Using Macroeconomic Frameworks to Analyze the Impact of COVID-19: An Application to Colombia and Cambodia

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TECHNICAL NOTES AND MANUALS

Using Macroeconomic Frameworks to Analyze the Impact of COVID-19: An Application to Colombia and Cambodia

This technical note and manual (TNM) addresses the following issues:

- Evaluating the full implications from the policies adopted to mitigate the impact of the COVID-19 pandemic on the economy requires a well-developed macroeconomic framework. This note illustrates how such frameworks were used to analyze Colombia and Cambodia's shock impact at the beginning of the pandemic.

- The use of macroeconomic frameworks is not to infer general policy conclusions from abstract models or empirical analysis but to help policymakers think through and articulate coherent forecasts, scenarios, and policy responses.

- The two country cases illustrate how to construct a baseline scenario consistent with a COVID-19 shock within structural macroeconomic models. The scenario is built gradually to incorporate the available information, the pandemic's full effects, and the policy responses.

- The results demonstrate the value of combining close attention to the data, near-term forecasting, and model-based analyses to support coherent policies.

CONTENTS

I.   INTRODUCTION

Governments have adopted a variety of policies to mitigate the impact of COVID-19 on their economies, their choices depending on the country's circumstances and the intensity of the shock. Evaluating the macroeconomic implications of these policies requires well- developed macroeconomic frameworks. ICD has helped Armenia, Cambodia, Colombia, Georgia, Ghana, Rwanda, and Vietnam to adjust their current frameworks or adopt new ones to analyze the COVID shock.

ICD technical assistance has helped national authorities to integrate their macro frameworks into policy-making. Because there is a lag between a policy action and the response of the economy, and the strength of policy transmission varies with time, economic policy must be forward-looking. Hence, forecasting and risk assessment are essential to the process of making policy decisions. A forecast should directly inform policy; it can, for example, help extend the policy horizon to the medium term and focus on policy response, avoiding excessive concentration on the near term. A coherent forecast can help ensure that central elements of fiscal, monetary, and other policies are consistent. Scenario analysis can also help policy-makers react to shocks and manage uncertainty. Integration of macro frameworks into the policy process is not, however, the focus of this technical note.[1]

ICD technical assistance (TA) projects are guided by the FP2.0 initiative, which mandates that ICD design and apply a series of macroeconomic frameworks that IMF country desks and country authorities will find useful. The four pillars of the FP2.0 initiative differ in the technical tools used and the degree of complexity embedded in the current macro model. In Pillar I, macroeconomic frameworks are built on Excel, with some projection equations integrated; this pillar emphasizes the accounting relationships of the real, fiscal, external, and monetary sectors. Pillar 2 frameworks incorporate a simple forecasting model. In Pillar 3, the frameworks use a general equilibrium gap model, and in Pillar 4, they are built around a dynamic stochastic general equilibrium (DSGE) model with a rich fiscal sector. Country authorities could benefit from the different pillars depending on the absorptive capacity of the technical staff.

This note uses two country cases to illustrate how macroeconomic frameworks can be used to analyze the COVID-19 shock and the associated policy responses. The goal of using macro frameworks is not to infer general policy conclusions from abstract models or empirical analysis but to help policymakers think through and articulate coherent forecasts, scenarios, and policy responses. In the first case, a DSGE model simulates the effect of COVID-19 in Colombia; the case illustrates how to construct a baseline scenario consistent with a COVID shock. In the second case, a semistructural gap model is used to assess how COVID-19 is affecting the Cambodian economy. Here, the scenario is built gradually to incorporate the pandemic's full effects and the policy responses. The macroeconomic frameworks discussed in the note use structural macroeconomic models; however, traditional Financial Programming frameworks (FP2.0 Pillar 1) can also be used for the analysis.   The models used in the case studies were available at the policy institutions or developed during previous ICD TA missions. All

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[1] See FAD TNM/18/04.

simulations are based on the information available at the beginning of the pandemic with data available until May 2020.

The general equilibrium models used in the case study characterize small and open economies. The models have several nominal and real rigidities. Fiscal policy is described through rules that govern the nondiscretionary behavior of fiscal instruments. The case study models are similar to those used by several policy institutions: the Cambodian gap model has the same basic structure as the IMF's Global Projection Model (Carabenciov et al. 2008a and b; Carabenciov et al. 2013, Coats et al. 2003; Andrle et al. 2013 and 2014); the DSGE model used for Colombia is a single-country model that resembles the IMF GIMF model (Laxton et al. 2010) and models used by the central banks of Norway (Brubakk et al. 2006) and Sweden (Adolfson et al. 2007). For additional details on the models used in this note see Gonzalez et al. 2021, and Baksa, et al, 2020.

DSGEs and semistructural macroeconomic models are regularly used at policy institutions to assess the current macroeconomic conditions and to evaluate policy options. The models' openness and transparency are characteristics that facilitate their evaluation, provide confidence on their results, the underlying assumptions, and the implications of these assumptions for policy simulations. In practice, the use of such models involves a complex iterative process between the model, the model operator (human), and the policymakers (another human) to incorporate judgments and validate the model results. The process helps to overcome model limitations stemming from the fact they are highly simplified descriptions of the real world; incorporate essential information to the analysis; and create realistic scenarios for policy evaluation. The case studies included in this note attempt to illustrate this process: "…policy decisions are made by real people using their best judgment. Used wisely, DSGE models can improve and sharpen that judgment," Christiano et al. (2018)[2].

DSGEs and semistructural gap models are both well-suited to building forecast scenarios that incorporate the COVID-19 impact on macroeconomic variables and conduct counterfactual policy analysis. These models are less subject to the Lucas critique and useful for policy analysis. DSGEs are derived from microeconomic principles, the simulations reflect optimizing behavior. In a DSGE model, the economy is characterized by dynamic equilibrium conditions that are affected by random structural shocks. These models make it easier to identify the structural shocks affecting the economy at any given moment, which informs the policy discussion. Semistructural gap models decompose the macroeconomic variables between gaps and stochastic trends. Well-established macroeconomic relations help distinguish them. The flexibility of the semistructural gap models facilitates forecasting.

