

Updating Investment Forecasts with Macro Consistency

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Updating Investment Forecasts with Macro Consistency

John León-Díaz*

April 2023

Abstract

This technical note presents a model to evaluate the costs and benefits of plans to scale up public investment. It creates a theoretical framework that considers the positive effects of investment on growth and, in turn, the impact it can have on government fiscal accounts, particularly debt service. This note is accompanied by a template that implements the proposed methodology, which the author hopes will be useful for the work of country economists at the Inter-American Development Bank.

JEL Codes: H50, H68, E17

Keywords: public investment, investment projections, debt sustainability analysis, macro consistency

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1. Introduction

Countries in Latin America and the Caribbean have sizable infrastructure gaps, exacerbated by the COVID-19 pandemic, that translate into subpar public services. Brichetti et al. (2021) find that the region would need to invest around US\$1.7 trillion to reach its Sustainable Development Goals by 2030.¹ Humphrey (2018) suggests that the infrastructure investment gap in similar emerging and developing economies in the rest of the world ranges between US\$500 million and US\$1.5 trillion. When factoring in the potential inefficiencies associated with infrastructure provision, as pointed out in Berg et al. (2012), the investment push would need to be even larger than those estimates.

Studies on investment gaps, while useful to establish a benchmark, have lacked an assessment of the feasibility of reaching investment goals. With debt levels soaring, again due in part to the public support provided during the pandemic, any efforts to close existing investment gaps would undoubtedly put further pressure on the fiscal accounts of Latin American and Caribbean governments. Consequently, it is necessary to analyze the extent to which countries can scale up public investment without jeopardizing their debt sustainability.

Toward this end, this paper presents a framework that models, in a simple and tractable way, the relationships and ensuing dynamics between public investment, GDP growth, fiscal deficits, and sovereign debt accumulation. The logic behind the framework is that the investment push leads to a rise in public expenditure—including higher debt service resulting from the public debt financing of such investment—that could be offset (at least partially) by higher GDP growth rates and fiscal revenues, mitigating the rise in the debt-to-GDP ratio.

The next section provides an overview of the theoretical framework, highlighting the relationships between investment, the fiscal deficit, and debt. Section 3 describes how the framework is implemented for a sample of 21 member countries of the Inter-American Development Bank (IDB). The final section presents conclusions and discusses potential avenues for using the template, as well as its potential limitations.

2. Main Framework

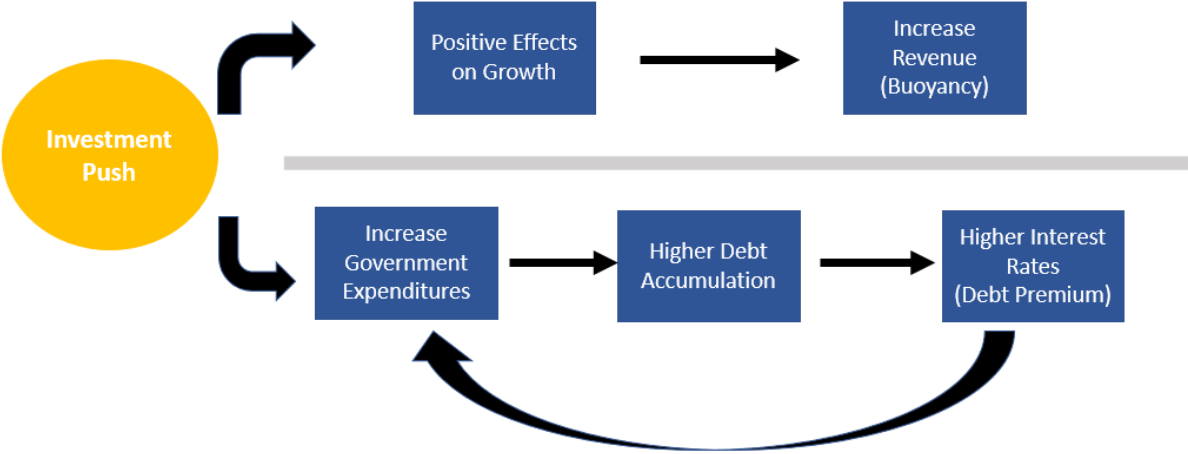
What is the economic impact of higher investment? Is it sustainable from a fiscal point of view? This section builds a macroeconomic framework that quantifies the costs and benefits of an investment push to answer these questions. The modeling framework consists of a set of theoretically-based functions linking investment, GDP growth, fiscal deficits, and debt. For a given baseline scenario, these functions provide a set of revised macro and fiscal forecasts in the presence of an alternative investment vector. It is important to clarify that this framework does not generate the initial baseline scenario. Instead, it helps derive an alternative scenario, with different investment assumptions, while ensuring macroeconomic consistency.

¹ This estimate includes new investment, depreciation, and maintenance expenses.

Figure 1 summarizes the main economic relationships captured by the theoretical framework. It considers two main channels of the impact of the investment push. On the one hand, the investment boost has positive effects on GDP growth, which leads to higher economic activity and tax collection. On the other hand, higher public investment increases public spending and debt, with the resulting feedback loop between debt, financing costs, and expenditure.

The effects shown in the figure are not intended to be an exhaustive list of the costs and benefits of increasing public investment. However, they represent a minimum set of theoretical conditions necessary to perform a debt sustainability analysis. The subsections that follow describe in detail how the forecast update process is carried out in each of the blocks presented in Figure 1.

Figure 1. Investment, Growth, and Fiscal Accounts



Source: Prepared by the author.

2.1. Positive Effects on Growth

The provision of infrastructure services (e.g., roads, water, sanitation, electricity) boosts economic growth by improving productivity and crowding in additional private investment. According to Abiad, Furceri, and Topalova (2016), increased public investment raises output both in the short and long term, crowds in private investment, and reduces unemployment. As the economy reaches higher levels of investment, those investments are expected to positively impact productivity and economic growth.

In the baseline scenario, current growth projections are presumed to be consistent with the investment trajectory. So if an alternative investment vector is considered, then the path of growth should be adjusted as well for consistency. To establish such a relationship between investment and GDP growth, the theoretical model presented in Devadas and Pennings (2018) is followed. Their model (discussed in Box 1 in more detail) allows for computing the change of economic growth due to a 1 percentage point increase in total investment (public and private) as a percent of GDP. The authors show that this is equivalent to the inverse of the incremental capital-to-output

ratio and is denoted as γ_{t+1}^G in the case of public investment and γ_{t+1}^p in the case of private investment.

The term g_{t+1} denotes the projected GDP growth in $t + 1$ in the baseline scenario. Then, the updated growth vector, \hat{g}_{t+1} , consistent with the new investment vector, is given by the following expression:

$$\hat{g}_{t+1} = g_{t+1} \left[1 + \gamma_{t+1}^G \Delta \left(\frac{I_t^G}{Y_t} \right) + \gamma_{t+1}^p \Delta \left(\frac{I_t^p}{Y_t} \right) \right],$$

where Δ represents the change in the investment ratios relative to the baseline scenario. There are two elements to note in the expression:

- The contributions of public investment (γ_{t+1}^G) and private investment (γ_{t+1}^p) to growth are not the same, especially if the stocks of private and public capital are very different. This distinction is important because most forecasts do not distinguish between these two types of investment. As will be discussed in Section 3, historical ratios are used here to disentangle the public and private contributions to the change in total investment.
- While the change in investment is dated at time t , economic growth is only affected in $t + 1$. This is because investment (either public or private) affects economic growth by increasing the capital stock, but it takes one period to accumulate new capital stock. This feature has implications for debt sustainability. It creates a mismatch between the funding costs of investment, which are dated in period t , and the benefits in terms of output, which only materialize in $t + 1$.

