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Policy Rules and Large Crises in Emerging Markets*

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Abstract

Emerging economies have adopted fiscal and monetary rules to discipline government policy. We study the value and macroeconomic implications of rules and flexibility within a sovereign-default model that incorporates domestic fiscal and monetary policies and long-term external debt. Adopting monetary targets and debt limits during normal times yields welfare gains. Suspending rules can significantly influence policy, macroeconomic outcomes, and welfare during large, unforeseen crises. The gains from flexibility depend on how quickly policymakers are able to reimpose rules after the crisis.

JEL Classification: E52, E62, F34, F41, G15.

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1 Introduction

Since the early 2000s, emerging economies have increasingly adopted rules to strengthen their fiscal frameworks, promote debt sustainability, and increase the credibility of fiscal and monetary policies. However, the COVID-19 shock led to the widespread use of escape clauses and *ad-hoc* suspensions or modifications of these rules to support domestic economies.[1]

In this paper, we study the value of fiscal and monetary rules in emerging markets and the merits of flexibility during large crises. We build on Espino, Kozlowski, Martin, and Sánchez (2024), EKMS hereafter, which models domestic policies and sovereign default in small open economies. Notably, we extend the model to include policy rules and long-term debt to understand the role of constraining government policy, during both normal times and crises. Imposing constraints on domestic policies seems natural in emerging economies, as they are often blamed for poor macroeconomic performance.[2] Debt duration also plays an important role, as rules may be used to correct, among other things, excessive indebtedness due to a debt-dilution problem which is absent with one-period debt—see Hatchondo, Martinez, and Sosa-Padilla (2016). Our analysis focuses on Latin America, where the risk of default is always relevant and a reflection of weak institutions and the nature and magnitude of the shocks regularly hitting these economies.[3]

The environment we consider is a tradable-nontradable (TNT) small open economy, as in Uribe and Schmitt-Grohé (2017). Firms produce non-tradable goods and exported goods; agents consume non-tradable goods and imported goods. As in EKMS, consumers need money to make their purchases, which gives rise to a demand for fiat money.[4] On the expenditure side, the government provides a valued public good and makes transfers to individuals. The government finances its expenditures with labor taxes, money creation,

[1] We describe how governments in Latin America responded to COVID-19 in Appendix D.

[2] For example, see Kehoe, Nicolini, and Sargent (2020).

[3] Fraga, Goldfajn, and Minella (2003) use the example of the challenges with inflation targeting in Brazil when, in 2002, it faced a sudden drop in capital inflows that led to a nominal depreciation of 50% and a large gap between the inflation target and actual inflation.

[4] Though we model domestic government liabilities as fiat money, one could interpret them more generally to include debt issued domestically in local currency.

and long-term external debt issued in foreign currency. The government cannot commit to future policy actions except when specific policy rules are imposed.

We study two classes of policy rules: a monetary rule, which fixes the money growth rate, and a fiscal rule, which limits the level of debt. We choose the optimal values for each rule, first on their own and then combined, assuming they are chosen in an economy without macroeconomic shocks.[5] These policies are equivalent to other policies adopted in emerging markets. For example, fixing the money growth rate is equivalent to targeting the long-run inflation rate.

We find that fixing the money growth rate below its long run value under discretion yields positive welfare gains. These gains are maximized at slightly negative rates, but can turn negative if the rate is set too low. Monetary rules trade off the cost of imposing a sub-optimal policy mix and the gains from mitigating a time-consistency problem in debt issuance due to how future policies affect current money demand. While previous research have found similar results in a closed economy without sovereign default (e.g., Martin, 2015), we show that this is also the case in a small open economy with sovereign default risk.

The optimal fiscal rule, which sets a ceiling on the amount of debt below the discretionary level, yields significant welfare gains. A debt ceiling alleviates the debt-dilution problem arising when governments issue long-term debt. Putting a debt ceiling that is not too tight goes a long way in overcoming this problem. These findings align with those in the literature.[6]

When monetary and fiscal rules are combined, we find it optimal to set the money growth rate slightly lower than when imposed on its own, while the optimal debt ceiling remains the same. The welfare gains associated with optimally combining the two rules are significantly larger than the sum of imposing each rule individually, underscoring their complementarity.

Having determined optimal policy rules during "normal times", we use the COVID-19 pandemic as a natural experiment, capturing the type of large, complex and unpredictable

[5]The optimal prescription for these rules remains fairly similar when we add shocks to the terms of trade, though the associated welfare gains are lower.

[6]For example, Hatchondo, Roch, and Martinez (2022) find that borrowing limits are beneficial in a sovereign default model that abstracts from monetary policy.

crises that often hit emerging countries. Specifically, we study the case of an economy that experiences a combination of adverse shocks: lower productivity, increased government transfers, increased trade costs, and increased demand for liquidity. These shocks are unexpected and severe, and they last a year.[7] By construction, the combination of shocks, or crisis, reproduces the main impact of COVID-19 during the first year of the pandemic: a drop in real GDP, an increase in government expenditure, a contraction in imports, a fall in inflation, and a rise in credit spreads.

Our benchmark scenario follows the experience in Latin America: fiscal and monetary rules are suspended during the crisis and reimposed immediately afterward. The government's response to the crisis involves a rise in the fiscal deficit, a significant portion of which is monetized, leading to higher inflation in the following period. The simulated response replicates the direction of the impact of COVID-19 on several non-targeted macroeconomic variables, such as the drop in employment and exports, the decrease in tax revenues, the increase in debt-to-GDP, and the depreciation of the currency. Our estimate of the welfare cost of the crisis is high: households would be willing to forgo 13% of non-tradable consumption to avoid it.

We consider three counterfactual scenarios: (i) both fiscal and monetary rules remain imposed during the crisis; (ii) only the monetary rule is suspended during the period of the crisis; and (iii) only the fiscal rule is suspended during the period of the crisis. For (ii) and (iii) the suspended rule is reimposed right after the crisis ends, while the other rule remains in effect throughout. We draw several lessons from these exercises.

When policy rules are imposed at all times, the government is severely limited in its ability to implement stabilization policies. Hence, the dynamics of taxes, inflation, and currency depreciation differ significantly from the benchmark scenario, when rules are suspended. The lack of countercyclical fiscal and monetary policies implies a sharper decline in real GDP, employment, imports, and exports. We find that households would be willing to forgo 0.83% of non-tradable consumption to be able to suspend both rules during the crisis.

[7] We also analyze the effects of increasing the duration of the crisis.

We find that the gains from suspending the monetary rule exceed those from suspending the fiscal rule. The reason is that, even when both rules are suspended, the government does not significantly increase debt, so the constraint on debt is not too tight (i.e., lenders already impose enough discipline on debt issuance, so flexibility is not as valuable). In contrast, the government would like to respond to the crisis with a loose monetary policy, which would be significantly curtailed if a monetary rule were in place.

The gains from suspending rules rely on the commitment to reimpose them immediately after the crisis ends. An unanticipated one-period suspension offers both the benefits of flexibility today and the benefits of constraining policy in the future. However, suspending a rule may severely limit the capacity to reimpose it. In extreme cases, the only alternatives may be to never suspend a rule or to abandon it forever. With this concern in mind, we compute counterfactuals in which the government abandons rules (both fiscal and monetary or each of them separately) when the COVID-19 shock hits the economy. We find that: (i) on impact, the responses of most macro variables are similar to those during suspension; (ii) the main exception is that abandoning the fiscal rule causes sovereign debt spreads to increase significantly more; and (iii) there would be large welfare losses associated with abandoning rules, mostly due to removing the debt ceiling and, thus, forgoing its significant long-term benefits. The lesson here is that there are welfare gains from suspending fiscal and/or monetary rules during crises if and only if reimposing the rules after the crisis remains credible.

We assess the robustness of our findings in relation to the type of shock affecting the economy, the duration of the crisis, and the duration of rule suspension beyond the crisis period. We find that the shock to liquidity demand is the most relevant for the gains from flexibility in monetary policy, while the shock to productivity is the most important for flexibility in fiscal policy. We also show that if the crisis had been expected to last two years instead of one, lenders would have constrained sovereign debt markets even more, resulting in larger credit spreads during the crisis and eliminating most of the gains from suspending the debt ceiling. Finally, we find that countries can safely delay reimposing rules for a few years after a crisis ends but that significantly delaying their reimposition may lead to (potentially large) welfare losses.

Related literature. The main framework is related to the literature on sovereign default started by Eaton and Gersovitz (1981) and the quantitative models proposed by Aguiar and Gopinath (2006), Arellano (2008), Hatchondo and Martinez (2009), and Chatterjee and Eyigungor (2012). However, we incorporate fiscal and monetary policy as in EKMS.

The analysis of fiscal policy connects with Cuadra, Sánchez, and Sapriza (2010) and Bianchi, Ottonello, and Presno (2023), which argue that fiscal policy is procyclical when default risk is taken into consideration.[8] More closely related is the analysis of fiscal policy rules in the context of sovereign default in Hatchondo, Roch, and Martinez (2022). They show how the fiscal rules are beneficial by preventing debt dilution. Since they do not consider a monetary economy, they miss the interplay between monetary and fiscal policy rules. In addition, their analysis does not consider the cost of sustaining a rule during a large unexpected shock.

There are a few relevant papers that connect to monetary policy by analyzing different exchange rate policies. Na, Schmitt-Grohé, Uribe, and Yue (2018) shows that, with a downward nominal wage rigidity, an exchange rate devaluation is optimal in periods of default. Bianchi and Sosa-Padilla (2023) complements the analysis by showing that in this context countries have incentives to accumulate reserves. In addition, Bianchi and Mondragon (2021) finds that not being able to adjust the exchange rate leaves a government more vulnerable to self-fulfilling crises. Also connected to monetary policy is the work of Arellano, Bai, and Mihalache (2020). They study a monetary policy rule in a cashless economy. Their focus is in understanding the commovement of inflation and sovereign risk in countries with inflation targeting.

The most recent paper related to our work is Arellano, Bai, and Mihalache (2024), which also studies the effects of the COVID-19 shock on emerging economies. They argue that

[8]See also Karantounias (2019) and Pouzo and Presno (2022).

default risk may limit the response to the epidemic and, consequently, find substantial gains from debt relief. In contrast, we only use COVID-19 as a benchmark of a shock with large economic consequences. We analyze how emerging markets cope with it by adjusting external debt and domestic fiscal and monetary policies.