The model framework used in the case studies has some limitations in that it relies on linear approximations around a stable long-run equilibrium. This means that it would take substantial fine-tuning and judgment to take into account the implications of nonlinear dynamics, such as exploding government debt, financial crises, or sudden stops that could be triggered after large macroeconomic shocks.

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[2] See Blanchard (2018), Christiano, Eichenbaum, and Trabandt (2018), and Lindé (2018) for a detailed discussion about this modeling framework and its usefulness at policy institutions.

II.   MODELLING THE COVID-19 SCHOCK WITH GENERAL EQULIBRIUM MODELS

An extensive literature has emerged on modeling macroeconomic issues related to the COVID-19 pandemic. One strand has mapped the epidemic based on established structural shocks. For example, Fornaro and Wolf (2020) argue that the COVID shock is similar to a negative shock to productivity growth; Faria-e-Castro (2020) models the pandemic through a large negative demand, such as a shock to the utility of consumption, and Guerrieri et al. (2020) associate the shock with a negative and persistent labor supply shock, mimicking the impact of shutdown and lockdown policies. Buera et al. (2020) show that a transitory lockdown can have persistent aggregate effects through its impact on unemployment and a decline in total factor productivity. Using a model with multiple sectors and input-output linkages, Baqaee et al. (2020) study the effects on aggregate output of negative supply shocks and shocks to the composition of final demand. They find that costly sectoral adjustments amplify the effect of the COVID shock by creating supply bottlenecks and disrupting supply chains. For small open economies, globally synchronized lockdowns and stress in international financial markets create other transmission sources. The fall in global demand reduces exports of goods and services and leads to lower, and more volatile, commodity prices.

A second COVID-19 modeling literature strand consists of attempts to quantify optimal lockdown policies by embedding into standard macroeconomic models' variants of the SIR (Susceptible-Infections-Recovered) disease transmission model. Alvarez et al. (2020), Eichenbaum et al. (2020), Engler et al. (2020), and Ansah et al. (2020) discuss optimal lockdown policies in models where the probability of infection and lockdown policies affect the supply of labor, aggregate demand, and the economic recovery rate.

Other papers evaluate how fiscal and monetary policies might relieve the economic impacts of lockdown policies. It is generally accepted that traditional monetary and fiscal policies are useful if an adverse supply shock leads to a contraction in output larger than the supply shock itself. Guerrieri et al. (2020) argue that fiscal and monetary policies are effective after lockdown shocks. For them, the fall in output and employment observed after the COVID shock is associated not only with the direct supply shock but with inefficient contraction of aggregate demand. The IMF has used an extension of the DIGNAR model to analyze COVID-19 impacts on GDP and public debt in low income countries (Meliana and Zanna, 2020, and Cugat, Melina, and Zanna, 2020).

The empirical COVID-related literature has devised ways to estimate the impact of COVID on aggregate variables. For example, Jordà et al. (2020), using data about historical pandemics, find that in the long run pandemics reduce real interest rates. Chetty et al. (2020) developed a real-time algorithm to track how the pandemic was affecting consumer spending, employment, and other indicators, using data from credit card processors, payroll firms, and financial services firms. Bekaert et al. (2020) use real-time data to distinguish the aggregate demand and supply associated with the pandemic. They find that in the U.S., two-thirds of the GDP contraction observed in 2020 Q1 was

attributable to a negative aggregate demand shock. Li at al. (2020) examine the economic consequences of past severe epidemics since the beginning of the 20th century to shed light on the potential impact of the COVID-19 crisis. They find that severe epidemics have significantly negative effects on growth and debt that last for at least a decade. Narita (2020) estimates the economic impact from a severe health-related shock such as COVID-19 epidemics on lower income and higher income economies. He finds that on average GDP declines more in lower-income economies. For lower income countries, the average decline in real GDP is between 4 and 7 percent, while for higher income economies is 3 percent.

Consistent with the literature, this note's macroeconomic frameworks mimic observed macroeconomic outcomes and policy responses associated with the pandemic through a combination of supply, demand, and external shocks. The frameworks do not directly incorporate transmission and recovery rates into the macroeconomic model, but the simulations incorporate insights from the literature.

The simulations presented here are counterfactual analyses, in which the impact of COVID-19 shock is contrasted with a pre- or no-COVID baseline scenario. The note illustrates how COVID scenarios are constructed in three steps: (1) Build a dataset that incorporates short-term forecasts for some variables that are obtained from auxiliary models or expert judgment; (2) identify the structural shocks consistent with the current state of the economy; and (3) supplement the forecast with expert judgment. The baseline forecast seeks to ensure consistency.

The macroeconomic frameworks incorporate features unique to each country because the strength and transmission of the COVID-19 shock depend on country factors: The degree of dollarization, currency mismatches, size of the commodity sector, current macroeconomic imbalances, and degree of access to capital markets can each magnify the shock. Policy simulations account for fiscal and external imbalances, the stance of monetary policy, and other factors restraining the government response. Minimal fiscal space and questionable public confidence in monetary policy make it difficult for the authorities to counteract the shock.

Colombia is a middle-income country where inflation-targeting (IT) is functioning well, supported by a flexible exchange rate and generally sound fiscal policy. The analysis here employs a large DSGE model to understand how both fiscal and monetary policy interact with various dimensions of the COVID shock. The choice of model responds to the questions of interest to the authorities and recognizes Colombia's high analytical capacity.

The Cambodian economy is characterized by trade and financial openness, a highly managed exchange rate, and limited space for monetary policy. Because the economy is almost completely dollarized, which limits management of monetary policy, the burden of macroeconomic management rests largely on fiscal policy. The choice of a trend-gap model with a rudimentary supply side reflects the relative ease with which such models can generate policy scenarios when

applied to the data.

III. COUNTRY CASES

A. Colombia[3]

In Colombia, the IT regime is paired with a flexible exchange rate and the country's fiscal policy is generally sound. The IT strategy has been successful, and monetary policy is credible. Inflation and inflation expectations have been fluctuating around the target with transitory deviations largely associated with supply shocks. The Colombian economy has benefited from the flexibility of the exchange rate in part because dollarization is nil[4], and there have been no large currency mismatches.[5] **Colombia uses a Medium-Term Fiscal Framework (MTFF) and a structural fiscal rule to implement fiscal policy.** Each year the fiscal rule consultative committee sets the intermediate fiscal target for the nonfinancial public sector's primary balance for the following year and aligns indicative targets for the following 10 years with the fiscal rule. The fiscal rule determines budget policy, links public spending to government revenue, and imposes a structural deficit target. Since this procedure began in 2011, the government has met the fiscal rule targets. For the current COVID-19 emergency, the Ministry of Finance (MF) has invoked the escape clause to suspend the rule in 2020 and 2021, with the agreement of the consultative committee.