With the new growth path, a new vector of nominal GDP forecasts, denoted by \hat{Y}_{t+1} , is recursively generated as follows:

$$\hat{Y}_{t+1} = \hat{Y}_t (1 + \hat{g}_{t+1}).$$

In the first year of projection, the new GDP level is computed using the level of GDP from the previous period, which corresponds to actual historical data.

2.2. Fiscal Impact: Above the Line

The economy is assumed to mobilize revenues through taxation in response to the increase in economic activity. The analysis of tax buoyancy illustrates the role of revenue policy in supporting fiscal sustainability. Dudine and Tovar Jalles (2017) point out that revenues that move in tandem with output help support the sustainability of investment pushes in the long run. Based on the baseline projections of revenue, denoted by R_t , the updated revenue projections \hat{R}_t are computed as follows:

$$\hat{R}_t = R_t \left(1 + \eta_{R,Y} \frac{\hat{Y}_t - Y_t}{Y_t} \right),$$

where $\eta_{R,Y}$ is the elasticity of fiscal revenues with respect to output; Y_t is the baseline projection of the nominal GDP level in a given period t ; and \hat{Y}_t is the updated projection of the nominal GDP level in the same period.

On the expenditure side, there are two forces driving the new path for primary expenditure. First, the investment push will have a direct one-on-one effect on primary expenditure. Second, primary expenditure will be impacted by the change in economic activity through the effect of the automatic stabilizers. This is computed as follows:

$$\widehat{PE}_t = PE_t \left(1 + \eta_{E,Y} \frac{\widehat{Y}_t - Y_t}{Y_t} \right) + \Delta I_t^G,$$

where \widehat{PE}_t is the new level of primary expenditure in a given period t ; PE_t is the baseline level of primary expenditure; $\eta_{E,Y}$ is the elasticity of primary expenditure with respect to output; Y_t is the baseline projection of nominal GDP; \widehat{Y}_t is the updated projection of nominal GDP; and ΔI_t^G is the change in the level of public investment relative to the baseline scenario.

The new path for the primary balance, denoted by \widehat{PB}_t , is given by:

$$\widehat{PB}_t = \widehat{R}_t - \widehat{PE}_t.$$

Box 1. Public Investment, Capital, and Growth

The relationship between investment and economic growth is modeled following Devadas and Pennings (2018).

Consider an economy where production (Y_t), depends on private capital (K_t^p), labor ($h_t L_t$), and public services (S_t), combined according to the following functional form:

$$Y_t = A_t S_t (K_t^p)^{1-\beta} (h_t L_t)^\beta,$$

where A_t represents total factor productivity. The parameter β reflects the labor share and is important for the calibration of the template. Public services (S_t), which are predetermined at any given period t , depend on the effective stock of public capital (G_t) and are subject to congestions problems:

$$S_t = \left[\frac{G_t}{(K_t^p)^\zeta} \right]^\phi.$$

The parameter ζ defines the degree of congestion in the economy. For simplicity, it is assumed that this parameter can only take the values 0 or 1 to illustrate situations of no congestion or full congestion.

It is also assumed that the effective stock of public capital (G_t) that is helpful for production is only a fraction, θ_t , of the measured public capital (K_t^G):

$$G_t = \theta_t K_t^G.$$

This is due to corruption, problems of absorptive capacity, mismanagement, or pork-barreling.

Based on this information, the production function can be rewritten as follows:

$$Y_t = A_t (\theta_t K_t^G)^\phi (K_t^p)^{1-\beta-\zeta\phi} (h_t L_t)^\beta,$$

where capital accumulation takes the standard one-period-to-build approach:

$$K_{t+1}^i = (1 - \delta^i)K_t^i + I_t^i, \quad i = \{G, p\}.$$

To analyze the theoretical impact of an increase of investment on economic growth, Devadas and Pennings (2018) log-linearize all the above expressions around the baseline. The change of economic growth in period $t + 1$ to a 1 percentage point increase in public investment as a share of GDP in period t is given by:

$$\gamma_{t+1}^G = \frac{\partial g_{t+1}}{\partial \left(\frac{I_t^G}{Y_t} \right)} = \frac{\phi}{K_t^G / Y_t}.$$

Thus, the growth effect of a 1 percentage point increase in the public investment share is given by the elasticity of output to public capital (ϕ) weighted by the inverse of the public capital stock as a share of GDP (K_t^G / Y_t).

The change of economic growth in period $t + 1$ resulting from a 1 percentage point increase in private investment as a share of GDP in period t is given by:

$$\gamma_{t+1}^P = \frac{\partial g_{t+1}}{\partial \left(\frac{I_t^P}{Y_t} \right)} = \frac{1 - \beta - \zeta\phi}{K_t^P / Y_t}.$$

Thus, the growth effect of a 1 percentage point increase in the private investment share is given by the elasticity of output to private capital ($1 - \beta - \zeta\phi$), reflecting the impact of congestion, weighted by the inverse of the private capital stock as a share of GDP (K_t^P / Y_t).

2.3. Fiscal Impact: Below the Line – Sustainability Analysis

Consider the debt-to-GDP ratio in the baseline scenario, denoted by b , which evolves according to the following debt-accumulating equation:

$$b_{t+1} = \frac{1 + r_t}{1 + g_t} b_t - p b_t,$$

where lowercase letters denote variables as a percentage of GDP. For any given period t , the variables $p b_t$, g_t , and r_t are the projected levels of primary balance, GDP growth, and interest rate, respectively, in the baseline scenario.

With the initial debt-to-GDP ratio taken from the historical data, a new debt path following the investment push, \hat{b}_{t+1} , is computed recursively with the above equation. Such derivation requires new levels for all the variables on the right-hand side of the equation. Sections 2.1 and 2.2 already showed how to obtain the new levels of GDP growth and primary balance, i.e., \hat{g}_t and $\hat{p} b_t$. Thus, the only remaining item is the new interest rate, \hat{r}_t .

Assumption 1. *The main assumption for the derivation of the new path of interest rates is that, when debt increases, investors demand higher interest rates. In other words, the interest rate is*

assumed to be endogenous and associated with previous debt levels, so higher levels of debt increase the cost of financing.

Following Mendoza and Oviedo (2009), the new interest rate is given by:

$$\hat{r}_t = \frac{r_t}{\exp(-a \times \Delta b_{t-1})},$$

where a is a parameter calibrated to match the interest rate differential between a given country and the market yield on U.S. Treasury securities; and Δb_{t-1} is the difference between the new debt-to-GDP ratio and the baseline debt-to-GDP ratio (i.e., $\Delta b_{t-1} = \hat{b}_{t-1} - b_{t-1}$).

It should be noted that the imposition of a contemporary relationship between the debt stock and the interest rate leads to a feedback loop that requires solving a non-linear problem, which does not necessarily have a unique solution.