Our paper also connects this paper and the literature on political economy and rules focused on developed economies. Azzimonti, Battaglini, and Coate (2016) studies balanced budget rule in a non-monetary economy where a legislature makes policy choices. Martin (2015) studies the effects of increasing central bank independence and adopting inflation targets. Martin (2023) analyzes fiscal rules and their effectiveness for curbing government spending in a monetary economy in which the government is prone to overspending. Notably, these papers abstract from long-term debt and default, which play important roles in our setup.

2 Model

We first present the model and define the equilibrium in the absence of fiscal and monetary rules. Then, we describe the restrictions imposed by policy rules.

2.1 Environment

We study a small open economy populated by many identical infinitely-lived agents. Time is discrete. In our recursive formulation, a variable's prime indicates that it corresponds to its value next period. Hence, $x \equiv x_t$ and $x' \equiv x_{t+1}$.

Preferences, endowments, and technology. There are three private goods in the economy. First, there is a non-tradable good that is consumed and produced domestically; these quantities are denoted c^N and y^N, respectively. Second, there is a tradable imported good that is consumed domestically but not produced. Let c^T denote the consumption of this imported good. Third, there is a tradable export good that is not consumed domestically and is only produced to be exported. Let y^T denote the production of this export good.

There is also a public good provided by the government. A linear technology transforms one unit of the non-tradable good into one unit of the public good, g.

The representative household is endowed with one unit of time each period, which can be either consumed as leisure, ℓ, or supplied in the labor market, h. Thus, $\ell + h = 1$.

A time-separable, expected discounted utility function represents preferences. Let the period utility be given by

$$u(c^N, c^T) + v(\ell) + \vartheta(g),$$

where u, v, and ϑ are strictly increasing and strictly concave (C^2) and they satisfy standard boundary conditions. Let $\beta \in (0, 1)$ denote the discount factor. In what follows, u_j denotes the partial derivative of u with respect to the consumption good c^j, with $j = \{N, T\}$; v_ℓ denotes the derivative of v with respect to $\ell = 1 - h$; and ϑ_g denotes the derivative of ϑ with respect to g.

An aggregate production technology transforms hours worked, h, into non-tradable output, y^N, and exportable goods, y^T. This technology is represented by a cost function $F : \mathbb{R}^2_+ \to \mathbb{R}_+$, which is strictly increasing, strictly convex, and homogeneous of degree one.

Feasible levels of (y^N, y^T, h) must satisfy

$$A(I)F(y^N, y^T) - h \leq 0. \tag{1}$$

The technological parameter $A(I)$ refers to the inverse of total factor productivity. It depends on whether the government is paying back its debt or is in default, as indicated by $I = \{P, D\}$. This technological parameter will experience one of the shocks we use to model an unexpected crisis in Section 5.

Market structure. Agents can exchange both tradable and non-tradable goods, as well as domestic currency (fiat money). Trading of other financial assets is restricted to the government. Prices are denominated in domestic currency (i.e., pesos) and given by P^X, P^M, and P^N for exports, imports, and non-tradable goods, respectively. Let W denote the nominal wage in units of the domestic currency. Let M^d denote individual nominal money holdings.

The nominal exchange rate E is defined as the units of domestic currency necessary to purchase one unit of foreign currency (i.e., pesos per dollar). There is a cost, $\phi \geq 0$, to trade internationally. This trade cost will experience an unexpected shock during the large crisis modeled in Section 5.

The law of one price holds for tradable goods, and so $P^X = Ep^T(1-\phi)$ and $P^M = E(1+\phi)$, where the international price of export goods is denoted by p^T and the international price of imported goods is assumed to be equal to 1. Thus, p^T also stands for the terms of trade, while $\frac{p^T(1-\phi)}{(1+\phi)}$ denotes *effective* terms of trade.

In order to study a stationary environment, we normalize nominal variables by the stock of the money supply, M. Let μ denote the growth rate of the money supply, and so, $M' = (1+\mu)M$ denotes its law of motion. Define the corresponding normalized variables as $p^N = P^N/M$, $w = W/M$, $e = E/M$ and $m = M^d/M$.

Households face a cash-in-advance constraint to purchase non-tradable goods so that

$$p^N c^N \leq \theta m, \tag{2}$$

i.e., (normalized) expenditure on non-tradable goods, $p^N c^N$, cannot exceed (normalized) money balances available at the beginning of the period, m, times θ. The parameter θ refers to a measure of the velocity of circulation.[9] It will also be affected during the crisis studied below.

Government. The government provides a public good, g, determined endogenously and produced using a linear technology, as mentioned above. In addition, there are government transfers to the households, which are exogenous. Let $\gamma \geq 0$ be the real value (in units of non-tradable output) of those transfers. The real value of transfers will increase unexpectedly during the crisis studied in Section 5 to represent a sudden need for additional fiscal

[9]See EKMS for a generalization of this cash-in-advance constraint, to include the necessity of holding domestic currency to purchase imports.

assistance.

The government has access to the following instruments to finance expenditures: (i) it can tax labor income, wh, at rate τ, (ii) it can increase the money supply at rate μ, and (iii) it can issue debt in international credit markets if not excluded.

The government can issue long-term bonds that pay in units of foreign currency. Each bond issued promises a deterministic infinite stream of coupons that decreases at an exogenous constant rate so that a fixed fraction $\delta \in (0, 1]$ matures every period.[10] Consequently, δB represents the corresponding payment of maturing coupons while $B' - (1 - \delta)B$ denotes the issuance of new bonds at a price q, which in equilibrium depends on the government's portfolio. Therefore, $q[B' - (1 - \delta)B]$ are funds collected from issuing new debt, expressed in foreign currency units.

The consolidated (fiscal and monetary) government budget constraint in (normalized) units of domestic currency can be expressed as

$$p^N(g + \gamma) + e\delta B \leq \tau wh + \mu + eq[B' - (1 - \delta)B]. \tag{3}$$

Government's decisions. Each period, the government has to make several decisions. First, it decides whether to default on its debt or not. Second, it sets the labor tax and the money growth rates and, if able to access international credit markets, decides how much new debt to issue.

When the government defaults, it avoids paying back its debt obligations but loses immediate access to international credit markets and earns a bad credit standing, $I = D$. Every period after exclusion from credit markets, the government regains a good credit standing, $I = P$, and reenters credit markets with zero debt obligations with probability π. With probability $1 - \pi$, the government remains excluded from credit markets.

Representative household. Agents know the government's default state at the be-

[10] As in Hatchondo and Martinez (2009), this simplified payment structure still permits summarizing all past long-term debt issuances into the number of long-term coupon obligations that mature in the current period.

ginning of each period before making any decisions. From their perspective, the aggregate state of the economy consists of the amount of foreign debt, B, and the government's credit standing, I.

All domestic prices, government policies, and the laws of motion of the aggregate state variables are functions of the aggregate state (B, I). To simplify notation, we omit this dependence. The individual state variable is the household's (normalized) money balances at the beginning of the period, m.

Given the current state I, the government's policy function for borrowing $\mathcal{B}$ implies a law of motion for debt from B to B'. As we shall describe below, at the beginning of each period, the government will be subject to a preference shock, which will affect its decision on whether to repay or default. Thus, agents form expectations for the law of motion of the government's credit standing, from I to I', as a function of the aggregate current state, (B, I).

The problem of the representative household is

$$V(m, B, I) = \max_{(c^N, c^T, m', h)} u(c^N, c^T) + v(1-h) + \vartheta(g) + \beta \mathbb{E}\left[V(m', B', I')|B, I\right]$$

subject to

$$\begin{aligned} p^N c^N + e(1+\phi)c^T + m'(1+\mu) &\leq (1-\tau)wh + m + p^N \gamma, \\ p^N c^N &\leq \theta m, \end{aligned}$$

the law of motions for B and I, $(c^N, c^T, m') \geq 0$ and $h \in [0, 1]$. Note that $V(m, B, I)$ denotes the agent's value function as a function of individual and aggregate state variables. Conditional on (B, I), the only source of aggregate uncertainty faced by the domestic agents is the ex-ante random decision of the government on whether to default or not next period. Thus, $\mathbb{E}[V(m', B', I')|B, I]$ is the conditional expectation of the agent's value function in the next period, given the current aggregate state (B, I).

Representative firm. Local firms produce non-tradable and tradable goods by hiring labor according to the technology represented by F. Constant returns to scale and competitive markets imply that we can assume that the industry behaves as a competitive representative firm.

Given prices, (p^N, e, w), and the government's credit standing, I, the representative firm solves the following problem,

$$\max_{(y^N, y^T, h) \geq 0} \; p^N y^N + e(1-\phi)p^T y^T - wh$$

subject to

$$A(I)F(y^N, y^T) - h \leq 0.$$

The firm does not need to take into account the laws of motion of the aggregate state variables due to the static nature of its problem.

2.2 Recursive monetary competitive equilibrium

Recall that the state variables are (B, I), domestic prices are $w(B,I), e(B,I), p^N(B,I)$, policy functions for the firm are $y^N(B,I), y^T(B,I)$, and the policy functions of the representative agent are $c^N(m,B,I)$, $c^T(m,B,I)$, $m'(m,B,I)$, $h(m,B,I)$. Next, we define a recursive competitive monetary equilibrium.

Definition 1. Given the government laws of motion for (B, I), domestic monetary and fiscal policy (μ, τ, g), a **recursive monetary competitive equilibrium** consists of policy functions for the representative agent (c^N, c^T, m', h), policy functions for the representative firm (y^N, y^T), and a domestic price system (w, e, p^N) such that:

(i) Given the laws of motion for (B, I), a monetary and fiscal policy (μ, τ, g), and the domestic price system (p^N, e, w), the policy functions (c^N, c^T, m', h) solve the representative household's problem;

(ii) Given the domestic price system (p^N, e, w), the policy functions (y^N, y^T) solve the representative firm's problem;

(iii) The budget constraint of the government (3) is satisfied; and

(iv) Markets clear. That is, for all (B, I): The money market clears, $m'(1, B, I) = 1$; the market for non-tradable goods clears, $c^N(1, B, I) + g = y^N(1, B, I)$; and the labor market clears, $A(I)F(y^N(1, B, I), y^T(1, B, I)) = h(1, B, I)$.