The Banco de la República (BR) and the MF requested IMF TA to update Colombia's macroeconomic models and estimate the economic impact of the pandemic.

The TA had two workstreams:
1. Estimate the short-term economic impact of the pandemic.
2. Use a DSGE model to assess its medium- and long-term effects.

The two workstreams are related. In particular, the results from the first exercise are used to inform estimation of the medium- to long-term impact—a procedure that resembles the practice of many central banks of using short-term forecasts (nowcasts) to inform the medium- to long-run forecast of

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[3] We thank Carlos Rojas, Juan Pablo Angel, Nicolas Moreno (all Banco de la República, Colombia), and Steven Zapata (Ministry of Finance, Colombia) for their contributions. For additional information: Andrés González agonzalezgomez@imf.org

[4] In Colombia, asset prices are not set in dollars, dollars are not used as means of payment, and unhedged private dollar-denominated debt is minimal.

[5] Currency mismatches occur when the government or a private agent issues debt denominated in foreign currency, and there is no financial or natural hedge. In Colombia, the currency mismatches are nil, in part because the dollar-denominated debt of the nonfinancial sector in Colombia is only a small proportion of total debt and most of it is hedged. Moreover, careful regulation prevents currency mismatches in the financial sector.

DSGE models. Short-term forecasts are useful sources of information because (1) they summarize expert knowledge and convey information to the forecasting exercise that is otherwise not available, and (2) there are time-series econometric methods that in the short term outperform the DSGE forecast.[6]

Estimating the Short-term Impact of the COVID-19 Shock

To reduce virus transmission and strengthen the health system, the Colombian authorities mandated stringent lockdown measures at the end of March. They began relaxing the lockdown early in May and allowed public works, construction, and manufacturing, with strict health protocols, to restart operations. Together, containment measures and the spread of the disease have had a dramatic adverse impact on production, investment, consumption, unemployment, and consumer confidence; the result has been to spread uncertainty throughout the economy.

To estimate the short-term impact of the COVID-19 shock and the response measures, we use the sectoral analysis framework developed by the IMF Research Department, which sees the effect on each economic sector as a combination of three elements: (1) *events:* defined as the policy actions, especially mandatory lockdowns, taken to contain the spread of the virus (the shock); (2) the *severity:* the output losses associated with these actions (the impact); and (3) the *persistence* of the event as defined by government decrees (persistence of shock and impact).

We identified the *event* as the government's emergency decree that imposed the lockdown. To estimate the *severity* of the lockdown, we considered the interactions between virus dynamics and the strength of lockdown measures: Several high-frequency indicators, such as energy consumption and retail sales, were used to estimate severity in each sector—the estimate reflects not only the direct supply impact but also how it lowered demand as households and firms postponed consumption and investment decisions. We assumed that no second wave of COVID-19 would occur after the second half of 2020 and estimated the *persistence* by assessing the speed of recovery for each sector.

Using data available up to May 2020, we estimated the short-term impact of the shock for each economic sector. The results vary significantly: sectors in which many workers are in contact-intensive occupations were affected more by lockdowns and social distancing; in 2020 those sectors were arts and entertainment, retail trade, transport, accommodation, and food services. The 2020 results suggest a 6.8% y-o-y contraction of GDP. These preliminary results were used by BR and MF as near-term forecasts in their quarterly macroeconomic exercises.

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[6] Del Negro and Schorfheide 2013 found that conditioning on short-term forecasts improves the forecast accuracy of DSGE models.

Although we estimated the short-term impact of the COVID-19 using sectoral analysis, it is possible to use real-time indicators in doing such an estimate (Chetty et al. 2020). An ICD TA mission to Rwanda used real-time data on VAT and retail sales to estimate GDP for 2020 Q1 and Q2. The sectoral approach can also be combined with real-time estimation; the Colombian MF used this extension, and the results are reported in the MTFF (MF 2020).

Estimating the Medium to Long-term Impact

To estimate the medium and long-term impacts of the shock, we used COFFEE, a DSGE model customized for Colombia. COFFEE[7] is a model for a small oil-exporting economy that comprises different types of households and firms and incorporates nominal price and wage rigidities. The model is an overlapping generation DSGE that includes households with and without access to credit and saving instruments. Domestic firms produce a composite good that can be consumed internally, exported, or used by other domestic firms to produce investment goods. Final household consumption and investment goods baskets include both domestic and imported goods. Imports are also intermediate goods in domestic production.

Given the emphasis on analysis of fiscal policy, COFFEE has a comprehensive module that characterizes Colombia's fiscal policy. The government receives revenues and dividends from oil production and taxes on consumption goods (domestic and imported), labor income, household wealth, and the profits of firms and capital producers. Government income is used for spending on consumption, interest payments, transfers to households, and public capital formation. Fiscal deficits are financed with both domestic and foreign debt. The fiscal rule set for the deficit considers the output and oil price gaps.

To enhance the ability of the model to capture essential features of COVID-19, we incorporated in the model shocks to domestic demand and to labor supply. These shocks allow the model to capture contraction of private spending, weakening of financial conditions[8], and the drop in total hours worked associated with containment and social distancing. The domestic private demand shock mimics an overall demand shock that causes private consumption and investment to move in tandem (Smets and Wouters 2007).[9] The labor supply shock affects the disutility of labor and reflects the disincentive of households to supply labor during the pandemic.

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[7] From late 2019 into early 2020, the ICD helped Colombian authorities in drawing up a new framework for fiscal policy analysis. In the TA, Colombian authorities and ICD staff together drafted COFFEE, the Colombian Framework for Fiscal Economics and Evaluation model. COFFEE is a DSGE model that incorporates several country-specific fiscal policy features and instruments. The model was used to simulate the macroeconomic impacts of the 2019 tax reform (*Ley de Crecimiento*). COFFEE is a variant of a model set out in Babajanyan et al. 2020.