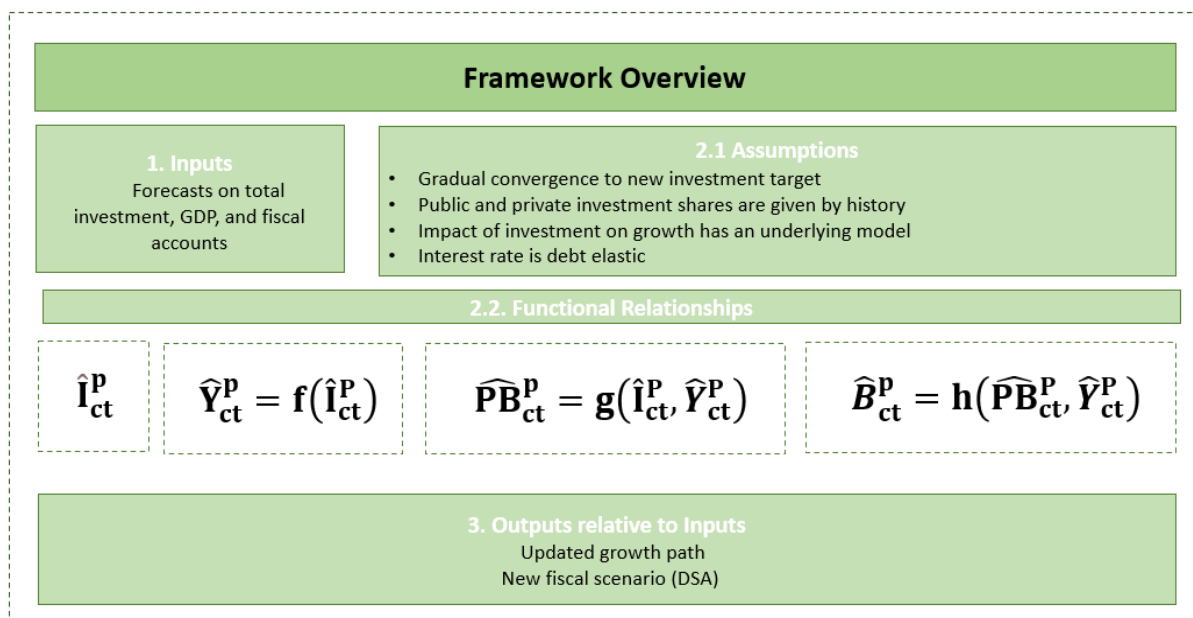
3. Implementation: Data Requirements and Calibration

The previous section described a framework to adapt fiscal scenarios in the presence of different investment trajectories. These fiscal scenarios are constructed by adjusting current forecasts of real variables, fiscal deficits, and debt levels. It means that the framework shows deviations of scenarios with respect to a baseline projection and does not create scenarios on its own.

Due to data availability, this model has been implemented in an Excel template for all IDB member countries except Argentina, Jamaica, Trinidad and Tobago, Suriname, and Venezuela. A description of the structure of the template is presented in the Appendix of this note. Figure 2 is a schematic overview of the elements that constitute the template. Three essential blocks make up the structure of the Excel file. The first block presents the data inputs necessary for the analysis, consisting of the current projected series of investment, GDP, and fiscal accounts. In the second block, all projections are updated using the model presented in Section 2. Finally, these forecasts are used to build different fiscal scenarios in the third block.

This section describes the data sources feeding the template and the calibration of the parameters. In addition, it presents how different investment trajectories are built, examines their implications, and discusses sustainability scenarios.

Figure 2. Template Overview



Source: Prepared by the author.
Note: DSA: Debt Sustainability Analysis.

3.1. Inputs

The primary source of information for the template is the *World Economic Outlook* (WEO) published by the International Monetary Fund (IMF). The model requires as inputs baseline projections for the following series: total investment (*nid_ngdp*), nominal gross domestic product (*ngdp*), fiscal revenues (*ggr_ngdp*), primary balance (*ggxonlb_ngdp*), and total debt (*ggxwdg_ngdp*). This series is the minimum necessary to carry out the calculations. Inflation (*pcpipch*) and exchange rate forecasts would also be required to update forecasts on real growth.

Although alternative sources can be used, there are two main advantages of using WEO information. The first is its coverage; the WEO yields one of the few comprehensive forecasting databases, covering all 189 IMF member states, with information for almost all IDB countries. The second advantage is its relevance; according to several surveys, 88 percent of country authorities (strongly) agree with the statement that they “consider the WEO’s projections to be the benchmark for assessing economic prospects” (IEO, 2006). Genberg and Martinez (2014) report that 64 percent of country authorities (strongly) agree with the statement that they “use WEO forecasts to check the accuracy of [their] own forecasts,” while 75 percent (strongly) agree that “WEO forecasts are valuable inputs to the economic policy process in [their] country.” As documented in the annex to Genberg, Martinez, and Salemi (2014), WEO forecasts are also considered in projections made by private sector forecasters.

However, it is advisable to complement these forecasts with alternative sources. Beaudry and Willems (2018) point out that WEO forecasts for real GDP growth have shown a tendency to be

overly optimistic. On average, the WEO growth rate prediction for the next year has been 0.58 percentage points higher than the subsequent growth that actually happened.

3.2. Functional Relationships

At this point, the existence of a new investment vector has been assumed and series' of assumptions have been made that delineate the relationship between investment with economic growth and fiscal sustainability in a simple way. This section discusses how to create alternative investment paths directly in the template. In addition, it discusses how the various parameters presented in Section 2 are calibrated to build country-specific scenarios.

Setting Investment Paths

Although imputing an investment vector directly in the template is possible, it is also possible to define it internally. This is done here by defining a target we want to reach in a certain period. In this way, different trajectories that connect the current investment with the target investment can be defined.

We focus on the impact of an investment push. Thus, for a given country, we define a total investment target $\hat{I}_{c,t}^p$ (percent of GDP), which is larger than the one provided by the current forecasts. This target reflects the level of investment to be achieved in the near future. As Assumption 2 indicates, convergence towards this new level is not immediate, but rather is done gradually.

Assumption 2: *Convergence to the new target is done gradually.*

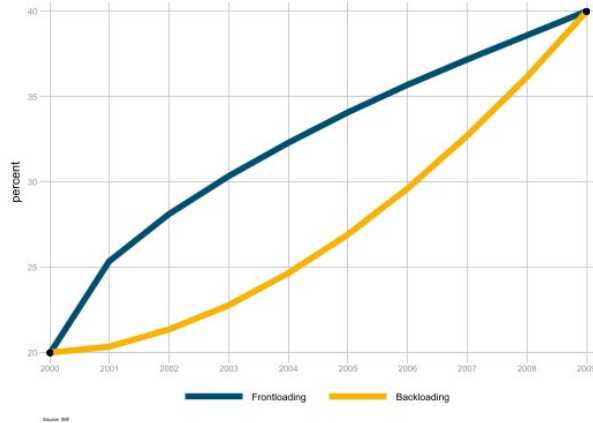
There are important reasons why gradualism is used in the template. First, as Presbitero (2019) points out, investment projects are less likely to be successful during periods of public investment scaling-up. These results are consistent with the idea of supply bottlenecks and poor project selection that prevent the economy from profiting from higher growth. Second, Gurara, Melina, and Zanna (2019) conclude that a gradual scaling up of investment is preferable, as it limits its crowding-out effects on the private sector, reduces the incidence of absorptive capacity constraints, and limits the debt sustainability risks.

