Accelerate Sustainable Development in Viet Nam: Policy Options

Macroeconomic Modelling (Augmented Public Debt Sustainability Analysis) Study Report

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1. Introduction

Viet Nam has achieved remarkable successes in promoting economic development, raising living standards, and lifting millions of people out of poverty. Building on the achievements, the country is strongly committed to the 2030 Agenda for Sustainable Development. Viet Nam aspires to be a high-income country by 2045 and achieve net zero by 2050. Whereas the VNR 2023 reveals that Viet Nam has made significant progress in various Sustainable Development Goals (SDGs), the country needs to expedite the implementation to bring all SDGs back on track to achieve the 2030 targets. In the current context of rising geopolitical contests and economic uncertainty, the country faces more critical development challenges, including building economic resilience, eradicating poverty, and tackling climate risks.

To attain development aspirations and overcome the challenges, the government of Viet Nam has launched various policy packages and planned to increase investments in key transitions. To inform the government's decisions on the policies, it is critical to answer questions about how the government's investments in SDGs and other national priorities, such as investment in renewable energy, might affect economic activities and other socio-economic and environmental indicators such as poverty rate and CO2 emissions.

In this context, the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and the United Nations in Viet Nam in collaboration with the Ministry of Planning and Investment (MPI) are carrying out a country study based on the region-wide ESCAP macroeconomic model[1]. The objectives of the study are to assess the impacts of selected policy scenarios on economic, social and environmental outcomes, including public debt sustainability, and further integrate sustainable development into macroeconomic modeling in Viet Nam.

The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) has developed a Macroeconomic Model to assist in the design of economic recovery policy packages for countries in Asia and the Pacific region in the post-COVID-19 period, along with consolidating sustainable economic, social and environmental development.

The selected policy scenarios include green growth and energy transition, poverty reduction and social transformation, and digital or innovation-based economy. The selected policy scenarios are highly relevant for Viet Nam in its efforts to achieve national development goals and accelerate the sustainable development agenda.

The two main results of this experiment are (a) the macroeconomic model based on the international scale model of ESCAPE is applied in Viet Nam's context; and (b) research to simulate policy scenarios and present economic, social, and environmental impacts in Viet Nam.

2. Development Challenges

Viet Nam has introduced the Socio-Economic Development Strategy (SEDS) 2021-2030 to guide the implementation of development policies and programmes to realize the national

[1] The model takes an augmented approach to assess public debt sustainability in the long term, which supplements the short- to medium term approaches currently adopted by International Financial Institutions and credit rating agencies

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development goals such as becoming a high-income country by 2045 and achieving net zero emissions by 2050. The Sustainable Development Goals (SDGs) with the principles of "leave no one behind" are also integrated into the SEDS 2021-2030, which is operationalized through the 5-year Socio-Economic Development Plans (SEDP).

In the past decades, Viet Nam has made great strides in various dimensions of its sustainable development agenda, propelling the country to move up a development ladder. With rapid economic growth, the country graduated from a low-income country to a lower middle-income country in 2010 and aimed to be an upper-middle-income country by 2030. Viet Nam's economy achieved a sustained high growth rate in the 1991-2020 period, with an average rate of 6.8% per annum. GDP per capita rose more than 10 times from USD 402 in 2000 to USD 4,109 in 2022.[2] Viet Nam's GDP per capita jumped 56 places to 117th in the world's ranking and became the 6th highest in Southeast Asia. According to the World Economic Forum's Global Competitiveness Report in 2019, Viet Nam's infrastructure system improved significantly and was ranked 77th out of 141 countries.[3]

Along with economic progress, social development outcomes have also improved significantly. Multidimensional poverty decreased by 4.9 percentage points from 9.2% in 2016 to an estimate of 4.3% in 2022. The multidimensional poverty rate among children declined from 19.1% in 2016 to 11.7% in 2020.[4] Human Development Index (HDI) increased from 0.689 in 2016 to 0.703 in 2021, which has categorized Viet Nam as a High Human Development country since 2019. Viet Nam has also achieved notable progress in education. Despite some adverse impacts of the COVID-19 pandemic, the rate of students completing the primary program reached 91.1% in 2022. The share of students completing lower secondary school was 86.9% in 2022. The number of workers registered in social insurance increased from 13 million in 2016 to about 17.5 million in 2023. Health insurance coverage increased to 92.0% in 2022. The national average rate of malnutrition (stunting) among children under 5 years decreased from 24.3% in 2018 to 19.2% in 2021, whilst it remains high at 31.4% among children under 5 years in ethnic minority regions.

However, Viet Nam faces many critical development challenges, including addressing economic vulnerability, eradicating poverty and inequality, and tackling climate risks. The global polycrisis, including the COVID-19 pandemic and the war in Ukraine, exposed the underlying vulnerability of Viet Nam's economy which is highly dependent on external demands and foreign capital inflows. Even though Viet Nam's economy still achieved positive growth rates of 2.9% in 2020 and 2.6% in 2021, it decreased from a high growth rate of 6.6% per annum a decade before the pandemic. In 2023, due to a drop in demand for Viet Nam's exports, many workers, especially those in the textile and electronic sectors who are dominantly women, have lost their jobs or experienced a reduction in their working hours.

[2] GSO, 2023

[3] MPI (2023), "Voluntary National Review 2023"

[4] MPI (2023), "Voluntary National Review 2023"

Despite notable progress, there are still gaps in social development outcomes such as poverty and inequality eradication, gender equality and women's empowerment, health care, and social protection. Although different measures of poverty, either multidimensional or income poverty, point to the same direction of progress with a low national rate, there remain high pockets of poverty in various population groups and regions such as ethnic minorities in mountainous and remote areas. Inequalities including income and wealth gaps and gender inequality continue to be a challenge. Violence against women and children remains persistent, and women continue to shoulder disproportionately unpaid care and domestic work.

Viet Nam's rapid economic development in the past decades has also put tremendous pressure on the environment. Carbon dioxide (CO2) emissions per capita doubled from 1.73 metric tons in 2010 to 3.51 metric tons in 2019. Viet Nam is one of the countries most vulnerable to climate change, with an estimated loss of 3.2% of GDP in 2020. Over the last three decades, Viet Nam has suffered an average annual loss of 1-1.5% of GDP and an average of 430 deaths due to climate-related disasters.[5] It has also been estimated that climate change could reduce national income by up to 3.5% by 2050. As reported in the 2023 VNR, the impacts of climate change have been more severe. The impacts include rising sea levels and saline intrusion affecting the plain areas such as the Mekong Delta; extreme climatic conditions eroding agriculture, tourism and infrastructure; and rising heat affecting labour productivity across economic sectors; and more severe and frequent floods and droughts. As such, addressing climate change through mitigation and adaptation, especially reducing greenhouse gas (GHG) and CO2 emissions, is a major national priority.

Financing, which is a means for Viet Nam to address development challenges and fulfill national development goals, is of paramount importance, especially in the context of global economic slowdown, tightened global financial conditions, and rising geopolitical contests. The official development assistance (ODA) is on a declining trend, especially after Viet Nam became a lower middle-income country in 2010. ODA decreased dramatically from 3.84% of GDP in 2001 to only 0.14% of GDP in 2021 while the remittance as a share of GDP was recorded at a stable and average level of 3.3%.[6] Between 2011 and 2021, the FDI inflows into Viet Nam were stable around an average of 5.9% of GDP.[7] Top sources of FDI inflows include Singapore, the Republic of Korea, Japan, China, and Hong Kong. Viet Nam remains a top destination for foreign investors given its cost competitiveness, comparatively low taxation, comprehensive free trade agreements, and special economic zones. Domestic private investment grew gradually from 15.5% of GDP in 2011 to 20.4% of GDP in 2019 before dropping slightly to 20.0% in 2020 and 20.1% in 2021, respectively, due to the economic fallout of the pandemic. Nevertheless, Viet Nam's domestic private investments remain low. The experience of newly developed economies such as South Korea,

[5] United Nations Office for Disaster Risk Reduction (UNDRR) and Asian Disaster Preparedness Center (ADPC) (2020). Disaster Risk Reduction in Viet Nam, available at https://www.undrr.org/media/48541/download?startDownload=true

[6] World Development Indicators (WDI)

[7] World Development Indicators (WDI)

China and Taiwan shows that high levels of domestic investments are essential for sustaining high growth and advancing to higher development levels. Despite sustained and high GDP growth, government revenues fluctuated highly between 2011 and 2022, with an average share of 18.9% of GDP. In this period, however, tax revenue decreased steadily from 16.7% of GDP in 2011 to 12.9% of GDP in 2022.[8] The negative trend in tax revenue must be reversed to expand government revenue to invest in development priorities. Meanwhile, with strong fiscal disciple in the past decades, Viet Nam has maintained the public debt well below the threshold of 60% of GDP. In 2022, the public debt was estimated at 37.1% of GDP, leaving ample room for further investing in tackling development challenges and meeting national development goals.[9]

3. Modeling Policy Scenarios

To attain national development goals and the SDGs by 2030, Viet Nam has developed and implemented various policies and strategies such as the National Master Plan for the period of 2021-2030 with Vision to 2050, Sustainable Agriculture and Rural Development Strategy for the period 2021-2030 with Vision to 2050; National Target Programmes for the period of 2021-2025; and, Power Development Plan VIII (PDP8).

Based on various government policies and intents in the 2021-2030 period, a few policy scenarios have been selected to assess ex-ante their potential impacts on economic, social, and environmental outcomes including public debt trajectory through the application of the ESCAP Macroeconomic Model. Four areas of policies and policy intents that are particularly relevant to Viet Nam's commitments to net-zero and attainment of SDGs selected for assessment include the development of renewable energy; introduction of a carbon tax; expansion of social protection, especially for poor people; and investment in ICT infrastructure for an innovation-based economy.

These policy areas are developed into four different policy scenarios with specific assumptions for simulations using the ESCAP Macroeconomic Model. The model generated alternative sets of results that compare trajectories of economic, social, and environmental indicators to the baseline forecast, providing insights into how they would differ from business-as-usual scenario.

a. Scenario 1: Toward a greener economy

Viet Nam has made a strong commitment at COP26 and the government has already started to revamp its plans and legal frameworks. To go on a net-zero pathway, Viet Nam will need to make significant efforts including investments in related sectors. Viet Nam is ready to receive support from partner countries when participating in the Just Energy Transition Partnership, under which Viet Nam is supported to implement solutions for Viet Nam's low-emission and climate resilient development, as well as to accelerate the just transition and decarbonization of the electricity system and develop new economic opportunities to support Viet Nam's transition towards a net zero future. Power Development Plan VIII also set the goal of successfully implementing a just

[8] IMF's World Economic Outlook Database April 2023 and CEIC

[9] IMF's World Economic Outlook Database April 2023.

energy transition associated with modernizing production, building a smart power grid, and advanced power system management, in line with the green transition trend, reducing emissions, and developing science and technology in the world up to 2030. The general orientation of the National Green Growth Strategy for the period 2021-2030, with a vision to 2050, is to focus on efforts to restructure the economy in association with innovating the growth model, reducing the intensity of greenhouse gas emissions through exploiting and economically and efficiently use energy and resources based on science and technology, apply digital technology and digital transformation, develop green and sustainable infrastructure, and build a lifestyle green, ensuring a principled, equitable, inclusive green transition process, improving resilience throughout the entire economy. Accordingly, Viet Nam's green growth is an important way to realize sustainable development, directly contributing to reducing greenhouse gas emissions towards a long-term carbon-neutral economy.

a1. Scenario 1.1. Development of renewable energy

The National Green Growth Strategy aims to improve energy efficiency and effectiveness, promoting effective exploitation and increasing the proportion of renewable energy sources and new energy in the country's energy production and consumption. These objectives were also included in the Power Development Plan VIII (PDP8) for the period 2021-2030, with a vision to 2050 approved in Decision No. 500/QD-TTg dated May 15, 2023. Accordingly, the Plan aims to form an overall energy industrial ecosystem based on renewable energy and new energy. Specifically, renewable energy is expected to achieve a power generation capacity of 72,332 MW by 2030, an increase of 136.6 percent compared to the level of 2020, and further reach 370,275 MW by 2050, an increased by 411.9 percent. Thus, by 2030, it is expected that renewable energy sources for electricity production will reach 30.9-39.2% in 2030 and progress to the goal of reaching 67.5-71.5% in 2050.

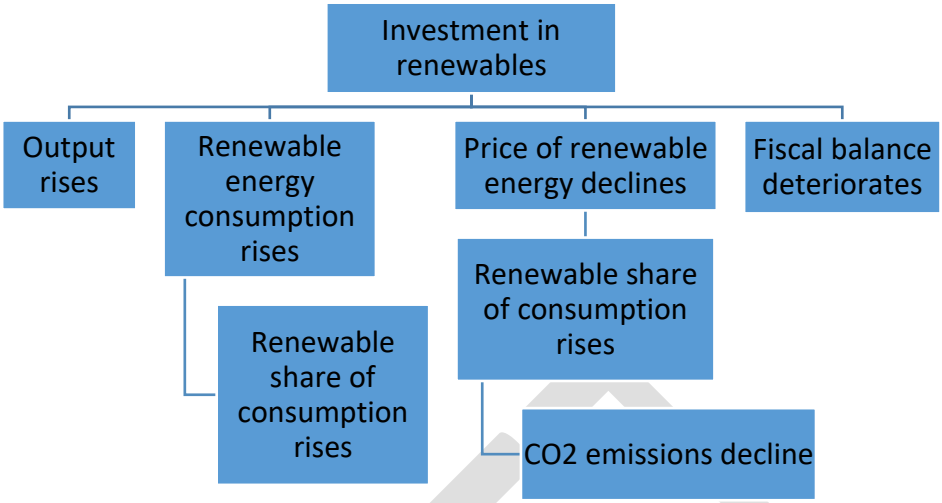
Table 1: Renewable capacity targets

Type of renewable energy (MW)	**2020**	**2030**	**2050**
Hydropower	20,859	29,346	36,016
Solar	8,852	12,836	168,594-189,294
Wind	538	27,880	130,050-168,550
Biomass	325	2,270	6,015
Total	30,574	72,332	370,275
Renewable capacity increase (%)		***136.6***	***411.9***

Source: MOIT of Viet Nam, Decision No. 500/QĐ-TTg

Renewable energy development is one of the important highlights in Viet Nam's green growth policy as well as the goal of achieving net zero emissions by 2050. Besides, renewable energy investment also creates many direct and indirect impacts on the entire economy.

Figure 1: Transmission channels of renewable energy investment in the ESCAP Macroeconomic Model



Source: ESCAP Macroeconomic Model

Figure 1 illustrates how investments in renewables are transmitted in the ESCAP Macroeconomic Model. These investments serve as a short-term stimulation to economic activity. As renewable capacity expands, the consumption of renewable energy gradually rises, offsetting declines in fossil fuel consumption. The increased renewable capacity also reduces the average production costs of renewables relative to fossil fuels, leading to a further shift in the energy mix towards renewables. This shift in the energy mix results in a decrease in CO2 emissions and air pollution. However, if the government finances the investment in renewables, it may put pressure on the fiscal balance.

In this scenario, we assume that the Government will increase investment in renewable energy with an estimated spending of about 13.5 bil. USD per year until 2030 and 23 bil. USD per year from 2031 to 2050 (which was stated under Decision No.500/QD-TTg). This investment period starts in 2021. In this scenario, we build two sub-scenarios based on assumptions about the source of capital for renewable energy.

- Scenario RCa: Total investment is financed completely by government spending.

- Scenario RCb: Total investment is financed 70% by government spending and 30% by private investment.

The results show that investing in renewable energy will help increase its share in the energy mix. The proportion of renewable energy will account for about 20% of the total national energy by 2030. In the first phase, the proportion increases slowly because the demand for traditional energy sources is still large, but after 2030, there is an accelerated increase in renewable energy, which outweighs the growth in energy consumption in the long run.

Figure 2: Impact on the renewable energy share (% different from baseline)

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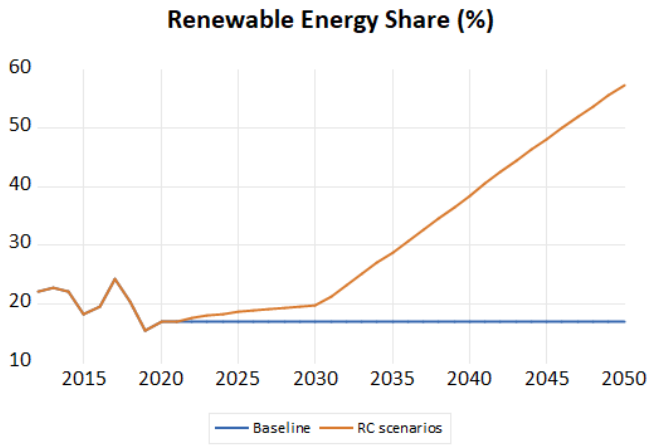
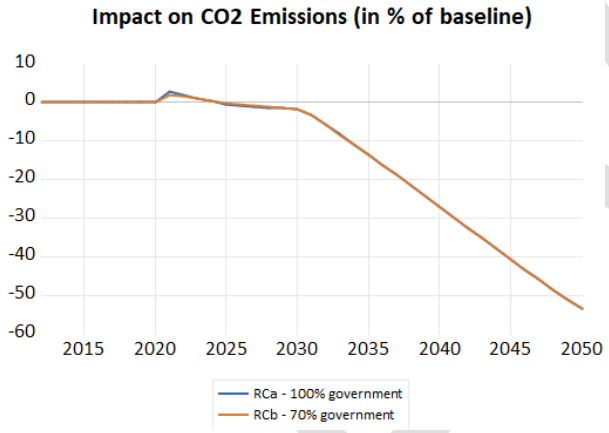
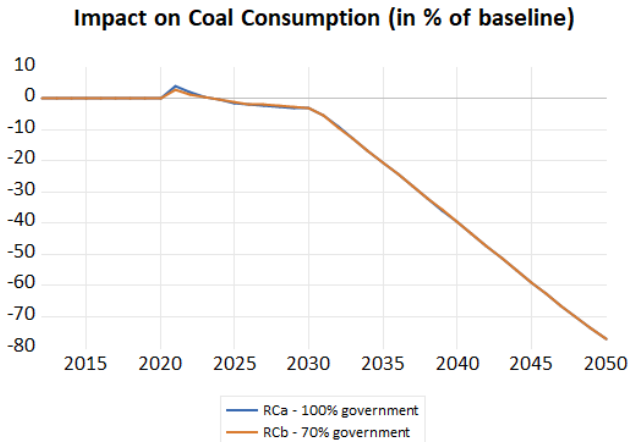


Source: ESCAP Macroeconomic Model

Increasing renewable energy sources helps reduce CO2 emissions as well as the use of fossil fuels such as coal. In the period from now to 2030, the increase in renewable energy consumption cannot fully compensate for the rising energy consumption associated with additional energy needs due to the substantial investment. Consequently, there is no reduction in coal consumption or a significant increase in the share of renewable energy as a percentage of overall energy consumption until 2030. The climate effect is significant, marked by a reduction in pollution and CO2 emissions, there will be a sharp decrease in CO2 emissions, which might decrease by 53% from the baseline in 2050.

Figure 3: Impact on CO2 emission and coal consumption (% difference from baseline)



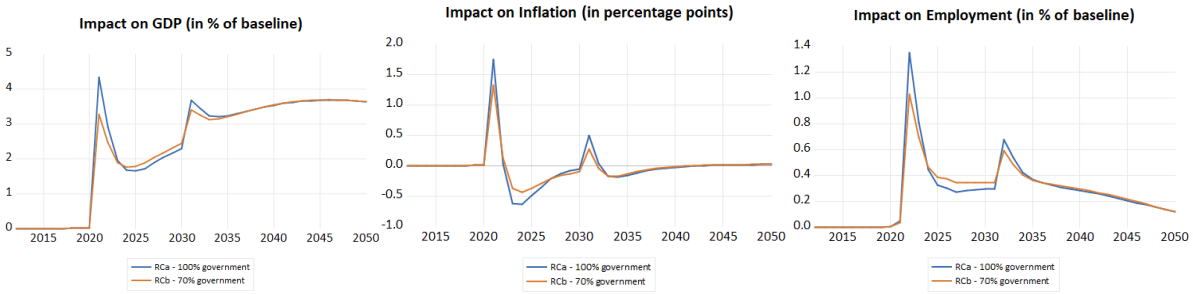


Source: ESCAP Macroeconomic Model

The extra spending on energy-related investments results in short-term economic stimulus, pushing up inflation, real GDP, and employment during the investment period. Model results also show that GDP will increase to a peak rate of 3-4% compared to the baseline scenario in the first years of investment before decreasing gradually to an average rate of around 2% until 2030. After 2030, the GDP growth will pick up again to an average rate of around 3.5% given the new and larger investments between 2030 and 2050. The increased investment in renewable energy will increase the demand for labor; thus, creating more employment. In the first phase, the investment will increase employment to a peak rate of 1.0-1.4% compared to the baseline, the positive employment effect will remain until 2040. The employment effect disappears after 2040 because the improvement of labor productivity (due to better health of the labor force resulting from reduced emissions and pollution) will reduce the demand for labor.

There is a short-term, positive surge in inflation due to the extra investment, but it dissipates quickly because the decline in the prices of renewable energy drives a reduction in the overall prices of goods and services. The effect on poverty is insignificant. In the initial period, poverty is likely to increase slightly up to 0.2% due to the rising inflation in this period. After that, it decreases slightly throughout the period until 2050.