[8] In absent of an explicit financial sector this shock captures the effect of financial frictions. The model however lacks feedback loops between the real and financial sectors and is not useful for assessing financial stability issues.

[9]The shock is a wedge between the stochastic discount factor and the domestic and foreign interest rates.

The model was calibrated to align with Colombia's fiscal policy targets and long-run ratios.
Table 1 summarizes the estimated long-term values for the main macroeconomic variables based on historical data (ratios to GDP of private consumption and investment, the trade balance, and the current account balance) and long-term assumptions (GDP growth rate, inflation, and the monetary policy rate). To calibrate fiscal policy variables, we considered the government's headline deficit target of 1% of GDP, consistent with the structural fiscal balance-based rule, and historical data for public revenue and spending. The long-term public debt-to-GDP ratio is consistent with the long-term deficit-to-GDP ratio, the interest rate, and GDP growth. We complemented the model's calibration with a set of priors reflecting the relative importance of each structural shock.

The baseline forecast is built in three steps. First, we built a dataset for 2020 containing data consistent with the shock's short-term impacts. Second, using the model, we estimated the structural shocks consistent with the economy's current conditions. Third, we added expert judgment and assumptions about the future path of the exogenous variables. In practice, each step involves several iterations; the final baseline scenario is the one considered consistent.

Table 1. COFFEE: Calibration of Initial Steady State

	Initial steady state
Macroeconomic Variables	
GDP (constant prices, percent growth)	3.0
Private consumption (percent of GDP)	67.6
Private investment (percent of GDP)	18.3
Public expenditure (percent of GDP)	16.0
Trade balance (percent of GDP)	-1.9
Current account balance (percent of GDP)	-2.8
Inflation rate (percent)	3.0
Monetary policy rate (percent)	5.1
Public Finances (percent of GDP)	
Government income	15.8
Government expenditure	16.0
Primary deficit	0.2
Interest payments	0.8
Total deficit	1.0
Total public debt	17.4

For the first step in forecasting we built a database for 2020 containing information on some of the model's variables. The database includes the GDP estimated using the sectoral analysis from the exercise discussed above. The database also contains estimates for year-end inflation, GDP growth in trade partners, the risk-free interest rate, the current account balance, remittances, oil prices, and the risk premium. These estimates are consistent with those of BR technical staff at the time of the exercise. Government spending and revenue estimates were obtained from the 2020 MTFF. These values capture the increase in spending owed to efforts to, e.g., expand health sector capacity, mitigate household income losses, and contribute to firm liquidity (Table 2).

Table 2. Observable Variables Provided to COFFEE
(Annual estimated value or deviation)

	Value	Source
Percent		
GDP growth	-6.8	IMF - TA
Inflation	2.3	
Trade partners GDP growth	-4.5	BR
Risk-free interest rate	0.5	
Percent of GDP		
Government revenue	15.5	
Government expenditure (exc. debt service)	20.6	MF
Government debt service	3.2	
Current account balance	-3.7	BR
Remittances	1.0	
Percent deviations from Steady State		
Oil price index	-38.8	BR
Risk premium	1.1	

The second step is to identify structural shocks to the economy that are consistent with the observable variables now in the database. This step gives a coherent narrative that incorporates both the historical data and the near-term data-based forecast. To estimate the structural shocks and unobservable variables consistent with the data, we used the Kalman Filter.[10] For 2020, the procedure

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[10] The Kalman Filter links the state space representation of the model with the data. The procedure estimates the unobservable variables (here, exogenous shocks) consistent with the model and the data observed.

identified negative demand and supply shocks, adverse foreign demand shocks, and a negative oil price shock. Partly offsetting these shocks, the model also identified positive fiscal shocks and lower external interest rates shocks (Figure 1)[11]. This combination is consistent with the idea that a COVID-19 shock can be incorporated within the macroeconomic framework through a combination of macroeconomic shocks. Lockdown policies are supply shocks; voluntary social distancing and the fall in firm and household incomes are demand shocks that adversely affect aggregate demand for consumption and investment. Costly intersectoral adjustments associated with the pandemic are a supply shock that affects aggregate productivity. The universality of the pandemic explains the negative shocks to oil and the external interest rate that the statistical procedure estimates.