Gradualism is implemented in the framework with a polynomial function that smoothly joins the current level of investment with the level set as a target for the future (Box 2). Thus, gradualism in this context takes the form of small and prudent increases in total investment (percent of GDP) from year to year.

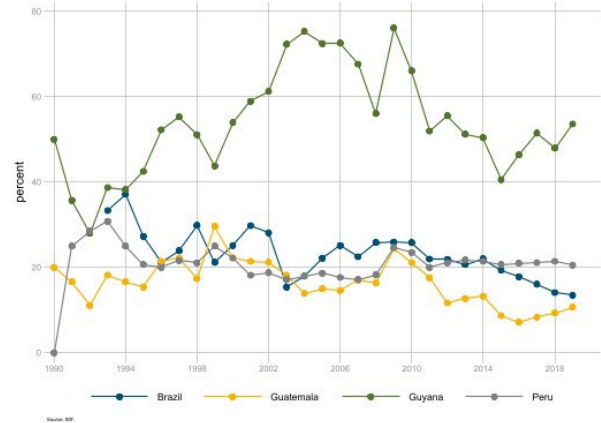
To illustrate, panel A in Figure 3 presents a sample scenario in which a country decides to increase its investment level from 20 to 40 percent of GDP between 2000 and 2010. How the country transitions towards the new equilibrium is a variable of choice in the template for the economist. This is because multiple paths can satisfy these conditions: a path where investment growth increases means a more significant investment push during the first years of transition (investment frontloading). Or, to the contrary, with a path where investment growth is decreasing, we start with more minor variations in investment that gradually increase as the final year of transition approaches (investment backloading).

Figure 3. Investment Push

A. Investment Target (Percent)



B. Public Investment (Percent of total investment)



Source: Author's calculations based on IMF databases.

The choice of the convergence path has important implications for subsequent simulations in the model. There are significant trade-offs to consider when balancing fiscal accounts. On the one hand, investment frontloading allows for more significant accumulated gains in economic growth at the cost of greater pressure on the fiscal deficit. On the other hand, investment backloading eases the pressures on the fiscal deficit at the expense of lower levels of growth. In other words, from the perspective of the model, although frontloading of investment is preferable from the point of view of economic growth, it is not always feasible.

Moving from Total to Private and Public Investment

Given the availability of information from the WEO, only the projections for total investment can be updated. However, it is vital to separate public and private investment for several reasons. The first is that the contribution to growth varies with the type of investment (see discussion in Section 2.1). The second is that what is essential for the fiscal sustainability exercise is the variation in public investment.

Assumption 3: Total public (private) investment is a constant share of total investment.

It is assumed that public and private investment are constant fractions of total investment over the years. The IMF's 2021 Investment and Capital Stock Dataset is used to define the share of public and private investment in total investment.² This database provides comprehensive data on public investment and capital stock (i.e., general government), private investment and capital stock, and investment and capital stock arising from public-private partnerships across IMF member countries.

²The database can be accessed from this link: <https://infrastructuregovern.imf.org/content/dam/PIMA/Knowledge-Hub/dataset/IMFInvestmentandCapitalStockDataset2021.xlsx>

As panel B of Figure 3 shows, the relationship between public, private, and total investment can vary over time. Depending on the type of country, one may want to consider the historical share using all the information available from the beginning of the sample or represent the most recent situation using only the information from recent years. For this purpose, the researcher can choose the year from which the historical relationship is calculated and check the sensitivity to changes in the starting date.

Box 2. Setting Investment Trajectories

This box presents the technical discussion on how investment trajectories are generated. The initial year t_0 is defined as the year when the investment push will start, and the year t_k as the year when the final investment target will be reached. The number of years necessary to achieve the target is defined as $y = t_k - t_0 + 1$. The vector x is defined as a vector of linearly spaced numbers between $[0, 1]$ with length y . Define the vector w as:

$$w = \frac{x^\varepsilon}{\max(x^\varepsilon)}.$$

This functional form allows for more flexibility to adapt investment paths. The vector w has a length of y and a maximum value of 1. The starting level of investment (percent of GDP) is defined as \hat{I}_{c,t_0}^p , and the final target as \hat{I}_{c,t_k}^p . For each ascending value of w , the updated investment path between t_0 and t_k is computed as follows:

$$\hat{I}_{c,t}^p = \hat{I}_{c,t_0}^p + (\hat{I}_{c,t_k}^p - \hat{I}_{c,t_0}^p) \cdot w.$$

In summary, w drives the rate at which investment grows. This rate is determined by the parameter $\varepsilon > 0$, which dictates the shape of the investment path. For values of $0 < \varepsilon < 1$, the investment path is concave, and the investment is frontloaded, while for values of $\varepsilon > 1$ the investment path is convex, and the investment is backloaded. For values $\varepsilon = 1$, investment grows at a constant rate period by period.

Calibration

Latin America and the Caribbean is a highly heterogeneous region, so the calibration strategy aims to compute country-specific parameters subject to data availability. The standard calibration of the growth block of the model uses the information in Devadas and Pennings (2018). To pin down the elasticity of output to public capital, and due to data availability, $\phi = 0,17$ is set for all countries in the sample. For almost every country in Latin America and the Caribbean, it is possible to calibrate the labor share β with information from the Penn World Tables (PWT version 10.0). In the basic calibration, congestion is assumed to exist, so the parameter is set at $\zeta = 1$. The stock of public and investment capital is projected using the capital accumulation equation and setting the depreciation of public capital at $\delta^G = 0.02$, which is the average depreciation rate for structure in all countries in the PWT. To calibrate the depreciation of private capital δ^P , the aggregate depreciation rate δ reported in the PWT and the assumption on the depreciation of public capital are used to compute the private depreciation for each country as the residual.

For the fiscal block, country-specific elasticities of revenues, $\eta_{R,Y}$, and country-specific elasticities of expenditure, $\eta_{E,Y}$, reported in studies from the IDB Fiscal Management Division are used for each IDB country. To update the debt premium on higher levels of debt, α is calibrated to match the interest rate differential between each IDB country and the market yield on three-month U.S. Treasury securities in the 2018–2019 period.

Outputs Relative to Inputs

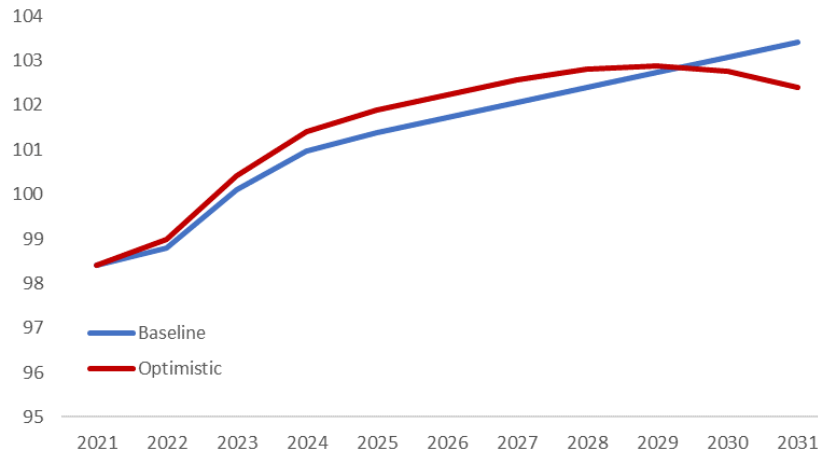
At this point, the analysis has managed to update a series of growth and fiscal projections associated with a new investment vector. It can be argued that the sustainability of this push is related to several factors: the multiplier effect of public investment to growth (i.e., how GDP increases due to a change in public investment); buoyance effects (i.e., how revenues increase due to a rise in economic activity); or the sensitivity of interest rates to larger debt levels. However, it all comes together in the relationship between interest rates and growth. To better see this point, the variation of debt based on the equation of debt accumulation is analyzed as follows:

$$\Delta b_{t+1}^u = \frac{(r_t^u - \hat{g}_t^u)}{(1 + \hat{g}_t^u)} b_t^u - \widehat{p} b_t^u.$$

This means that if the interest rate increases more than growth, either because it responds strongly to higher debt levels or because the buoyance effect is moderate, the debt path becomes unsustainable. But if, on the contrary, the impact of investment on growth is more significant, the debt will tend to stabilize.