Figure 4: Impact on GDP, inflation, and employment (% different from baseline)



Source: ESCAP Macroeconomic Model

However, debt pressure will increase when this investment is assumed to be financed fully 100% by the state budget. The government debt will increase from the baseline of around 60% of GDP to hover around 77% of GDP until 2050 because the investment package is relatively substantial,

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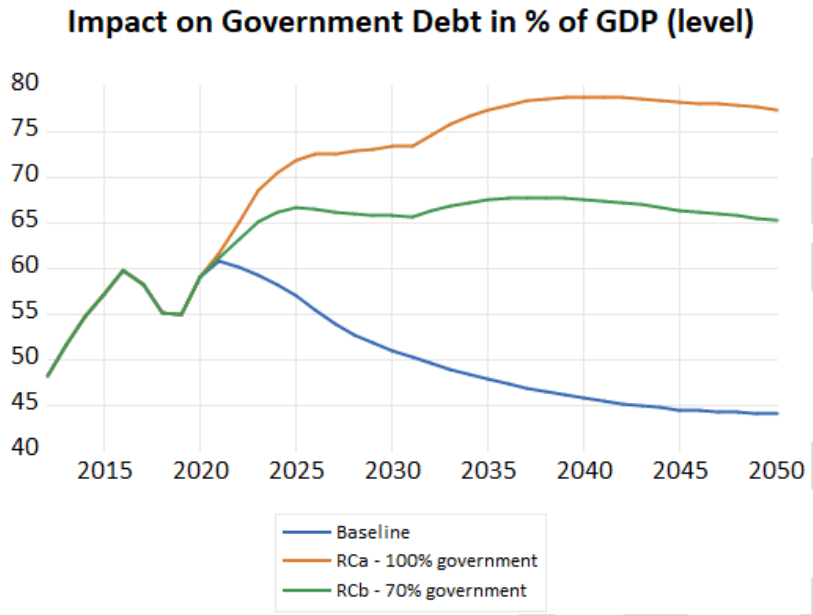
accounting for approximately 3-4% of GDP per year. However, in the scenario RCb where only 70% of the investment is financed by the government and the rest comes from the private sector, the fiscal deterioration is less pronounced. The government debt will remain below 70% of GDP throughout the period until 2050.

Figure 5: Impact on Government Debt in % of GDP (level)



Source: ESCAP Macroeconomic Model

a2. Scenario 1.2. Introduction of a carbon tax

The phenomenon of global warming due to the accumulation of emissions, mainly carbon dioxide (CO2), or carbon emissions in the ozone layer, also known as the greenhouse effect, causes climate change globally. There are many measures to prevent global climate change, mainly cutting global emissions that were ratified by many countries in Japan in 1997 (1997 Kyoto Protocol to combat climate change). In May 2021, the European Commission (EC) presented a proposal for a regulation establishing the EU Carbon Border Adjustment Mechanism (CBAM) as one of the initiatives to promote the reduction of greenhouse gas emissions and achieve carbon neutrality by 2050. CBAM is scheduled to take effect from 2026 and be fully operational by 2034. Accordingly, the EU imposes a carbon tax on all goods exported to this market based on the intensity of GHG emissions in the production process in the host country. CBAM will initially apply to imported goods such as steel, cement, fertilizer, aluminum, electricity, and hydrogen. These are sectors with a high risk of "carbon leakage" and high carbon emissions, accounting for 94% of the EU's industrial emissions. Importers will have to report the emissions contained in imported goods. If these emissions exceed EU standards, they will have to buy “emission certificates” according to the EU's current carbon price. If a non-EU exporting country fails to account for the environmental cost of carbon emissions, this regulation will effectively increase the import prices. Consequently, unless Viet Nam implements a carbon tax by 2026, the country's competitiveness and exports to the EU might be negatively impacted by the new carbon pricing system on Viet Nam's exports to the EU.

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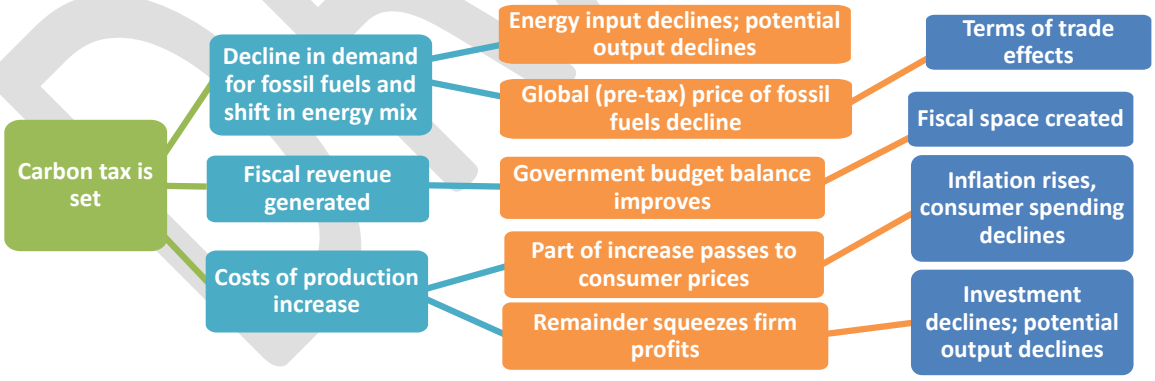
Viet Nam is currently applying the Law on Environmental Protection No. 72/2020/QH14 dated November 17, 2020, in which some subjects and items subject to environmental tax include carbon emission products such as gasoline, oil, coal, etc. has also had some positive impacts such as enhancing social responsibility and awareness towards the environment; encouraging the production and consumption of environmentally friendly goods[10]. However, the Law did not cover all environmental polluters. There are many products and goods whose use has the potential to cause environmental pollution but are not regulated by the Law on Environmental Protection, such as industrial emissions, cigarettes, radioactive waste; chemicals (including inorganic acids, caustic soda, plant protection chemicals, etc.); electronics (generating electronic waste); rubber (tubes, tires, etc.); polymers, etc.. including some items related to carbon emissions.

A carbon tax is considered an economic policy and a cost-effective tool to incentivize the reduction of greenhouse gas emissions where they occur according to the polluter pays principle. Currently, many countries have applied carbon taxes to promote the economy to reduce emissions. Viet Nam so far has no direction or roadmap for applying carbon tax. Although applying carbon tax as an official tool brings many benefits in helping Viet Nam reduce emissions and increase budget revenue, it also poses many challenges, so careful research is needed before implementing the experiment and widely applied. The ESCAP Macroeconomic Model can be used to assess the macroeconomic implications of a carbon tax and the impacts on inflation and production costs, to study the appropriate speed of subsidy withdrawal and introduction of a carbon price, and to understand the economic, social, and environmental trade-offs and benefits.

Figure 6 depicts the impact transmission channels of the implementation of a carbon tax in the ESCAP Macroeconomic Model for Viet Nam. Carbon-linked subsidies, such as energy subsidies, follow a similar transmission path, although with the opposite sign. For example, rather than a decline in demand for fossil fuels, a subsidy would encourage a rise in demand for fossil fuels.

Figure 6. Transmission channels of a carbon tax in ESCAP Macroeconomic Model



Source: ESCAP Macroeconomic Model

By using the ESCAP Macroeconomic Model, we establish a carbon tax scenario based on the World Bank study[11] for Viet Nam. According to the World Bank, the existing carbon tax – the Environmental Protection Tax is around 0.05 USD per tCO2e on coal, 77.60 USD per tCO2e on

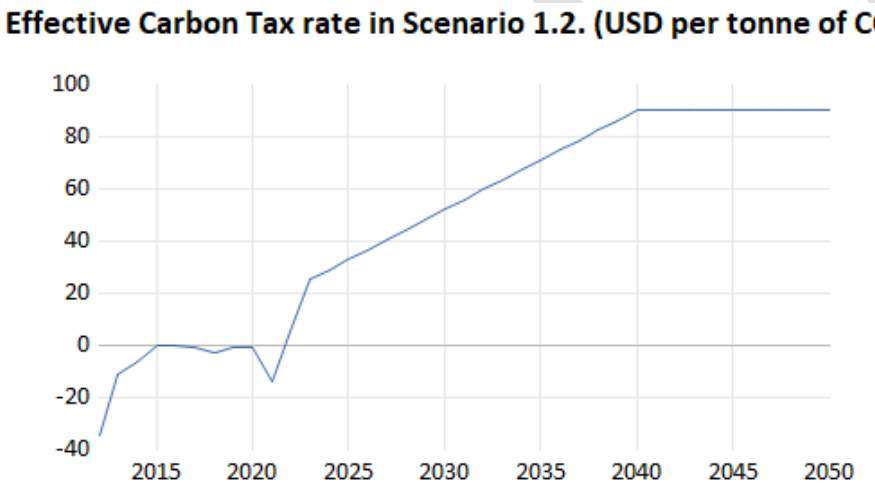
[10] https://mof.gov.vn/webcenter/portal/btcvn/pages_r/l/tin-bo-tai-chinh?dDocName=MOFUCM172895

[11] https://openknowledge.worldbank.org/server/api/core/bitstreams/a27f1b05-910d-59ab-ba2c-84206bf107c2/content

gasoline, and 32.90 USD per tCO2 on diesel, lower than most countries and too low to incentivize large-scale decarbonization. The carbon price is estimated at $12 per tCO2e in 2022 which is the weighted average of the Environmental Protection Tax rate on coal, diesel, and gasoline. We use this average carbon tax as our starting point. In the carbon tax scenario, we increased the carbon tax rate in 2023, moreover, we eased the carbon-related subsidy and implemented a gradual increase in carbon tax to 90 USD per CO2 until 2040. This long-term carbon tax rate is in line with the WB scenario. There are three assumptions:

- Carbon Tax: In 2023 we expect carbon tax to increase in line with government regulation[12] to around 25 USD per CO2. In the long run, we expect it to increase to 90 USD per CO2 by 2040.
- Carbon subsidy: According to the IEA, carbon subsidy increased to 13.9 USD per CO2 in 2021 from 1.2 USD in 2020. We expect this subsidy to ease completely until 2023.
- Extra revenue will be used to finance the budget deficit and pay back debt, with no increase in spending.

Figure 7: Scenario on introducing carbon tax for Viet Nam

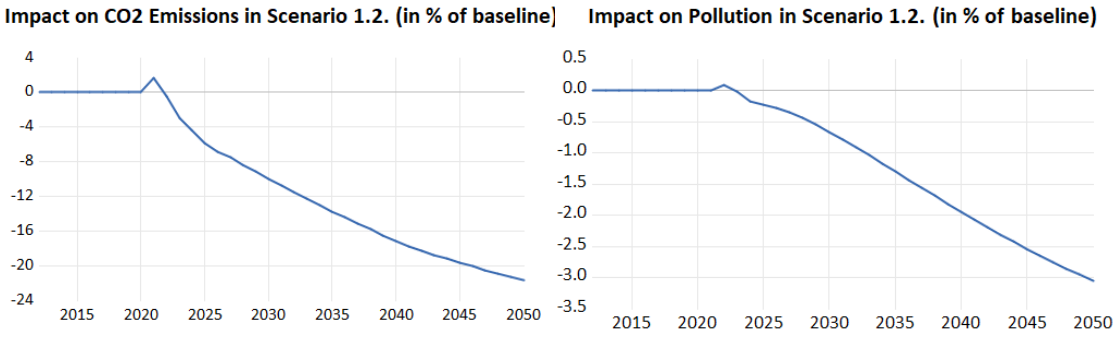


Source: ESCAP Macroeconomic Model

The first application of a carbon tax has shown that it is a useful tool in reducing emissions. An increase in carbon tax and a reduction in carbon subsidies would raise the price of fossil fuel, thereby reducing energy consumption, shifting consumption towards renewable energy sources, and expediting the decarbonization process. Consequently, CO2 emission and pollution levels will decrease. CO2 emissions are projected to decrease by around 10% by 2030, leading to improved air quality and subsequent health benefits that contribute to overall productivity growth. Over the long term, the high carbon tax will continue to lead to a decline in CO2 emissions and pollution.

Figure 8: Impact on CO2 and Pollution (% different from baseline)

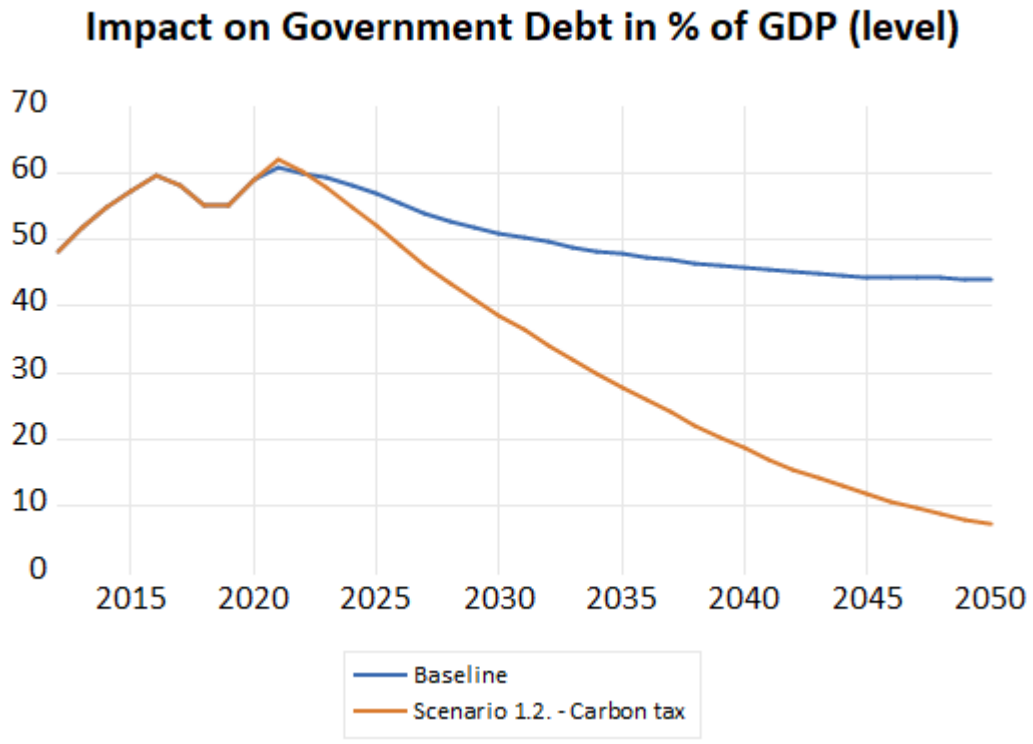
[12] https://thuvienphapluat.vn/van-ban/Thue-Phi-Le-Phi/Nghi-quyet-30-2022-UBTVQH15-muc-thue-bao-ve-moi-truong-xang-dau-mo-nhon-548478.aspx



Source: ESCAP Macroeconomic Model

The carbon tax will supplement budget revenue, thereby reducing fiscal pressure. The revenue generated from the carbon tax and the savings from eliminating carbon-linked subsidies creates significant fiscal space. This allows the government debt in percentage of GDP ratio to decline to 38.8% in 2030 and to experience a significant reduction over the long term. A portion of this government can be reinvested into the economy, prioritizing areas such as energy infrastructure, transportation improvements, or enhancing energy efficiency, as discussed in the subsequent scenarios. Furthermore, the revenue can also be directed toward crucial sectors such as social protection, health, or education.

Figure 9: Impact on Government debt in % of GDP

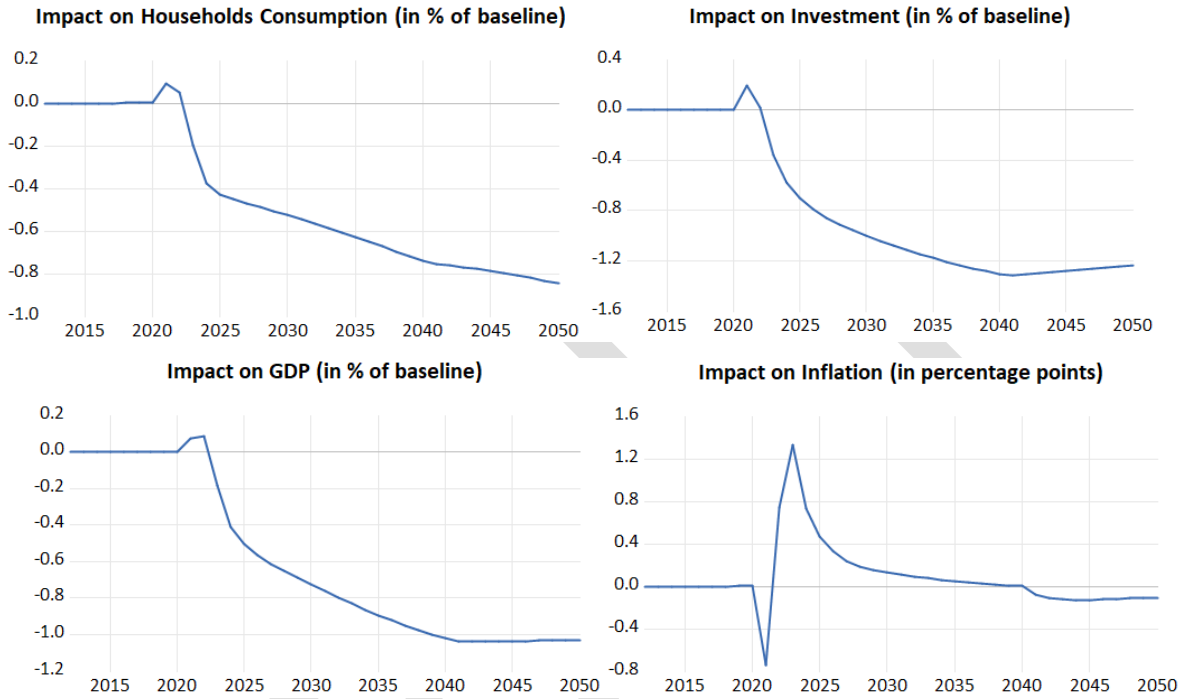


Source: ESCAP Macroeconomic Model

The increase in costs contributes to inflationary pressures. In this scenario, where the government does not counterbalance the negative effects by allocating a portion of carbon tax revenue to social spending, inflation is projected to increase in the initial period by approximately 1.5% above the baseline. However, the inflation effect is temporary and dissolves quickly. The policy has a

negative net impact on GDP and the demand side, especially on household consumption and investment. With the rise in production costs, GDP is expected to experience a slight decline, although the impact remains moderate. The decrease in GDP stabilizes over the long run, indicating a modest, approximately 1% decline in long-term GDP. If the government does not utilize the extra revenue to boost social, health, or education spending, the impact of the carbon tax on social indicators remains dismissed.

Figure 10: Impact on GDP and demand side and Inflation



Source: ESCAP Macroeconomic Model

b. Scenario 2: Poverty and inequality reduction and social protection

b1. Scenario 2.1. Implementation of National target programs

With sustained high economic growth in the past decades, Viet Nam has achieved notable success in economic development, rapid industrialization, modernization, and poverty reduction. People's lives have improved significantly; however, it also shows that the gap between rich and poor, between urban and rural areas is increasing. The government has implemented the National Target Programs since the 2000s to improve living conditions, especially in vulnerable groups. In the 2021-2030 period, Viet Nam will continue to implement three National Target Programs (NTPs), including the National Target Program for Sustainable Poverty Reduction, the National Target Program for Building New Rural Areas, and the National Target Program for Improving living standard for Minorities and Mountainous Areas. These Programs are aimed to gradually narrow the gap in living standards and the average income of the region compared to the national average; support the poor and vulnerable households to rise above the minimum standard of living, and access to basic social services according to the national multidimensional poverty line, improve the quality of life; support poor districts and communes with special difficulties in the lowlands, coastal areas and islands to get rid of poverty and especially difficult situations. These

programs are designed to achieve the goal of "leaving no one behind" in Viet Nam's sustainable development process.

These NTPs comprise many investment projects, which are divided into several sectors, focusing mainly on improving infrastructure in poor, remote, and disadvantaged areas, training and creating sustainable jobs for the poor and replicating poverty reduction models. Different forms of investments may yield differentiated social, economic, and environmental outcomes. The impact simulation results of these Target Programs are the results of synthesizing impacts from many policy options. Here, small projects in target programs are distributed among investment categories to be able to handle them in the model.

The investment projects in the NTPs cannot be easily categorized into groups that can be simulated in the model. Hence, the grouping of those investment projects is made according to expert opinions to be inputted into the model to simulate their impacts. It is assumed that the majority of the infrastructure spending is focused on improving energy efficiency. This assumption is crucial, as without it, infrastructure investment would not have any effect on environmental outcomes such as CO2 emission and energy efficiency. The investment period begins from 2021 to 2025.