Figure 1. COFFEE Simulation: Decomposition of Shocks

| a. GPD Level | b. Headline Inflation |

c. Monetary Policy Rate
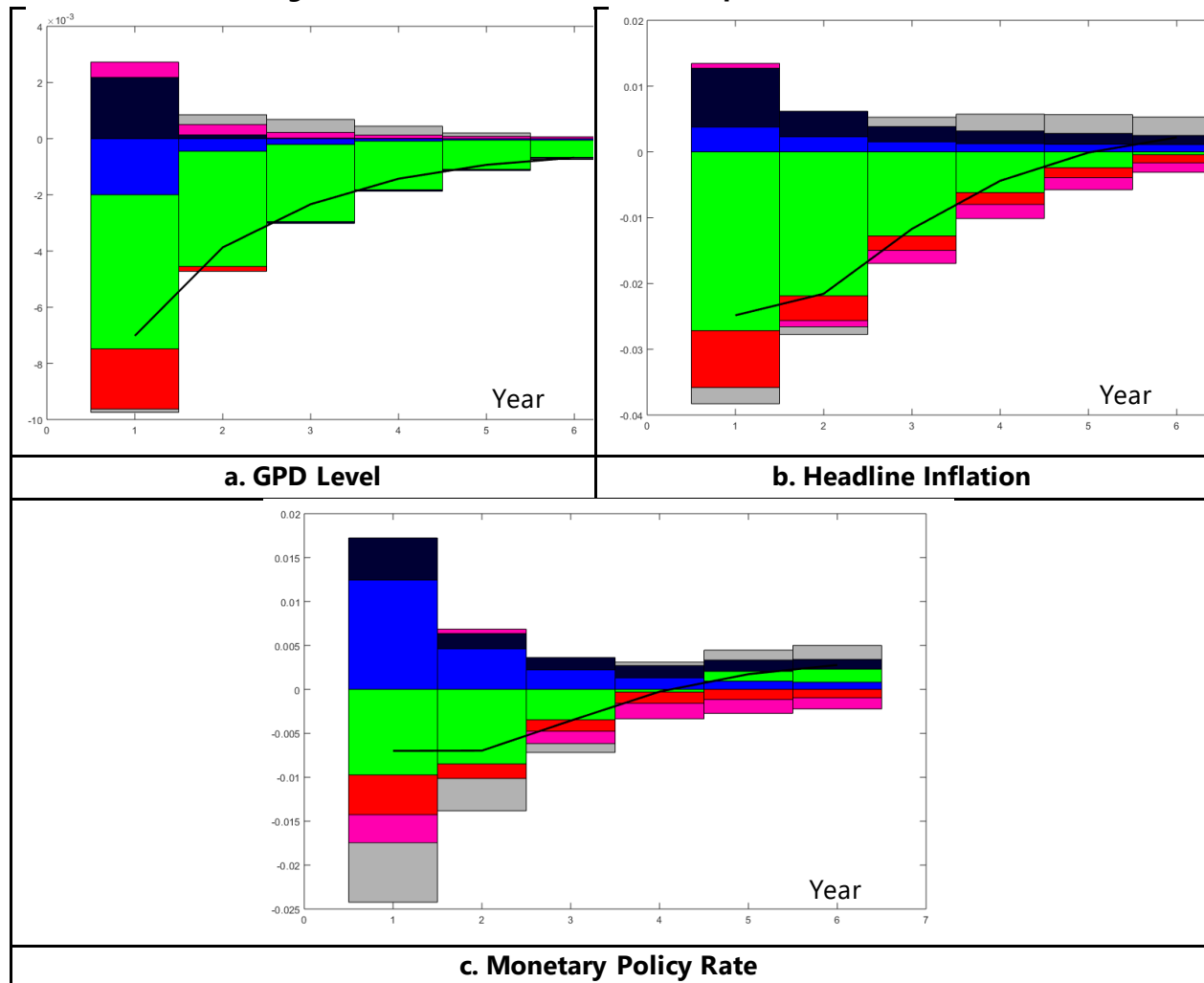
Supply shocks: labor supply and total factor productivity (blue)**. Local demand shocks:** consumption and investment (green)**. Foreign demand shocks:** GDP growth in trade partners and oil price (red)**, Fiscal shocks:** government expenditure (black)**. Foreign shocks:** Risk-free interest rate and risk premium (pink)

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[11] The persistency of the shocks is consistent with previous estimates at the BR and adjusted to reflect the likely duration of the pandemic based on the expected duration of the lockdowns and social distancing measures.

In the simulations, both fiscal and monetary policies are expansive. In line with the view that traditional monetary and fiscal policies are useful if there is an inefficient contraction of the aggregate demand after a shock. The mixture of demand and supply shocks identified leaves room for expansive fiscal and monetary policies to counteract the fall in demand. Structural measures are needed to diminish the scarring effects of the pandemic on long-term productivity and employment. In the last step, to complement the forecast we added expert judgment for the exogenous variables. The COVID scenario is driven by the decaying effect of the structural shocks estimated in the second step and complemented by the following expert assumptions:

1. A permanent negative oil price shock, implying a different steady-state for GDP owed to income-related channels (Fernandez et al. 2018)
2. Shocks to foreign interest rates, reflecting the expected lower-for-longer US Federal Reserve monetary policy rate.
3. Shocks to spending to reflect the path presented in the 2020 MTFF. These shocks are consistent with the fiscal stimulus package to counteract the effects of COVID-19.

The simulation suggests a permanent loss in GDP, a reduction in private investment and consumption, a fall in inflation, and a larger public debt-to-GDP ratio.[12] The permanent contraction in GDP comes from destruction of jobs and firms, lower productivity, and lower oil prices. While there is permanent damage to supply, in the near term the damage is greater when households and firms postpone consumption and investment decisions because of precautionary saving, voluntary social distancing, and lower incomes due to job losses. The trade deficit narrows because of a significant contraction of imports that more than offset the fall in exports. This prolonged demand contraction is expected to keep inflation below target for some time, though it may be partly offset by loose fiscal and monetary policy. The monetary policy rate declines in response to the drop in inflation and the negative output gap; the fiscal deficit expands to 8.2% of GDP; and public debt reaches 65.5%. Higher interest payments on public debt, higher government spending, and lower revenues explain the fiscal outcome. After 2021, the easing of lockdown policies and the recovery of private demand would bring GDP growth close to 4%.

Because of low foreign interest rates, a gradual recovery of household and firm confidence, and a loose fiscal policy, the scenario shows slow but smooth normalization of the economy (Table 4). The improvement in private investment and sustained public spending will contribute to the recovery. Given job losses and lower income, private consumption would continue to be depressed over the next few years. The public debt-to-GDP ratio is expected to rise in 2020 before beginning to decline.[13] Debt service could hold at about 3% of GDP. Spending needs, and the commitment to

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[12] The preliminary simulation results are not the official forecast of Banco de la República or the Ministry of Finance.

[13] According to the MTFF 2020, the government expects the public debt-to-GDP ratio to decline in 2021.

achieve a public deficit of just 1% of GDP, imply that fiscal revenues should go up by about 2% of GDP by 2022.

Table 3. Main Macroeconomic Variables After Covid-19

	2020	2021	2022	2023	2024	2025
Macroeconomic Variables						
GDP (constant prices, percent growth)	-6.8	4.8	4.6	4.0	3.5	3.3
GDP level (model units)*	9.6	9.7	9.9	10.0	10.1	10.1
Private consumption (deviation from ss in % of GDP)	-0.2	-0.9	-1.3	-1.3	-1.2	-1.1
Private investment (deviation from ss in % of GDP)	-4.5	-2.0	-0.3	0.5	0.8	0.8
Public expenditure (deviation from ss in % of GDP)	4.2	2.3	1.5	1.1	0.9	0.8
Trade balance (percent of GDP)	-1.6	-1.4	-2.0	-2.4	-2.6	-2.6
Current account balance (percent of GDP)	-3.7	-2.9	-2.6	-2.4	-2.4	-2.4
Remmitances (percent of GDP)	1.0	1.8	2.0	2.0	2.1	2.1
Inflation rate (percent)	2.3	2.4	2.4	2.7	2.8	2.8
Monetary policy rate (percent)	2.7	3.0	4.0	4.6	4.9	5.1
Public Finances (percent of GDP)						
Government income	15.5	16.3	17.8	18.2	18.6	18.9
Government expenditure	20.6	18.7	17.9	17.6	17.3	17.2
Primary deficit	5.1	2.4	0.2	-0.7	-1.3	-1.8
Interest payments	3.2	2.8	2.9	3.0	3.0	2.9
Total deficit	8.2	5.2	3.1	2.3	1.7	1.2
Total public debt	65.5	69.1	67.9	66.1	63.9	61.4