Figure 4 presents an example of how the analysis is carried out when a more optimistic investment target is set. This specific example presents a scenario when the investment is backloaded. In the short run, debt levels (percent of GDP) increase relative to the baseline estimations because higher growth rates do not offset the cost of financing. However, as the investment push becomes larger with time, the growth effect dominates and there is a change in trend debt.

Figure 4. Debt Sustainability (Percent)



Source: Author's calculations.

4. Concluding Remarks

We often find ourselves in a situation where it is necessary to discuss how the countries of Latin America and the Caribbean can close their development gaps. The answer is frequently tied to the need to implement more ambitious investment plans. Fiscal sustainability analysis is as crucial as linking investment to development gaps, mainly when there are doubts about the macroeconomic feasibility of these investment plans.

This technical note has presented a framework that relates the benefits of economic growth and the costs associated with financing alternative plans to scale up public investment. However, instead of making forecasts isolated from the fiscal effects of these plans, the analysis updates the trajectories of the general forecasts. In this way, the results are presented as deviations from a baseline scenario. Developing this tool and applying it to the Latin American and Caribbean countries helps to formalize the discussion on the financing envelopes of the country's strategies, estimate alternative disbursement scenarios for the IDB, and analyze the financing implications in terms of domestic and external savings (current account).

However, it is important to point out some limitations to the framework presented here. It does not present alternative sources of financing, and it is not suited to considering tax reforms. Discussion and modeling of inefficiencies in the investment process have been limited, so there is little that the model can quantify about the potential role of policy reforms in reducing investment bottlenecks. The complementarity between public and private investment has been assumed from the outset, limiting possible crowding-out effects. However, these elements could be incorporated into future versions of the template.

Appendix: How to Build Scenarios from the Template

There are nine sheets in the Excel template classified by color. The **blue** sheet is used to define the inputs for the exercise. The **red** sheets contain all the inputs from original external data sources. The **gray** sheet summarizes the information available for the selected country. The **green** sheet generates and summarizes the results of the simulations. A general description of the sheets along with each one's references and sources are described below.

Parameters: In this blue sheet, you can select the overall targets (country and dates to carry out the study). It also contains a summary of country parameters for the simulation.

World Economic Outlook (WEO): This red sheet contains all the information downloaded directly from the International Monetary Fund's WEO webpage (all countries, all series). There is no modification to the original file. To update, copy and paste the full file. The link for the current download is reported in the sheet labeled as notes.

INV: This red sheet contains all the historical information on investment and capital stocks (public and private). There is no modification to the original file. To update, copy and paste the full file. The source of information is reported in the sheet labeled as notes.

FMM: This red sheet contains revenue and spending elasticities. These values are computed by the IDB's Fiscal Management Division.

EMBI: This red sheet contains information on spreads for a subset of countries in Latin America and the Caribbean. This file is shared by the IDB's Department of Research and Chief Economist.

PWT: This red sheet contains all the historical information from the Penn World Tables. There is no modification to the original file. To update, copy and paste the full file. The link for the current download is reported in the sheet labeled as notes.

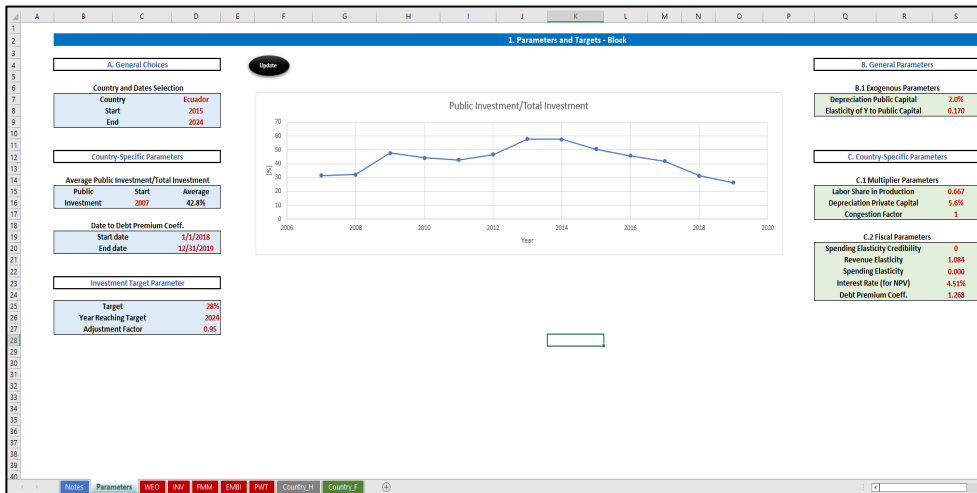
Country_H: This gray sheet is the historical data sheet. It contains historical series and ratios for the selected country.

Country_F: This green sheet generates and presents all the results for the simulation. Do not modify it.

Creating Simulation Scenarios

Step 0: Open the Parameters Sheet

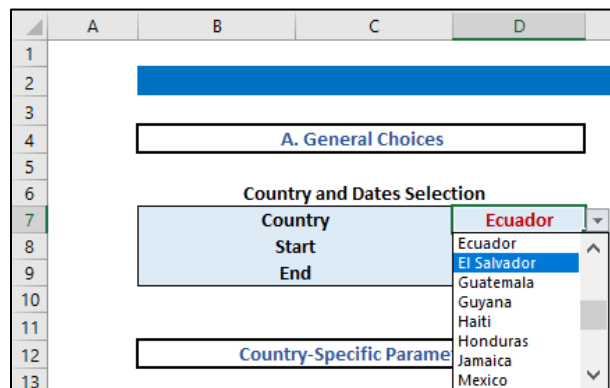
This sheet includes two blocks of information. To the **left**, you find a block of cells in blue that will help you modify the inputs for the simulation. To the **right**, there is a block of structural parameters that will be updated based on the choices made.