The NTPs' investments in specific sectors are presented as follows:

Table 2: Investment categories of National Target programs

Categories	Overall investment	State budget	Non-Government spending
Infrastructure spending	258,783	255,983	2,800
Health spending	7,500	5,500	2,000
Social protection	2,134,495	71,202	2,063,293
Education spending	43,018	39,308	3,710
SUM	2,443,796	371,993	2,071,803

Source: Decision No. 1719/QD-TTg, No. 90/QD-TTg, 263/QD-TTg, in Bil. VND

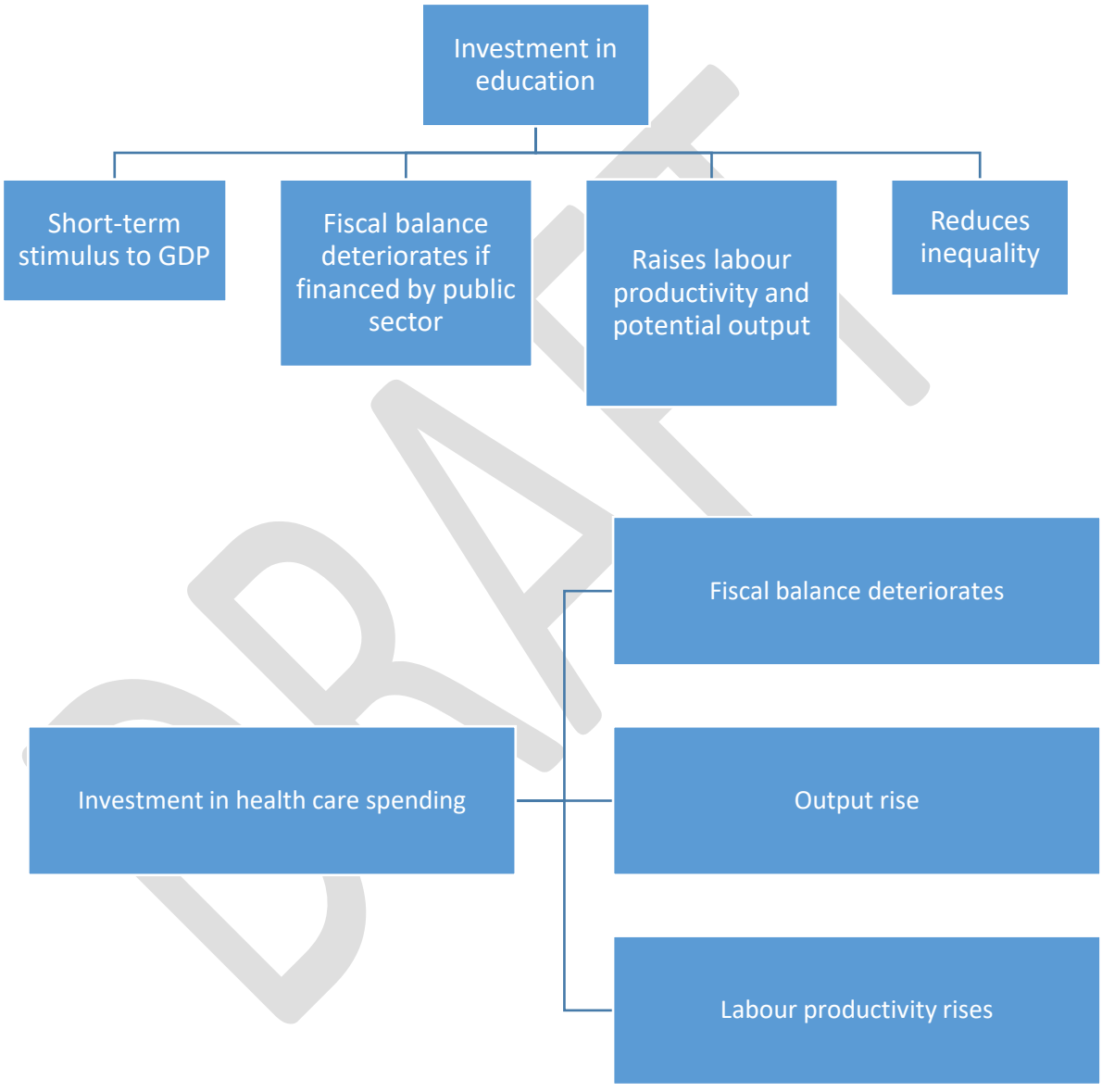
To facilitate a comparison of the effects of different spending categories, further simulations were generated in Scenario 2.1.2. In these simulations, the total spending of 2,443,796 billion VND under the NTPs is allocated entirely among each spending category. It is also assumed that in these scenarios, the entire social package will be funded from the government budget.

As a result, the following scenarios were generated within Scenario 2.1:

- Scenario 2.1.1: The investment package is allocated based on the table above. It is partly financed by the government budget, and partly by private sources.
- Scenario 2.1.2a: It is assumed that all the investment package is for infrastructure projects and financed by the government.
- Scenario 2.1.2b: it is assumed that all the investment package is for health spending and financed by the government.
- Scenario 2.1.2c: it is assumed that all the investment package is for social spending and financed by the government.

- Scenario 2.1.2d: it is assumed that all the investment package is for education spending and financed by the government.

Figure 11: Transition channels from investment in education, health care, and social protection in ESCAP Macroeconomic model



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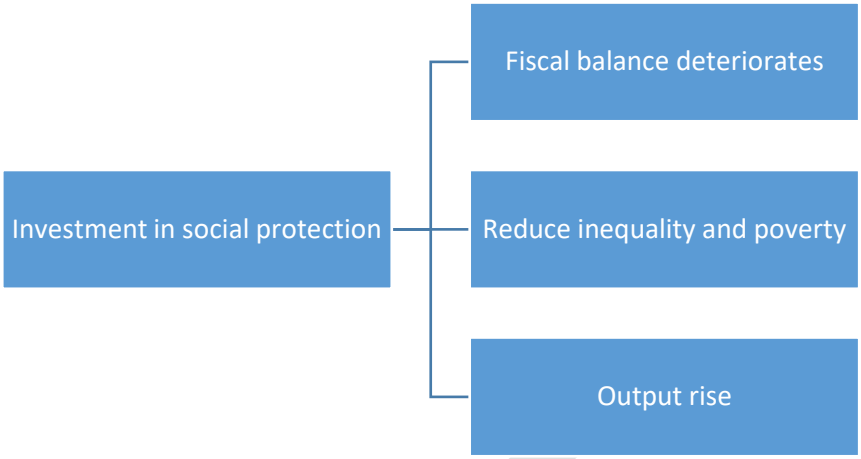

Source: ESCAP Macroeconomic Model

The impact transmission channels of investment in education, healthcare, and social protection are shown in Figure 11. In the macroeconomic model, there is no distinction between poor and non-poor households or urban and rural areas. The investment is assumed to be channeled to a specific sector, including education, health, social protection, and infrastructure, without making a distinction whether the rural areas or poor households receive the investment more than the urban areas or non-poor households.

Government spending on education acts as a short-term stimulus to the economy. The returns to education have been widely studied in academic literature. We assume a benchmark estimate that a 1% GDP rise in spending on education adds about 0.1 percentage points to trend productivity growth per year, calibrated regarding the social returns to education reported by Botev, Égert, Smidova, and Turner (2019). Broader access to education is also expected to reduce income inequality and raise labor productivity over the longer term. The modeling assumption applied is that a 1% of GDP rise in spending on education delivers a 1% decline in the Gini coefficient in the long run, which in turn raises trend productivity.

Meanwhile, investment in health care will help improve productivity and the output of the economy. Improvement in economic growth will create motivation to improve people's lives, including the poor and disadvantaged in society. However, similar to investing in education, investing in health also creates pressure on the government budget. In the long term, if labor productivity is improved well, economic growth can offset the initial investment in health care, increase budget revenue, and reduce fiscal pressure.

Investment in social protection is assumed to benefit directly the intended beneficiaries of the social protection programs. The beneficiaries can use the social protection support to serve the needs of their families and improve their livelihoods, resulting in poverty and inequality reduction. The investment in social protection programs also props up the aggregate demand in the economy, thereby driving output rise or economic growth. If the social protection investment is wholly financed by the government, there is pressure on the government budget.

Figure 12: Transition channel from investment on green infrastructure in ESCAP Macroeconomic model

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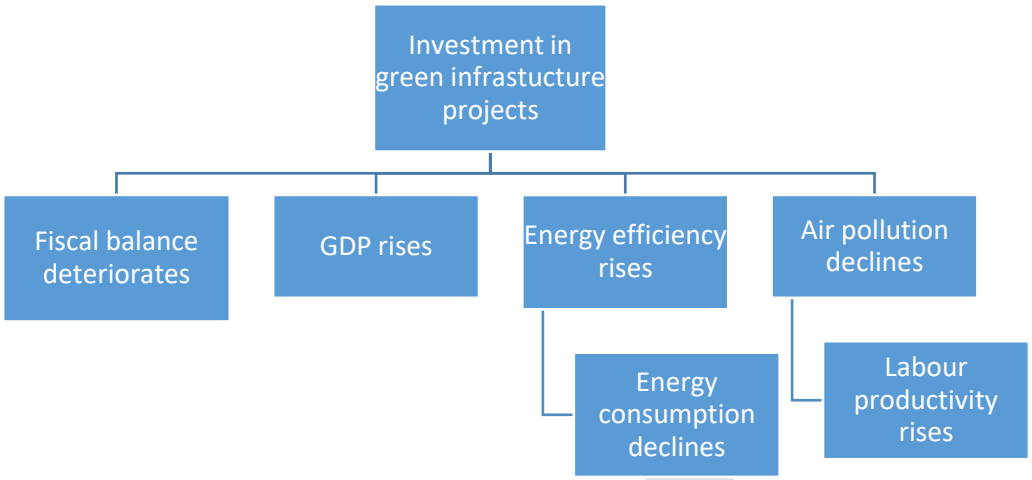
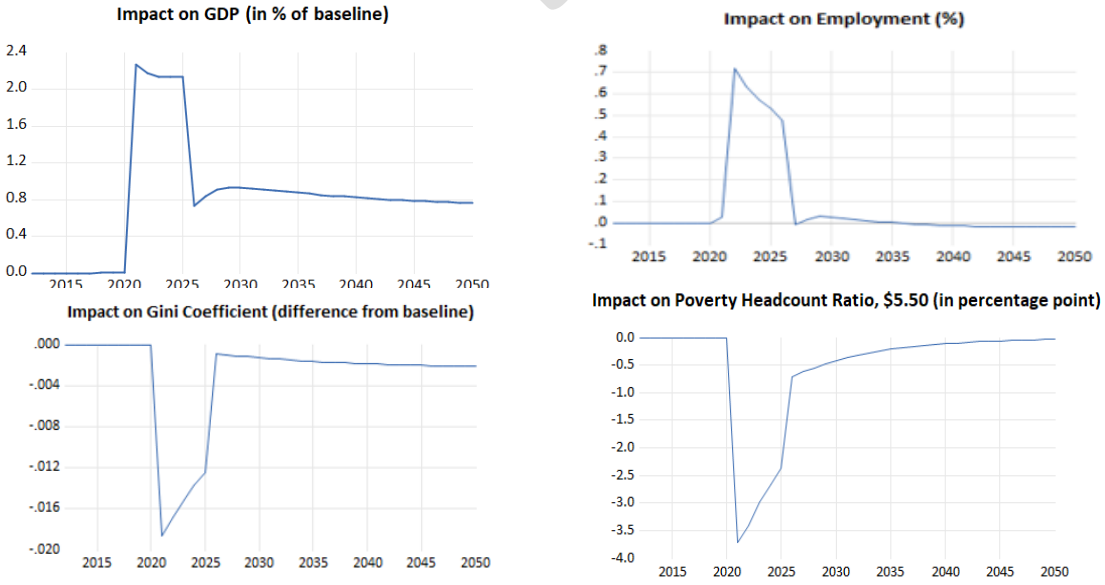


Source: ESCAP Macroeconomic Model

Once we assume that the majority of the infrastructure spending is focused on improving energy efficiency, increasing investment in infrastructure contributes to economic growth, as well as focusing on increasing the efficiency of energy, energy consumption will tend to decrease in the long term. Consuming less energy leads to environmental improvements, reducing CO2 emissions, and improving quality of life, thereby increasing the labor productivity of the economy.

The combined impact results from the 3 target programs show that (scenario 2.1.1) economic growth can be 2% higher than the baseline scenario, this impact is quite strong during the years of the program implementation process but once stopped, the impact will subside. The impact on society is positive, as a portion of the spending is allocated to education, social, and healthcare sectors. In particular, expenditures on social policies have a favorable effect in the coming years. The inflationary effect is insignificant, as a portion of the spending is directed toward the social sector, which counteracts inflationary pressures. More jobs will be created from the beginning years of the shock and aligned with the poverty rate falling, income inequality improving significantly with decreasing 0.016-0.018 of the GINI Coefficient compared to baseline.

Figure 13: Impact on GDP, employment (% different from baseline) and Poverty Headcount ratio ($5,50), Gini Coeffienct (in percentage points different from baseline)

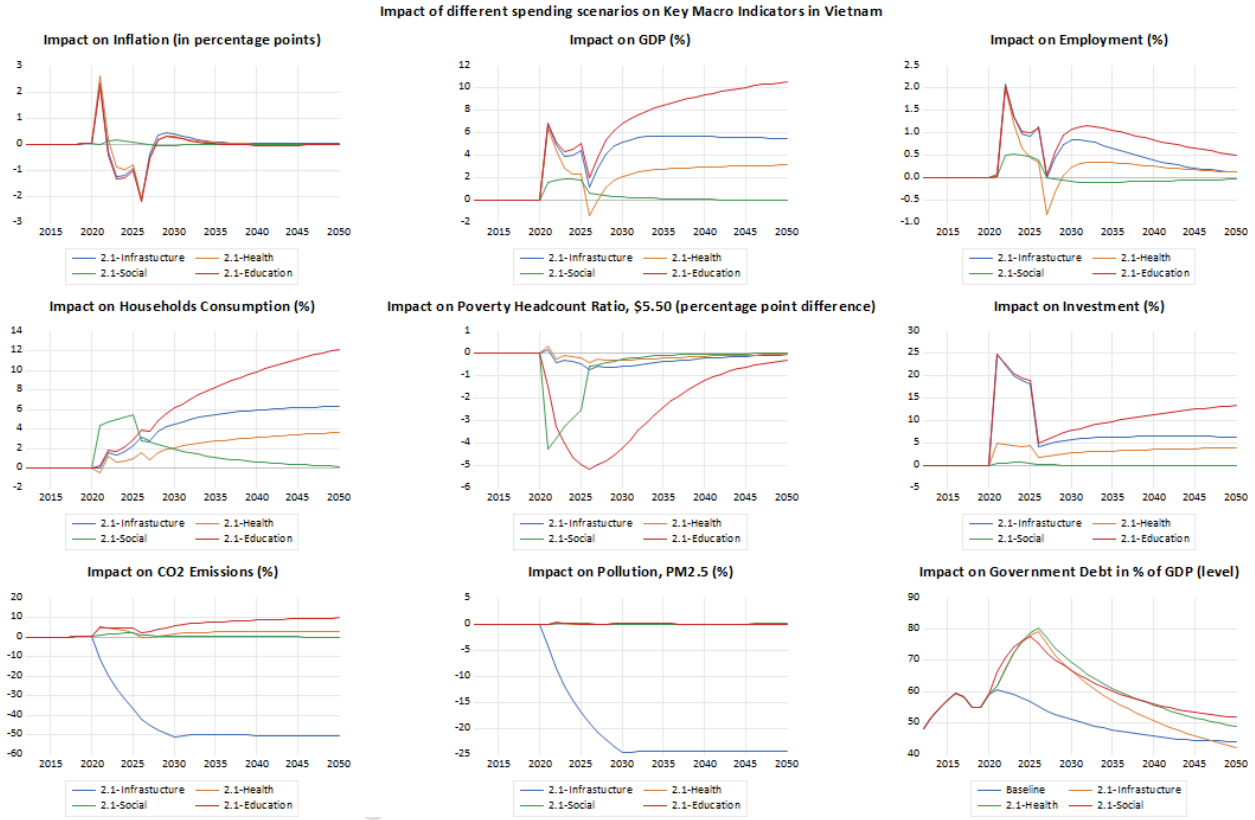


Source: ESCAP Macroeconomic Model

The fiscal impact is also insignificant, as only 15% of the total spending package is funded by the state budget, with the remainder expected to be covered by the private sector. Therefore, the increase in GDP more than offsets the small increase in government spending, resulting in public debt remaining marginally below the baseline in 2030. In the long run, the debt-to-GDP ratio is slightly below the baseline, as the improvement in GDP outweighs the impact of government spending.

For the remaining scenarios, the difference with the original scenario 2.1.1 is that the allocation of total investment resources for target projects will be assumed to be entirely from the state budget and only invested in a single field (one of the four fields of infrastructure, education, health, and social protection).

Figure 14: Impact of investment in different categories



Source: ESCAP Macroeconomic Model

Scenario 2.1-Infrastructure: By investing in green infrastructure that enhances energy efficiency, climate indicators such as CO2 emissions and pollution will see significant improvement. This type of investment will also lead to a long-term boost in productivity. Thus, in this scenario, GDP is 6% higher than the baseline scenario, this impact drops down after that but continues to increase after 2025 and maintains the impact of about 6% difference. The notable point here is that investing in green infrastructure will create a very positive impact on reducing CO2 emissions and fine dust in the air, positively affecting the living environment. The amount of CO2 emissions will decrease by about 50% compared to the level of the baseline scenario, and also there is a

decrease of 25% of PM2.5. This is a remarkable impact compared to other scenarios. Since this type of investment boosts productivity, it helps to increase the output, offset the investment costs, and create less impact on Government debt compared to other scenarios.

Scenario 2.1-Health: Investment in healthcare has a primary impact on productivity since it enhances the labor productivity of the workforce. At first, this investment also increases GDP by about 6% higher than the baseline scenario, but this impact disappears quickly and only maintains around 3% from 2030. The impact on other indicators is small or insignificant. However, it still creates a burden on the fiscal stance as much as other scenarios.

Scenario 2.1-Social: Given significant spending in the social sector, targeting vulnerable groups, rural populations, and people in poverty, household consumption increases, and poverty decreases in the short term. However, if the investment is limited to a 5-year timeframe, the effects are only temporary. The economic impact is only a 2% difference from the baseline scenario and quickly disappears after 2025. Compared to other scenarios, this shock creates much less impact on economic growth. Since this is a direct subsidy to poor people and this is not a type of investment, households receive support from the Government and could spend this amount of money for consumption or saving instead of investment. The impact on investment is negligible. However, this policy could create the highest impact on household consumption, and then affect the total economy. It also can help to reduce the poverty headcount ratio by 4 percentage points compared to baseline since they receive direct support but this impact dissolves quickly.

Scenario 2.1-Education: Investment in education makes a positive contribution to social indicators, such as reducing poverty. Additionally, it improves productivity and results in a substantial increase in potential output in the long run. Therefore, this is the scenario that could create the highest impact on GDP. From the beginning, GDP has increased by more than 6% compared to the basic scenario, affecting GDP will not die but increase much higher than the starting point, and by 2050, it can help increase more than 10% of GDP. This is the only situation in which the impact will increase in the long term. Along with economic growth, employment opportunities are created while for the poor group of people who enjoy the benefits of education, there are more opportunities to access jobs and raise income, from which the poverty rate in general will generally be a downward trend. Therefore, this is the scenario that creates the most positive impact on poverty, the poverty headcount ratio could decrease up to 5 percentage points compared to the baseline scenario.

However, the obvious difference is that the pressure on the State budget is huge since it is assumed that the total investment will be made by the Government. These investments have pushed up the debt-to-GDP ratio during the investment period, possibly reaching 80% of GDP. This impact tends to gradually decrease when investment does not increase and is exchanged for increased revenue from the positive impact of economic growth.

b2. Scenario 2.2. More education for a better future

Viet Nam has continued to improve the system and policies for the development of education and training, especially the policy of free tuition for primary school children nationwide and preschool children in ethnic minority areas, mountainous areas, islands, and areas with extremely difficult socio-economic conditions. As a result, Viet Nam has achieved positive results in the implementation of Goal 4 for education of SDGs.

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However, the proportion of children under 5 years of age who are appropriately developed in terms of health, learning, and psychosocial well-being was 78.2% and gaps existed between different ethnic groups; the percentage of teachers who meet the training standards or higher according to the requirements of the Education Law in 2019 was 75% for primary school and 87% for lower secondary school - a reduction from 99.5 % and 99.6% respectively in the 2018-2019 school year; the percentage of schools with basic conditions and services to serve the learning needs of all children, including children with disabilities is still limited. Furthermore, the rate of trained workers in Viet Nam is only 26.2% in 2022 and slowly improving, causing a shortage of highly qualified workers in Viet Nam, affecting the process of industrialization and international integration[13].

The proportion of the state budget spent on education in 2022 has not reached the minimum level of 20% of total state budget expenditure as instituted in Resolution No. 37/2004/NQ-QH11. The Government's report on educational activities and implementation of the 2022 education budget shows that the estimated current expenditure in education and training is 275,709 billion VND out of the total budget of 1,784,600 billion VND, accounting for approximately 15.45% of the total budget[14].