Units are specified for each variables within the table

* Per capita and adjusted for productivity growth

B. The Cambodia TA project[14]

Cambodia's macro-framework is characterized by trade and financial openness, a stable exchange rate, and little space for monetary policy. Since trade and the capital account were liberalized after the internal conflict ended in 1998, Cambodia has averaged real GDP growth of 7¾ percent, with inflation averaging about 4 percent. Growth has been driven by garment exports, tourism, and

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[14] For additional information: Dyna Heng DHeng@imf.org.

construction, much of it funded by foreign investment. Openness to trade and capital flows and a stable exchange rate has boosted growth; together, tourism and light manufacturing represent one-third of the country's GDP. However, openness has also heightened its external vulnerability, especially given its narrow economic base and significant dependence on foreign funding. The economy is almost completely dollarized; and the monetary framework consists of a highly managed and stabilized exchange rate and an open capital account.

The burden of macroeconomic management is therefore borne largely by fiscal policy. Operationally, the government has been running a small surplus on the current balance, with foreign grants and concessional lending covering most capital spending. Gross external debt has stabilized at about 30 percent of GDP. With limited market access, the government has accumulated fiscal deposits, which, equal to about 15 percent of GDP at the end of 2019, act as buffers. All government borrowing is on concessional terms from multilateral institutions and bilateral donors.

In 2019 the Cambodian authorities requested TA on model-based financial programming, FP2.0, that would allow them to consistently simulate the impact on the economy of various domestic and external shocks. The TA is building the capacity of the MF core group to carry out macro-fiscal forecasting and policy analysis; this was linked to a continuing effort to build a Medium-Term Budget Framework (MTBF).[15] When the COVID-19 shocks hit, efforts turned to using the new tools to assess its impact and consider policy responses.

Building the CAMFI Model for Cambodia

The IMF team and the MF core group built and calibrated the model and then applied it to the Cambodian data. The model contains, in addition to the usual aggregate demand, supply, and uncovered interest rate relationships a rudimentary fiscal and debt-accounting block. The key challenge was to capture the idiosyncratic characteristics of Cambodia's economy, such as, almost complete dollarization.[16] To this end, the dollarization regime is approximated by the exchange rate peg version of the UIP condition and the credit risk premium in the IS curve. The team then used several applications to examine how it was working: impulse response functions, multivariate filtration to obtain unobserved variables, and testing the model's in-sample forecasting capability. In general, the model results conform to empirical analyses of the Cambodian economy, reproduce the main stylized facts, and generate intuitive and easy-to-understand policy scenarios. It has thus proved useful for simulating the medium-term economic impact of COVID-19 on Cambodia.

The semistructural CAMFI model is similar to those used for policy analysis in many central banks and often referred to as trend-gap models; they have been introduced to many countries in the

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[15] The working name is the Cambodia Macro-Fiscal model (CAMFI)—for technical details and policy application see Baksa, Bulíř, and Heng 2020.

[16] Deposits, saving, loans, and payment are largely transacted in US dollar in Cambodia.

context of TA on the IMF Forecasting and Policy Analysis System (FPAS). We have incorporated into the model a rudimentary fiscal and debt accounting block, re-cast annually and calibrated to capture the details of Cambodia's macroeconomic policies. This is motivated by the fact that with dollarization and a de facto peg regime limiting monetary policy, the authorities have relied more on fiscal policy to stabilize the economy. The model blends the New Keynesian emphasis on nominal and real rigidities, the role of aggregate demand in determining output, and the real business cycle methods of DSGE modeling with rational expectations (Berg et al. 2006; Adrian et al. 2018). Rather than deriving our baseline model strictly from microeconomic foundations, we pragmatically allow adaptive as well as rational expectations and substantial inertia in the equations to match the data.

The CAMFI model has five building blocks (Figure 2): (1) aggregate demand (IS curve); (2) price-setting (Philips curve) that relates inflation to the output gap, exchange rate, oil prices, and past and expected inflations; (3) uncovered interest rate parity; (4) the monetary regime; and (5) the fiscal policy response, which captures the behavior of fiscal authorities.

Figure 2. Key Links in the Macrofiscal Model
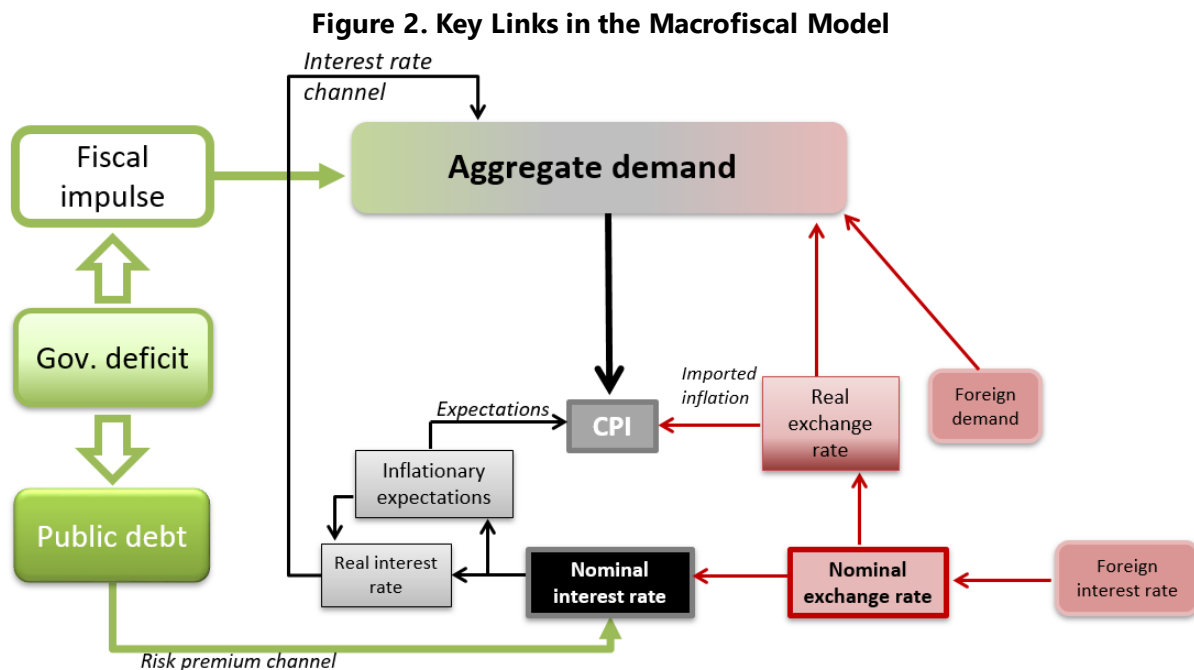
Source: Baksa, Bulíř, and Heng (2020).