It is convenient to observe that the balance of payments, expressed in units of foreign currency, results from consolidating the household's and the government's budget constraints and thus

$$(1-\phi)p^T y^T - (1+\phi)c^T = \delta B - q[B' - (1-\delta)B], \tag{4}$$

where the left-hand side of the expression above is the trade balance, while the right-hand side is the change in the country's net asset position plus implicit debt interest payments.

2.3 Government policy under discretion

We now describe the setting in which the government cannot commit to future policies, i.e., it has full discretion and is not constrained by any policy rules. Consequently, every period, the government chooses whether to repay its debt, as well as its borrowing, labor income taxes, and money growth rate. In the next section, we describe alternative settings in which the government is subject to rules restricting its choices.

We consider a Markov perfect equilibrium where the government makes decisions taking into account how they affect equilibrium allocations, as well as future policy choices. We follow the primal approach and thus solve for allocations and debt choices that are implementable in a monetary competitive equilibrium as described above. In order to proceed, we use equilibrium conditions to replace domestic prices (p^N, w, e) and policies (μ, τ) in the government budget constraint (3).

After the appropriate replacements (see Appendix A for the derivation), the government budget constraint in a monetary competitive equilibrium can be written as,

$$\begin{aligned} u_T c^T + \beta \mathbb{E}\left[\Omega(c^{N\prime}, c^{T\prime}, y^{T\prime}, g')|I\right] - v_\ell A(I)F(c^N + g, y^T) \\ + \frac{(1-\phi)}{(1+\phi)} \frac{u_T p^T F_N}{F_T} \left[c^N \left(1 - \frac{1}{\theta}\right) - \gamma\right] \geq 0, \end{aligned} \tag{5}$$

where

$$\Omega(c^N, c^T, y^T, g) \equiv \frac{c^N}{\theta}\left[\theta u_N + (1-\theta)\frac{(1+\phi)}{(1-\phi)}\frac{u_T p^T F_N}{F_T}\right].$$

Condition (5) depends on current and future allocations $(c^N, c^T, y^T, g, c^{N\prime}, c^{T\prime})$. Note that future decisions are a function of the state, (B', I').

Suppose the government is currently in good credit standing and not excluded from international credit markets. At the beginning of that period, the government decides between repaying $(I = P)$ and defaulting $(I = D)$ on its debt. If it decides to default, the government loses access to the current international credit market, to which it reenters in the future with probability π and zero debt obligations.

Define the value of the optimal decision problem as

$$\hat{\mathcal{V}}(B, \varepsilon) = \max\{V^P(B) + \varepsilon, V^D\}, \tag{6}$$

where V^P and V^D denote the value of repayment and default, respectively, defined below. An idiosyncratic additive shock to utility also influences this decision. We assume that ε has mean zero and follows

$$F(\varepsilon) = \frac{\exp[\varepsilon/\zeta]}{1 + \exp[\varepsilon/\zeta]},$$

where $\zeta > 0$ is the scale parameter of the distribution, which controls the variance of the ε shocks. We denote $\mathcal{I}(B, \varepsilon)$ as the government's default policy function. Under these assumptions, the policy function for repayment conditional only on B is

$$\mathcal{P}(B) \equiv \Pr(V^P(B) - V^D \geq -\varepsilon) = \frac{\exp[V^P(B)/\zeta]}{\exp[V^P(B)/\zeta] + \exp[V^D/\zeta]}, \tag{7}$$

for any B (see EKMS).

Every period, after deciding on whether to repay or default on its debt, the government implements the corresponding policies for that period, internalizing the response of private domestic agents, international lenders, the future government policies, and the evolution of its credit standing. A period policy consists of choices on the amount of future debt, the money growth rate, the tax rate and government expenditure.

If the government is currently repaying, the probability that it will remain in repayment status tomorrow, conditional on B', is given by $\mathcal{P}(B')$ as in (7). On the other hand, if the government is currently in default, the probability that it will transition to repayment status tomorrow is given by $\pi\mathcal{P}(0)$.

Every period, the government chooses a debt level (only when repaying) and the allocation (c^N, c^T, y^T, g) to implement optimal domestic policies. These choices need to satisfy the balance of payment, (4), the government budget constraint, (5), and a non-negativity constraint regarding the Lagrange multiplier for the cash-in-advance constraint (see Appendix A, Equation (22)).

When the government is in repayment status, $I = P$, its policies are a function of the state B. Let the relevant aggregate policy functions be denoted by $\{\mathcal{B}, \mathcal{C}^N, \mathcal{C}^T, \mathcal{Y}^T, \mathcal{G}\}$. When the government is in default, $I = D$ and the aggregate policy functions are denoted $\{\bar{\mathcal{C}}^N, \bar{\mathcal{C}}^T, \bar{\mathcal{Y}}^T, \bar{\mathcal{G}}\}$, which are independent of the state B as the debt level is reset to 0.

International investors. In equilibrium, zero expected profits by risk-neutral international lenders implies that the price of bonds is given by the following recursion:

$$Q(B') = \frac{1}{1+r}\left[\mathcal{P}\left(B'\right)\left(\delta + (1-\delta)Q\left(\mathcal{B}(B')\right)\right)\right] \tag{8}$$

where r is the one-period risk-free international interest rate.

Repayment. The problem of the government in the repayment state is

$$V^P(B) = \max_{(B', c^N, c^T, y^T, g)} u(c^N, c^T) + v(1 - F(c^N + g, y^T)) + \vartheta(g) + \beta\mathcal{V}(B') \tag{9}$$

subject to

$$(1-\phi)p^T y^T - (1+\phi)c^T - \delta B + Q(B')[B' - (1-\delta)B] = 0, \tag{10}$$

$$\begin{aligned} u_T c^T + \beta\mathbb{E}\left[\Omega(c^{N\prime}, c^{T\prime}, y^{T\prime}, g')|P\right] - v_\ell A(P) F(c^N + g, y^T) \\ + \frac{(1-\phi)}{(1+\phi)} \frac{u_T p^T F_N}{F_T}\left[c^N\left(1 - \frac{1}{\theta}\right) - \gamma\right] \geq 0, \end{aligned} \tag{11}$$

$$u_N - \frac{(1-\phi)}{(1+\phi)} \frac{u_T p^T F_N}{F_T} \geq 0. \tag{12}$$

As mentioned, the constraints in the government's problem correspond to the balance of payment, (4), the government budget constraint, (5), and the non-negativity constraint, (22). Note that the expectation term in the government budget constraint is conditioned on the current state being $I = P$. The transition probabilities are $\mathcal{P}(B')$ for repay and $(1 - \mathcal{P}(B'))$ for default.

Default. The problem of the government in the default state is

$$V^D = \max_{(c^N, c^T, y^T, g)} u(c^N, c^T) + v(1 - F(c^N + g, y^T)) + \vartheta(g) + \beta[\pi \mathcal{V}(0) + (1 - \pi)V^D] \quad (13)$$

subject to

$$(1 - \phi)p^T y^T - (1 + \phi)c^T = 0, \quad (14)$$

$$u_T c^T + \beta \mathbb{E}\left[\Omega(c^{N\prime}, c^{T\prime}, y^{T\prime}, g')|D\right] - v_\ell A(D) F(c^N + g, y^T) + \frac{(1 - \phi)}{(1 + \phi)} \frac{u_T p^T F_N}{F_T} \left[c^N \left(1 - \frac{1}{\theta}\right) - \gamma\right] \geq 0, \quad (15)$$

$$u_N - u_T p^T \frac{(1 - \phi)}{(1 + \phi)} \frac{F_N}{F_T} \geq 0. \quad (16)$$

As the government is excluded from international credit markets, the balance of payments is simply the trade balance—which must be zero. The expectation term in the government budget constraint is conditioned on the current state being default ($I = D$); hence, the relevant transition probabilities are $\pi\mathcal{P}(0)$ for repay and $(1 - \pi\mathcal{P}(0))$ for default.

We now define the equilibrium for the benchmark economy without rules.

Definition 2. A **Markov perfect equilibrium** is characterized by a set of value functions $\{V^P(B), V^D\}$; policy functions for the government, $\{\mathcal{P}, \mathcal{B}, \mathcal{C}^N, \mathcal{C}^T, \mathcal{Y}^T, \mathcal{G}\}$ and $\{\bar{\mathcal{C}}^N, \bar{\mathcal{C}}^T, \bar{\mathcal{Y}}^T, \bar{\mathcal{G}}\}$; and bond price function Q such that the following conditions are satisfied:

(i) Given Q, the value functions (V^P, V^D) satisfy (9) and (13), and the corresponding policy functions are $\{\mathcal{P}, \mathcal{B}, \mathcal{C}^N, \mathcal{C}^T, \mathcal{Y}^T, \mathcal{G}\}$ and $\{\bar{\mathcal{C}}^N, \bar{\mathcal{C}}^T, \bar{\mathcal{Y}}^T, \bar{\mathcal{G}}\}$;

(ii) Given $(\mathcal{P}, \mathcal{B})$, the bond price equation Q satisfies (8);

(iii) Government policies and values are consistent with future policies and values.

2.4 Monetary and fiscal rules

We aim to understand the role of rules restricting government policies in normal times and during a crisis. These rules take the form of additional constraints on the government's problem. We impose policy rules only in the repayment state (i.e., the government in the default state has full discretion).

The **monetary policy rule** consists of fixing the money growth rate so that $\mu = \mu^*$ every period. In Appendix A we derive μ as a function of allocations. We can use that expression to impose the following additional constraint to the government's problem under repayment,

$$\frac{(1+\phi)}{(1-\phi)} \frac{F_T}{u_T p^T F_N} \frac{\theta\beta\mathbb{E}\left[\Omega(c^{N\prime}, c^{T\prime}, y^{T\prime}, g')|P\right]}{c^N} - 1 = \mu^*$$

The left-hand side of the constraint above is the implementation of a particular money growth rate in equilibrium, as a function of allocations in the repayment state. The right-hand side is the money growth rate target. Note that in a steady state, inflation is equal to the money growth rate. In general, inflation may fluctuate even though the money growth rate is kept constant under the rule.