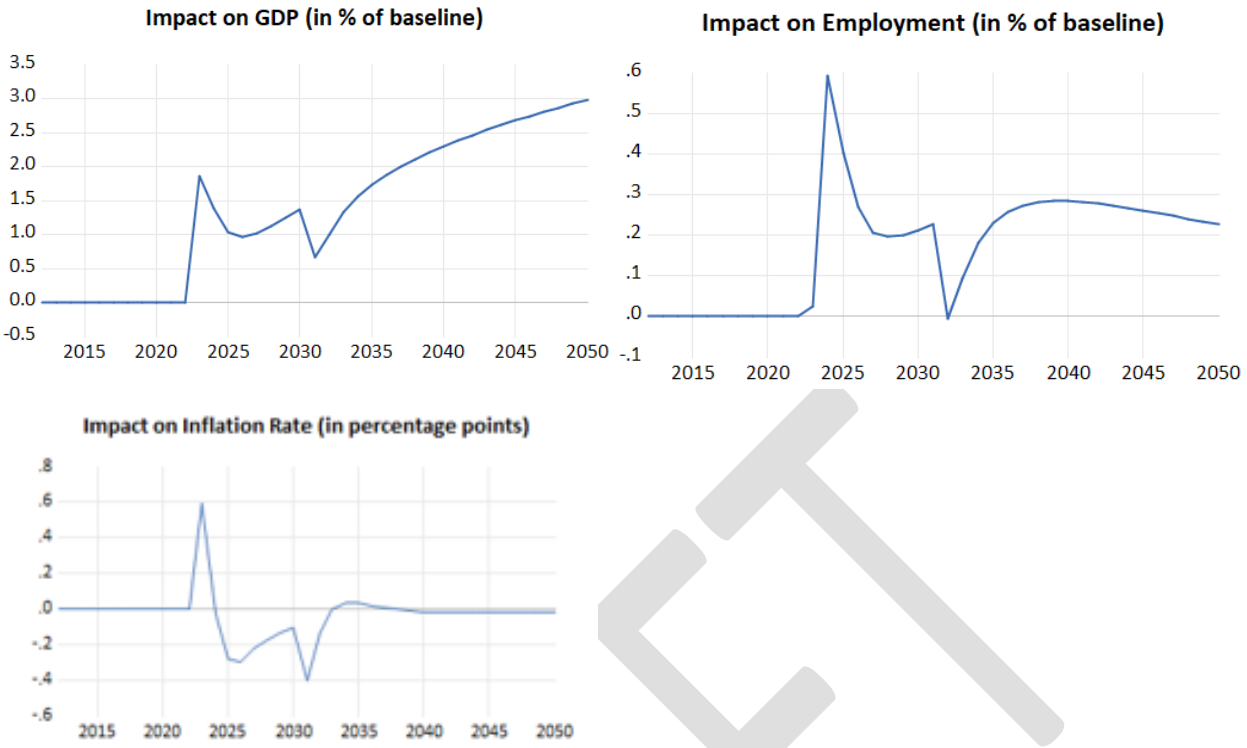
In this scenario, the model is simulated to evaluate the impact of an extra 4.55% of the total state budget (approximately VND 81,199.3 billion) to meet the minimum level of 20% of the state budget needed to invest in the education sector in the period 2023-2030. There are two options for financing this extra investment. The first option is that it is financed by debt because the extra investment may cause a budget deficit. Another option is that it is financed by reallocation from other government investment spending.

The simulation results show that, in the first option, the increased investment in education will act as an economic stimulus that generates a positive short-term effect on both GDP and employment. GDP will increase to a peak of nearly 2% and employment might increase up to 0.6% compared to the baseline scenario during the initial period of the stimulus. In the long run, GDP growth will continue to outpace the baseline gradually and increase up to 3% by 2050, due mainly to the improvements in productivity resulting from better education and training. The employment effect continues to be positive throughout the period until 2050 although the size of the effect is marginal. The impact on inflation is limited, from the beginning of the shock, the inflation rate is 0.6 percentage points higher than the level of the baseline scenario but the effect is gradually disappearing.

Figure 15: The impact of investment in education on GDP and employment (% different from baseline) - Scenario 2.2.1

[13] VNR, 2023

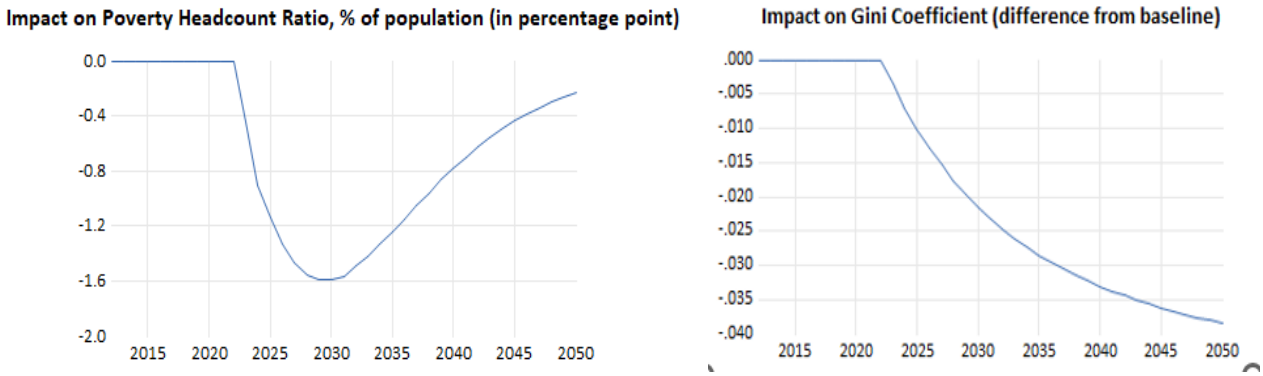
[14] https://vaefa.edu.vn/images/2023/23.08.03_VIETNAM_spotlight_2023--04_rev.pdf



Source: ESCAP Macroeconomic Model

The positive impact of investment in education can be seen quite clearly with a reduction in poverty compared to the baseline scenario. From the first year of the investment, poverty will decrease subsequently to the highest rate of 1.6 percentage points by around 2030, compared to the baseline. Poverty reduction is attributable mainly to the fact that the extra education investment helps the population to gain higher skills and know-how and improve productivity, resulting in higher income and living standards. This positive effect, however, will gradually moderate after 2030. As the poverty rate declines, there is a corresponding improvement in income inequality. The GINI coefficient in this case is 0.035-0.04 lower than the baseline scenario to 2050 and has a lasting impact. Income increases and household spending also tend to increase compared to the baseline scenario in the long term.

Figure 16: The impact of investment in education on Poverty Headcount ratio (in percentage points different from baseline) – Scenario 2.2.1



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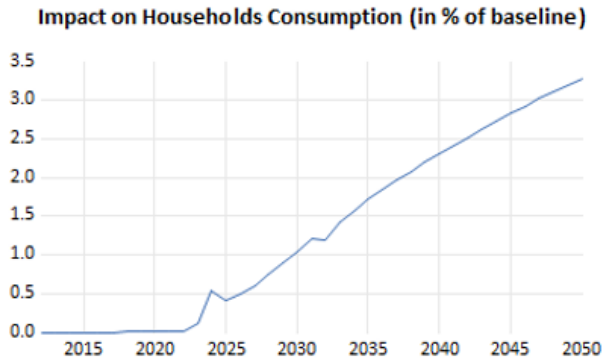
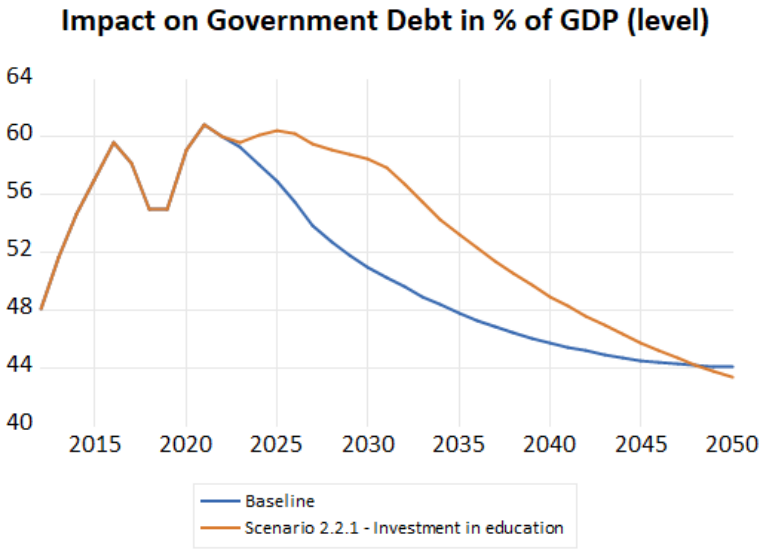


Source: ESCAP Macroeconomic Model

However, additional government spending on education, without a reduction in other areas, would lead to a fiscal deficit that needs to be financed by government borrowing. Given the additional education investment, the government debt as a share of GDP will increase higher up to the peak level of about 7 percentage points around 2030 compared to the baseline scenario. In the long run, the productivity improvements will contribute to higher GDP growth, which is expected to offset the impact of higher government spending, thereby pushing the government debt to the same level in the baseline scenario.

Figure 17: The impact of investment on debt to GDP ratio (%) – Scenario 2.2.1

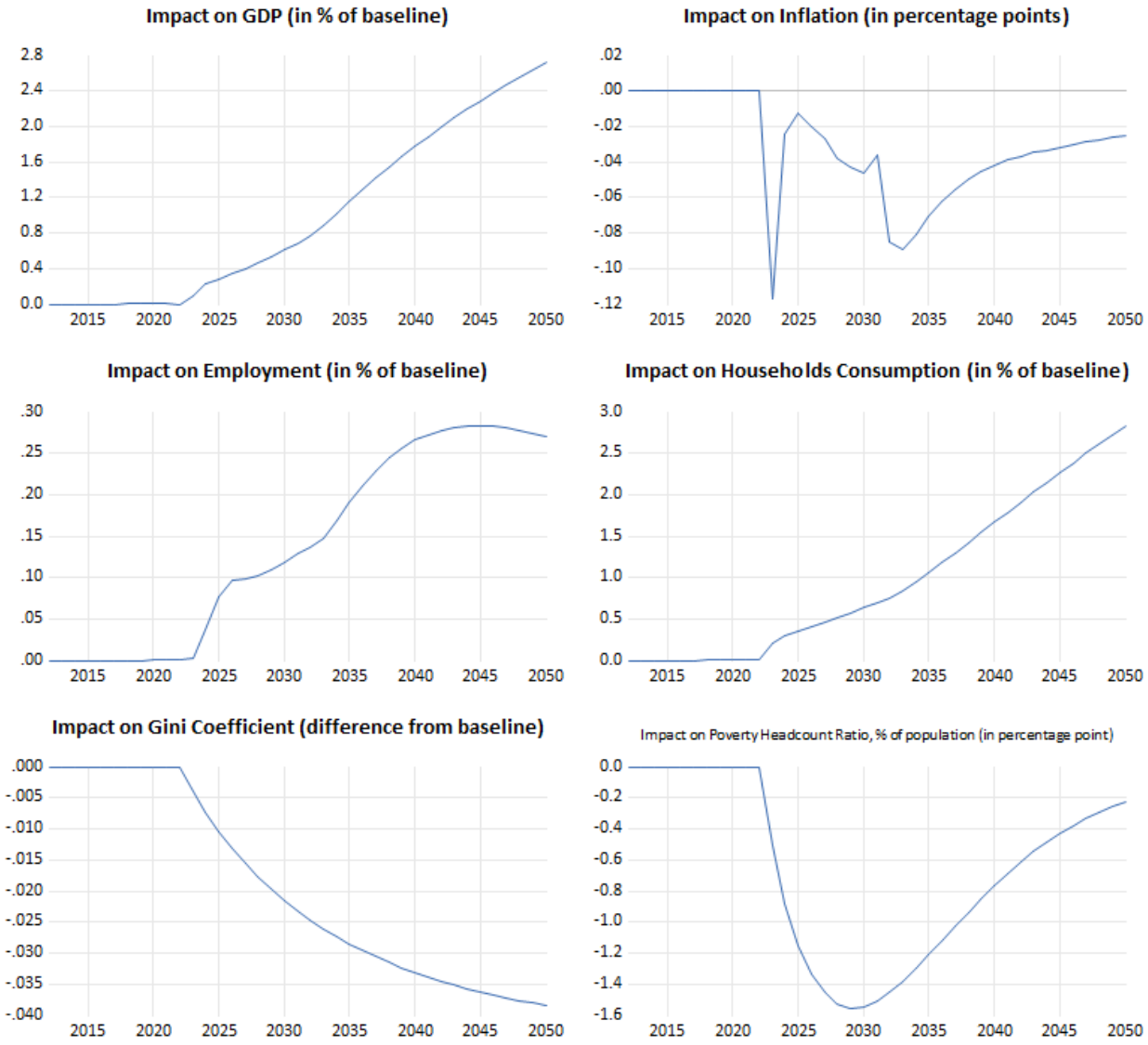


Source: ESCAP Macroeconomic Model

For Scenario 2.2.2, there is no increase in total budget expenditures. The additional education investment comes from the reallocation of the budget from other investment areas. In other words, the increase in education investment comes from a cut to the budget for other investments. The increased investment in education in this case still creates a positive impact on economic growth and employment, but the level of impact is lower than Scenario 2.2.1 because there is no fiscal stimulus to the economy and the investment in other sectors is reduced. The impact on GDP growth is a long-term impact. By 2030, GDP will increase by 0.6% compared to the baseline scenario, but by 2050, the impact will reach 2.6%. Economic growth and new job creation have a positive impact on employment, the number of employed workers will increase by about

0.12% compared to the baseline scenario in 2030 and continue to increase until 2045 at a rate increased by about 0.27%. Not increasing investment compared to the baseline scenario causes inflation to not be pushed up, economic growth takes place in a context where prices are controlled lower than in the baseline scenario. Social impacts such as income inequality and poverty rate all have positive improvements similar to scenario 2.2.1.

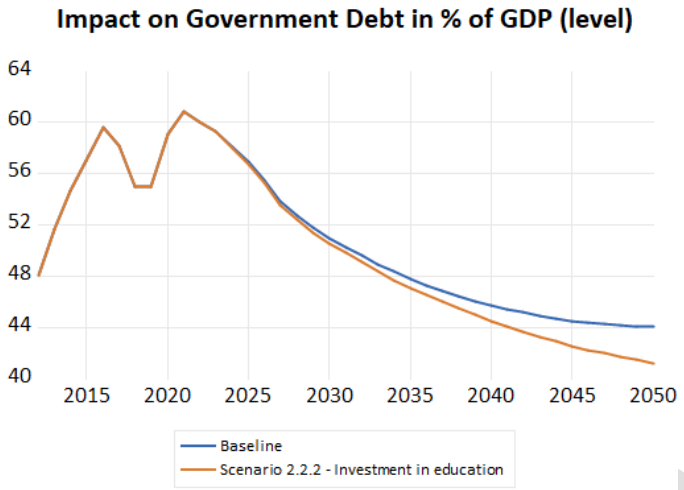
Figure 18: The impact of investment on Education by reallocation (% different from baseline) – Scenario 2.2.2



Source: ESCAP Macroeconomic Model

The notable point here is that because there is no increase in the total budget, inflationary pressure is absent. There is still a positive effect on poverty reduction because of the improvement in skills and productivity, which translates into higher income and higher GDP growth, the poverty headcount ratio is around 1.5 percentage points lower than the baseline scenario. In the long run, the productivity improvements will result in higher GDP, which causes the public debt as a share of GDP to decline compared to the baseline scenario.

Figure 19: The impact of investment on debt to GDP ratio (%) – Scenario 2.2.2



Source: ESCAP Macroeconomic Model

Therefore, the simulations indicate that investment in the education sector is beneficial for sustaining economic growth and reducing poverty in the long term. Particularly, the simulation shows that, without driving debt pressure, education investment still can help the country to achieve the goals of economic growth and poverty reduction.

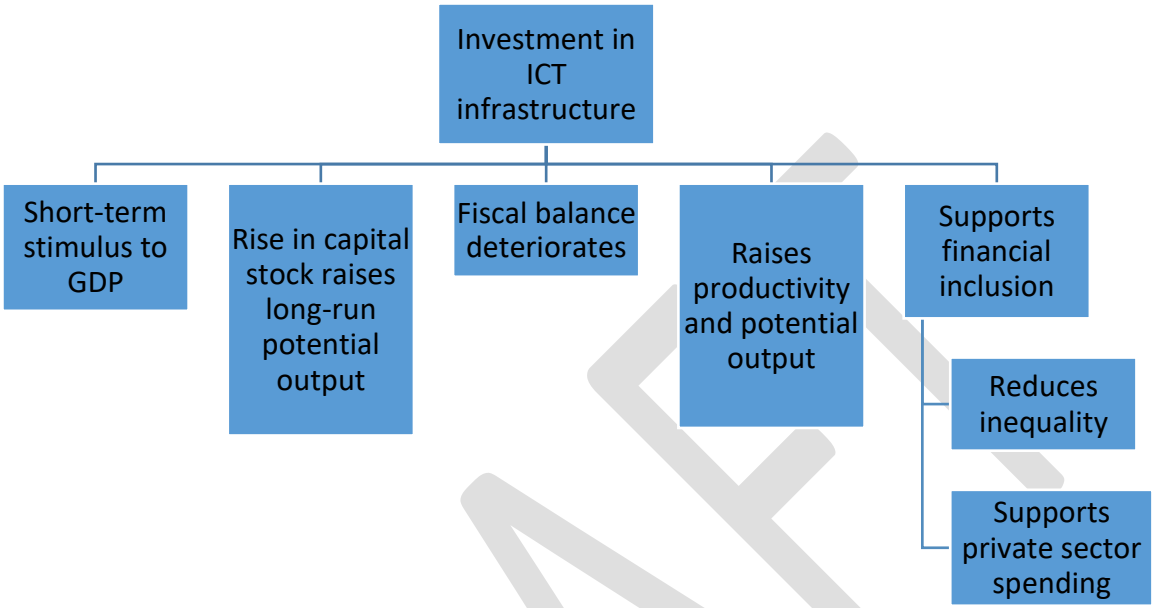
c. Scenario 3: Toward innovation-based growth

Innovating the growth model and restructuring the economy is a major policy and has been mentioned since the 11th National Congress of the Communist Party of Vietnam. In the country's development orientation for the period 2021-2030, the Resolution of the 13th National Congress affirmed "continuing to strongly innovate the growth model and the basis for restructuring the economy" with the important strategy of “Strongly shift the economy to a growth model based on increased productivity, scientific and technological progress, and innovation”. Implementing the orientation, the Government issued Resolution No. 54/NQ-CP promulgating the Government's Action Program to implement the National Assembly's Resolution on Economic Restructuring Plan for the period 2021 – 2025; Decision No. 36/QD-TTg of the Prime Minister on Promulgating the General Plan to improve productivity based on science, technology, and innovation for the period 2021 – 2030, as well as many other legal documents.

One of these policy actions is the Information and Communications Infrastructure Plan (ICIP) for the period 2021-2030, with a vision for 2050. The ICIP aims to develop infrastructure for national digital transformation, opening up new development space for the economy and society, linking development in the digital space with the traditional physical development space, and creating a favorable environment for innovation to improve national competitiveness. By 2030, the ICIP’s target is to complete the basic telecommunications infrastructure, moving to infrastructure with large capacity, high speed and reliability, ultra-low latency, guaranteed mobility, network information security, and services number of the fourth industrial revolution, contributing to the successful implementation of national digital transformation and maintaining national sovereignty in cyberspace. The ICIP is still being developed. It has not yet been officially approved and issued. Given the far-reaching potential of this plan to promote Viet Nam’s innovation-based economy, it is vitally important to assess ex-ante the plan’s effects on social, economic, and

environmental outcomes through the application of the ESCAP macroeconomic model. It is estimated that the investment needed for this plan will be 266 trillion VND for the entire 2021-2030 period, of which capital from the state budget is 11.8 trillion VND and capital from other sources is 254.9 trillion VND.

Figure 20: Transition channel from investment in ICT infrastructure



Source: ESCAP Macroeconomic Model

Increasing investment in ICT infrastructure will first of all provide a boost to economic growth. Additional new investments create more demand for production goods and services in the economy and increase capital accumulation and productivity in the long term, thereby boosting potential growth. ICT infrastructure investment may also enhance financial inclusion (e.g., financial technology) that can help people and businesses, especially those in rural and remote areas to access finance and other financial services. This would lead to higher private sector spending and lift economic activities and living conditions, especially those in rural areas; thereby contributing to reducing inequality. However, the investments will put pressure on the fiscal balance if they are largely financed by the government.

Simulation results show that increasing investment in ICT could create a positive effect on growth stemming from the additional investment. The initial investment phase has not created a significant impact, but from 2025 onwards, the impact becomes more obvious and tends to increase, possibly reaching over 0.7% higher than the baseline by 2040. However, given that the size of this investment package is relatively moderate (approximately 2% of GDP) when compared to other scenarios, the impact is correspondingly smaller. There are more jobs because new investment is implemented. However, due to the small size of the shock, the effect of this scenario on inflation is negligible. The impact on employment is relatively low, peaking in 2031 with an impact of about 0.11% compared to the baseline scenario, but the impact gradually disappears. However, the impact on household consumption is relatively positive, possibly causing household

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consumption to increase by over 2% compared to the base scenario and the positive impact takes place in the long term.