Simulation of COVID-19 Macroeconomic Effects Using the CAMFI Model

COVID-19 affected Cambodia on several fronts. Due to the flexible and minimalistic assumptions of the FP 2.0 on about aggregate macroeconomic variables, it is relatively easy to incorporate external and domestic elements of the current recession. Externally, the lockdown measures in major economies led to the collapse of tourism in Cambodia, a significant drop in garment exports, and a massive drop in remittances. Domestically, domestic activity fell, not only because of reduced income

from abroad but also because of pandemic containment measures that included border closures and restrictions on movement. Before the pandemic, growth in 2020 had been projected at 6.8 percent, supported by strong external demand and continued foreign investment.

Using the CAMFI model, our analysis of the COVID-19 impact is informed by three layers of assumptions: (1) a recession in trading partners affects demand for Cambodia's exports and leads to a collapse in tourist arrivals; (2) a second-round impact affects domestic demand and supply and the country risk premium, working mostly through the expectations channel; and (3) the government introduces a fiscal stimulus to mitigate the impact from the previous two layers. The scenario is then compared with the baseline built around the pre-pandemic October 2019 *World Economic Outlook* (WEO) growth projection.

For the first layer, economic activities are assumed to decline most in France, Germany, the US, and the UK (Figure 3). We also assumed that the US Federal Reserve will keep the policy rate at or near zero in 2020 and 2021 before gradually lifting it. Oil prices plunge in 2020 and are assumed to recover only slightly in 2021. Foreign assumptions are consistent with the WEO and the country-level expert knowledge of the Asia and Pacific Department (APD) team in the IMF.

The second layer captures a decline in domestic demand driven by the drop in private consumption and investment. Analyses of Cambodian national account data, input-output tables, and the experience from the global financial crisis (GFC) suggest that domestic demand decreases by an additional 2 pp each year in 2020 and 2021, and the country's risk premium goes up by 200 basis points each year in 2020 and 2021 due to tighter financial conditions. Food prices rise due to hoarding. In the second layer, we also make a judgment call about medium-term supply-side disruptions: tourism travel restrictions extending into 2021, or even 2022, and a sustained decline in demand for Cambodia export goods are likely to slow investment in both physical and human capital. The corresponding slowdown in productivity growth and disruption in supply chains would depress potential GDP for some time. We therefore envisage drops in potential GDP of 4.5 percentage points (pp) in 2020 and 3.5 pp in 2021, but they should fully dissipate by 2024. The judgment call was guided by estimated declines during past pandemics in the natural rate of interest (Jordà et al. 2020).
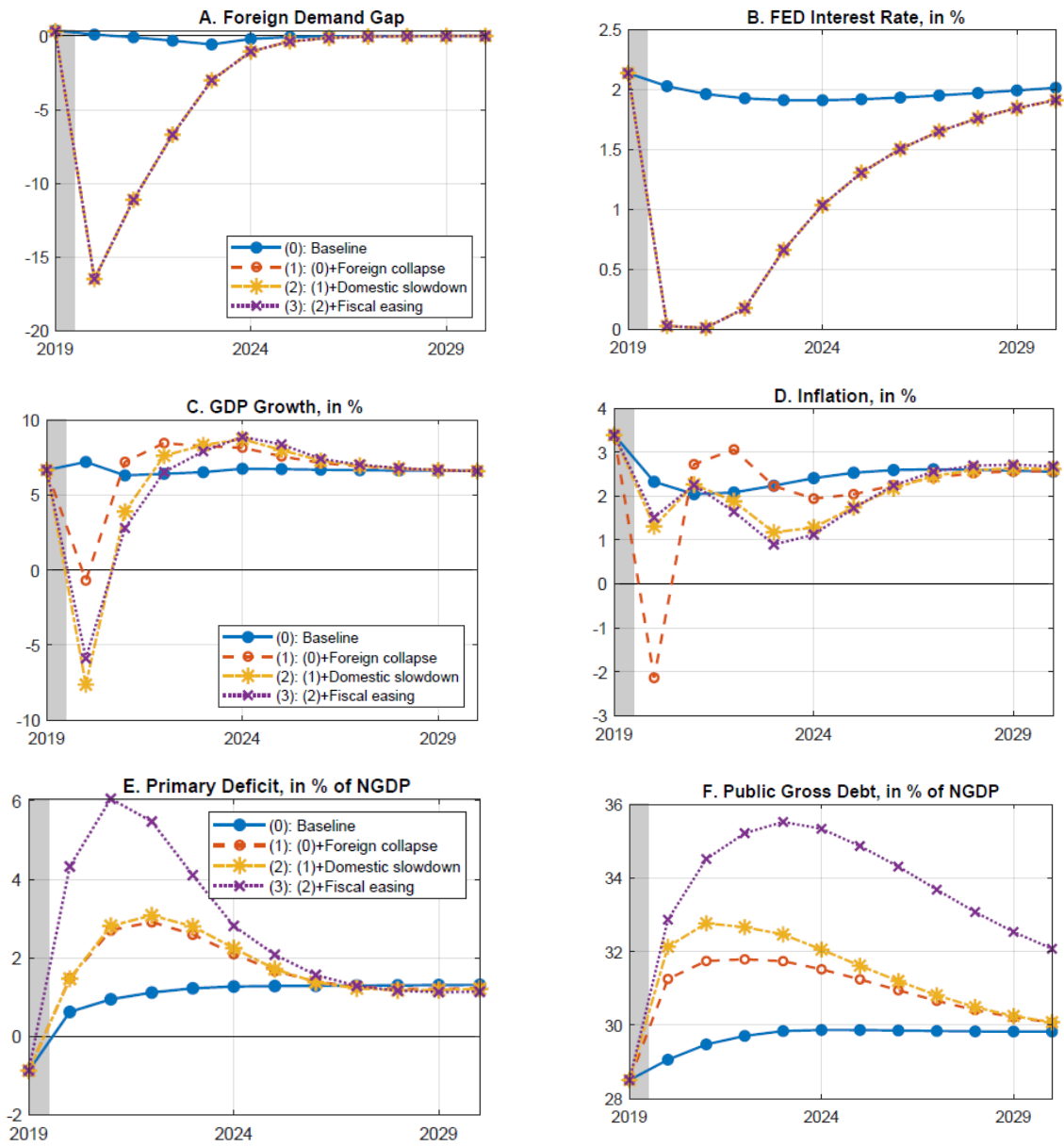
The final layer of the COVID-19 scenario captures the impact of a possible discretionary fiscal policy response. We expect the public debt target to go up by 5 pp in 2020 and return only gradually to the original level.

