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Introduction

The GRADE (Government Revenue and Development Estimations) allows the user to predict what would happen regarding access to health determinants and survival if government revenue increases in an individual country. The critical determinants of health, water, sanitation, education and healthcare are also fundamental economic and social rights and are among the targets of the Sustainable Development Goals (SDGs) 3,4,5 and 6. The research underpinning the GRADE used data from most countries globally, over several decades, to model this relationship. This model may assist advocates in assessing policies and multinational corporations to review their economic, social and governance contributions (ESG) acting via their contributions to public finances.

This guide aims to assist the user to understand the thinking behind the GRADE, the modelling, the sources of data, frequently asked questions and how to use the GRADE. More detailed information on the modelling is available in the associated publications, and there are short recordings on the website explaining how to use it.

We believe this work and its visualisation will offer robust and realistic estimates of the potential of increased government revenue and will be of interest to organisations who advocate for a reduction in debt service and tax avoidance. It may also be of interest to corporations for their economic, social and governance reporting.

The background of the GRADE project

The GRADE project aims to predict the impact of a change in government revenue on the Sustainable Development Goals (SDGs) 3,4,5, and 6 and fundamental economic and social rights by 2030. The GRADE was developed to assess the impact of increased or decreased government revenue on these developmental outcomes.

This GRADE allows the estimation of the downstream impacts of upstream decisions that impact government revenue. Therefore, if a policy change increases or decreases government revenue, the user can estimate the effect on access to health determinants. These models may assist with the attribution of responsibility and, hopefully, remedy. This work has helped advocacy groups target their efforts towards the policies most likely to increase government revenue, government spending on public services, access to health determinants, and improved health outcomes.

A multi-disciplinary team developed the GRADE; The team believes increased government spending on the determinants of health could offer sustainable solutions and hence their interest in the leaks from government revenues or lost government revenues. Conversely, if leaks from government revenues are curtailed, government spending will increase, as will coverage of health determinants, reducing survival. In addition, research shows that the significant leaks from government revenue baskets include tax abuses and debt service, and low government revenue increases corruption which further drives lost government revenues.

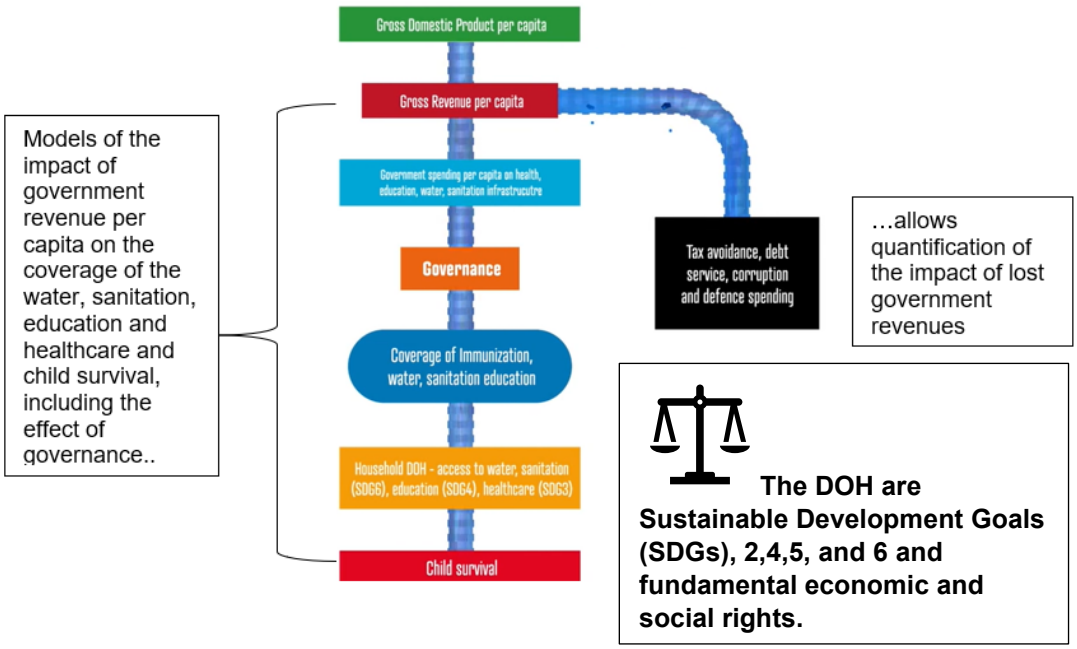
Why use government revenue per capita?