Figure 21: Impact of investment in ICT infrastructure (% different from baseline)



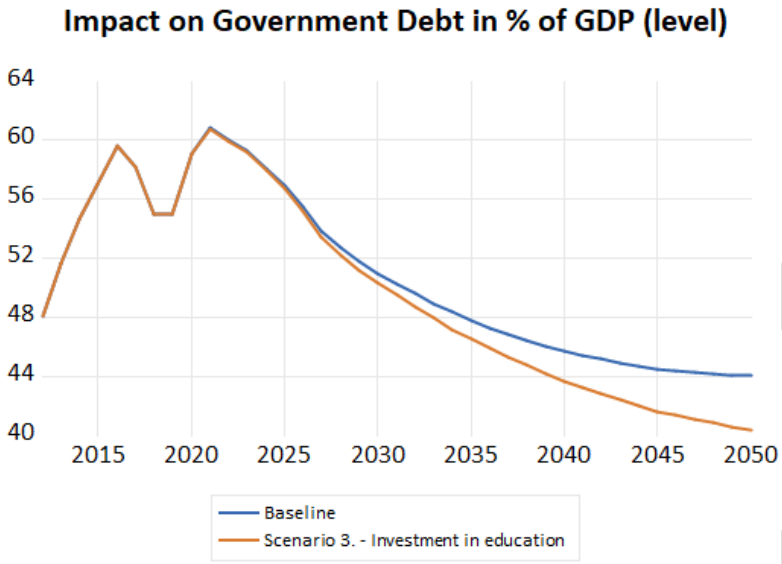
Source: ESCAP Macroeconomic Model

The enhancement of ICT infrastructure will yield beneficial effects on social variables, including inequality and poverty reduction. As the investment is expected to promote financial inclusion, the GINI coefficient tends to decrease in the period 2021-2030 and stabilize at a low level compared to the baseline scenario after 2030. The poverty rate compared to the baseline scenario tends to be 0.14 percentage points lower by 2031, but the impact then gradually decreases as the investment effect dies out.

As the size of the investment is relatively small and the private sector contributes significantly (96%) to the financing, there is an insignificant effect on the government fiscal balance. In the first few years, the government debt as a share of GDP will increase slightly by less than one percentage point. However, in the long run, public debt as a percentage of GDP decreases

gradually thanks to the higher GDP. In this scenario, debt-to-GDP is expected to decrease from the baseline of around 60% of GDP in 2020 to 40% of GDP by 2050.

Figure 22~~23~~: Impact on debt–to–GDP ratio (%)



Source: ESCAP Macroeconomic Model

4. Concluding remarks

With the application of the ESCAP Macroeconomic Model for Viet Nam, this study assesses the potential economic, social, and environmental impacts of the selected policies that might help Viet Nam in poverty reduction and achieving green and innovative growth, The interactions among, economic activity, social development, and environmental protection are explored to illustrate trade-offs of various policy initiatives and provide government officials a holistical view of policy implications.

A targeted investment package in the coming years in green growth, poverty reduction, and innovation-based growth could encourage a relatively rapid decline in CO2 emissions and pollution as well as a positive impact on economic development. The investment packages and policies might have short-term costs such as inflation and fiscal pressures, but it has a huge impact on long-term growth and a decline in CO2 emissions and air pollution.

Investing in renewable energy yields highly positive outcomes for environmental protection in the long run. However, short-term positive environmental effects may be constrained by the additional energy demand resulting from the initial investment and the prolonged nature of increasing production capacity. On the other hand, regulatory or tax changes, like the introduction of a relatively high carbon tax rate, could prompt a swift transition in energy sources and a reduction in demand in the short run. Therefore, it is advisable for authorities to contemplate implementing comprehensive policy packages. For instance, an elevation in the carbon tax can generate supplementary revenue that can be directed towards advantageous investments in renewable energy.

Investing in social protection, healthcare, education, and green infrastructure enhances a country's fundamentals and living conditions. Nevertheless, if financial support is lacking from the

private sector, an excessively aggressive investment (as evident in Scenario 2.1.2 a-d) may result in substantial fiscal imbalances. It is also crucial to see that additional investments should strategically target sectors with long-term effects, particularly in education, to sustain positive outcomes.

investing in ICT infrastructure will create positive impacts on long-term economic growth. It enhances productivity and fosters social inclusion through its positive impact on financial inclusion, also fosters social inclusion. However, due to the relatively small size of the planned investment package presented in the paper, its macroeconomic effect is limited.

The macroeconomic simulation results provide quantitative evidence that investing in inclusive and sustainable development would bring about significant positive economic outcomes as well. As a result of stronger domestic demand and higher total factor productivity, the potential output levels are higher than the baseline.

But how the additional investment is funded matters. It is clear that, while all selected policy options can notably improve economic, social, and environmental outcomes in Asia and the Pacific, these policies also incur various degrees of fiscal cost. Navigating a balance between prudent public debt management and realizing long-term development goals is essential.

To meet large fiscal needs and avoid public debt distress, the Vietnamese government needs to step up its efforts in exploring untapped public financial resources and mobilizing private capital. For instance, the Government could explore public bond financing, including offshore bonds and diaspora bonds, to supplement traditional fiscal borrowings. To finance Viet Nam's commitment of achieving carbon neutral by 2050, the Vietnamese government and the International Partners Group (IPG) launched a Just Energy Transition Partnership (JETP), which is another new financing mechanism that helps fund Viet Nam's energy transition towards renewables.

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Summary Table of the Scenarios

Scenario	Sub-scenario		Scenario setup					Difference from the baseline (%, if not indicated otherwise)							Interpretation of the results
			Size of the investment package (% of 2020 GDP)	Investment time frame	% of investment from budget	Reallocation of gov. spending	Extra spending in which sectors:	Real GDP Change in 2030 (%)	% of GDP Public Debt Change in 2030 (%)	Poverty reduction in 2030 (%)	CO_2 Reduction in 2030 (%)	CO_2 Reduction in 2050 (%)	Renewable energy share in 2030	Renewable energy share in 2050	
1. Toward a greener economy	1.1.1.	Renewable energy inv. from budget	220%	2021-2050	100%	no	Renewable energy (100%)	2.28	43.8	-3.5	-1.7	-53.5	19.8	57.3	The climate effect is significant, marked by a reduction in pollution and CO2 emissions. Also, there is an accelerated increase in renewable energy, which outweighs the growth in energy consumption in the long run. The growth effect is positive and is driven by the substantial investment shock and supports poverty reduction. Negligible on social impact. Highest pressure on public debt because the investment package is relatively substantial.
	1.1.2.	Renewable energy inv. partly from budget	220%	2021-2050	70%	no	Renewable energy (100%)	2.43	28.8	-3.1	-1.6	-53.5	19.8	57.3	The same size of impact on the environment with the scenario above. Because the investment is partially financed by the private sector, there is less pressure on fiscal and more stimulus to the economy.
	1.2.	Introduction of carbon tax	-	2021-2050	-	yes, from carbon tax revenue	Debt reduction (100%)	-0.73	-24.2	2.2	-9.9	-21.6	19.0	25.4	No new investment. With the rise in production costs, GDP is expected to experience a slight decline, although the impact remains moderate. If the government does not utilize the extra revenue to boost social, health, or education spending, the impact of the carbon tax on social indicators remains negligible. Over the long term, the high carbon tax would continue to lead to a decline in CO2 emissions and pollution but smaller effects than Scenario 1.1. However, there is significant fiscal space.
2: Poverty and inequality reduction and social protection	2.1.1.	Implementation of NTP	39%	2021-2025	15%	no	Infr. (10.6%), Health (0.3%), Social (87.3%), Education (1.8%)	0.93	-1.0	-8.2	-7.0	-7.0	17.1	17.1	There is a significant poverty reduction. The impact on economic growth is positive, driven by the additional investments in various sectors and the creation of more fiscal space. The effect on the climate is moderate, but somewhat larger than in Scenario 1 in 2030, due to our assumption that infrastructure investments will enhance energy efficiency, leading to an expected decline in CO2 emissions even in the short term.

Scenario	Sub-scenario		Scenario setup					Difference from the baseline (%, if not indicated otherwise)							Interpretation of the results
			Size of the investment package (% of 2020 GDP)	Investment time frame	% of investment from budget	Reallocation of gov. spending	Extra spending in which sectors:	Real GDP Change in 2030 (%)	% of GDP Public Debt Change in 2030 (%)	Poverty reduction in 2030 (%)	CO_2 Reduction in 2030 (%)	CO_2 Reduction in 2050 (%)	Renewable energy share in 2030	Renewable energy share in 2050	
	2.1.2.a	***Implementation of NTP - spending on infrastructure***	*39%*	2021-2025	*100%*	no	Infrastructure (100%)	*5.20*	*30.5*	*-11.3*	*-51.4*	*-50.5*	*17.2*	*16.9*	By investing in green infrastructure that enhances energy efficiency, climate indicators such as CO2 emissions and pollution will see significant improvement. This type of investment will also lead to a long-term boost in productivity. However, this could lead to a high pressure on fiscal.
	2.1.2.b	***Implementation of NTP - spending in healthcare***	*39%*	2021-2025	*100%*	no	Healthcare (100%)	*2.09*	*36.1*	*-5.7*	*1.6*	*2.9*	*16.9*	*17.1*	Investment in healthcare has a primary impact on productivity since it enhances the labor productivity of the workforce. However, extra investment leads to high fiscal pressure because the positive impact of this investment type on the real economy is limited to offset the additional public spending. Negligible effects on environmental variables.
	2.1.2.c	***Implementation of NTP - spending in the social sector***	*39%*	2021-2025	*100%*	no	Social (100%)	*0.26*	*31.1*	*-5.2*	*0.3*	*0.0*	*17.1*	*17.1*	Given significant spending in the social sector, targeting vulnerable groups, rural populations, and people in poverty, household consumption increases, and poverty decreases in the short term. However, if the investment is limited to a 5-year timeframe, the effects are only temporary. To systematically improve social conditions, it is preferable to invest in sectors with long-term effects, such as education or health
	2.1.2.d	***Implementation of NTP - spending on education***	*39%*	2021-2025	*100%*	no	Education (100%)	*6.83*	*29.8*	*-81.6*	*5.8*	*9.7*	*16.9*	*17.1*	Investment in education makes a positive contribution to social indicators, such as reducing poverty. Additionally, it improves productivity and results in a substantial increase in potential output in the long run
	2.2.1.	***Education inv. from budget***	*20%*	2023-2030	*100%*	no	Education (100%)	*1.37*	*14.6*	*-30.9*	*1.2*	*2.7*	*17.0*	*17.1*	Increased investment in education will have a positive short-term effect on both GDP and employment due to the additional government stimulus. The positive effects of educational investment gradually manifest. Additional government spending, without reductions in other areas of investment, would lead to an increase in the fiscal deficit, resulting in a higher debt-to-GDP ratio in the coming years. Education spending does not yield a positive impact on climate indicators.

Scenario	Sub-scenario		Scenario setup					Difference from the baseline (%, if not indicated otherwise)							Interpretation of the results
			Size of the investment package (% of 2020 GDP)	Investment time frame	% of investment from budget	Reallocation of gov. spending	Extra spending in which sectors:	Real GDP Change in 2030 (%)	% of GDP Public Debt Change in 2030 (%)	Poverty reduction in 2030 (%)	CO_2 Reduction in 2030 (%)	CO_2 Reduction in 2050 (%)	Renewable energy share in 2030	Renewable energy share in 2050	
															Extra government spending pushes up CO2 emissions.
	2.2.2.	***Education inv. from reallocation***	*20%*	2023-2030	*100%*	yes, from other gov. Investment	Education (100%)	*0.61*	*-0.8*	*-30.1*	*0.5*	*2.4*	*17.0*	*17.1*	Additional government spending in education with reductions in other areas of investment would lead to a very similar fiscal balance and public debt path in the coming years than in the baseline scenario. However, as education spending is financed by reallocation, other investment of the government budget in the meantime declines. Growth will continue to outpace the baseline in the long run, primarily due to the expected productivity improvements resulting from education spending. Poverty will continue to decline in the long term, although the positive impact moderates over time
3: Toward innovation-based growth	***3***		*4%*	2021-2030	*5%*	no	Infrastructure (100%)	*0.57*	*-1.3*	*-2.5*	*0.5*	*0.8*	*17.0*	*17.1*	There is a positive effect on growth stemming from the additional investment. However, given that the size of this investment package is relatively moderate when compared to other scenarios, the impact is correspondingly smaller. As the size of the investment is relatively small and mostly financed by the private sector (95%), this scenario's influence on fiscal balance and debt in the coming years is a small positive.

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6. Appendix: Technical description of the ESCAP Macroeconomic Model

The ESCAP Macroeconomic Model is a global model and comprises 46 individual full-country models for the Asia-Pacific region, including a model of Viet Nam, smaller models of 9 key trading partners outside of the region, plus aggregate models for the remaining world's economies grouped into 4 regions. The individual country models are linked via trade, remittances, financial markets, and global energy markets. A full description of the model equations follows.

The country models are characterized by a short-run Keynesian demand side and a long-run neo-classical supply side. In the model, households consume, save and supply labor, while firms produce output, hire labor and invest. Governments pursue fiscal policy by spending and taxing, while monetary authorities conduct monetary policy by setting the short-term interest rate and exchange rate policy. The balance of demand and supply, together with tax policy, global commodity prices and other imported prices, determine inflation. Higher prices constrain consumption and dampen the net trade balance. Most of the key behavioural relationships are specified in an error-correction framework, which allows us to distinguish short- and long-term relationships between variables.

In the short run, GDP is driven by aggregate demand, which comprises private and public consumption, private and public investment and net foreign trade. Household consumption depends on real personal disposable income, financial inclusion (proxied by the share of population with a bank account) and the gap between actual and expected inflation rates. Private investment is determined by potential output, user cost of capital, financial inclusion and gross domestic income (which captures terms-of-trade shocks). Financial inclusion depends on government investment in connectivity.

Public consumption and investment and policy variables, and are disaggregated into spending on health, environmental protection and other areas. Exports depend on external demand and relative non-commodity export prices, both of which are derived from a global bilateral trade matrix. Finally, imports depend on domestic demand, the output gap, the relative price of imported goods and oil imports.

In the long term, each country's potential output level is driven by its aggregate supply, which is determined by the labor force, capital stock, energy use, energy efficiency, trend productivity growth and damage from climate shocks. The labor force depends on demographic factors and the labor force participation rate. The capital stock is driven by the accumulation of investment, after allowing for depreciation. The capital depreciation rate depends on global carbon emissions to capture the impact of climate change on the erosion of capital. Total energy demand depends on output, energy prices and energy efficiency. The energy mix depends on relative prices of oil, gas, coal and renewables. Trend productivity growth is modelled as a function of the global productivity frontier (which is related to global trade), inequality, air pollution and government expenditure on health, education and connectivity. Finally, damage from climate shocks depends on government expenditure on environmental protection.

Deviations of actual output from potential output will activate adjustment processes that bring the economy back to potential in the long run. Among other channels, the gap between demand and supply, or output gap, feeds through prices. For example, a positive output gap will put upward pressure on prices, resulting in slower consumption growth and a deterioration of the trade balance, so that demand falls towards available supply.

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In the fiscal module, government spending is disaggregated into spending on social protection, spending on health, spending on environmental protection, fossil fuel subsidies, other government consumption, other government investment and interest payments. Spending on education is modelled through a rise in spending on other government consumption and other government investment. Government revenue is disaggregated into income tax revenue, corporate tax revenue, indirect tax revenue, taxes on international transactions, carbon tax revenue, commodity revenue and other net revenue. The fiscal deficit is financed by an increase in government debt, and debt service payments flow back onto the fiscal balance. In the model, an increase in the government debt-to-GDP ratio leads to a higher risk premium for that country. In this way, running a large fiscal deficit for an extended period of time can cause government debt to spiral and become unsustainable. The risk premium is also sensitive to above target inflation. Countries with a higher initial level of risk premium are more sensitive to any rise in public debt. A rise in the risk premium pushes up inflation and increases borrowing costs, which results in lower investment.

In addition to economic relationships, the model has additional channels to capture interactions with key social and environmental variables, such as poverty, income inequality, GHG emissions and air quality. Relationships between variables are econometrically estimated where appropriate or guided by the academic literature. For example, losses associated with climate shocks are underpinned by benchmarks contained in World Bank (2019), in which an investment in resilience valued at 1 percent of GDP reduces annual damage by 5 percent. Other major studies that are used for developing relationships among the variables include Botev, Egert and Jawadi (2019), Briceño-Garmendia, Estache and Shafik (2004), ECB (2017), Griscom and others (2017), IEA (2019, 2020), OECD (2019) and Wang (2015).

The poverty model assumes that income follows approximately a log-normal distribution. The cumulative density function of log income is calculated based on estimates of mean income and income inequality and evaluated at the poverty benchmarks of $1.90/day and $5.50/day. Income inequality is measured according to the after-tax Gini coefficient. It declines in response to a rise in government spending on social protection and education, or a rise in financial inclusion.

Carbon emissions depend on the composition of energy consumption, which in turn depends on the relative (after carbon tax) price of coal, gas, oil and renewables. Air pollution (PM2.5) also depends on the composition of energy consumption, especially the consumption of coal and oil. Emissions and air pollution also both depend on the number of tourists. Air pollution feeds into trend productivity growth to reflect the relationship between pollution, health and productivity.

a. ESCAP Macroeconomic Model equation listing

Consumer Price Index, Period Average, 2015 = 100 (HIC)

$$\Delta\, ln\, ln\,(HIC\quad_t) = \beta_1 \Delta\, ln\, ln\,(HIC_{t-1}) + \beta_2 \Delta\, ln\, ln\,(MTD_t) + (1-\beta_1-\beta_2)\left(\frac{INFT_t}{100}\right) + \beta_3\left(\frac{YER_t}{YFT_t} - \frac{YER_{t-1}}{YFT_{t-1}}\right) + \Delta\, ln\, ln\,(1+ITAXR_t) + 0.5 * \Delta\, ln\, ln\left(1+\frac{GCARB_t}{0.6 * YEN_{t-1}}\right) + \beta_4 \frac{PREM_t - PREM_{t-1}}{100}$$

MTD	Deflator for Imports of Goods and Services, National currency, 2015 = 100
INFT	Inflation target (not necessarily explicit)
YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency
YFT	Trend output, Constant 2015 prices, Billions National Currency
ITAXR	Tax rate on goods and services
GCARB	General government net (after subsidies) carbon tax revenue, Billions National Currency
YEN	Gross Domestic Product (GDP), Current prices, Billions National Currency
PREM	Country-specific risk premium, basis points.

Deflator for GDP, National Currency, 2015 =100 (YED)

$$YED_t = YED_{t-1} * \frac{HIC_t}{HIC_{t-1}}$$

HIC	Consumer Price Index, Period Average, 2015 = 100

Monetary Policy-Related Interest Rate, Percent per annum (INT)

$$INT_t \equiv INT_{t-1} + [INT_t^{USA} - INT_{t-1}^{USA}]$$

INT^{USA}	Monetary Policy-Related Interest Rate, Percent per annum, USA

Long-term bond yield, per cent (LTI)

$$LTI_t \equiv LTI_{t-1} + \beta_1 * (INT_t - INT_{t-1}) + \frac{PREM_t - PREM_{t-1}}{100}$$

INT	Monetary Policy-Related Interest Rate, Percent per annum
PREM	Country-specific risk premium, basis points.