Simulation results suggest a deep recession in 2020 before a gradual recovery starting in 2021. As shown in the third chart in Figure 5, in the first layer, the recession in advanced economies can bring Cambodia's growth down to -1¼ percent in 2020 compared to the baseline projection of 6 percent. In the second layer, domestic demand and supply slow economic growth to -8¼ percent. Headline

inflation is projected to decline slightly due to economic slack and lower oil prices. These two factors offset the 4-pp increase in domestic food prices due to households hoarding foodstuff. In the third layer of our scenario, we expect the fiscal stimulus to boost real growth by about 2½ percent, bringing GDP growth to -5¾ percent. The economy will start recovering in 2021, growing at more than 2 percent and in 2022 closing the output gap.

The fiscal stimulus has only a short-lived impact on growth—we expect only a temporary increase in the debt target, similar to the GFC episode. The results of the fiscal stimulus layer should be interpreted with a caveat: The model assumes a fiscal multiplier of 0.5 based on cross-country experience. Should the fiscal multiplier be lower, the effect of the fiscal stimulus will also be smaller. The case for a smaller fiscal multiplier can be based on the limited effectiveness of the spending, lags in budget implementation, and import leakage. An easy-to-implement sensitivity test of the scenario is a prolonged period of a higher debt-to-GDP ratio and its medium-term impact on the economy and fiscal balances.

Figure 3: Key Variables and Results

A. Foreign Demand Gap

B. FED Interest Rate, in %

C. GDP Growth, in %

D. Inflation, in %

E. Primary Deficit, in % of NGDP

F. Public Gross Debt, in % of NGDP

(0): Baseline
(1): (0)+Foreign collapse
(2): (1)+Domestic slowdown
(3): (2)+Fiscal easing

IV. COMPARING ALTERNATIVE APPROACHES

The two case studies are similar in many respects. In both, the COVID scenario identifies supply, demand, financial, and external factors as the fundamental transmitters of the pandemic to the

economy. Aggregate demand plays a dominant role, suggesting a negative output gap and a drop in inflation. In the longer term, adverse productivity shocks take a toll on output and national incomes. The expected adjustment would push up growth rapidly in 2021; the output gap will be negative for several years, but fiscal and monetary policies will be effective in supporting recovery.

There are significant differences that make clear the advantages of working with each type of model. The semistructural gap model can complement data analysis and help guide discussion of fundamental policy issues. It can be easily adapted to alternative monetary and exchange rate regimes and applied to the data. The COVID scenario can be worked out in three layers: (1) external demand shock, (2) domestic demand and supply response, and (3) fiscal adjustment. The fiscal stimulus has only a brief impact on growth, and the scenario permits only a temporary increase in the debt target. Furthermore, the relatively small fiscal multiplier of 0.5 limits the smoothing ability of the government.

The DSGE model gives a more granular identification of shocks and transmission channels. In Colombia's macroeconomic adjustment, the current account is expected to shrink due to import compression and lower remittances. The adjustment is consistent with the deep contraction of investment and private consumption. Depreciation of the nominal and real exchange rates facilitates external adjustment through income and substitution effects. The fall in fiscal revenue and the rise in spending causes the fiscal balance to deteriorate and leads to fiscal adjustment in the medium term. In the baseline COVID scenario, the fiscal adjustment uses transfers to households, theoretically non-distortionary fiscal instruments; however, the authorities constructed alternative policy scenarios for their internal policy discussion using other fiscal instruments, such as public investment and consumption.

These two examples give a sense of how CD in macroeconomic frameworks can help countries to deal with the COVID-19 shock. They give an inevitably incomplete picture, in terms of both the depth and the range of possible analytical approaches and country applications. They nonetheless show the value of combining close attention to the data, near-term forecasting, and model-based analyses to support coherent policy-making. Table 5 details the exercises.

Table 4: Case Study Exercises Compared

	COLOMBIA	CAMBODIA
Model type	DSGE	Semi-structural Gap
Country features	Small open economy oil exporter IT regime with a flexible exchange rate.	Small open economy, highly dependent on trade partners and dollarized.
COVID Scenario		
Domestic shocks associated with the COVID pandemic	Labor disutility, financial liquidity shock, government spending, total factor productivity shocks, external output shock	Shocks analyzed: IS curve, external output gap, foreign interest rate, fiscal impulse, potential output, spread
External shocks	Oil prices, foreign interest rates, country risk premium shocks	External output, foreign interest rates
Shocks with permanent effects	Permanent fall in oil prices, productivity shocks	Permanent shock to potential output
Use of short-term forecast	Input output tables complemented with government estimates of inflation, nominal interest rate, and fiscal variables.	Real time indicators
Frequency	Annual	Annual
Identification of initial conditions	Kalman Filter and judgment	Kalmar Filter and judgment
Judgment on medium-term forecast	Oil prices, external interest rate, and government spending	External output, foreign interest rate and government spending.

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