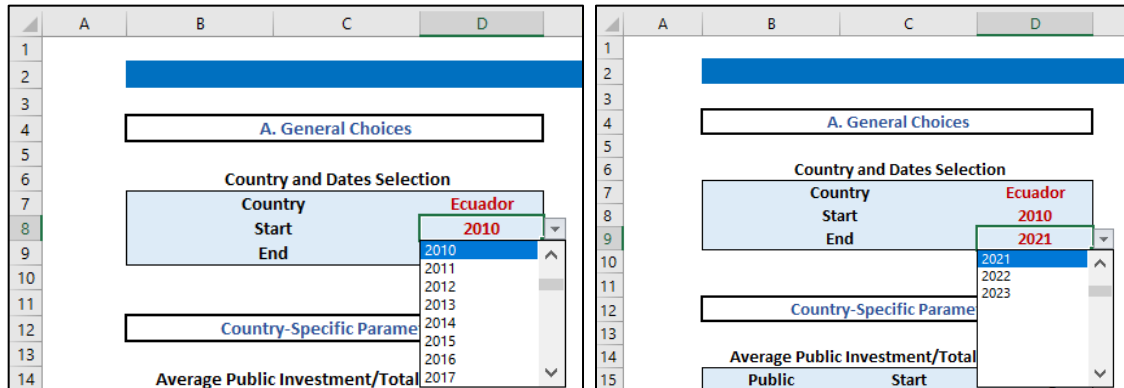
Step 1: Choose Parameters for the Simulation

To the left in this sheet, all highlighted blue tabs allow the user to choose the values used in the simulation. The choices are summarized as follows:

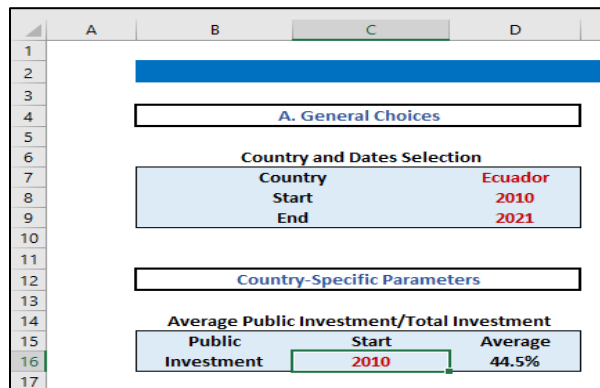
- 1) Select your **country** of interest from the drop-down menu in cell D7.



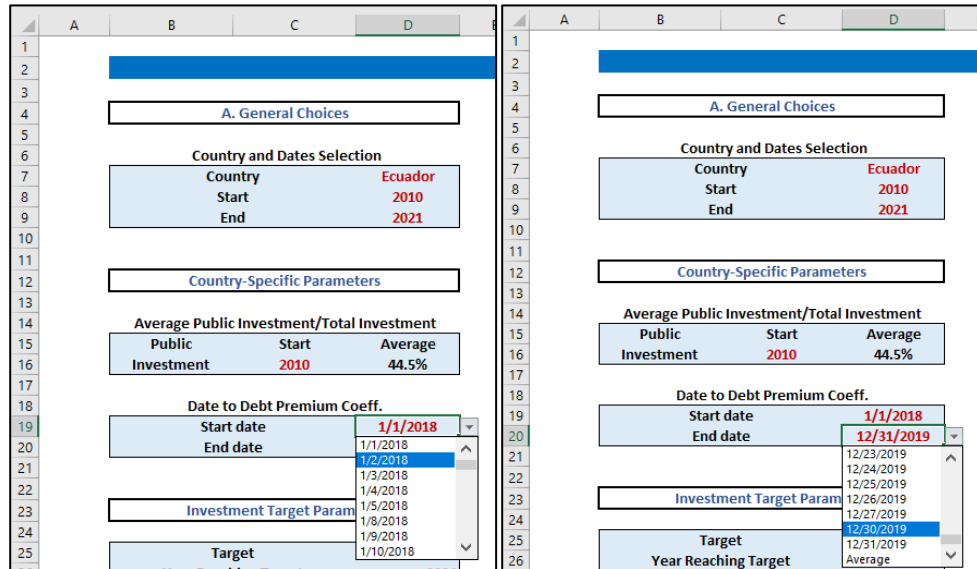
- 2) Once the country is chosen, wait a few seconds for the template to update. Then select the **start and end date** of the simulation from the drop-down menu of cells D8 and D9.



- 3) Choose the **year** from which the historical **relationship for public and private investment** is calculated. To help you with the decision, once a country is chosen, we show the graph of public investment over the total. Type the year in cell C16.

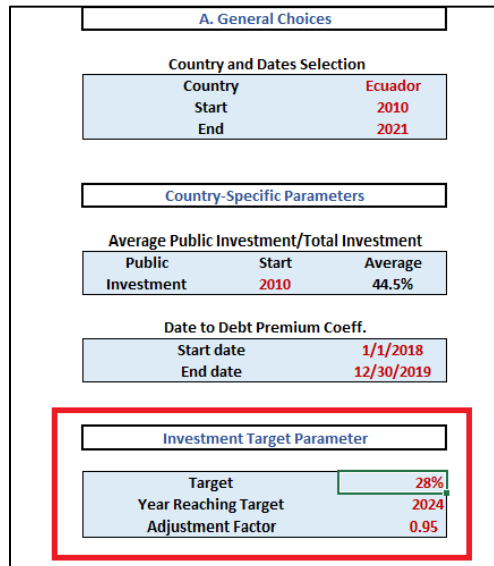


- 4) From the drop-down menu of cells D19 and D20, select the **start and end date** used to compute the average of Emerging Market Bond Index (EMBI) spreads.



- 5) Choose targets for the new investment vector.

- Target:** What is the new level of investment to reach?
- Year Reaching Target:** In what year do we reach this goal?
- Adjustment Factor:** Define the shape of the investment trajectory (see Box 2 in the main text).



Step 2: Run the Simulation

6) Click on the update button.

A. General Choices

Update

Country and Dates Selection

| | |
|---------|---------|
| Country | Ecuador |
| Start | 2010 |
| End | 2021 |

Country-Specific Parameters

Average Public Investment/Total Investment

| | | |
|-------------------|-------|---------|
| Public Investment | Start | Average |
| | 2010 | 44.5% |

Date to Debt Premium Coeff.

| | |
|------------|------------|
| Start date | 1/1/2018 |
| End date | 12/30/2019 |

Investment Target Parameter

| | |
|----------------------|------|
| Target | 28% |
| Year Reaching Target | 2021 |
| Adjustment Factor | 0.95 |

Step 3: Verify the Simulation

7) After clicking the update button, you will be redirected to the **Country_F** sheet. Here you can review the results of the simulation exercise.