Country-specific risk premium, basis points. (PREM)

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$$PREM_t = PREM_{t-1} * \left(1 + \beta_1 * \frac{GDNRATIO_{t-1} - GDNRATIO_{t-2}}{100}\right)$$

GDNRATIO	Gross government debt, % of GDP

Employment, 1000s (LNN)

$$\Delta\, ln\, ln\, (LNN_t) = \beta_1 \Delta\, ln\, ln\, (LFN_t) - \beta_2 * (ln\, ln\, (LNN_{t-1}) - ln\, ln\, (LFN_{t-1})) + \beta_3 * \Delta\, ln\, ln\, (YER_{t-1}) + \beta_4 * \Delta\, ln\, ln\, (ARRIVALS_t)$$

LFN	Labour Force, 1000s
YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency
ARRIVALS	Inbound tourist arrivals, 1000s

Female employment, 1000s (LNNF)

$$\Delta\, ln\, ln\, (LNNF_t) = \Delta ln\, (LNN_t)$$

LNN	Employment, 1000s

Income tax rate (TAXR)

$$TAXR_t = TAXR_{t-1} + \beta_1 * \frac{GLNT_{t-1} - GLNRATIO_{t-1}}{100} * \frac{YEN_{t-1}}{RPDI_{t-1} * HIC_{t-1}} * SOLV_t$$

GLNT	General government fiscal balance target, % GDP
GLNRATIO	General government net lending (fiscal balance), % GDP
YEN	Gross Domestic Product (GDP), Current prices, Billions National Currency
RPDI	Real personal disposable income, Constant 2015 prices, Billions National Currency
HIC	Consumer Price Index, Period Average, 2015 = 100
SOLV	Solvency rule switch

Corporate tax rate (CTAXR)

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$$CTAXR_t = CTAXR_{t-1} + \beta_1 * \frac{GLNT_{t-1} - GLNRATIO_{t-1}}{100} * \frac{YEN_{t-1}}{PROF_{t-1}} * SOLV_t$$

GLNT	General government fiscal balance target, % GDP
GLNRATIO	General government net lending (fiscal balance), % GDP
YEN	Gross Domestic Product (GDP), Current prices, Billions National Currency
PROF	Profits, Billions National Currency
SOLV	Solvency rule switch

Other general government consumption expenditure, Billions National Currency (OGC)

$$OGC_t = OGC_{t-1} * \left(\frac{YFT_t}{YFT_{t-1}} * \frac{YED_t}{YED_{t-1}}\right)$$

YFT	Trend output, Constant 2015 prices, Billions National Currency
YED	Deflator for GDP, National Currency, 2015 =100

User cost of capital, per cent (USER)

$$USER_t = \frac{LTI_t - INFT_t + DEP_t * 100}{1 - CTAXR_t} + \beta_1 * \left(\frac{GCARB_t}{YEN_{t-1}}\right) * 100$$

LTI	Long-term bond yield, per cent
INFT	Inflation target (not necessarily explicit)
DEP	Depreciation rate of capital stock
CTAXR	Corporate tax rate
GCARB	General government net (after subsidies) carbon tax revenue, Billions National Currency
YEN	Gross Domestic Product (GDP), Current prices, Billions National Currency

Exports of goods and services, Current prices, Billions National Currency (XTN)

$$XTN_t \equiv XTD\$_t * \frac{EXR_t}{EXR_{2015}} * XTR_t$$

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XTD$	Deflator for Export of Good & Services, US$, 2015 =100
EXR	Exchange rate (national currency / US$)
XTR	Exports of goods and services, Constant 2015 prices, Billions National Currency

Gross Domestic Product (GDP), Current prices, Billions National Currency (YEN)

$$YEN_t \equiv YER_t * YED_t$$

YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency
YED	Deflator for GDP, National Currency, 2015 =100

Imports of goods and services, Current prices, Billions National Currency (MTN)

$$MTN_t \equiv MTD_t * MTR_t$$

MTD	Deflator for Imports of Goods and Services, National currency, 2015 = 100
MTR	Imports of goods and services, Constant 2015 prices, Billions National Currency

Exports of goods and services, Current prices, Billions US$ (XTN$)

$$XTN\$_t \equiv \frac{XTN_t}{EXR_t}$$

XTN	Exports of goods and services, Current prices, Billions National Currency
EXR	Exchange rate (national currency / US$)

Tourist arrivals (ARRIVALS)

$$ARRIVALS_t = ARRIVALS_{t-1} * 1.01$$

Gross Domestic Product (GDP), Current prices, US$ billion (YEN$)

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$$YEN\$_t \equiv \frac{YEN_t}{EXR_t}$$

YEN Gross Domestic Product (GDP), Current prices, Billions National Currency

EXR Exchange rate (national currency / US$)

Imports of goods and services, Current prices, US$ (MTN$)

$$MTN\$_t \equiv \frac{MTN_t}{EXR_t}$$

MTN Imports of goods and services, Current prices, Billions National Currency

EXR Exchange rate (national currency / US$)

Imports of goods and services, Constant 2015 prices, US$ billion (MTR$)

$$MTR\$_t \equiv MTR\$_{t-1} * \frac{MTR_t}{MTR_{t-1}}$$

MTR Imports of goods and services, Constant 2015 prices, Billions National Currency

Exports of goods and services, Constant 2015 prices, Billions US$ (XTR$)

$$XTR\$_t \equiv XTR\$_{t-1} * \frac{XTR_t}{XTR_{t-1}}$$

XTR Exports of goods and services, Constant 2015 prices, Billions National Currency

Gross Domestic Product (GDP), Constant 2015 prices, US$ billion (YER$)

$$YER\$_t \equiv YER\$_{t-1} * \frac{YER_t}{YER_{t-1}}$$

YER Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency

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Trend output, Constant 2015 prices, Billions US$ (YFT$)

$$YFT\$_t \equiv YFT\$_{t-1} * \frac{YFT_t}{YFT_{t-1}}$$

YFT	Trend output, Constant 2015 prices, Billions National Currency

Total population, 1000s (POPT)

$$POPT_t = POPT_{t-1} - LIVES_t$$

LIVES	Lives lost from climate shocks

Population aged 15-64, 1000s (POPWA)

$$POPWA_t = POPWA_{t-1} * \frac{POPT_t}{POPT_{t-1}}$$

POPT	Total population, 1000s

Accumulation of inventories, Constant 2015 prices, Billions National Currency (SCR)

$$SCR_t = SCR_{t-1} + |SCR_{t-1}| * \left(\frac{YFT_{t-1}}{YER_{t-1}} - \frac{YFT_{t-2}}{YER_{t-2}}\right)$$

YFT	Trend output, Constant 2015 prices, Billions National Currency
YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency

Gross fixed capital formation (including Acquisitions less disposals of valuables), Constant 2015 prices, Billions National Currency (ITR)

$$ITR_t \equiv IGR_t + IPR_t$$

IGR	Public gross fixed capital formation, Constant 2015 prices, Billions National Currency

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IPR — Private gross fixed capital formation, Constant 2015 prices, Billions National Currency

Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency (YER)

$$YER_t \equiv PCR_t + GCR_t + ITR_t + SCR_t + XTR_t - MTR_t$$

PCR — Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency

GCR — General government final consumption expenditure, Constant 2015 prices, Billions National Currency

ITR — Gross fixed capital formation (including Acquisitions less disposals of valuables),Constant 2015 prices, Billions National Currency

SCR — Accumulation of inventories, Constant 2015 prices, Billions National Currency

XTR — Exports of goods and services, Constant 2015 prices, Billions National Currency

MTR — Imports of goods and services, Constant 2015 prices, Billions National Currency

Profits, Billions National Currency (PROF)

$$PROF_t \equiv (YEN_t - ITAX_t) * (1 - LABSH_t)$$

YEN — Gross Domestic Product (GDP), Current prices, Billions National Currency

ITAX — General government taxes on goods and services, Billions National Currency

LABSH — Share of labour compensation in GDP at current national prices

Gross domestic income (terms of trade adjusted), Constant 2015 prices, Billions National Currency (GDI)

$$GDI_t \equiv YER_t - XTR_t + MTR_t + \frac{XTN_t}{\frac{YEN_t - XTN_t + MTN_t}{YER_t - XTR_t + MTR_t}} - \frac{MTN_t}{\frac{YEN_t - XTN_t + MTN_t}{YER_t - XTR_t + MTR_t}}$$

YER — Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency

XTR — Exports of goods and services, Constant 2015 prices, Billions National Currency

MTR — Imports of goods and services, Constant 2015 prices, Billions National Currency

YEN — Gross Domestic Product (GDP), Current prices, Billions National Currency

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XTN	Exports of goods and services, Current prices, Billions National Currency
MTN	Imports of goods and services, Current prices, Billions National Currency

Real personal disposable income, Constant 2015 prices, Billions National Currency (RPDI)

$$RPDI_t \equiv LABSH_t * \beta_1 * (YER_{t-1} + GDI_{t-1}) * \frac{YED_{t-1}}{HIC_{t-1}} * \left(\frac{LNN_t}{LNN_{t-1}} + TECHL_t - TECHL_{t-1}\right) + \frac{REMIT_t}{HIC_t} + \frac{EXPSP_t}{HIC_t} - \frac{TAX_t}{HIC_t}$$

LABSH	Share of labour compensation in GDP at current national prices
YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency
GDI	Gross domestic income (terms of trade adjusted), Constant 2015 prices, Billions National Currency
YED	Deflator for GDP, National Currency, 2015 =100
HIC	Consumer Price Index, Period Average, 2015 = 100
LNN	Employment, 1000s
TECHL	Labour augmenting technical progress trend, indexed to GDP per employee in 2015
REMIT	Inflow of personal remittances, Billions National Currency
EXPSP	General government expense on social benefits, Billions National Currency
TAX	General government taxes on income, profits, and capital gains, payable by individuals, plus social contributions, Billions National Currency

Trend output, Constant 2015 prices, Billions National Currency (YFT)

$$\Delta\, ln\, ln\,(YFT_t) = (1 - ALPHA_t - LABSH_t) * \Delta\, ln\, ln\left(\frac{K_{t-1}}{LFN_{t-1}}\right) + (1 - ALPHA_t) * \Delta\, ln\, ln\,(LFN_t) + LABSH_t * \Delta(TECHL_t) + ALPHA_t * \left(\Delta\, ln\, ln\,(EC_t) + \Delta(EFF_t)\right) - \left(\frac{CLIMLOSS_t}{CLIMLOSS_{t-1}} - 1\right) * \left(\frac{DAMAGE_t}{100}\right)$$

ALPHA	Energy share of production costs
LABSH	Share of labour compensation in GDP at current national prices
K	Capital stock, Constant 2015 prices, Billions National Currency

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LFN	Labour Force, 1000s
TECHL	Labour augmenting technical progress trend, indexed to GDP per employee in 2015
EC	Primary energy consumption, Exojoules
EFF	Energy efficiency index
CLIMLOSS	Financial losses from climate shocks, Constant prices, Billions National Currency
DAMAGE	Average annual damages from weather-related shocks, % GDP

Capital stock, Constant 2015 prices, Billions National Currency (K)

$$K_t \equiv K_{t-1} * (1 - DEP_t) + ITR_t$$

DEP	Depreciation rate of capital stock
ITR	Gross fixed capital formation (including Acquisitions less disposals of valuables),Constant 2015 prices, Billions National Currency

Deflator for Imports of Goods and Services, National currency, 2015 = 100 (MTD)

$$\Delta\, ln\, ln\,(MTD_t) = (1 - OMS_t) * (\Delta\, ln\, ln\,(CMUD_t) + \Delta\, ln\, ln\,(EXR_t)) + OMS_t * (\Delta\, ln\, ln\,(POIL_t^{WLD}) + \Delta\, ln\, ln\,(EXR_t))$$

OMS	Imports of Petroleum, petroleum products and related materials as a share of Total Merchandise imports plus Total Services imports
CMUD	Non-oil import price, US$, 2015 = 1
EXR	Exchange rate (national currency / US$)
$POIL^{WLD}$	World oil price ($ per barrel)

Deflator for Export of Good & Services, US$, 2015 =100 (XTD$)

$$XTD\$_t = (1 - OXS_t) * \Delta\, ln\, ln\,(XTDNO\$_t) + OXS_t * \Delta\, ln\, ln\,(POIL_t^{WLD}) + \beta_1 * \Delta\, ln\, ln\,(ARRIVALS_t)$$

OXS	Exports of Petroleum, petroleum products and related materials as a share of Total Merchandise exports plus Total Services exports
XTDNO$	Non-oil export price deflator, US$, 2015 =100
$POIL^{WLD}$	World oil price ($ per barrel)

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ARRIVALS	Inbound tourist arrivals, 1000s

Inflation target (not necessarily explicit) (INFT)

$$INFT_t = \beta_1 * INFT_{t-1} + (1 - \beta_1) * 2$$

Exports of Petroleum, petroleum products and related materials as a share of Total Merchandise exports plus Total Services exports (OXS)

$$OXS_t = OXS_{t-1}$$

Imports of Petroleum, petroleum products and related materials as a share of Total Merchandise imports plus Total Services imports (OMS)

$$OMS_t = OMS_{t-1} * \left(\frac{OILC_{t-1} * POIL_{t-1}^{WLD} * \frac{EXR_{t-1}}{MTN_{t-1}}}{OILC_{t-2} * POIL_{t-2}^{WLD} * \frac{EXR_{t-2}}{MTN_{t-2}}} \right)^{\beta_1}$$

OILC	Oil consumption, Exojoules
$POIL^{WLD}$	World oil price ($ per barrel)
EXR	Exchange rate (national currency / US$)
MTN	Imports of goods and services, Current prices, Billions National Currency

Exports of Primary commodities, precious stones and non-monetary gold as a share of Total Merchandise exports plus Total Services exports (CXS)

$$CXS_t = CXS_{t-1}$$

Benchmark index for financial inclusion. (FINC)

$$FINC_t = FINC_{t-1}$$

Current Account Balance, US$ billion (CAN)

$$CAN_t \equiv \frac{XTN_t}{EXR_t} - \frac{MTN_t}{EXR_t} + \frac{REMIT_t}{EXR_t} + CANOTH_t$$

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XTN	Exports of goods and services, Current prices, Billions National Currency
MTN	Imports of goods and services, Current prices, Billions National Currency
REMIT	Inflow of personal remittances, Billions National Currency
EXR	Exchange rate (national currency / US$)
CANOTH	Other items for current account, including net ODI and other grants, US$ billion

Derived as ratio of current account balance to nominal GDP in US$ (CANRATIO)

$$CANRATIO_t \equiv \frac{CAN_t}{YEN\$_t} * 100$$

CAN	Current Account Balance, US$ billion
YEN$	Gross Domestic Product (GDP), Current prices, US$ billion

Other items for current account, including net ODI and other grants, US$ billion (CANOTH)

$$CANOTH_t = CANOTH_{t-1} + |CANOTH_{t-1}| * \left(\frac{YEN\$_t}{YEN\$_{t-1}} - 1\right) + \frac{REVG_t}{EXR_t} - \frac{REVG_{t-1}}{EXR_{t-1}}$$

YEN$	Gross Domestic Product (GDP), Current prices, US$ billion
REVG	General government revenue, grants, Billions National Currency
EXR	Exchange rate (national currency / US$)

Effective exchange rate, 2015 = 1 (EFEX)

$$ln\ ln\ (EFEX_t) \equiv -\ ln\ ln\left(\frac{EXR_t}{EXR_{2015}}\right) + \sum_{i \in \{AFG, ARM \ldots\}} \beta_i * ln\ ln\left(\frac{EXR_t^i}{EXR_{2015}^i}\right)$$

EXR	Exchange rate (national currency / US$)
EXR^i	Exchange rate (national currency / US$), for country *i*

Real effective exchange rate, 2015 = 1 (REFEX)

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$$ln\ ln\ (REFEX_t) \equiv -\ ln\ ln \left(\frac{\frac{EXR_t}{EXR_{2015}}}{\frac{HIC_t}{HIC_{2015}}} \right) + \sum_{i \in \{AFG, ARM \dots\}} \beta_i * ln\ ln \left(\frac{\frac{EXR_t^i}{EXR_{2015}^i}}{\frac{HIC_t^i}{HIC_{2015}^i}} \right)$$

EXR	Exchange rate (national currency / US$)
EXR^i	Exchange rate (national currency / US$), for country *i*
HIC	Consumer Price Index, Period Average, 2015 = 100
HIC^i	Consumer Price Index, Period Average, 2015 = 100, for country *i*

Inflow of personal remittances, Billions National Currency (REMIT)

$$REMIT_t = \frac{REMIT_{t-1}}{EXR_{t-1}} * \left(\sum_{i \in \{AFG, ARM \dots\}} \beta_i * \frac{YEN\$_t^i}{YEN\$_{t-1}^i} \right) * EXR_t$$

EXR	Exchange rate (national currency / US$)
YEN$^{i}	Gross Domestic Product (GDP), Current prices, US$ billion, for country *i*

General government average interest rate on outstanding debt (GINT)

$$GINT_t = GINT_{t-1} + \beta_1 * (LTI_t - LTI_{t-1})$$

LTI	Long-term bond yield, per cent

General government gross debt, Billions National Currency (GDN)

$$GDN_t = GDN_{t-1} * \left(GDFXSH_t * \left(\frac{EXR_t}{EXR_{t-1}} \right) + (1 - GDFXSH_t) \right) - GLN_t$$

GDFXSH	Foreign currency share of general government gross debt
EXR	Exchange rate (national currency / US$)
GLN	General government net lending (fiscal balance), Billions National Currency

Gross government debt, % of GDP (GDNRATIO)

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$$GDNRATIO_t \equiv \frac{GDN_t}{YEN_t} * 100$$

GDN General government gross debt, Billions National Currency

YEN Gross Domestic Product (GDP), Current prices, Billions National Currency

Foreign currency share of general government gross debt (GDFXSH)

$$GDFXSH_t = \frac{GDFXSH_{t-1} * \left(\frac{EXR_t}{EXR_{t-1}}\right)}{GDFXSH_{t-1} * \left(\frac{EXR_t}{EXR_{t-1}}\right) + 1 - GDFXSH_{t-1}}$$

EXR Exchange rate (national currency / US$)

Change in stringency of measures introduced to contain the pandemic (LOCK)

$$LOCK_t = 0$$

General government net (after subsidies) carbon tax rate, expressed as US$ per tonne of CO2. (GCARBR)

$$GCARBR_t = GCARBR_{t-1}$$

Tax rate on international trade and transactions (GTRADER)

$$GTRADER_t = GTRADER_{t-1}$$

Tax rate on goods and services (ITAXR)

$$ITAXR_t = ITAXR_{t-1}$$

General government revenue, Billions National Currency (REV)

$$REV_t \equiv TAX_t + CTAX_t + ITAX_t + GTRADE_t + REVG_t + GCARB_t + GCOM_t + GOTH_t$$

TAX General government taxes on income, profits, and capital gains, payable by individuals, plus social contributions, Billions National Currency

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CTAX	General government taxes on income, profits, and capital gains, payable by corporations, Billions National Currency
ITAX	General government taxes on goods and services, Billions National Currency
GTRADE	General government taxes on international trade and transactions, Billions National Currency
REVG	General government revenue, grants, Billions National Currency
GCARB	General government net (after subsidies) carbon tax revenue, Billions National Currency
GCOM	General government resource-related revenue, Billions National Currency
GOTH	Government other net revenue, Billions National Currency

General government taxes on income, profits, and capital gains, payable by individuals, plus social contributions, Billions National Currency (TAX)

$$TAX_t \equiv TAXR_t * \left(LABSH_t * \beta_1 * (YER_{t-1} + GDI_{t-1}) * YED_{t-1} * \left(\frac{LNN_t}{LNN_{t-1}} + TECHL_t - TECHL_{t-1}\right) + REMIT_t + EXPSP_t\right)$$

TAXR	Income tax rate
LABSH	Share of labour compensation in GDP at current national prices
YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency
GDI	Gross domestic income (terms of trade adjusted), Constant 2015 prices, Billions National Currency
YED	Deflator for GDP, National Currency, 2015 =100
LNN	Employment, 1000s
TECHL	Labour augmenting technical progress trend, indexed to GDP per employee in 2015
REMIT	Inflow of personal remittances, Billions National Currency
EXPSP	General government expense on social benefits, Billions National Currency

General government taxes on income, profits, and capital gains, payable by corporations, Billions National Currency (CTAX)

$$CTAX_t \equiv CTAXR_t * PROF_t$$

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CTAXR	Corporate tax rate
PROF	Profits, Billions National Currency

General government taxes on goods and services, Billions National Currency (ITAX)

$$ITAX_t \equiv ITAXR_t * \left(PCR_t * \frac{HIC_t}{HIC_{2015}}\right)$$

PCR	Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency
HIC	Consumer Price Index, Period Average, 2015 = 100

General government taxes on international trade and transactions, Billions National Currency (GTRADE)

$$GTRADE_t \equiv GTRADER_t * XTN_t$$

GTRADER	Tax rate on international trade and transactions
XTN	Exports of goods and services, Current prices, Billions National Currency

General government revenue, grants, Billions National Currency (REVG)

$$REVG_t = REVG_{t-1} * \left(\left(\sum_{i\in\{USA,DEU\ldots TWN\}} \beta_i * \frac{YEN\$_t^i}{YEN\$_{t-1}^i}\right) - \beta_1 * \left(\frac{\frac{YER\$_t}{POPT_t}}{\frac{YER\$_t^{WLD}}{POPT_t^{WLD}}} - \frac{\frac{YER\$_{t-1}}{POPT_{t-1}}}{\frac{YER\$_{t-1}^{WLD}}{POPT_{t-1}^{WLD}}}\right)\right) * \frac{EXR_t}{EXR_{t-1}}$$

YEN^{i}	Gross Domestic Product (GDP), Current prices, US$ billion, for country *i*
YER$	Gross Domestic Product (GDP), Constant 2015 prices, US$ billion
POPT	Total population, 1000s
YER^{WLD}	Gross Domestic Product (GDP), Constant 2015 prices, US$ billion, World
POPT^{WLD}	Total population, 1000s, World

General government net (after subsidies) carbon tax revenue, Billions National Currency (GCARB)

DRAFT

$$GCARB_t \equiv GCARBR_t * CO2_t * \frac{EXR_t}{1000}$$

GCARBR	General government net (after subsidies) carbon tax rate, expressed as US$ per tonne of CO2.
CO2	Territorial carbon dioxide emissions, MtCO2
EXR	Exchange rate (national currency / US$)

General government resource-related revenue, Billions National Currency (GCOM)

$$GCOM_t = GCOM_{t-1} * \left(\frac{OILC_t}{OILC_t + GASC_t + COALC_t} * \frac{OILC_t^{WLD} * POIL_t^{WLD}}{OILC_{t-1}^{WLD} * POIL_{t-1}^{WLD}} + \frac{GASC_t}{OILC_t + GASC_t + COALC_t} * \frac{GASC_t^{WLD} * PG_t^{WLD}}{GASC_{t-1}^{WLD} * PG_{t-1}^{WLD}} + \frac{COALC_t}{OILC_t + GASC_t + COALC_t} * \frac{COALC_t^{WLD} * PC_t^{WLD}}{COALC_{t-1}^{WLD} * PC_{t-1}^{WLD}} \right)$$

OILC	Oil consumption, Exojoules
GASC	Natural gas consumption, Exojoules
COALC	Coal consumption, Exojoules
$OILC^{WLD}$	Oil consumption, Exojoules, World
$POIL^{WLD}$	World price of oil, inclusive of net carbon tax, US$ per Mn kJ
$GASC^{WLD}$	Natural gas consumption, Exojoules, World
PG^{WLD}	World price of natural gas, inclusive of net carbon tax, US$ per Mn kJ
$COALC^{WLD}$	Coal consumption, Exojoules, World
PC^{WLD}	World price of coal, inclusive of net carbon tax, US$ per Mn kJ