The **fiscal policy rule** takes the form of a debt ceiling or limit. The government is then constrained to maintain a debt level that does not exceed a certain threshold, B^*. This rule imposes the following additional constraint on the government's problem in the repayment state, $B' \leq B^*$.

3 Calibration

We implement the following quantitative strategy. First, in this section we calibrate the steady state economy. Since we use historical data of Latin American countries from 1991 to 2018, we use the model without rules to identify the parameters that reproduce the targets. Second, Section 4 uses this calibration to study the optimal fiscal and/or monetary rules. Third, Section 5 models a large, unforeseen crisis. In this case, our benchmark is an economy that had been implementing the optimal fiscal and monetary rules derived in Section 4 but suspends them during the crisis. Finally, the main quantitative results are in Section 6, which studies counterfactual economies to understand the role of rules versus flexibility during crises.

3.1 Functional forms

The utility functions for consumption and leisure are

$$\begin{aligned} u(c^N, c^T) &= \alpha^N \frac{\left(c^N\right)^{1-\sigma}}{1-\sigma} + \alpha^T \frac{\left(c^T\right)^{1-\sigma}}{1-\sigma}, \\ v(\ell) &= \alpha^H \frac{\ell^{1-\varphi}}{1-\varphi}, \end{aligned}$$

Note that $1/\sigma$ is both the intra-temporal elasticity of substitution between c^N and c^T and the inter-temporal elasticity of substitution. The utility associated with the public good is

$$\vartheta(g) = \alpha^G \log(g),$$

which is a standard representation in the optimal taxation literature and close to empirical estimates.

The function describing the labor requirement for production is

$$F(y^N, y^T) = \left[\left(y^N\right)^\rho + \left(y^T\right)^\rho\right]^{1/\rho},$$

where $\frac{1}{1-\rho}$ is the elasticity of substitution determining how costly it is to change the composition of y^N and y^T that is produced, in terms of labor units.

3.2 Exogenous parameters

Table 1 shows the values of parameters set externally. The annual risk-free interest rate is 3%, in line with the average real interest rate of the world since 1985 in King and Low (2014). We calibrate φ to 1.50 so that the Frisch elasticity is one-half on average.[11] The values of α^T and θ are normalized to one, while ϕ is normalized to zero—we will allow θ

[11] We can calibrate this parameter externally because we target hours, as explained below.

and ϕ to vary when we study crises. Given the duration of a default episode from Das et al. (2012) and the length of exclusion after restructuring from Cruces and Trebesch (2013), we choose an expected period of exclusion after a default of 6 years, which implies $\pi = 1/6$. We calibrate $\delta = 0.2$ to get a maturity of five years as in Hatchondo and Martinez (2009).

Table 1: Parameters calibrated externally

Parameter	Description	Value	Basis
r	risk-free rate	0.03	Long-run average
φ	curvature of leisure	1.50	Frisch elasticity
α^T	preference share for c^T	1.00	Normalization
θ	velocity of circulation	1.00	Normalization
ϕ	trade cost	0.00	Normalization
p^T	price of exports	1.00	Normalization
π	re-entry probability	0.17	Exclusion duration
δ	fraction of maturing coupons	0.20	Debt maturity
σ	curvature of $u(c^N, c^T)$	0.50	EKMS
ρ	elasticity of substitution in $F(y^N, y^T)$	1.50	EKMS

We follow EKMS to set $\sigma = 0.5$ and $\rho = 1.5$. Here, we briefly summarize the rationale for these choices. Setting $\sigma < 1$ is sufficient for the non-negativity constraint in the government's problem to be satisfied with strict inequality (it is also necessary when transfers, γ, are zero). This choice implies that imported goods are gross substitutes for non-tradable goods, as in the estimates of Ostry and Reinhart (1992).[12] The value of ρ determines the elasticity of substitution between y^N and y^T in the cost function F. A number larger than one guarantees that the production possibilities frontier is concave. As shown in EKMS, the value of $\rho = 1.5$ allows the model to reproduce the response of real GDP to terms-of-trade shocks.

3.3 Targeted steady-state moments

The following set of parameters is jointly calibrated to match the long-term average of important macro variables. Empirical averages are matched with the value of these macro variables at the model's *steady-state debt level*. The steady-state debt level is the level at

[12]Note, however, the estimates in Ostry and Reinhart (1992) are in the range of 1.22–1.27, while our calibration implies an elasticity of 2.

which the economy converges over time if the shocks ε are such that there is no default. More precisely, that level of debt B^{ss} is such that $\mathcal{B}(B^{ss}) = B^{ss}$.

We compare the statistics from the model with data collected by the World Bank for Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Uruguay from 1991 to 2018. Since we use historical data, we use the model without rules to identify the parameters that reproduce the targets as in EKMS. Table 2 presents the value of the parameters and the matched moments. Although all the parameters are jointly determined, it is useful to think about the connection between moments and targets.

Table 2: Parameters calibrated internally and matched statistics

Parameter	Value	Statistic	Target
β	0.8563	Inflation, %	3.800
γ	0.1082	Transfers/GDP	0.117
α^H	0.9366	Employment/Population	0.587
α^G	0.4397	Gov. Consumption/GDP	0.133
α^N	2.7880	Exports/GDP	0.209
ω_0	1.4575	Real GDP	1.000
ω_1	0.1034	Debt/GDP	0.365
ζ	0.0663	Default, %	2.000

The value of the discount factor $\beta = 0.8563$ helps the model reproduce an annual inflation rate of 3.8%. The parameter $\gamma = 0.1082$ matches the ratio of transfers to GDP, which in the data average 11.7%. The value of $\alpha^H = 0.9366$ allows the model to hit the long-run average for the employment-to-population ratio, 0.59. The weight in the utility of the government consumption good, $\alpha^G = 0.4397$, delivers government consumption-to-GDP ratio of 13.3%. The parameter $\alpha^N = 2.7880$ allows the model to reproduce the ratio of exports to GDP, which is 21% in the data.

Recall that $A(I)$ is a measure of the inverse of labor productivity as a function of the repayment state, I. We set $\frac{1}{A(P)} = \omega_0 = 1.4575$ to normalize steady-state output to one, which makes some statistics easier to read. We assume that the economy experiences a drop in productivity when the government is in default, and so $\frac{1}{A(D)} = \omega_0 - \omega_1$. The value of $\omega_1 = 0.1034$ reproduces the external debt-to-GDP ratio in the repayment state, which is 36.5%. Finally, the scale parameter in the distribution of taste shocks, $\zeta = 0.0663$, determines the risk of sovereign default in the steady state and is calibrated to reproduce a default rate of 2.0% annually.

4 Optimal fiscal and monetary rules

Before we examine the impact of a major unanticipated crisis, such as COVID-19, on the desirability of maintaining or suspending policy rules, we will focus on their implementation during normal times. To keep the analysis simple, we examine the benefits of introducing rules in the economy calibrated in the previous section, where there are no aggregate shocks. Nevertheless, Appendix C.2 shows that the optimal rules and welfare gains are similar in an economy with terms-of-trade shocks, as in EKMS.

4.1 Welfare measures

We design rules to maximize the welfare of households.[13] Our measure of welfare is a one-time compensation in non-tradable consumption, Δ, that leaves the representative household indifferent between two alternative regimes. First, let $V^P(B,\Delta)$ be the value in the repayment state given compensation Δ:

$$\begin{aligned} V^P(B,\Delta) &= u\left((1+\Delta)\,c^N, c^T\right) + v\,(1-h) + \vartheta(g) + \beta\mathcal{V}\,(B') \\ &= V^P(B) - \frac{\alpha^N (c^N)^{1-\sigma}[1-(1+\Delta)^{1-\sigma}]}{1-\sigma} \end{aligned}$$

Similarly, let $V^D(\Delta)$ be the value in the default state given compensation Δ:

$$\begin{aligned} V^D(\Delta) &= u\left((1+\Delta)\,c^N, c^T\right) + v\,(1-h) + \vartheta(g) + \beta\delta\mathcal{V}\,(0) + \beta\,(1-\delta)\,V^D \\ &= V^D(\Delta) - \frac{\alpha^N (c^N)^{1-\sigma}[1-(1+\Delta)^{1-\sigma}]}{1-\sigma} \end{aligned}$$

[13]In Appendix C.1 we also show how to compute welfare when international investors need to be compensated for the loss in the value of debt after a rule is adopted.

Then, the *ex-ante* value (before the extreme value shock is realized) is given by

$$\mathcal{V}\left(B,\Delta\right)=\zeta\log\left[exp\left(\frac{V^{P}\left(B,\Delta\right)}{\zeta}\right)+exp\left(\frac{V^{D}\left(\Delta\right)}{\zeta}\right)\right]$$

Let $\mathcal{V}^R(B)$ be the corresponding value function under policy rule $R=\{\mu^*,B^*,\mu^*+B^*\}$, corresponding to a monetary, a fiscal, or a monetary and fiscal rule, respectively. For a given level of debt and a specific policy rule, the welfare measure Δ solves

$$\mathcal{V}\left(B,\Delta\right)=\mathcal{V}^{R}(B)$$

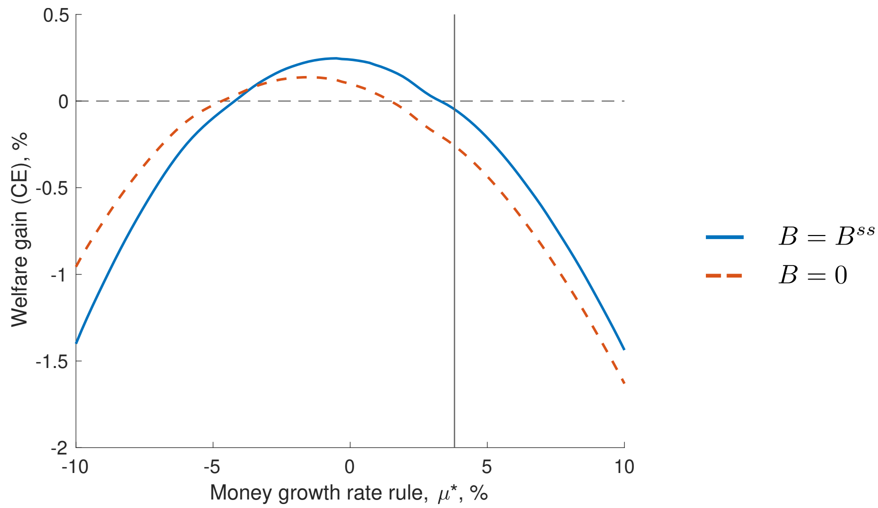
Therefore, Δ is a function of the level of debt, B, and the specific target of the policy rule. In the analysis below, we will compute welfare at zero debt, $B=0$, and at the repayment steady state, $B=B^{ss}$, for a range of targets for the monetary and fiscal rules. Our selection criterion will be to adopt rules that maximize welfare at the repayment steady-state level of debt.