| Ecuador | | | | | | | | | | | | | | | | | | | | | |
|-----------------------|-------------------|--------------------|---------|------------------|---------------|--------------------------------|----------------------|--------------|------------------------------|------------------------------|-----------------------|----------------------------|-----------------------------|-------------|---------------|----------------|-----------------------|-----------------|-----------------|-------------|--|
| 1. Investment - Block | | | | | | | | | | | | | | | | | | | | | |
| Baseline Info (WEO) | | | | | | | | | | Investment Vector | | | | | Growth Update | | | | | Projections | |
| Year | GDP (USD Billion) | Nominal Growth (%) | Y/Y (%) | Investment (USD) | Inflation (%) | Exchange Rate (Local Currency) | ER Exchange Rate (%) | Upd. Y/Y WEO | New Investment (USD Billion) | Delta I Public (USD Billion) | Delta I Private (USD) | Capex Stock Public (Local) | Capex Stock Private (Local) | Public ICOR | Private ICOR | Nominal Growth | New GDP (USD Billion) | Real Growth (%) | Real Growth (%) | | |
| 2010 | 69.56 | 28.04% | 28.04% | 19.50 | 3.55% | 1.0000 | 0.0% | 28.04% | 19.50 | 0.00 | 0.00 | 66 | 128 | 0.18 | 0.09 | 13.98% | 69.56 | 0.09 | 13.98% | | |
| 2011 | 79.28 | 13.98% | 28.14% | 22.31 | 4.48% | 1.0000 | 0.0% | 28.13% | 22.30 | -0.01 | 0.00 | 75 | 138 | 0.18 | 0.10 | 10.91% | 79.28 | 9.10% | 10.91% | | |
| 2012 | 87.93 | 10.91% | 27.80% | 24.44 | 5.10% | 1.0000 | 0.0% | 28.17% | 24.77 | 0.15 | 0.18 | 84 | 140 | 0.18 | 0.11 | 8.25% | 87.92 | 5.38% | 8.25% | | |
| 2013 | 95.13 | 8.19% | 28.47% | 27.08 | 2.72% | 1.0000 | 0.0% | 28.20% | 28.83 | -0.11 | 0.14 | 94 | 147 | 0.17 | 0.11 | 6.90% | 95.17 | 3.19% | 6.90% | | |
| 2014 | 101.73 | 6.93% | 28.33% | 28.80 | 3.59% | 1.0000 | 0.0% | 28.24% | 28.73 | -0.03 | 0.06 | 105 | 155 | 0.16 | 0.11 | 6.90% | 101.74 | 3.19% | 6.90% | | |
| 2015 | 99.29 | -2.39% | 26.87% | 26.68 | 3.97% | 1.0000 | 0.0% | 28.27% | 28.07 | 0.62 | 0.77 | 116 | 162 | 0.15 | 0.10 | -2.40% | 99.29 | -6.13% | -2.40% | | |
| 2016 | 99.94 | 0.65% | 24.98% | 24.96 | 1.73% | 1.0000 | 0.0% | 28.31% | 28.29 | 1.48 | 1.85 | 126 | 168 | 0.14 | 0.10 | 0.82% | 100.11 | -0.89% | 0.82% | | |
| 2017 | 104.90 | 4.99% | 26.38% | 27.41 | 0.42% | 1.0000 | 0.0% | 28.34% | 29.56 | 0.96 | 1.19 | 137 | 175 | 0.13 | 0.10 | 4.74% | 104.88 | 4.92% | 4.74% | | |
| 2018 | 107.56 | 3.13% | 26.75% | 28.77 | -0.22% | 1.0000 | 0.0% | 28.38% | 30.52 | 0.78 | 0.97 | 147 | 182 | 0.13 | 0.10 | 3.36% | 108.38 | 3.59% | 3.36% | | |
| 2019 | 108.11 | 0.51% | 25.91% | 28.61 | 0.27% | 1.0000 | 0.0% | 28.41% | 30.71 | 1.20 | 1.50 | 158 | 189 | 0.12 | 0.09 | 0.68% | 109.12 | 0.42% | 0.68% | | |
| 2020 | 99.29 | -8.16% | 22.05% | 21.89 | -0.34% | 1.0000 | 0.0% | 28.44% | 28.24 | 2.83 | 3.51 | 167 | 195 | 0.10 | 0.08 | -7.90% | 100.50 | -7.68% | -7.90% | | |
| 2021 | 106.17 | 6.92% | 22.35% | 23.73 | 0.13% | 1.0000 | 0.0% | 28.48% | 30.23 | 2.90 | 3.61 | 178 | 200 | 0.10 | 0.09 | 7.51% | 108.05 | 7.36% | 7.51% | | |

| 2. DSA Aspirational Scenario - Block | | | | | | | | | | | | | | | | | | | |
|--------------------------------------|-----------------------|-------------------------------|--------------------|--------------------------|--------------|-----------------------|-----------------------------------|-------------------------------|-------------------|--------------------------|-----------------|--------------------------|--|--|--|--|--|--|--|
| Fiscal Projections (WEO) | | | | | | | | | | Updated Variables | | | | | | | | | |
| Year | Revenue (USD Billion) | Primary Balance (USD Billion) | Debt (USD Billion) | Implicit Interest R. (%) | Debt/GDP (%) | Revenue (USD Billion) | Primary Expenditure (USD Billion) | Primary Balance (USD Billion) | Primary / GDP (%) | Implicit Interest R. (%) | Debt to GDP (%) | Debt Level (USD Billion) | | | | | | | |
| 2010 | 23.18 | -0.53 | 12.56 | 18.1% | 18.1% | 23.18 | 23.71 | (0.53) | -0.8% | 18.1% | 18.1% | 12.56 | | | | | | | |
| 2011 | 31.19 | 0.40 | 14.70 | 20.2% | 18.5% | 31.19 | 30.78 | 0.41 | 0.5% | 20.2% | 18.5% | 14.69 | | | | | | | |
| 2012 | 32.35 | -1.08 | 16.47 | -1.4% | 18.7% | 32.35 | 34.47 | (2.12) | -2.4% | -1.4% | 18.9% | 16.62 | | | | | | | |
| 2013 | 34.43 | -6.56 | 22.12 | -5.5% | 23.3% | 34.43 | 40.89 | (6.43) | -6.8% | -5.5% | 23.3% | 22.13 | | | | | | | |
| 2014 | 35.49 | -7.02 | 28.46 | -3.1% | 28.0% | 35.50 | 42.48 | (6.98) | -6.9% | -3.1% | 27.9% | 28.42 | | | | | | | |
| 2015 | 32.65 | -5.37 | 34.97 | 4.0% | 35.2% | 32.65 | 38.84 | (5.99) | -6.0% | 4.0% | 35.8% | 35.55 | | | | | | | |
| 2016 | 30.03 | -8.09 | 44.56 | 4.3% | 44.6% | 30.09 | 39.60 | (9.51) | -9.5% | 4.3% | 46.6% | 46.60 | | | | | | | |
| 2017 | 33.68 | -4.25 | 49.05 | 0.6% | 47.0% | 33.67 | 38.88 | (5.01) | -4.8% | 0.6% | 49.5% | 51.88 | | | | | | | |
| 2018 | 36.87 | -2.42 | 51.76 | 2.6% | 49.1% | 37.18 | 40.08 | (2.90) | -2.7% | 2.7% | 51.8% | 56.19 | | | | | | | |
| 2019 | 36.39 | -0.81 | 55.58 | 3.8% | 51.4% | 36.76 | 38.40 | (1.64) | -1.5% | 3.9% | 55.0% | 60.04 | | | | | | | |
| 2020 | 29.21 | -4.28 | 60.46 | 1.1% | 60.9% | 29.59 | 36.32 | (6.72) | -6.7% | 1.1% | 67.1% | 67.44 | | | | | | | |
| 2021 | 36.12 | -0.21 | 66.07 | 8.9% | 61.2% | 36.81 | 39.23 | (2.42) | -2.2% | 9.7% | 70.7% | 76.38 | | | | | | | |

Step 4: Create New Scenarios

8) Click on Return to Parameters and repeat guidelines from Step 1.