Government other net revenue, Billions National Currency (GOTH)

$$GOTH_t = GOTH_{t-1}$$

General government expenditure, Billions National Currency (EXP)

$$EXP_t \equiv EXPE_t + EXPH_t + EXPSP_t + OGC_t + OGI_t + GIP_t$$

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EXPE	General government expenditure on environmental protection, Billions National Currency
EXPH	General government expenditure on health, Billions National Currency
EXPSP	General government expense on social benefits, Billions National Currency
OGC	Other general government consumption expenditure, Billions National Currency
OGI	Other general government investment expenditure, Billions National Currency
GIP	Gross government interest payments, Billions National Currency

General government expenditure on environmental protection, Billions National Currency (EXPE)

$$EXPE_t = EXPE_{t-1} * \left(\frac{YED_t}{YED_{t-1}}\right)$$

YED	Deflator for GDP, National Currency, 2015 =100

General government expenditure on health, Billions National Currency (EXPH)

$$EXPH_t = EXPH_{t-1} * \left(\frac{YED_t}{YED_{t-1}}\right)$$

YED	Deflator for GDP, National Currency, 2015 =100

General government expense on social benefits, Billions National Currency (EXPSP)

$$EXPSP_t = EXPSP_{t-1} * \left(\frac{YED_t}{YED_{t-1}}\right) * \frac{POPT_t - LNN_t}{POPT_{t-1} - LNN_{t-1}}$$

YED	Deflator for GDP, National Currency, 2015 =100
POPT	Total population, 1000s
LNN	Employment, 1000s

Other general government investment expenditure, Billions National Currency (OGI)

$$\Delta\, ln\, ln\, (OGI_t) = \Delta ln\, (YED_t)$$

DRAFT

YED — Deflator for GDP, National Currency, 2015 =100

General government final consumption expenditure, Constant 2015 prices, Billions National Currency (GCR)

$$GCR_t = GCR_{t-1} + \left(\frac{OGC_t}{YED_t} - \frac{OGC_{t-1}}{YED_{t-1}}\right) + 0.5 * \left(\frac{EXPH_t}{YED_t} - \frac{EXPH_{t-1}}{YED_{t-1}}\right) + 0.5 * \left(\frac{EXPE_t}{YED_t} - \frac{EXPE_{t-1}}{YED_{t-1}}\right)$$

OGC — Other general government consumption expenditure, Billions National Currency

YED — Deflator for GDP, National Currency, 2015 =100

EXPH — General government expenditure on health, Billions National Currency

EXPE — General government expenditure on environmental protection, Billions National Currency

Public gross fixed capital formation, Constant 2015 prices, Billions National Currency (IGR)

$$IGR_t = IGR_{t-1} + \left(\frac{OGI_t}{YED_t} - \frac{OGI_{t-1}}{YED_{t-1}}\right) + 0.5 * \left(\frac{EXPH_t}{YED_t} - \frac{EXPH_{t-1}}{YED_{t-1}}\right) + 0.5 * \left(\frac{EXPE_t}{YED_t} - \frac{EXPE_{t-1}}{YED_{t-1}}\right)$$

OGI — Other general government investment expenditure, Billions National Currency

YED — Deflator for GDP, National Currency, 2015 =100

EXPH — General government expenditure on health, Billions National Currency

EXPE — General government expenditure on environmental protection, Billions National Currency

Gross government interest payments, Billions National Currency (GIP)

$$GIP_t = \left(GIP_{t-1} + (GDN_{t-1} - GDN_{t-2}) * \frac{GINT_{t-1}}{100} + \frac{GDN_{t-6}}{5} * \left(\frac{GINT_{t-1}}{100} - \frac{GINT_{t-6}}{100}\right)\right) * \left(GDFXSH_t * \left(\frac{EXR_t}{EXR_{t-1}}\right) + (1 - GDFXSH_t)\right)$$

GDN — General government gross debt, Billions National Currency

GINT — General government average interest rate on outstanding debt

GDFXSH — Foreign currency share of general government gross debt

DRAFT

EXR Exchange rate (national currency / US$)

General government net lending (fiscal balance), Billions National Currency (GLN)

$$GLN_t \equiv REV_t - EXP_t$$

REV General government revenue, Billions National Currency

EXP General government expenditure, Billions National Currency

General government net lending (fiscal balance), % GDP (GLNRATIO)

$$GLNRATIO_t \equiv \frac{GLN_t}{YEN_t} * 100$$

GLN General government net lending (fiscal balance), Billions National Currency

YEN Gross Domestic Product (GDP), Current prices, Billions National Currency

General government fiscal balance target, % GDP (GLNT)

$$GLNT_t = \beta_1 * GLNT_{t-1} + (1 - \beta_1) * (-2)$$

Trend TFP growth rate, expressed as log change (TFP)

$$TFP_t = LABSH_t * (TECHL_t - TECHL_{t-1})$$

LABSH Share of labour compensation in GDP at current national prices

TECHL Labour augmenting technical progress trend, indexed to GDP per employee in 2015

Share of labour compensation in GDP at current national prices (LABSH)

$$LABSH_t = LABSH_{t-1}$$

Labour Force, 1000s (LFN)

$$LFN_t \equiv LRX_t * POPWA_t$$

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LRX	Participation ratio
POPWA	Population aged 15-64, 1000s

Participation ratio (LRX)

$$LRX_t = LRX_{t-1} + \beta_1 * ln\ ln\left(\frac{YER_{t-1}}{YFT_{t-1}}\right)$$

YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency
YFT	Trend output, Constant 2015 prices, Billions National Currency

Unemployment Rate (ILO definition) (URX)

$$URX_t \equiv \left(1 - \frac{LNN_t}{LFN_t}\right) * 100$$

LNN	Employment, 1000s
LFN	Labour Force, 1000s

Female unemployment Rate (ILO definition) (URXF)

$$URXF_t = URXF_{t-1} * \frac{URX_t}{URX_{t-1}} * \frac{\frac{LNN_t}{LNNF_t}}{\frac{LNN_{t-1}}{LNNF_{t-1}}}$$

URX	Unemployment Rate (ILO definition)
LNN	Employment, 1000s
LNNF	Female employment, 1000s

Survey mean consumption or income per capita, total population (2011 PPP $ per day) (YBAR)

$$\Delta\ ln\ ln\ (YBAR_t)\ = \beta_1 * \Delta\ ln\ ln\left(\frac{PCR_t}{POPT_t}\right)$$

DRAFT

PCR	Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency
POPT	Total population, 1000s

Standard deviation of log income (SDLI)

$$SDLI_t = 2 * erf^{-1}[GINI_DISP_t]$$

erf	Inverse error function (approximated with gamma quantile function)
GINI_DISP	Estimate of Gini index of inequality in equivalized household disposable (post-tax, post-transfer) income.

Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population) (HEAD19)

$$HEAD19_t = HEAD19_{t-1} * \frac{\left[CDF_{LOGNORMAL}\left(\$1.90, ln(YBAR_t) - 0.5 * {SDLI_t}^2, SDLI_t\right)\right]}{\left[CDF_{LOGNORMAL}\left(\$1.90, ln(YBAR_{t-1}) - 0.5 * {SDLI_{t-1}}^2, SDLI_{t-1}\right)\right]}$$

$CDF_{LOGNORMAL}$	Log normal cumulative distribution, evaluated at $1.90
YBAR	Survey mean consumption or income per capita, total population (2011 PPP $ per day)
SDLI	Standard deviation of log income

Poverty headcount ratio at $5.50 a day (2011 PPP) (% of population) (HEAD55)

$$HEAD55_t = HEAD55_{t-1} * \frac{\left[CDF_{LOGNORMAL}\left(\$5.50, ln(YBAR_t) - 0.5 * {SDLI_t}^2, SDLI_t\right)\right]}{\left[CDF_{LOGNORMAL}\left(\$5.50, ln(YBAR_{t-1}) - 0.5 * {SDLI_{t-1}}^2, SDLI_{t-1}\right)\right]}$$

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$CDF_{LOGNORMAL}$	Log normal cumulative distribution, evaluated at $5.50
YBAR	Survey mean consumption or income per capita, total population (2011 PPP $ per day)
SDLI	Standard deviation of log income

Exports of goods and services, Constant 2015 prices, Billions National Currency (XTR)

$$\Delta \, ln \, ln \, (XTR_t) = \Delta \, ln \, ln \, (WDR_t) \, + (1 - CXS_t) * \left(\beta_1 * \Delta \, ln \, ln \left(\frac{XTDNO\$_t}{CXUD_t} \right) \right) + \beta_2 * \Delta \, ln \, ln \, (ARRIVALS_t)$$

WDR	Trade-weighted external demand, Constant 2015 prices, US$ billion
CXS	Exports of Primary commodities, precious stones and non-monetary gold as a share of Total Merchandise exports plus Total Services exports
XTDNO$	Non-oil export price deflator, US$, 2015 =100
CXUD	Global non-oil export price, US$, 2015 = 1
TOURSH	Travel and transport services exports as a share of nominal GDP
ARRIVALS	Inbound tourist arrivals, 1000s

Non-oil export price deflator, US$, 2015 =100 (XTDNO$)

$$XTDNO\$_t = XTDNO\$_{t-1} * \left[\beta_1 * \left\{ \Delta ln \left(\frac{YED_{t-1}}{EXR_{t-1}} \right) + 1 \right\} + (1 - \beta_1) * \{ \Delta ln(CXUD_{t-1}) + 1 \} \right] * \frac{1 + GTRADER_t}{1 + GTRADER_{t-1}}$$

YED	Deflator for GDP, National Currency, 2015 =100
EXR	Exchange rate (national currency / US$)
CXUD	Global non-oil export price, US$, 2015 = 1
GTRADER	Tax rate on international trade and transactions

DRAFT

Labour augmenting technical progress trend, indexed to GDP per employee in 2015 (TECHL)

$$\Delta(TECHL_t) = \Delta(TECHL_t^{WLD}) + \beta_1 * \left(\frac{EXPH_{t-1}}{YEN_{t-1}}\right) - \beta_2 * \left(\frac{EXPH_{t-1}}{YEN_{t-1}}\right)^2 - \beta_3 * \Delta(GINI_DISP_t) - \beta_4 * \Delta(PM25_t) - \beta_5 * PREM_t + \beta_6 * \Delta\left(\frac{XTR_{t-1} + MTR_{t-1}}{YER_{t-1}}\right)$$

$TECHL^{WLD}$	Labour augmenting technical progress trend, indexed to GDP per employee in 2015, World
EXPH	General government expenditure on health, Billions National Currency
YEN	Gross Domestic Product (GDP), Current prices, Billions National Currency
EXPH	General government expenditure on health, Billions National Currency
GINI_DISP	Estimate of Gini index of inequality in equivalized household disposable (post-tax,post-transfer) income.
PM25	PM2.5 air pollution, mean annual exposure, micrograms per cubic meter
PREM	Country-specific risk premium, basis points.
XTR	Exports of goods and services, Constant 2015 prices, Billions National Currency
MTR	Imports of goods and services, Constant 2015 prices, Billions National Currency
YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency

Relative redistribution parameter (percentage difference between Gini Coefficients measures in terms of gross and disposable income) (REL_RED)

$$REL_RED_t = \beta_0 + \beta_1 * \left(\frac{EXPSP_t}{YEN_t}\right)$$

EXPSP	General government expense on social benefits, Billions National Currency
YEN	Gross Domestic Product (GDP), Current prices, Billions National Currency

Estimate of Gini index of inequality in equivalized household disposable (post-tax,post-transfer) income. (GINI_DISP)

$$\Delta\ ln\ ln\ (GINI_DISP_t)\ = \beta_1 * \Delta\ ln\ ln\ \left(1 - \frac{REL_RED_t}{100}\right) + \beta_2 * (FINC_t - FINC_{t-1})$$

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REL_RED	Relative redistribution parameter (percentage difference between Gini Coefficients measures in terms of gross and disposable income)
FINC	Benchmark index for financial inclusion.

Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency (PCR)

$$\Delta\, ln\, ln\,(PCR_t) = \beta_0 + \beta_1 * \left(ln\, ln\,(PCR_{t-1}) - ln\, ln\,(RPDI_{t-1}) - \beta_2 * (FINC_{t-1})\right) + \beta_3 * \Delta\, ln\, ln\,(RPDI_t) + (1-\beta_3) * \Delta\, ln\, ln\,(POPT_t) + \beta_4 * \left(\Delta\, ln\, ln\,(HIC_t) - \frac{INFT_t}{100}\right) - \beta_5 * \frac{LOCK_t}{100} - \beta_5 * \beta_6 * \frac{LOCK_{t-1}}{100} + \beta_7 * (ln\, ln\,(YFT_{t-1}) - ln\, ln\,(YER_{t-1}))$$

RPDI	Real personal disposable income, Constant 2015 prices, Billions National Currency
FINC	Benchmark index for financial inclusion.
POPT	Total population, 1000s
HIC	Consumer Price Index, Period Average, 2015 = 100
INFT	Inflation target (not necessarily explicit)
LOCK	Change in stringency of measures introduced to contain the pandemic
YFT	Trend output, Constant 2015 prices, Billions National Currency
YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency

Private gross fixed capital formation, Constant 2015 prices, Billions National Currency (IPR)

$$\Delta\, ln\, ln\,(IPR_t) = \beta_0 - \beta_1 * \left(ln\, ln\left(\frac{IPR_{t-1}}{YFT_{t-1}}\right) + \beta_2 * USER_{t-1} - \beta_3 * FINC_{t-1}\right) + \beta_4 * \Delta\, ln\, ln\left(PCR_t + GCR_{t-1} + IGR_{t-1} + \frac{XTN_t}{YED_t}\right) + \beta_5 * \Delta\, ln\, ln\,(IPR_{t-1}) - \beta_6 * (USER_t - USER_{t-1}) - \left(\beta_7 * TOURSH + \beta_8 * (1 - FUELSH - TOURSH)\right) * \frac{LOCK_t}{100} - \beta_9 * \left(\beta_7 * TOURSH + \beta_8 * (1 - FUELSH - TOURSH)\right) * \frac{LOCK_{t-1}}{100} + \beta_{10} * (ln\, ln\,(YFT_{t-1}) - ln\, ln\,(YER_{t-1}))$$

YFT	Trend output, Constant 2015 prices, Billions National Currency
USER	User cost of capital, per cent

DRAFT

FINC	Benchmark index for financial inclusion.
PCR	Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency
GCR	General government final consumption expenditure, Constant 2015 prices, Billions National Currency
IGR	Public gross fixed capital formation, Constant 2015 prices, Billions National Currency
XTN	Exports of goods and services, Current prices, Billions National Currency
YED	Deflator for GDP, National Currency, 2015 =100
IPR	Private gross fixed capital formation, Constant 2015 prices, Billions National Currency
FUELSH	Fuel exports (SITC 3) as a share of nominal GDP
TOURSH	Travel and transport services exports as a share of nominal GDP
LOCK	Change in stringency of measures introduced to contain the pandemic
YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency

Imports of goods and services, Constant 2015 prices, Billions National Currency (MTR)

$$\Delta\, ln\, ln\,(MTR_t) = \beta_0 - \beta_1 * \left(ln\, ln\,(MTR_{t-1}) - ln\, ln\,(PCR_{t-1} + ITR_{t-1} + GCR_{t-1} + XTR_{t-1}) + ln\, ln\left(\frac{YFT_{t-1}}{YER_{t-1}}\right) + \beta_2 * ln\, ln\left(CMUD_{t-1} * \frac{EXR_{t-1}}{YED_{t-1}}\right) - \beta_3 * OMS_t * ln\, ln\,(OILC_{t-1})\right) + \beta_4 * \Delta\, ln\, ln\,(XTR_t) + \beta_5 * \Delta ln\,(PCR_t) + \beta_6 * \Delta ln\,(IPR_t) + \beta_7 * \Delta ln\,(GCR_t + IGR_t)$$

PCR	Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency
ITR	Gross fixed capital formation (including Acquisitions less disposals of valuables),Constant 2015 prices, Billions National Currency
GCR	General government final consumption expenditure, Constant 2015 prices, Billions National Currency
XTR	Exports of goods and services, Constant 2015 prices, Billions National Currency
YFT	Trend output, Constant 2015 prices, Billions National Currency
YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency

DRAFT

CMUD	Non-oil import price, US$, 2015 = 1
EXR	Exchange rate (national currency / US$)
YED	Deflator for GDP, National Currency, 2015 =100
OMS	Imports of Petroleum, petroleum products and related materials as a share of Total Merchandise imports plus Total Services imports
OILC	Oil consumption, Exojoules
IPR	Private gross fixed capital formation, Constant 2015 prices, Billions National Currency
IGR	Public gross fixed capital formation, Constant 2015 prices, Billions National Currency

Territorial carbon dioxide emissions, MtCO2 (CO2)

$$\Delta ln(CO2_t) = \Delta ln(\beta_1 * COALC_t + \beta_2 * GASC_t + \beta_3 * OILC_t) - \beta_4 * [ln(CO2_{t-1}) - ln(\beta_1 * COALC_{t-1} + \beta_2 * GASC_{t-1} + \beta_3 * OILC_{t-1})] + \beta_4 * \Delta ln(ARRIVALS_t)$$

COALC	Coal consumption, Exojoules
GASC	Natural gas consumption, Exojoules
OILC	Oil consumption, Exojoules
ARRIVALS	Inbound tourist arrivals, 1000s

Domestic price of oil, inclusive of net carbon tax, US$ per Mn kJ (POIL)

$$POIL_t = POIL_{t-1} * \frac{POIL_t^{WLD}}{POIL_{t-1}^{WLD}} + \beta_1 * (GCARBR_t - GCARBR_{t-1})$$

$POIL^{WLD}$	World price of oil, inclusive of net carbon tax, US$ per Mn kJ
GCARBR	General government net (after subsidies) carbon tax rate, expressed as US$ per tonne of CO2.

Domestic price of natural gas, inclusive of net carbon tax, US$ per Mn kJ (PG)

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$$PG_t = PG_{t-1} * \frac{PG_t^{WLD}}{PG_{t-1}^{WLD}} + \beta_1 * (GCARBR_t - GCARBR_{t-1})$$

PG^{WLD}	World price of natural gas, inclusive of net carbon tax, US$ per Mn kJ
GCARBR	General government net (after subsidies) carbon tax rate, expressed as US$ per tonne of CO2.

Domestic price of coal, inclusive of net carbon tax, US$ per Mn kJ (PC)

$$PC_t = PC_{t-1} * \frac{PC_t^{WLD}}{PC_{t-1}^{WLD}} + \beta_1 * (GCARBR_t - GCARBR_{t-1})$$

PC^{WLD}	World price of coal, inclusive of net carbon tax, US$ per Mn kJ
GCARBR	General government net (after subsidies) carbon tax rate, expressed as US$ per tonne of CO2.