4.2 Optimal monetary rule

Figure 1 plots the welfare gains from imposing a monetary rule for a range of targets. When initial debt is zero (the dashed line), the optimal monetary rule fixes the money growth rate at $\mu^*=-1.5\%$; when initial debt is at the repayment steady state (the solid line), the optimal target is $\mu^*=-0.5\%$. Both these targets are negative and well below the discretionary steady state of 3.8% (indicated by the vertical solid line). Potential welfare gains are 0.14% and 0.25% of non-tradable consumption, respectively.

Fixing the money growth rate has two offsetting effects. On the one hand, it forces the current government to implement a suboptimal policy mix—relying on money creation too little or too much. On the other hand, it corrects a time-consistency problem in debt choice. As explained in EKMS, the current debt choice is affected by the fact that it affects future fiscal and monetary policies; the latter has an effect on current money demand, and thus, the government budget constraint, which future governments do not take into account. A constant money growth rate eliminates this channel. This channel is also absent when the

Figure 1: Welfare gains Δ as a function of money growth rate target μ^*



Note: The vertical line corresponds to the value of the policy in a steady state without rules.

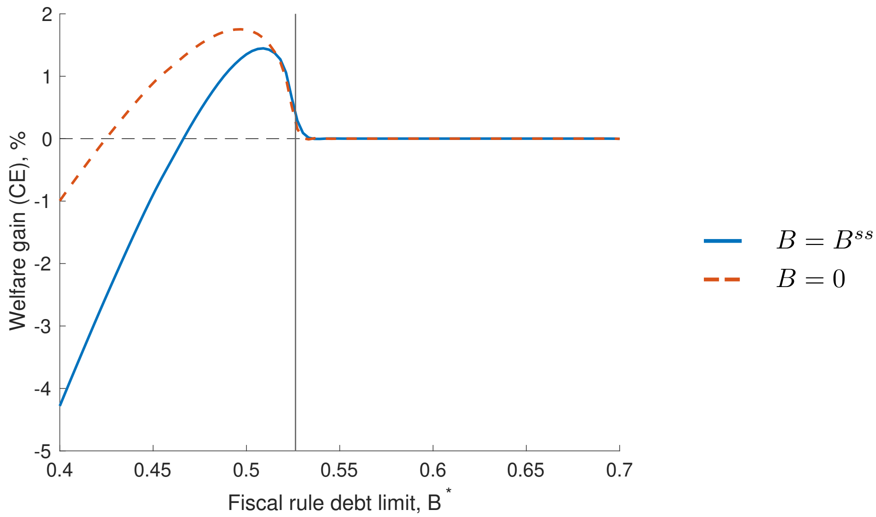
income and substitution effects on money demand are exactly offset—a case that arises here when $\sigma = 1$. In Appendix C.3 we show that there are no positive gains from a monetary rule when $\sigma = 1$.

The potential welfare gains from a monetary rule are smaller than those from the optimal fiscal rule described in the next section. This result is consistent with the literature that analyzes the welfare costs of inflation. Note that imposing a money growth rate that is either too low or too high may yield large welfare losses.

4.3 Optimal fiscal rule

Figure 2 plots the welfare gains from imposing a fiscal rule for a range of debt ceilings. The optimal debt ceiling is very similar, regardless of initial debt. Welfare, however, strongly depends on initial debt. If adopting the fiscal rule when debt is zero, the optimal limit is 0.495 and welfare gains are equal to 1.76% of non-tradable consumption. When adopting the rule at the repayment steady state, the optimal limit is 0.510 and welfare gains are equal to 1.45%. In either case, imposing a limit that is too tight may lead to large welfare losses, while imposing a limit above the discretionary steady state has no impact.

Figure 2: Welfare gains Δ as a function of debt limit B^*



Note: The vertical line corresponds to the policy's value in a steady state without rules.

The welfare gains from imposing a debt limit stem from alleviating a debt-dilution problem. Debt dilution refers to the reduction in the value of existing debt triggered by the issuance of new debt that increases the probability of default. The current government cannot control the amount of new debt issued by future governments. Rational investors anticipate that additional borrowing by future governments will increase the risk of default on long-term bonds issued by the current government and, thus, offer a lower price for these bonds. The current government benefits from constraining future borrowing up to a debt limit $B^* < B^{ss}$ since this increases the funds collected by bonds that it issues today—i.e., it increases the price of newly issued debt. Hence, properly imposed debt limits alleviate the debt-dilution problem.

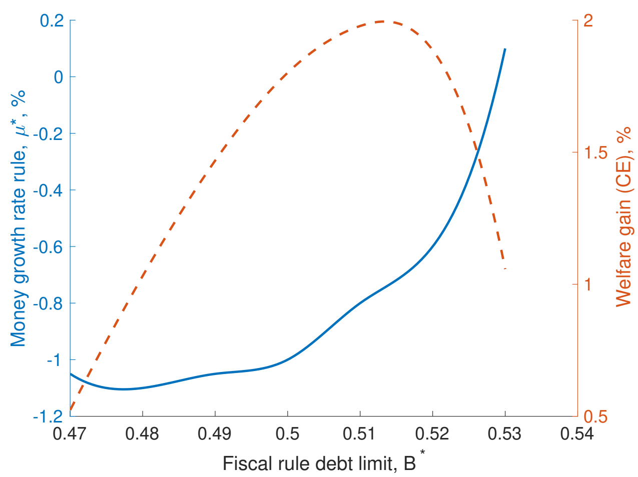
The debt-dilution problem is mitigated as the maturity of debt decreases. In the extreme case that the government issues only one-period debt (i.e., when $\delta = 1$), the debt dilution problem disappears altogether and there is no benefit from imposing a debt limit. See Appendix C.4 for further analysis.

4.4 Optimal fiscal and monetary rules

Next, we present our baseline scenario: an economy with both fiscal and monetary rules. Figure 3 shows there is substantial complementarity between the fiscal and the monetary rules. The blue curve shows the optimal monetary target for each debt limit. For the most part, the optimal money growth target increases as the debt limit increases. As the government is allowed to issue more debt, higher financing costs give more prominence to the seigniorage role of monetary policy.

The red dashed curve shows the associated welfare gains. The figure shows the complementarity between both rules. Note that there is an additional benefit of a monetary policy target, as it allows for a more relaxed debt limit. Hence, welfare gains are positive even for debt limits above the discretionary long-run debt, B^{ss}.

Figure 3: Optimal money growth rate target μ^* as a function of debt limit B^*



4.5 Long-run implications of policy rules

Table 3 presents the long-run implications of the optimal policy rules computed above. We let the economies run in the repayment state and report the long-run averages. The first column displays the case with discretion (i.e., no rules), which was calibrated in the previous section. The second column fixes the money growth rate at -0.5%. The most significant differences relative to discretion are the correspondingly lower inflation and the higher revenue over GDP necessary to make up for the lost seigniorage. Debt over GDP and the default probability do not change significantly, while the changes in macroeconomic variables are minor.

Table 3: Rules vs. discretion—long-run statistics

	Discretion	Money growth $\mu^* = -0.50\%$	Debt ceiling $B^* = 0.51$	Both $\mu^* = -0.80\%$ $B^* = 0.51$
Debt / GDP	0.365	0.363	0.351	0.347
Inflation	0.038	-0.005	0.036	-0.008
Revenue / GDP	0.240	0.269	0.238	0.268
Expenditure / GDP	0.250	0.251	0.250	0.251
Real GDP	1.000	0.993	1.000	0.992
Employment	0.587	0.586	0.587	0.586
Exports / GDP	0.209	0.200	0.207	0.197
Default probability	0.020	0.021	0.010	0.010
Welfare gains, %		0.250	1.450	1.978

The third column sets a debt limit of 0.51. This implies a lower debt-to-GDP ratio than under discretion, which then allows for inflation and tax revenue to be lower as well. The biggest change is in the default probability, which roughly halves. Despite these changes, macroeconomic variables remain essentially unaltered.

The last column in Table 3 presents the case of choosing monetary and fiscal rules jointly. The optimal combination of rules implies an even lower money growth rate, $\mu^* = -0.80\%$, but the same debt limit, $B^* = 0.51$. This leads to a lower inflation rate and debt-to-GDP ratio. The welfare gains of optimally combining the two rules are significantly larger than the sum of imposing each rule individually, once again highlighting the complementarity of fiscal and monetary rules described in the previous section. To get a quantitative sense of this complementarity, note that the difference between the welfare gains of both rules and the sum of each of them individually is 0.278% of non-tradable consumption, which is larger than the welfare gains of the monetary rule alone, 0.250%.

5 Modeling a large crisis

We take the COVID-19 pandemic as an example of a major, unforeseen crisis. Our benchmark is designed to replicate the macroeconomic and policy experience in the Latin American countries we used in our calibration. Therefore, in our baseline scenario, monetary and fiscal rules are imposed prior to the crisis, then suspended for its duration, and finally reimposed right afterwards. Since there are many differences in the implementation of policy rules across these countries, we impose the optimal rules we derived in Section 2.4.[14] Thus, the monetary rule corresponds to fixing the money growth rate $\mu^* = -0.80\%$ and the fiscal rule corresponds to setting a debt limit $B^* = 0.51$, which implies a 35% of steady-state GDP.