| Ecuador | | | | | | | | | | | | | | | | | | | |
|---------------------|---------------------|--------------------|--------|--------------------------|---------------|-----------------------|-------------------|----------------|--------------------------|-----------------------|--------------------|--------------------------|---------------------------|-------------|--------------|----------------|-----------------------|-----------------|--|
| I. Investment-Block | | | | | | | | | | | | | | | | | | | |
| Year | Baseline Info (WED) | | | | | | Investment Vector | | | | | | Growth Update | | | | Projections | | |
| | Cur (USD Billion) | nominal Growth (%) | IV (%) | Investment (USD Billion) | Inflation (%) | Rate (Local Exchange) | Ln Data (%) | Op. IV_WED (%) | Investment (USD Billion) | Deficit (USD Billion) | Public Private (%) | Capital Stock Public (%) | Capital Stock Private (%) | Public ICOR | Private ICOR | Nominal Growth | New GDP (USD Billion) | Real Growth (%) | |
| 2010 | \$ 83.56 | - | 28.04% | \$ 15.50 | 3.55% | \$ 10000 | - | 28.04% | \$ 15.50 | \$ - | \$ - | \$ 66 | \$ 128 | 0.18 | 0.09 | - | \$ 83.56 | | |
| 2011 | \$ 79.28 | 13.98% | 28.14% | \$ 22.31 | 4.48% | \$ 10000 | 0.0% | 28.13% | \$ 22.30 | \$ - | \$ 0.00 | \$ 75 | \$ 133 | 0.18 | 0.10 | 13.98% | \$ 79.28 | 8.10% | |
| 2012 | \$ 87.93 | 10.91% | 27.80% | \$ 24.44 | 5.10% | \$ 10000 | 0.0% | 28.17% | \$ 24.77 | \$ 0.15 | \$ 0.18 | \$ 84 | \$ 140 | 0.18 | 0.10 | 10.91% | \$ 87.92 | 5.52% | |
| 2013 | \$ 95.13 | 8.19% | 28.47% | \$ 27.08 | 2.72% | \$ 10000 | 0.0% | 28.20% | \$ 26.83 | \$ - | \$ 0.11 | \$ 94 | \$ 147 | 0.17 | 0.11 | 8.25% | \$ 95.17 | 5.38% | |
| 2014 | \$ 101.73 | 6.93% | 28.31% | \$ 28.80 | 3.59% | \$ 10000 | 0.0% | 28.24% | \$ 28.73 | \$ - | \$ 0.03 | \$ 105 | \$ 155 | 0.16 | 0.11 | 6.30% | \$ 101.74 | 3.18% | |
| 2015 | \$ 99.29 | -2.38% | 26.67% | \$ 26.68 | 3.97% | \$ 10000 | 0.0% | 28.27% | \$ 28.07 | \$ 0.62 | \$ 0.77 | \$ 116 | \$ 162 | 0.15 | 0.10 | -2.40% | \$ 99.29 | -6.13% | |
| 2016 | \$ 93.94 | 0.65% | 24.98% | \$ 24.96 | 1.73% | \$ 10000 | 0.0% | 28.31% | \$ 28.29 | \$ 1.48 | \$ 1.65 | \$ 126 | \$ 168 | 0.14 | 0.10 | 0.62% | \$ 100.11 | -0.63% | |
| 2017 | \$ 104.30 | 4.36% | 26.28% | \$ 27.41 | 0.42% | \$ 10000 | 0.0% | 28.34% | \$ 23.56 | \$ 0.36 | \$ 1.19 | \$ 137 | \$ 175 | 0.13 | 0.10 | 4.74% | \$ 104.05 | 4.30% | |
| 2018 | \$ 107.59 | 3.13% | 26.75% | \$ 28.77 | -0.22% | \$ 10000 | 0.0% | 28.38% | \$ 30.52 | \$ 0.78 | \$ 0.97 | \$ 147 | \$ 182 | 0.13 | 0.10 | 3.36% | \$ 108.38 | 3.53% | |
| 2019 | \$ 108.11 | 0.51% | 25.91% | \$ 28.01 | 0.27% | \$ 10000 | 0.0% | 28.41% | \$ 30.71 | \$ 1.20 | \$ 1.50 | \$ 158 | \$ 189 | 0.12 | 0.09 | 0.68% | \$ 109.12 | 0.42% | |
| 2020 | \$ 99.29 | -8.18% | 22.05% | \$ 21.89 | -0.34% | \$ 10000 | 0.0% | 28.44% | \$ 28.24 | \$ 2.83 | \$ 3.53 | \$ 167 | \$ 195 | 0.10 | 0.08 | -7.90% | \$ 100.50 | -7.58% | |
| 2021 | \$ 106.17 | 6.92% | 22.35% | \$ 23.73 | 0.13% | \$ 10000 | 0.0% | 28.48% | \$ 30.23 | \$ 2.90 | \$ 3.61 | \$ 178 | \$ 200 | 0.10 | 0.09 | 7.57% | \$ 108.05 | 7.36% | |



28.1% 2020
28.0% 2021
WED Estimations

References

- Abiad, A., D. Furceri, and P. Topalova. 2016. The Macroeconomic Effects of Public Investment: Evidence from Advanced Economies. *Journal of Macroeconomics* 50: 224–40.
- Beaudry, P., and T. Willems. 2018. On the Macroeconomic Consequences of Over-Optimism. NBER Working Paper No. 24685. National Bureau of Economic Research, Cambridge, MA.
- Berg, A., R. Portillo, E. Buffie, C. Pattillo, and L. Zanna. 2012. Public Investment, Growth and Debt Sustainability; Putting Together the Pieces. IMF Working Paper No. 12/144. International Monetary Fund, Washington, DC.
- Brichetti, J., M.E. Rivas, T. Serebrisky, and B. Solis 2021. *The Infrastructure Gap in Latin America and the Caribbean: Investment Needed through 2030 to Meet the Sustainable Development Goals*. Washington, DC: Inter-American Development Bank.
- Devadas, S., and S. Pennings. 2018. Assessing the Effect of Public Capital on Growth. Policy Research Working Paper No. S8604. World Bank, Washington, DC.
- Dudine, P., and J. Tovar Jalles. 2017. How Buoyant Is the Tax System? New Evidence from a Large Heterogeneous Panel. IMF Working Paper No. 17/4. International Monetary Fund, Washington, DC.
- Genberg, H., and A. Martinez. 2014. User Perspectives on IMF Forecasts: Survey Methodology and Results. IMF Independent Evaluation Office Background Document 1. International Monetary Fund, Washington, DC.
- Genberg, H., A. Martinez, and M. Salemi. 2014. The IMF/WEO Forecast Process. IMF Independent Evaluation Office Background Document 3. International Monetary Fund, Washington, DC.
- Gurara, D., G. Melina, and L.-F. Zanna. 2019. Some Policy Lessons from Country Applications of the DIG and DIGNAR Models. IMF Working Paper No. 19/62. International Monetary Fund, Washington, DC.
- IEO, Independent Evaluation Office of the International Monetary Fund. 2006. An Evaluation of the IMF's Multilateral Surveillance – Background Documents. International Monetary Fund, Washington, DC.
- Humphrey, C. 2018. Channelling Private Investment to Infrastructure: What Can Multilateral Development Banks Realistically Do? Working Paper No. 534. Overseas Development Institute.
- Mendoza, E., and M. Oviedo. 2009. Public Debt, Fiscal Solvency and Macroeconomic Uncertainty in Latin America. NBER Working Paper No. 10637. National Bureau of Economic Research, Cambridge, MA.
- Presbitero, A. 2019. Too Much and Too Fast? Public Investment Scaling-Up and Absorptive Capacity. *Journal of Development Economics* 120: 17–31.