Domestic price of renewable energy, US$ per Mn kJ (PR)

$$\Delta\, ln\, ln\, (PR_t) = \Delta\, ln\, ln\, (PR_t^{WLD})$$

PR^{WLD}	World price of renewable energy, US$ per Mn kJ

Domestic price of energy, inclusive of net carbon tax, US$ per Mn kJ (PE)

$$PE_t = PE_{t-1} * \left(\frac{OILC_{t-1}}{OILC_{t-1} + COALC_{t-1} + GASC_{t-1} + RC_{t-1}} * \frac{POIL_t}{POIL_{t-1}} + \frac{GASC_{t-1}}{OILC_{t-1} + COALC_{t-1} + GASC_{t-1} + RC_{t-1}} * \frac{PG_t}{PG_{t-1}} + \frac{COALC_{t-1}}{OILC_{t-1} + COALC_{t-1} + GASC_{t-1} + RC_{t-1}} * \frac{PC_t}{PC_{t-1}} + \frac{RC_{t-1}}{OILC_{t-1} + COALC_{t-1} + GASC_{t-1} + RC_{t-1}} * \frac{PR_t}{PR_{t-1}} \right)$$

OILC	Oil consumption, Exojoules
COALC	Coal consumption, Exojoules
GASC	Natural gas consumption, Exojoules
RC	Consumption of non-fossil fuel energy (nuclear, hydro and renewables), Exojoules

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POIL	Domestic price of oil, inclusive of net carbon tax, US$ per Mn kJ
PG	Domestic price of natural gas, inclusive of net carbon tax, US$ per Mn kJ
PC	Domestic price of coal, inclusive of net carbon tax, US$ per Mn kJ
PR	Domestic price of renewable energy, US$ per Mn kJ

Depreciation rate of capital stock (DEP)

$$\Delta(DEP_t) = \beta_1 * \Delta \, ln \, ln \, (CO2_t^{WLD})$$

$CO2^{WLD}$	World carbon dioxide emissions, MtCO2

PM2.5 air pollution, mean annual exposure, micrograms per cubic meter (PM25)

$$\Delta \, ln \, ln \, (PM25_t) = \beta_1 * \left(\frac{COALC_{t-1}}{EC_{t-1}} - \frac{COALC_{t-2}}{EC_{t-2}}\right) + \beta_2 * \left(\frac{COALC_{t-2}}{EC_{t-2}} - \frac{COALC_{t-3}}{EC_{t-3}}\right) + \beta_3 * \left(\frac{OILC_{t-1}}{EC_{t-1}} - \frac{OILC_{t-2}}{EC_{t-2}}\right) + \beta_4 * \left(\frac{OILC_{t-2}}{EC_{t-2}} - \frac{OILC_{t-3}}{EC_{t-3}}\right) + \beta_5 * \Delta \, ln \, ln \, (ARRIVALS_t)$$

COALC	Coal consumption, Exojoules
EC	Primary energy consumption, Exojoules
OILC	Oil consumption, Exojoules
ARRIVALS	Inbound tourist arrivals, 1000s

Primary energy consumption, Exojoules (EC)

$$\Delta \, ln \, ln \, (EC_t) = \beta_1 * \Delta \, ln \, ln \, (YER_t) + \beta_2 * \Delta \, ln \, ln \, (YER_{t-1}) + \beta_3 * \Delta \, ln \, ln \, (YER_{t-2}) + \beta_4 * \Delta \, ln \, ln \, (YER_{t-3}) - \beta_5 * \beta_1 * \Delta \, ln \, ln \left(PE_t * \frac{EXR_t}{HIC_t}\right) - \beta_5 * \beta_2 * \Delta \, ln \, ln \left(PE_{t-1} * \frac{EXR_{t-1}}{HIC_{t-1}}\right) - \beta_5 * \beta_3 * \Delta \, ln \, ln \left(PE_{t-2} * \frac{EXR_{t-2}}{HIC_{t-2}}\right) - \beta_5 * \beta_4 * \Delta \, ln \, ln \left(PE_{t-3} * \frac{EXR_{t-3}}{HIC_{t-3}}\right) - (EFF_t - EFF_{t-1})$$

YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency
PE	Domestic price of energy, inclusive of net carbon tax, US$ per Mn kJ

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EXR Exchange rate (national currency / US$)

HIC Consumer Price Index, Period Average, 2015 = 100

EFF Energy efficiency index

Coal consumption, Exojoules (COALC)

$$\Delta\, ln\, ln\, (COALC_t) = \Delta\, ln\, ln\, (EC_{t-1}) - \beta_1 * \left(ln\, ln \left(\frac{COALC_{t-1}}{EC_{t-1}}\right) - ln\, ln \left(\frac{PE_{t-1}}{PC_{t-1}}\right)\right)$$

EC Primary energy consumption, Exojoules

PE Domestic price of energy, inclusive of net carbon tax, US$ per Mn kJ

PC Domestic price of coal, inclusive of net carbon tax, US$ per Mn kJ

Natural gas consumption, Exojoules (GASC)

$$\Delta\, ln\, ln\, (GASC_t) = \Delta\, ln\, ln\, (EC_{t-1}) - \beta_1 * \left(ln\, ln \left(\frac{GASC_{t-1}}{EC_{t-1}}\right) - ln\, ln \left(\frac{PE_{t-1}}{PG_{t-1}}\right)\right)$$

EC Primary energy consumption, Exojoules

PE Domestic price of energy, inclusive of net carbon tax, US$ per Mn kJ

PG Domestic price of natural gas, inclusive of net carbon tax, US$ per Mn kJ

Consumption of non-fossil fuel energy (nuclear, hydro and renewables), Exojoules (RC)

$$RC_t = EC_t - COALC_t - GASC_t - OILC_t$$

EC Primary energy consumption, Exojoules

COALC Coal consumption, Exojoules

GASC Natural gas consumption, Exojoules

OILC Oil consumption, Exojoules

Oil consumption, Exojoules (OILC)

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$$\Delta\, ln\, ln\, (OILC_t) = \Delta\, ln\, ln\, (EC_{t-1}) - \beta_1 * \left(ln\, ln \left(\frac{OILC_{t-1}}{EC_{t-1}} \right) - ln\, ln \left(\frac{PE_{t-1}}{POIL_{t-1}} \right) \right)$$

EC	Primary energy consumption, Exojoules
PE	Domestic price of energy, inclusive of net carbon tax, US$ per Mn kJ
POIL	Domestic price of oil, inclusive of net carbon tax, US$ per Mn kJ

Exchange rate (national currency / US$) (EXR)

$$EXR_t = EXR_{t-1} * \left(\frac{EXR_t^{IND}}{EXR_{t-1}^{IND}} \right)$$

EXR^{IND}	India's exchange rate to US$

Non-oil import price, US$, 2015 = 1 (CMUD)

$$CMUD_t = \sum_{i \in \{AFG, ARM \dots\}} \beta_i * XTDNO\$_t^i$$

$XTDNO\$^i$	Non-oil export price deflator, US$, 2015 =100, for country *i*

Global non-oil export price, US$, 2015 = 1 (CXUD)

$$CXUD_t = \sum_{i \in \{AFG, ARM \dots\}} \beta_i * XTDNO\$_t^i$$

$XTDNO\$^i$	Non-oil export price deflator, US$, 2015 =100, for country *i*

Trade-weighted external demand, Constant 2015 prices, US$ billion (WDR)

$$WDR_t = \sum_{i \in \{AFG, ARM \dots\}} \beta_i * MTR\$_t^i$$

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MTR$[i] Imports of goods and services, Constant 2015 prices, US$ billion, for country *i*

b. List of variables and data sources

Variable	Definition	Data source
ALPHA	Energy share of production costs (constant)	Derived from energy consumption and GDP
ARRIVALS	Inbound tourist arrivals, 1000s	UNWTO
CAN	Current Account Balance, US$ billion	IMF WEO Extended Database
CANOTH	Other items for current account, including net ODI and other grants, US$ billion	Derived as residual on current account balance.
CANRATIO	Derived as ratio of current account balance to nominal GDP in US$	Derived as ratio of current account balance to nominal GDP in US$
CLIMLOSS	Financial losses from climate shocks, Constant prices, Billions National Currency (exogenous)	Derived from EM-DAT
CMUD	Non-oil import price, US$, 2015 = 1	Trade-weighted average of global export prices, with weights based on share of NPLs imports. See matrix_equations.prg for details.
CO2	Territorial carbon dioxide emissions, MtCO2	Global Carbon Project, Gilfillan et al. (2019), UNFCCC (2019), BP (2019)
COALC	Coal consumption, Exojoules	bp Statistical Review of World Energy. Missing values estimated based on CO2 emissions from coal from Global Carbon Project.
CTAX	General government taxes on income, profits, and capital gains, payable by corporations, Billions National Currency	IMF WEO Extended Database. Missing values filled from IMF Government Finance Statistics Revenue database where available. Where unavailable, Asia-Pacific average revenue shares are applied to total revenue.
CTAXR	Corporate tax rate	Derived as corporate tax revenue as a share of profits
CXS	Exports of Primary commodities, precious stones and non-monetary gold as a share of Total Merchandise exports plus Total Services exports	UNCTAD

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CXUD	Global non-oil export price, US$, 2015 = 1	Trade-weighted average of global export prices, with weights based on share of global exports. See matrix_equations.prg for details.
DAMAGE	Average annual damages from weather-related shocks, % GDP (exogenous)	Derived from EM-DAT
DEP	Depreciation rate of capital stock	Derived as Asia-Pacific average
EC	Primary energy consumption, Exojoules	bp Statistical Review of World Energy. Missing values derived as sum of coal, oil, gas and renewable consumption.NPL_EXR.LABEL(D) Exchange rate (national currency / US$)
EFEX	Effective exchange rate, 2015 = 1	Trade-weighted average of global exchange rates, with weights based on bilateral trade as a share of reporting country total trade. See matrix_equations.prg for details.
EFF	Energy efficiency index (exogenous)	Derived from panel estimation
EXP	General government expenditure, Billions National Currency	Derived from general government revenue and general government net lending
EXPE	General government expenditure on environmental protection, Billions National Currency	IMF Government Finance Statistics, Expenditure by Functions of Government Database. Missing values estimated from Asia-Pacific average expenditure share.
EXPH	General government expenditure on health, Billions National Currency	IMF Government Finance Statistics, Expenditure by Functions of Government Database. Missing values estimated from Asia-Pacific average expenditure share.
EXPSP	General government expense on social benefits, Billions National Currency	IMF WEO Extended Database. Missing values estimate from IMF Government Finance Statistics, Expenditure by Functions of Government Database where available. Where unavailable estimated with Asia-Pacific average expenditure share.
EXR	Exchange rate (national currency / US$)	Derived as ratio of GDP in current domestic prices to GDP in current US$
FINC	Benchmark index for financial inclusion.	World Bank WDI Database. Account ownership at a financial institution or with a mobile-money-service provider (% of

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		population ages 15+). Missing values filled with Asia-Pacific regional averages.
FUELSH	Fuel exports (SITC 3) as a share of nominal GDP (constant)	Derived from 2018 benchmark fuel exports from ESCAP Excel Model, which is sourced from UNCTADStat, Trade structure by partner, product or service category.
GASC	Natural gas consumption, Exojoules	bp Statistical Review of World Energy. Missing values estimated based on CO2 emissions from gasl from Global Carbon Project.
GCARB	General government net (after subsidies) carbon tax revenue, Billions National Currency	Gross carbon tax revenue assumed zero to 2019. Gross subsidies from IEA fossil fuel subsidies database. Missing values treated as zero subsidies.
GCARBR	General government net (after subsidies) carbon tax rate, expressed as US$ per tonne of CO2.	Estimated as net carbon tax revenue as a share of CO2 emissions.
GCOM	General government resource-related revenue, Billions National Currency	Derived from Resource revenue share from ESCAP Excel Model, which is based on IMF WEO Extended Database and National Resource Governance Institute.
GCR	General government final consumption expenditure, Constant 2015 prices, Billions National Currency	United Nations Statistics Division National Accounts Main Aggregates Database
GDFXSH	Foreign currency share of general government gross debt	Derived from IMF WEO Extended Database. Missing values filled from FX share applied in ESCAP Excel Model, which was derived from World Bank Database of Fiscal Space or Asia-Pacific regional average.
GDI	Gross domestic income (terms of trade adjusted), Constant 2015 prices, Billions National Currency	Derived by revaluing exports and imports in GDP with a domestic demand deflator
GDN	General government gross debt, Billions National Currency	IMF WEO Extended Database
GDNRATIO	Gross government debt, % of GDP	Derived from Gross government debt and nominal GDP

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GINI_DISP	Estimate of Gini index of inequality in equivalized household disposable (post-tax,post-transfer) income.	Standardized World Income Inequality Database (SWIID).
GINT	General government average interest rate on outstanding debt	Ratio of government interest payments to government debt. Missing values set to Asia-Pacific regional average.
GIP	Gross government interest payments, Billions National Currency	IMF WEO Extended Database. MIssing values estimated by applying Asia-Pacific regional average interest rate to government debt.
GLN	General government net lending (fiscal balance), Billions National Currency	IMF WEO Extended Database.
GLNRATIO	General government net lending (fiscal balance), % GDP	Derived as ratio of fiscal balance to nominal GDP
GLNT	General government fiscal balance target, % GDP	Baseline set to historical deficit ratio, converging gradually to 2% of GDP
GOTH	Government other net revenue, Billions National Currency	Derived as residual on fiscal balance.
GTRADE	General government taxes on international trade and transactions, Billions National Currency	IMF WEO Extended Database. Missing values estimate from IMF Government Finance Statistics, Revenue Database where available. Where unavailable estimated with Asia-Pacific average revenue share.
GTRADER	Tax rate on international trade and transactions	Derived as ratio of tax on international trade and transactions to nominal exports
HEAD19	Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population)	World Bank WDI Database. Missing values filled by interpolation and via assumption of lognormality for a given mean income and gini coefficient.
HEAD55	Poverty headcount ratio at $5.50 a day (2011 PPP) (% of population)	World Bank WDI Database. Missing values filled by interpolation and via assumption of lognormality for a given mean income and gini coefficient.
HIC	Consumer Price Index, Period Average, 2015 = 100	IMF WEO Extended Database.
IGR	Public gross fixed capital formation, Constant 2015 prices, Billions National Currency	Based on investment shares from IMF WEO Extended Database. Where unavailable, based on IMF Investment and Capital Stock Database. Missing values estimated with

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		Asia-Pacific regional average share of total investment.
INFT	Inflation target (not necessarily explicit)	Recent values from Central Bank News. Historical information from Jahan, Inflation Targeting: Holding the Line. For countries without an explicit inflation target, estimated based on trend inflation.
INT	Monetary Policy-Related Interest Rate, Percent per annum	IMF International Financial Statistics. Missing values filled with IMF WEO Extended Database Short-term interest rate, or maintaining differential against the US in long-term interest rates.
IPR	Private gross fixed capital formation, Constant 2015 prices, Billions National Currency	Based on investment shares from IMF WEO Extended Database. Where unavailable, based on IMF Investment and Capital Stock Database. Missing values estimated with Asia-Pacific regional average share of total investment.
ITAX	General government taxes on goods and services, Billions National Currency	IMF WEO Extended Database. Missing values estimate from IMF Government Finance Statistics, Revenue Database where available. Where unavailable estimated with Asia-Pacific average revenue share.
ITAXR	Tax rate on goods and services	Derived as ratio of tax on goods and services to nominal consumption
ITR	Gross fixed capital formation (including Acquisitions less disposals of valuables),Constant 2015 prices, Billions National Currency	United Nations Statistics Division National Accounts Main Aggregates Database
K	Capital stock, Constant 2015 prices, Billions National Currency	Derived as accumulation of investment from 1970, applying Asia-Pacific average rate of depreciation
LABSH	Share of labour compensation in GDP at current national prices	Penn World Tables
LFN	Labour Force, 1000s	Derived from total employment and unemployment rate
LIVES	Lives lost from climate shocks (exogenous)	Derived from EM-DAT
LNN	Employment, 1000s	ILO Modelled Estimates

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LNNF	Female employment, 1000s	ILO Modelled Estimates
LOCK	Change in stringency of measures introduced to contain the pandemic	From ESCAP Excel Model, which is sourced from Oxford COVID-19 Government Response Tracker
LRX	Participation ratio	Derived as ratio fo labour force to working age population
LTI	Long-term bond yield, per cent	IMF WEO Extended Database. Missing values estimated from IMF International Financial Statistics Government Bonds rate or Lending rate, or as the country-specific risk premium mark-up over US rates.
MTD	Deflator for Imports of Goods and Services, National currency, 2015 = 100	Derived as the ratio of current price imports in domestic currency to constant price imports in domestic currency
MTN	Imports of goods and services, Current prices, Billions National Currency	United Nations Statistics Division National Accounts Main Aggregates Database
MTN$	Imports of goods and services, Current prices, US$	Derived as imports in domestic currency adjusted by exchange rate.
MTR	Imports of goods and services, Constant 2015 prices, Billions National Currency	United Nations Statistics Division National Accounts Main Aggregates Database
MTR$	Imports of goods and services, Constant 2015 prices, US$ billion	United Nations Statistics Division National Accounts Main Aggregates Database
OGC	Other general government consumption expenditure, Billions National Currency	Derived as government consumption in current prices less a share of expenditure on health and environmental protection
OGI	Other general government investment expenditure, Billions National Currency	Derived as government investment in current prices less a share of expenditure on health and environmental protection
OILC	Oil consumption, Exojoules	bp Statistical Review of World Energy. Missing values estimated based on CO2 emissions from oil and gas flaring from Global Carbon Project.
OMS	Imports of Petroleum, petroleum products and related materials as a share of Total Merchandise imports plus Total Services imports	UNCTAD

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OXS	Exports of Petroleum, petroleum products and related materials as a share of Total Merchandise exports plus Total Services exports	UNCTAD
PC	Domestic price of coal, inclusive of net carbon tax, US$ per Mn kJ	Global coal price per metric ton converted to Mn kJ, plus net carbon tax times carbon per Mn kJ of coal
PCR	Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency	United Nations Statistics Division National Accounts Main Aggregates Database
PE	Domestic price of energy, inclusive of net carbon tax, US$ per Mn kJ	Derived as weighted average of domestic oil, gas, coal and renewable prices. Weights based on consumption shares.
PG	Domestic price of natural gas, inclusive of net carbon tax, US$ per Mn kJ	Global gas price per Mn BTU converted to Mn kJ, plus net carbon tax times carbon per Mn kJ of gas
PM25	PM2.5 air pollution, mean annual exposure, micrograms per cubic meter	World Bank WDI Database. Missing values filled by interpolation.
POIL	Domestic price of oil, inclusive of net carbon tax, US$ per Mn kJ	Global oil price per barrel converted to Mn kJ, plus net carbon tax times carbon per Mn kJ of oil
POPT	Total population, 1000s	United Nations Population Division, World Population Prospects
POPWA	Population aged 15-64, 1000s	United Nations Population Division, World Population Prospects
PR	Domestic price of renewable energy, US$ per Mn kJ	Global average renewable price per kWh converted to Mn kJ
PREM	Country-specific risk premium, basis points.	Derived from Moodys credit ratings, following methodology of Aswath Damodaran. Missing values benchmarked from lending spreads or government bond spreads relative to the US.
PROF	Profits, Billions National Currency	Derived as the non-labour share of nominal GDP less indirect taxes, less depreciation
RC	Consumption of non-fossil fuel energy (nuclear, hydro and renewables), Exojoules	derived from bp Statistical Review of World Energy. Missing values estimated from World Bank WDI series: Renewable energy

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		consumption (% of total final energy consumption)
REFEX	Real effective exchange rate, 2015 = 1	Trade-weighted average of global exchange rates deflated by consumer prices, with weights based on bilateral trade as a share of reporting country total trade. See matrix_equations.prg for details.
REL_RED	Relative redistribution parameter (percentage difference between Gini Coefficients measures in terms of gross and disposable income)	Standardized World Income Inequality Database (SWIID).
REMIT	Inflow of personal remittances, Billions National Currency	Derived from World Bank WDI Database, Personal remittances, received (% of GDP). Missing values set to zero.
REV	General government revenue, Billions National Currency	IMF WEO Extended Database.
REVG	General government revenue, grants, Billions National Currency	IMF WEO Extended Database. Missing values filled from IMF Government Finance Statistics Revenue database where available. Where unavailable, Asia-Pacific average revenue shares are applied to total revenue.
RPDI	Real personal disposable income, Constant 2015 prices, Billions National Currency	Derived to reflect developments in labour compensation, remittances, social protection spending and income tax
SCR	Accumulation of inventories, Constant 2015 prices, Billions National Currency	Derived as residual on national accounts
SDLI	Standard deviation of log income	Derived from Gini coefficient, based on assumption that income approximately follows a lognormal distribution
SOLV	Solvency rule switch (exogenous)	Set to 1 to impose solvency
TAX	General government taxes on income, profits, and capital gains, payable by individuals, plus social contributions, Billions National Currency	IMF WEO Extended Database. Missing values filled from IMF Government Finance Statistics Revenue database where available. Where unavailable, Asia-Pacific average revenue shares are applied to total revenue.
TAXR	Income tax rate	Derived as income tax revenue as a share of income

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TECHL	Labour augmenting technical progress trend, indexed to GDP per employee in 2015	Derived from decomposition of capacity output growth
TFP	Trend TFP growth rate, expressed as log change	Derived as labour share times trend labour augmenting technical progress growth
TOURSH	Travel and transport services exports as a share of nominal GDP (constant)	Derived from 2018 benchmark fuel exports from ESCAP Excel Model, which is sourced from UNCTADStat, Trade structure by partner, product or service category.
URX	Unemployment Rate (ILO definition)	ILO Modelled estimates
URXF	Female unemployment Rate (ILO definition)	ILO Modelled estimates
USER	User cost of capital, per cent	Derived from long-term real interest rate, depreciation rate and corporate tax rate
WDR	Trade-weighted external demand, Constant 2015 prices, US$ billion	Trade-weighted average of import volumes, with weights based on share of NPLs exports. See matrix_equations.prg for details.
XTD$	Deflator for Export of Good & Services, US$, 2015 =100	Derived as ratio of exports in current US$ to exports in constant US$
XTDNO$	Non-oil export price deflator, US$, 2015 =100	Derived from XTD$ and oil share of exports (OXS)
XTN	Exports of goods and services, Current prices, Billions National Currency	United Nations Statistics Division National Accounts Main Aggregates Database
XTN$	Exports of goods and services, Current prices, Billions US$	Exports in domestic currency converted to US$
XTR	Exports of goods and services, Constant 2015 prices, Billions National Currency	United Nations Statistics Division National Accounts Main Aggregates Database
XTR$	Exports of goods and services, Constant 2015 prices, Billions US$	Export volumes in domestic currency converted to US$
YBAR	Survey mean consumption or income per capita, total population (2011 PPP $ per day)	World Bank WDI Database. Missing values interpolated or estimated with GDP per capita.
YED	Deflator for GDP, National Currency, 2015 =100	Derived as ratio of GDP in current domestic prices to GDP in constant domestic prices
YEN	Gross Domestic Product (GDP), Current prices, Billions National Currency	United Nations Statistics Division National Accounts Main Aggregates Database

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YEN$	Gross Domestic Product (GDP), Current prices, US$ billion	United Nations Statistics Division National Accounts Main Aggregates Database
YER	Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency	United Nations Statistics Division National Accounts Main Aggregates Database
YER$	Gross Domestic Product (GDP), Constant 2015 prices, US$ billion	United Nations Statistics Division National Accounts Main Aggregates Database
YFT	Trend output, Constant 2015 prices, Billions National Currency	Derived from sum of filtered productivity growth and labour force growth
YFT$	Trend output, Constant 2015 prices, Billions US$	Trend output in domestic currency converted to US$

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