The GRADE uses government revenue per capita rather than, say, health spending for two reasons.

1. A better understanding of the relationship between government revenue per capita and the determinants of health and survival/survival is helpful because the policies and practices of governments, multinational organisations, including corporations and banks, are much more likely to influence government revenue than government spending. For example, the facilitation of capital flight results in a large public debt or tax avoidance by multinational corporations. In contrast, international actors are unlikely to influence government spending except for the international monetary fund and donors in highly aid-dependent countries.
2. Government revenue per capita also reflects the ability of governments to spend across all sectors. Many studies have concentrated on just one part of social spending, for example, spending on health. Yet, we know that sectors outside the health sector account for half of the reduction in child survival in low- and middle-income countries. For example, spending on education raises maternal literacy, which is known to reduce child survival.

Studies show that governments spend more on public services, such as schools and hospitals, when governments have more revenue, which increase survival. Government revenue increases when leaks are curtailed (see figure 1).

Figure 1 The GRADE allows estimation of the potential if there is an increase in revenue equivalent to the revenues lost.



Many thousands more have improved life chances for every life saved by attending school, drinking clean water, and accessing healthcare.

The modelling

1. GRADE- DOH/Rights

The GRADE project provides a model of the relationship between government revenue per capita and six determinants of health (DOH) and child and maternal survival while controlling for each quality of governance (QoG). For GRADE-DOH, we did not add any controls to the model because we want to capture the total effect of government revenue per capita and QoG. Most variables used in the literature are influenced by government revenue and QoG, so there would be collinearity problems. The actual and fitted models are available.

The DOH model includes basic water facilities, safe water facilities, basic sanitation, safe sanitation, schooling, and maternal and child survival rates. See the section on data for the definitions.

We employed an unbalanced non-linear panel data study for 217 countries between 1960-2000 and expressed health determinants as a percentage ranging from 0 to 100. A linear relationship between revenue and these variables would not be appropriate, as this would not respect these boundaries. We employed a logistic function as the correct specification to model such variables. A standard panel logistic function would impose the same shape 'S' curve on all countries, which is inappropriate. Therefore, we augmented the logistic function parameters with measures of governance quality, which allows each country to have a different 'S' shape as its government's quality varies.

We found that increased government revenue is associated with an increase in the coverage of health determinants. Moreover, the quality of governance significantly amplifies the size of this influence in each country.

Government Revenue per capita data

For the GRADE-DOH modelling, the Government revenue per capita data used was from the World Development Indicators, https://databank.worldbank.org/WDI, downloaded 12/8/2020. Government revenue per capita is calculated by multiplying the revenue, excluding grants (% of GDP) *GDP per capita (constant 2010 US$). Our reasoning for using the World Development Indicators (WDI) government revenue data for the modelling was data availability before 1980. We could also extract government revenue per capita data, data on governance, survival, and the determinants of health from one source.

There were 60 countries with no data available (1960-2020) in the WDI. Therefore, for the visualisation, we used Government Revenue data from the UNU WIDER Government Revenue Dataset (GRD), which was last updated June 2020 with data for 2018. The GRD has data available for 196 countries, 1980-2018 [5]. (See the spreadsheet BASE Population, column L on the GRADE-DOH tab).

The UNU WIDER GRD dataset has general and central government revenue, and we used the former as the latter would underestimate total revenue in fiscally decentralised states. In addition, data which includes and excludes grants are available, and we used total general government revenue, excluding grants, as this variable best reflects the capacity of domestic revenue. For the same reason, we used data that includes social contributions. The GRD expresses all data as a percentage of GDP taken from the World Economic Outlook (WEO) in Local Currency Units (ICTD/UNU-WIDER 2018b). GR as % of GDP was multiplied by the GDPpc in constant 2010 US$ (taken from the World Development Indicators) to convert to government revenue per capita. Where there is missing data for government revenue per capita, we used linear interpolation with two known data points, but we did not extrapolate any data.

Water and sanitation are recorded as a percentage ranging from 0 to 100. The education data used is the school life expectancy (SLE), both primary and secondary for both sexes and is the number of years of education a child of school entrance age can expect to attend. The maximum SLE is just under 17 years, and we express the data as a percentage of 17, which gives us a variable between 0 and 100. See Appendix A for the definitions of the variables used.

Frequently Asked Questions about the GRADE

What does the GRADE show?

