0.2282	0.2041	0.1529
Indicator 3.4.1d - Respiratory disease death rate per thousand	0.1086	0.1149	0.0728
Indicator 3.4.1e - Diabetes death rate per thousand	0.1084	0.1195	0.0726
Indicator 3.4.1f - Mental Health death rate per thousand	0.0122	0.0134	0.0082
Indicator 3.4.1g - Other Non Communicable disease death rate per thousand	0.5889	0.4951	0.3946
Indicator 3.6.1 - Road traffic injuries death rate per thousand	0.2948	0.3584	0.1474
Indicator 3.7.1 - Contraception use as percentage of fertile women	38.4	51.09	97
Indicator 3.a.1 - Smoking Rate - Total	16.27	16.84	8.137

The blue column shows the indicator value in 2015, the white column the 2030 value under the baseline (business as usual) forecast and in the last green column is the 2030 indicator target value. E.g. if a country has adopted its own targets, the user can easily input these into the model. If not the model will show a

[8] A Tier 1 indicator is conceptually clear, has an internationally established methodology and standards are available, and data are regularly produced by countries for at least 50 per cent of countries and of the population in every region where the indicator is relevant.

[9] In fact the model allows the user to select any threshold as poverty is calculated internally using consumption per capita and the gini as the income distribution proxy.

number of global default targets where possible (and a blank cell where not) as illustrated in the example above.

Some default targets are straightforward to enter as they are explicitly mentioned in the SDG framework. E.g. target 3.2 states *"By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births*". So, the 2030 target value for indicator 3.2.2 in IFs is set to 12 as shown above (unless the country is already below 12, then that value will remain the target). Other times where it is more difficult, but not impossible, to put a target value based on the SDG framework text the user will have some degrees of freedom to interpret the text. Returning to the example of target 1.1, "eradicate" is in the example above interpreted as 3% as evident by the 2030 target value entered for indicator 1.1.1a (and 1.1.1b).

7. Data uncertainty

A last important issue concerns the database used in IFs. For all countries included in IFs, international recognized and public data sources are used. However, this also means that for many countries (especially low income countries) a lot of data is missing, and for some most data is missing. In IFs this means that many data points are estimates performed by the IFs modeling framework based on projections from a few, and potentially far back, historical values and/or cross-country comparisons/regressions.

As an example; for educational attainment data the model uses the Barro-Lee survey dataset[10] to set the level for each country. As several countries were not covered by that survey there is no data (at least from that source) available. What the model will then do is estimate the attainment value for the country based on cross-country regressions on the relationship between educational attainment and other highly correlated variables. For simplicity, say that GDP per capita is highly correlated with educational attainment. Given that identified statistical relationship the model will then assign the country an educational attainment value based on its GDP per capita value.

Often, it will be possible to find other datasets by other organizations or institutions (e.g. national statistical offices) that will have that particular (in IFs) missing variable or variables. Pardee Center (which manages the IFs model) will not update the IFs database based on such data, as there is good reason to keep all sources identical for all countries in the model and use data from internationally recognized and independent sources.

However, it is important to understand that the user can at any time change any variable values in the database at their own discretion. This means that if e.g. a country office or UN agency or national counterpart believes that some value or values are wrong based on more recent evidence, then data can be changed and saved by the user in his/her "own version" of the model.

It should also be noted, that often times it matters less whether the level of a variable is completely accurate if the user is only interested in assessing the impacts from changes to a variable. As an example; the positive impact on multifactor productivity from raising educational attainment by 1 year is the same whether the level is raised from 7-8 years or from 8-9 years.

[10] http://barrolee.com/data/oup_download_c.htm