We identify the shocks so that the impact of COVID-19 on five macroeconomic variables in 2020 resembles our estimates of the impact in the data (see Appendix E for the estimation of the impact of COVID-19 on these data moments). The five variables are real GDP growth, government expenditures, imports, inflation, and credit spreads. We model the crisis as a combination of shocks lasting one period.[15]

First, government authorities across the world imposed multiple measures to reduce the spread of the virus, and these measures restricted production in some sectors (Carrieri et al., 2021). As a result, a significant number of firms were hit hard through a variety of channels, such as lockdowns, quarantine or home isolation for staff, decreases in productivity and capacity, higher costs, a collapse in demand, supply-chain disruptions, and generalized uncertainty (Ebeke et al., 2021). We model this impact as a drop in productivity ω_0, from 1.4575 to 1.4112, to match the observed 9.5% fall in real GDP growth in 2020.

Second, governments engaged in expansionary fiscal policies to mitigate the impact of the pandemic. For the most part, these measures took the form of direct transfers to households

[14] Note that if we were to consider rules that are not optimal in the absence of COVID-19, we would underestimate the cost of abandoning the rules.

[15] In a subsequent section, we will look at a crisis that lasts longer than a single period.

and businesses. We model this fiscal assistance as an increase in exogenous transfers, γ, from 0.1082 to 0.1282, calibrated to match the temporary increase of 4.1% in government expenditure over GDP.

Third, the pandemic disrupted global trade. The initial health measures involving travel restrictions, border closures, and lockdowns affected trade in goods and services by disrupting freight transport, business travel, and the supply of services that rely on individual presence abroad (World-Trade-Organization, 2020). These policies had an impact on trade costs, mainly through their effects on transport and travel costs, as international trade is heavily dependent upon the transportation of individuals and goods across borders (Vo and Tran, 2021). Shipping costs did, in fact, increase around 350% from May 2020 to June 2021 (Dickinson and Zemaityte, 2021). We model this impact as an increase in trade costs, ϕ, from 0 to 0.1231. This shock can be interpreted as either a drop in the efficiency of transporting goods or an increase in trade restrictions. The increase in ϕ is calibrated to match the fall in imports of 15.4%.

Fourth, there was a flight to liquidity.[16] We model this liquidity shock as a decrease in θ, i.e., a temporary increase in the demand for money (equivalently, a fall in the velocity of circulation). With a constant θ, the monetary expansion, which arises endogenously in response to the other shocks, would have generated a large increase in inflation. However, actual inflation was relatively low in 2020, about 0.2%, and then increased significantly in 2021, to around 6.3%. The temporary drop in θ, from 1 to 0.8452, rationalizes the behavior of inflation in our model and is calibrated to match the fall in inflation in 2020.

Lastly, sovereign debt spreads increased during 2020, especially in the early stages of the pandemic. To reproduce this fact, we allow the default penalty to vary with the state of the economy, which has been the standard approach since Arellano (2008). We assume that

[16] For example, see Novick, Cound, Edgar, Parkes, Pasquali, Radcliffe, DeZur, and Jackson (2022). Early on in the pandemic, and in spite of a significant decrease in cash payments, the demand for cash rose significantly in Europe between March 2020 and May 2021 (Panetta, 2021). The use of cash as a store of value was also evidenced in many other countries, including Brazil (Goodhart et al., 2020).

labor productivity in default is a function of the other four shocks

$$1/A(D) = \omega_0 - \max\{\omega_1 + \omega_2 \times gap(\omega_0, \gamma, \theta, \phi), 0\}$$

where *gap* is the deviation from the steady state of the GDP in dollars.[17] Thus, $\omega_2 > 0$ lowers the cost of default when output is low.[18] We calibrate $\omega_2 = 0.3114$ to match the increase in credits spreads of 96 basis points during 2020.

Table 4: Response to COVID-19 shock—benchmark model (rule suspension)

	Data	Model
Targeted		
Δ Real GDP, %	-9.5	-9.5
Δ Expenditure / GDP, pp	4.1	4.1
Δ Imports, %	-15.4	-15.4
Δ Inflation, pp	-0.2	-0.2
Δ Credit spreads, bps	96.2	96.3
Non-targeted		
Δ GDP USD, %	-18.6	-21.9
Δ Employment, pp	-7.3	-2.9
Δ Exports, %	-13.2	-13.9
Δ Debt / GDP, pp	5.2	12.7
Δ Tax rate, pp	-0.8	-9.9
Δ Money growth rate, pp	28.9	15.8
Δ Depreciation, pp	8.2	13.0
Δ Inflation in 2021, pp	6.3	18.0
Welfare gain of shock, %		-13.1

Note: Δ stands for the change in 2020, unless specified otherwise.

The top panel of Table 4 shows that we closely match the five targeted moments. The middle panel shows that the model reasonably reproduces the changes in non-targeted macroeconomic variables. Importantly, the model correctly predicts the signs of the changes in

[17] The gap is measured in terms of output in foreign currency (dollars), since this captures the country's capacity to repay its debt. However, our approach is flexible and the gap could alternatively be specified using exports or real GDP.

[18] Note that the advantage of this specification is that the gap is exogenous and depends only on parameters. In particular, to compute this relationship, we use a Taylor expansion so that $gap(s) = \sum_i \text{elast}_i \frac{\Delta \text{s}_i}{\bar{s}}$, where $\text{elast}_i = \frac{\partial Y^{USD}}{\partial \text{s}_i} \frac{\bar{s}}{Y^{USD}}$, the sum is over $s_i = \{\omega_0, \theta, \gamma, \phi\}$, the derivative is the change in output measured in dollars with respect to each s_i (taken at the steady state), and Δs_i is the change in s_i with respect to its value in steady state.

every case. Quantitatively, it matches well the contraction of GDP in dollars, but underpredicts the falls in employment. In terms of policy, the model overreacts for debt, taxes, and depreciation while it underreacts for money growth. Though the monetary policy response is somewhat muted, the impact on inflation in the model for 2021 is higher than in the data. Despite these differences, the model captures the overall impact of the COVID-19 shock, which is our baseline to understand the effects of large crises more generally. The last row of Table 4 presents the welfare cost of the unexpected COVID-19 shock. To measure welfare, we consider the equivalent increment in non-tradable consumption during one period to keep utility constant. We find that the crisis had a high economic cost to individuals, equivalent to a one-period drop in non-tradable consumption of 13.1%.

6 The value of flexibility

This section examines the role of fiscal and monetary policies during a major crisis. We assume the government was subject to the optimal combination of fiscal and monetary rules before the crisis hits: the money growth rate fixed at -0.80% and the debt ceiling is set at 0.51. The crisis consists of the combination of unexpected shocks identified in the previous section. In our benchmark both rules are suspended during the period of the crisis—this is the case we used for the calibration in the previous section. We consider six alternative scenarios that correspond to suspending or abandoning at least one of the rules. The results are presented in Table 5.

6.1 Suspending rules

The benchmark case, when both rules are suspended during the crisis, corresponds to column 1 in Table 5. To understand the impact of suspending these rules, we consider three counterfactual cases: (i) both rules remain in effect throughout (column 2); (ii) only the monetary rule is suspended in the crisis period and is reinstated in subsequent periods (column 4); and (iii) only the fiscal rule is suspended in the crisis period and is reinstated in subsequent periods (column 6). The first alternative scenario lets us understand the effect

Table 5: Response to a large crisis—maintaining vs. suspending or abandoning rules

	Both rules are			Monetary rule is		Fiscal rule is	
	Suspended	Maintained	Abandoned	Suspended	Abandoned	Suspended	Abandoned
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ Real GDP, %	-9.49	-12.13	-9.54	-9.30	-9.41	-11.91	-11.92
Δ GDP USD, %	-21.95	-21.23	-22.56	-23.61	-23.81	-19.20	-19.57
Δ Employment, pp	-2.93	-4.41	-2.99	-2.92	-2.99	-4.22	-4.24
Δ Imports, %	-15.40	-31.78	-16.76	-20.44	-20.44	-24.75	-26.38
Δ Exports, %	-13.86	-22.01	-12.77	-10.02	-9.89	-25.08	-24.47
Δ Debt / GDP, %	36.64	26.95	36.88	30.90	31.26	33.28	33.42
Δ Tax rate, pp	-9.87	4.73	-9.60	-9.16	-9.06	2.40	2.90
Δ Expenditure / GDP, pp	4.05	4.33	3.99	3.78	3.79	4.58	4.52
Δ Primary deficit / GDP, pp	13.92	-0.41	13.59	12.94	12.85	2.18	1.61
Δ Money growth rate, pp	15.81	0.00	16.31	17.94	17.90	0.00	0.00
Δ Credit spreads, bps	96.28	94.58	218.57	74.80	95.66	117.94	242.09
Δ Default probability, pp	2.77	3.86	4.32	3.08	3.58	3.31	4.63
Δ Inflation, pp	-0.19	-1.21	0.52	1.72	1.99	-2.99	-2.70
Δ Inflation 2021, pp	18.01	1.23	18.24	15.95	16.99	5.14	3.78
Δ Depreciation, pp	12.95	7.74	14.56	17.73	18.22	3.50	4.25
Δ Depreciation 2021, pp	6.37	-7.18	6.74	0.18	2.74	0.84	-2.11
Welfare gains of shocks, %	-13.13	-13.85	-15.10	-13.35	-13.87	-13.51	-15.20
Welfare gains of flexibility, %	0.83	–	-1.42	0.57	-0.02	0.39	-1.54

Note: Δ stands for the change in 2020 unless specified otherwise. Prior to the crisis, both rules are in effect. A rule is "suspended" if it is temporarily lifted during the crisis period and reinstated in subsequent periods; a rule is "abandoned" when it is lifted permanently from the onset of the crisis.

of losing the ability to use monetary and fiscal policy to respond to the crisis. The other two scenarios are useful for understanding which margin of flexibility is more important.

Since the crisis is unexpected and lasts only one period, the case when the rules are suspended dominates, in terms of welfare, the case when rules always applied. Basically, the two problems are equivalent, except that the former has two fewer constraints. The welfare gains of flexibility (i.e., suspending both rules) is equivalent to a one-period drop in non-tradable consumption of 0.83%. Maintaining both rules during the crisis implies that the government must increase taxes by 4.7 percentage points instead of reducing them by 9.9 percentage points. Furthermore, to satisfy the debt ceiling while keeping the money growth rate fixed, the government needs to reduce the primary deficit by 0.4 percentage points rather than letting it increase by 13.9 percentage points under rules suspension. These policies imply a significantly larger decline in real GDP, 12.1% instead of 9.5%, as well as larger effects on employment, imports and exports.