Using panel data, the relationship between government revenue per capita and survival rates and the determinants of health was highly non-linear. Thus, countries with small per-capita government revenues have a better scope for reducing survival rates. However, as per capita revenue rises, the possible gains decline rapidly.

Do all countries benefit the same when there is an increase in revenue?

No. A given amount of additional revenue does not increase health determinants or reduce the survival rates in different countries by the same amount. There is considerable scope for reducing survival rates and saving lives in countries with small per-capita revenues.

The reasons for this are as follows:

1. In wealthy or high-income countries, the average government revenue per person is more than a hundred times larger than in low-income countries. So, additional income in a low-income country is relatively more significant. For example, in 2016, the average government revenue per person was $80 in low-income countries, $380 in lower-middle-income countries, $1250 in upper-middle-income countries and $12,750 in high-income countries. Thus, an additional 200 million in revenue in a low-income country with a population of 10 million will increase government revenue per capita by $20, an increase of 25%. In comparison, in a high-income country, the increase will be a 0.16% increase on average. Thus, extra revenue will go much further regarding access to services that contribute to health and ultimately save lives.

2. Gains are smaller at higher levels of development. The reason for this is reducing high child mortality rates, for example, from 150 to 75 per 1000 live births, involves reducing more easily preventable deaths by, for example, ensuring more people have access to clean water, sanitation, and primary healthcare. On the other hand, reducing child survival rates from 40 to 20 per 1000 live births involves reducing less preventable deaths, requiring more advanced healthcare services.

Does the GRADE assume governments spend additional revenue on specific sectors?

No. All governments allocate their resources according to their national priorities. Therefore, the GRADE assumes that governments will spend additional revenue the same as in recent years.

Therefore, health benefits and reductions in mortality are likely to result from increased spending across multiple sectors, with increased access to education, water, sanitation, and healthcare.

After an increase in revenue, when do benefits accrue?

Increased spending takes time to show an impact, but the most benefit has accrued within 5-6 years. The GRADE does not attempt to estimate the benefits during the first five years.

Which currency does the GRADE use?

The modelling used constant 2010 USD, so if inputting additional revenue, convert this to 2010 values. There is a tool on the website which allows deflation from 2020 to 2010. To deflate from other years to 2010 values, see https://fred.stlouisfed.org/series/GDP/

Where can I obtain the data used for the models?

At the bottom of the visualisation, there is a button to download the data. See figure below.

Why do the estimates fluctuate?

The model incorporates the quality of governance, which has a considerable influence on the impact of an increase in government revenue. This varies between years, so, the estimates vary between years.

Why do we use the average for water and sanitation but the total for school years and lives saved?

Some variables, such as water and sanitation, are stock variables; this means that an increase in government revenue produces a one-off increase in the stock of these capital assets. We present the average change over the projection period selected because there are slight differences over time in the effect caused by changes in governance or government revenue. Other variables are flow variables, such as lives saved and additional school years. In this case, an increase in government revenues represents the lives saved and extra school years every year over the projection period. Therefore, we present the sum of the annual increase over the projection period as the total effect.

Who funded the research underpinning the GRADE?

The GRADE project is supported by the Scottish Funding Council, the Global Challenges Research Fund and the Professor Sonia Buist Global Child Health Research Fund.

Using the GRADE – DOH tool – a step-by-step guide

1. **Select country:** hover over the country on the map or select from the dropdown. The map can be moved and zoomed in.
2. **Input the additional revenue:** the increase as a percentage of government revenue, total additional revenue, or the increase per capita. We have introduced a new feature which allows you to upload a CSV file with data for multiple years and countries. Please see the instructions for this on the next page.
3. **Use the deflator tool** to convert the revenue from 2020 to 2010 values. If the estimates are for a year other than 2020, use https://fred.stlouisfed.org/series/GDP/
4. **Select the projection period**, but remember most losses occur over many years, and it takes about five years before benefits become apparent. So the longer, the better, but you may have to toggle the start year and projection period depending on data availability.
5. **Select the determinant of health or increase in survival** (either children or mothers). We use the average over the projection period for water and sanitation as these may vary (see FAQ below). For extra child school years and deaths averted, we use the total for the period.
6. **ADVANCED – adjust the results to account for a change in governance quality.** Improved governance quality means resources will be allocated efficiently to public services.
7. **ADVANCED - download projections for multiple countries.** Here you can download a spreadsheet that applies your projection to multiple countries. This is especially useful if you've uploaded data for multiple countries via a CSV file in Step 2.

8. ADVANCED – change the target for the coverage of the SDG indicator. This feature allows an estimation of the increase in government revenue required to reach the SDG of interest.