Suspending the monetary rule while keeping the fiscal rule (column 4) lets the government respond to the crisis in a way that is similar to when both rules are suspended: the money growth rate increases sharply while taxes fall significantly. Consequently, real GDP, employment, exports, and imports all contract by less than when both rules are imposed. Inflation and currency depreciation are significantly higher when the rule is suspended, both on impact and in the period afterward. As a result, GDP in dollars contracts slightly more when the monetary rule is suspended. The added flexibility also implies that credit spreads do not increase as much when the shocks hit the economy. More than two-thirds of the gains from flexibility are attained when only the monetary rule is suspended.

Next, we evaluate the impact of suspending the debt ceiling while keeping the monetary rule (column 6). The output contraction is similar to the case in which both rules are maintained. Nonetheless, there are some notable differences. The monetary rule limits the government's capacity to conduct monetary policy. Thus, it must rely more on fiscal policy. As a result, the increase in credit spreads is the greatest of all options, with an increase of 118 basis points. Suspending only the fiscal rule yields less than half of the gains from flexibility, i.e., of suspending both rules.

6.2 Abandoning the rules

Suspending a rule improves welfare because we assume that the rule will be reinstated in the next period. However, it may be reasonable to expect that a rule that is suspended will never be reinstated. We refer to this case as abandoning the rule. The welfare implications of abandoning a rule are ambiguous. There is higher flexibility during the crisis (short-run gains) but the gains from having optimal policy rules in place are foregone (long-run losses).

The bottom row of Table 5 for columns 3, 5 and 7 shows how this trade off is resolved and how the net welfare effect varies with different specifications. Abandoning a rule is markedly worse than suspending it. If both rules are abandoned the welfare loss is 1.42% of non-tradable consumption, while the short-run gains of flexibility are 0.83 percent. If only the monetary rule is abandoned but the fiscal rule remains always in place, the gains from flexibility are offset by the lost benefits of a more disciplined monetary policy in normal times—the net effect is slightly negative. Finally, abandoning the debt ceiling but keeping the monetary rule forgoes the large gains associated with this constraint and, thus, implies a welfare loss of 1.54%.

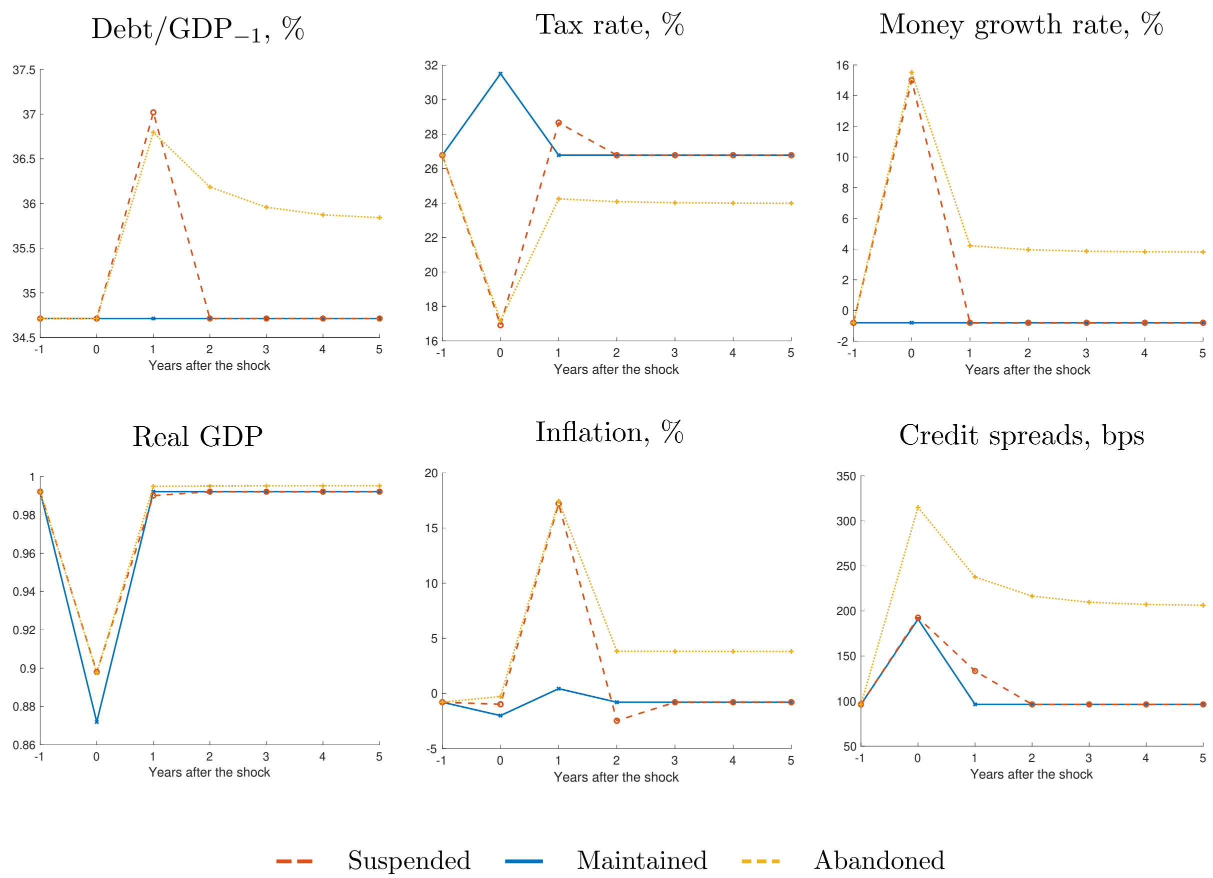
On impact, the real economy and government policy behave similarly when rules are suspended or abandoned. However, the subsequent dynamics differ substantially, as shown in Figure 4. Debt rises about the same in both cases but is more persistent and converges to a higher level when both rules are abandoned (yellow line). Credit spreads increase significantly on impact and converge to a much higher number when the rules are abandoned. The sharp rise in credit spreads is explained by the extra debt dilution that abandoning the fiscal rule allows for. Monetary policy is also different in the long run when the policy rules are abandoned. As a consequence, the money growth rate and inflation are also higher in the years following the crisis.

6.3 Unpacking the gains from flexibility

In this section, we study how different shocks interact with the gains from flexibility, i.e., the value of suspending or abandoning policy rules during a crisis. Table 6 shows the welfare gains associated with suspending or abandoning the rules for a given set of shocks. The symbols $\surd$ and $\times$ denote whether the corresponding shock is present or not, respectively. The first row includes all the shocks we considered above and, thus, replicates the findings from Table 5. We then take away one shock each time and compute welfare relative to the case when the rule is in effect at all times. The labels of the columns correspond to those in Table 5—column 2 is omitted since it is the reference case (when rules are maintained).

As we explained above, suspending a rule is always beneficial since the crisis is unanticipated and lasts only one period. The results in Table 6 show that the value of suspending both rules, and in particular of suspending the monetary policy rule, is significantly reduced

Figure 4: Dynamics of a large crisis: suspending, maintaining and abandoning both rules



Note: In $t = -1$ the economy is in the repayment steady state under monetary and fiscal rules. Shocks are realized in $t = 0$.

when the shock to money demand, θ, is not present. In other words, having the money growth rate as an instrument is especially valuable when there are shocks to the money demand.

The second-largest reduction in the benefit of suspension of both rules is when the shock to international trade, ϕ, is absent. Suspending the fiscal rule is slightly costlier than suspending the monetary rule, as shown by columns 4 and 6.

Following in importance is the exogenous expenditure shock, γ. When the transfer shock is absent, suspending the monetary rule carries a heavier cost than suspending the fiscal rule. This result follows from seigniorage being used to finance transfers during the crisis.

Table 6: Unpacking the welfare gains of flexibility

Shocks				Both rules are		Monetary rule is		Fiscal rule is	
ω_0	γ	ϕ	θ	Suspended (1)	Abandoned (3)	Suspended (4)	Abandoned (5)	Suspended (6)	Abandoned (7)
$\surd$	$\surd$	$\surd$	$\surd$	0.83	-1.42	0.57	-0.02	0.39	-1.54
$\surd$	$\surd$	$\surd$	$\times$	0.39	-1.72	0.19	-0.35	0.25	-1.58
$\surd$	$\surd$	$\times$	$\surd$	0.49	-1.74	0.40	-0.20	0.17	-1.75
$\surd$	$\times$	$\surd$	$\surd$	0.56	-1.67	0.32	-0.26	0.33	-1.59
$\times$	$\surd$	$\surd$	$\surd$	0.66	-1.54	0.46	-0.12	0.31	-1.58

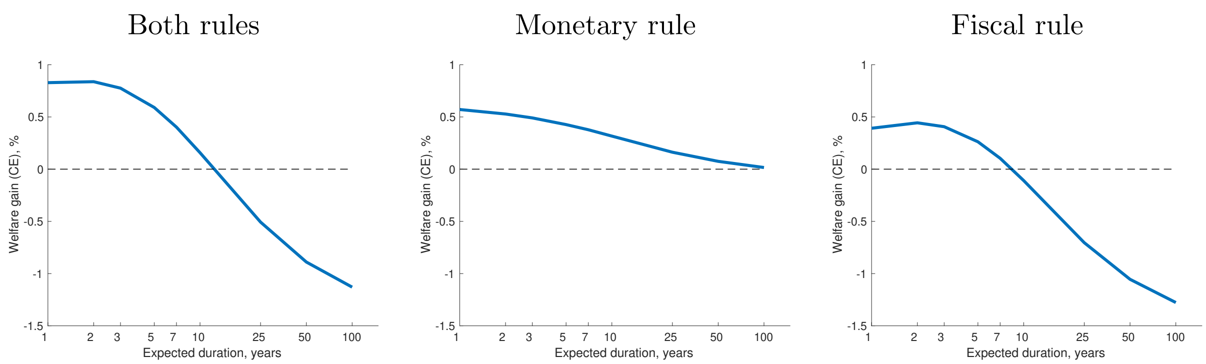
Finally, the bottom row considers the case in which the productivity shock is absent. The impact on welfare is modest in all cases, suggesting that the productivity shock played a secondary role in the analysis above.