9. **Read the results!** For example, if Afghanistan had a 10% increase in government revenue from 2007 to 2017, 4,763 children would have spent an additional year at school.

10. The graph. The projection shows no increase for the first five years. However, research has demonstrated this is a realistic timeframe until the effect of increased GR takes place. The graph also shows a slight dip in school years around 2014 because the model considers governance quality.

11. Download the raw datasets To see the data used to create this projection.

Additional information

Uploading additional revenue data via a CSV file

To simplify uploading upload data for multiple countries, we have introduced the option to upload data via a CSV file. For instance, we used the Tax Justice Network's State of Tax Justice, which provides estimates on revenues lost to tax abuse for 215 countries. To estimate the impact of an increase in revenue equivalent to these losses, it would be possible to upload the figures as a CSV files in the format shown in the image below, using one column titled "REVENUE" (detailing the amount in 2010 constant US Dollars), one titled "ISO" detailing the country's ISO code, and a third titled "YEAR" listing the year in which an increase in revenue should occur.

	A	B	C
1	REVENUE	ISO	YEAR
2	1.48E+11	ALB	2000
3	1153284000	ALB	2001
4	1186440915	ALB	2002
5	938196534	ALB	2003

Upload the file as detailed in step 2 on the previous page, then adjust the slider in step 4 for your projection years.

To view the projections, either view the on the interactive map or download the projections in step 7 by selecting the countries for which you have entered data (it is possible to select "All countries").

Appendix A Definitions for the determinants of health used in GRADE [6]

Definitions from the World Bank

Basic drinking water services – the percentage of the population drinking water from an improved source, provided collection time is not more than 30 minutes for a round trip. Improved water sources include piped water, boreholes or tube wells, protected dug wells, protected springs, and packaged or delivered water.
Safely managed drinking water services – the percentage of the population using drinking water from an improved source accessible on-premises, available when needed, and free from faecal and priority chemical contamination.
Basic sanitation services - the population using at least, that is, improved sanitation facilities not shared with other households. This indicator encompasses both people using basic sanitation services as well as those using safely managed sanitation services. Improved sanitation facilities include flush/pour flush to piped sewer systems, septic tanks or pit latrines; ventilated improved pit latrines, compositing toilets or pit latrines with slabs.
Safely managed sanitation services –the population using improved sanitation facilities, not shared with other households and where excreta are safely disposed of in situ or transported and treated offsite. Improved sanitation facilities include flush/pour flush to piped sewer systems, septic tanks or pit latrines: ventilated improved pit latrines, compositing toilets or pit latrines with slabs.
Child immunisation - the percentage of children ages 12-23 months who received diphtheria, pertussis (or whooping cough), and tetanus (DPT) vaccinations before 12 months or at any time before the survey. A child is adequately immunised against (DPT) after receiving three doses of vaccine.
School life expectancy (primary and secondary), both sexes (years) -the number of years a person of school entrance age can expect to spend within the specified education level. For a child of a certain age, the school life expectancy is calculated as the sum of the age-specific enrolment rates for the levels of education specified. The part of the enrolment not distributed by age is divided by the school-age population for the level of education they are enrolled in, multiplied by the duration of that level of education. The result is added to the sum of the age-specific enrolment rates. A relatively high school life expectancy indicates a greater probability of children spending more years in education and higher overall retention within the education system. Note that the expected number of years does not necessarily coincide with the expected number of education grades completed because of repetition. Since school life expectancy is an average based on participation in different levels of education, the expected number of years of schooling may be pulled down by the magnitude of children who never go to school.

The Worldwide Governance Indicators

The WGI reports aggregate and individual governance indicators for over 200 countries and territories over 1996–2019 for six governance dimensions (see table 1). These are composite indicators based on more than thirty data sources. Firstly, individual questions from the underlying sources are assigned to one of the aggregate indicators. The compilers then rescale the data to make it comparable across sources using the unobserved components model. The resulting composite measures are units of a standard normal distribution with mean zero, running from -2.5 to +2.5 and higher values corresponding to better governance [7,8].

Table 1: Definitions of dimensions of Quality of Governance Worldwide Governance Indicators

Dimension of Governance	What it captures
Control of corruption	Perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests
Government effectiveness	Perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies
Political stability	Perceptions of the likelihood that the government will be destabilised or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism
Regulatory quality	Perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development
The rule of law	Perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence
Voice and accountability	Perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media

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