6.4 Duration of suspension

In the analysis above, we have showed that there are gains from having rules in place during normal times, that suspending them during an unexpected crisis is beneficial, and that abandoning them is the worst option. What happens if a rule is suspended beyond the crisis? Is that better or worse than a "crisis-time" suspension? For example, a longer suspension could be beneficial since it gives the government more time to transition back to the rule after the crisis ends. Since suspending rules is beneficial while abandoning them is detrimental, one could also ask how long rules may be suspended until they are no longer beneficial. To answer these questions, we allow the suspension of rules to continue in the future with a given probability. The duration of the rule suspension increases with this probability and converges to the case in which the rule is abandoned when the probability approaches one.

Figure 5 shows how welfare varies with the duration of a rule suspension. As in the previous analysis, welfare is computed relative to the case when both rules are in place all the time. The left panel shows that there are still positive welfare gains when both rules are expected to be suspended for quite some time, up to fourteen years. Importantly, welfare gains are relatively flat for a number of years after the crisis ends, suggesting that reimposing rules can be safely delayed for a short time. However, when the probability of rules remaining suspended is large enough (suspension duration is long enough) these gains convert into sizable losses.

Figure 5: Welfare gains of flexibility and duration of suspension



The middle panel shows that the gains from suspending only the monetary rule decrease monotonically with the duration of suspension. For example, the gains from flexibility are halved if the rule is expected to remain suspended for ten years. Eventually, as the probability of the monetary rule approaches one (duration of suspension approaches abandonment) these gains turn into tiny losses.

The right panel shows that the gains from suspending the fiscal rule are non-monotone in duration. If the debt limit rule is expected to be suspended for two years welfare gains are slightly larger than if it were suspended for only one year. Gains start falling the longer the fiscal rule is expected to stay suspended, remaining positive for up to seven years. As the debt limit suspension is expected to persist beyond that, the long-run benefits of the fiscal rule are foregone and welfare turns negative.

6.5 Persistence of the crisis

One important assumption we made in our analysis is that the crisis lasts one period. However, crises in general do not have a fixed and known duration, and one would expect this uncertainty to significantly shape government policy and private actions. In this section, we allow for the crisis to end stochastically. The probability of the crisis ending is given and known by all. Specifically, we assume that the crisis ends with a probability of one-half, i.e., is expected to last two years. We revisit our results on rules vs. flexibility and study the same scenarios as in our previous analysis: (i) rules are suspended as long as the crisis persists; (ii) rules are imposed all the time; or (iii) rules are abandoned when the crisis starts. The results of this exercise are summarized in Table 7.

Table 7: Rules vs flexibility when the crisis is expected to last for two years

	Both rules are			Monetary rule is		Fiscal rule is	
	Suspended (1)	Maintained (2)	Abandoned (3)	Suspended (4)	Abandoned (5)	Suspended (6)	Abandoned (7)
Δ Real GDP, %	-8.57	-11.35	-8.61	-8.57	-8.62	-11.35	-11.44
Δ GDP USD, %	-23.79	-20.89	-24.42	-23.79	-24.04	-20.89	-21.43
Δ Employment, pp	-2.52	-3.95	-2.59	-2.52	-2.56	-3.95	-4.02
Δ Imports, %	-24.02	-37.05	-25.26	-24.02	-24.39	-37.05	-38.37
Δ Exports, %	-7.65	-20.67	-6.44	-7.65	-7.25	-20.67	-19.90
Δ Debt / GDP, %	27.01	21.90	26.30	27.01	26.79	21.90	21.35
Δ Tax rate, pp	-9.15	6.12	-8.87	-9.15	-9.04	6.12	6.63
Δ Expenditure / GDP, pp	3.49	4.01	3.42	3.49	3.47	4.01	3.95
Δ Primary deficit / GDP, pp	12.64	-2.12	12.29	12.64	12.51	-2.12	-2.68
Δ Money growth rate, pp	19.84	0.00	20.44	19.84	20.01	0.00	0.00
Δ Credit spreads, bps	497.58	647.62	752.54	497.57	562.59	647.48	916.19
Δ Default probability, pp	13.62	17.20	18.78	13.61	15.21	17.19	22.09
Δ Inflation, pp	1.80	-1.94	2.63	1.80	2.13	-1.94	-1.42
Δ Inflation 2021, pp	16.80	1.11	17.33	16.80	17.65	1.11	0.33
Δ Depreciation, pp	19.01	7.41	20.88	19.01	19.71	7.40	8.58
Δ Depreciation 2021, pp	-1.01	-8.64	-0.09	-1.01	0.81	-8.64	-10.09
Welfare gains of shocks, %	-22.53	-23.08	-24.29	-22.53	-23.00	-23.08	-24.60
Welfare gains of flexibility, %	0.66	–	-1.46	0.66	0.10	0.00	-1.84

Note: Δ stands for the change in 2020 unless specified otherwise. Prior to the crisis, both rules are in effect. A rule is "suspended" if it is temporarily lifted during the crisis period and reinstated in subsequent periods; a rule is "abandoned" when it is lifted permanently from the onset of the crisis.

Our qualitative results are not significantly affected by the fact that the crisis does not end with certainty and may instead persist with some probability. The most interesting result is that now, suspending only the fiscal rule (column 6) does not yield any welfare gains. The reason for this result is that, when the crisis is expected to last for some time, lenders restrict what they are willing to lend enough that the debt ceiling is no longer binding—hence, columns 2 (both rules are maintained) and 6 (only fiscal rule is suspended) are essentially identical. The mechanism at play can be seen in the large surge in credit spreads at the onset of the crisis and in the increase in the debt-to-GDP ratio, which is smaller than when the crisis lasts for only one year. Similar to a sudden stop, the market rather than a fiscal rule disciplines government policy in this case.

Credit restrictions are alleviated when the government can rely on monetary policy to finance expenditures during the crisis. If the monetary rules is suspended (columns 1 and 4), the increase in the money supply helps improve the fiscal position of the government, which, in turn, moderates the surge in credit spreads.

7 Conclusions

We studied the value of imposing policy rules in emerging countries and the gains from flexibility during large, unexpected crises. Our findings support the widespread adoption of rules in recent times. Both monetary and fiscal rules lead to welfare gains in normal times as they mitigate time-consistency problems in debt choice. Debt limits are particularly beneficial as the debt-dilution problem is severe. During a crisis, temporarily suspending rules can be beneficial, as it allows governments to implement more appropriate policy mixes. However, suspension during trying times can lead to outright abandonment of pre-existing norms. Our results indicate that prolonged suspension or abandonment of debt limits leads to large welfare losses, so caution is warranted when tinkering with this type of rule in response to adverse shocks.

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Appendix

A Derivation of the government budget constraint

Necessary and sufficient first-order conditions to characterize the firm's problem imply that the wage and exchange rate can be expressed as functions of (y^N, y^T, p^N, p^T),

$$w = \frac{p^N}{A(I)F_N}, \tag{17}$$

$$e = \frac{p^N F_T}{(1-\phi)p^T F_N}. \tag{18}$$

Using (17) and (18), the necessary first-order conditions for the agent's problem imply

$$p^N = \frac{\theta}{c_N}, \tag{19}$$

$$\tau = 1 - \frac{(1+\phi)}{(1-\phi)} \frac{v_\ell A(I) F_T}{u_T p^T}, \tag{20}$$

$$1+\mu = \frac{(1+\phi)}{(1-\phi)} \frac{F_T}{u_T p^T F_N} \frac{\theta\beta\mathbb{E}\left[\Omega(c^{N\prime}, c^{T\prime}, y^{T\prime}, g')|B, I\right]}{c^N}, \tag{21}$$

where

$$\Omega(c^N, c^T, y^T, g) \equiv \frac{c^N}{\theta}\left[\theta u_N + (1-\theta)\frac{(1+\phi)}{(1-\phi)}\frac{u_T p^T F_N}{F_T}\right].$$

The Lagrange multiplier for the CIA constraint (2) is non-negative and thus,

$$u_N - \frac{(1-\phi)}{(1+\phi)}\frac{u_T p^T F_N}{F_T} \geq 0. \tag{22}$$

Combining the government budget constraint, (3), and the balance of payments, (4), we can re-express the government budget constraint as a relationship between the external sector (the trade balance) and the public sector (the primary surplus plus seigniorage):

$$\tau w h - p^N(g+\gamma) + \mu - e((1-\phi)p^T y^T - (1+\phi)c^T) \geq 0. \tag{23}$$

Using (1) and (17)–(21), condition (23) simplifies to

$$\left[1-\frac{(1+\phi)}{(1-\phi)}\frac{v_\ell A(I)F_T}{u_T p^T}\right]F(c^N+g,y^T)-F_N(g+\gamma)-F_T y^T+\frac{(1+\phi)}{(1-\phi)}\frac{F_T c^T}{p^T}$$
$$-\frac{c^N F_N}{\theta}+\frac{(1+\phi)}{(1-\phi)}\frac{F_T}{u_T p^T}\beta\mathbb{E}\left[\Omega(c^{N\prime},c^{T\prime},y^{T\prime},g')|B,I\right]\geq 0. \tag{24}$$

Using the fact the F is homogeneous of degree one, i.e., $F(c^N+g,y^T)=F_N(c^N+g)+F_T y^T)$, we can rearrange (24) to obtain (5).

B Credit spreads

We compute credit spreads on sovereign bonds (CS) as a proxy of EMBI (Emerging Markets Bonds Index). Let $Q^{EMBI}(B)$ be the implicit spot price in the secondary market for the outstanding sovereign debt B at the beginning of the period before the government decides whether to default or not, which is given by

$$Q^{EMBI}(B)=\mathcal{P}(B)[\delta+(1-\delta)Q(\mathcal{B}(B))]$$

To compute the sovereign credit spread that is implicit in Q^{EMBI}, we compute the yield as the return that an investor would earn if he holds the bond to maturity (forever) and no default is declared. This yield, expressed as $(1+r)(1+CS(B))$, is then computed as

$$Q^{EMBI}(B)=\sum_{j=0}^{\infty}\frac{\delta(1-\delta)^j}{(1+r)^j(1+CS(B))^{j+1}}$$

Therefore, sovereign credit spread is

$$CS(B)=\frac{\delta}{Q^{EMBI}(B)}+\frac{(1-\delta)}{(1+r)}-1 \tag{25}$$

C Robustness on the welfare gains of policy rules

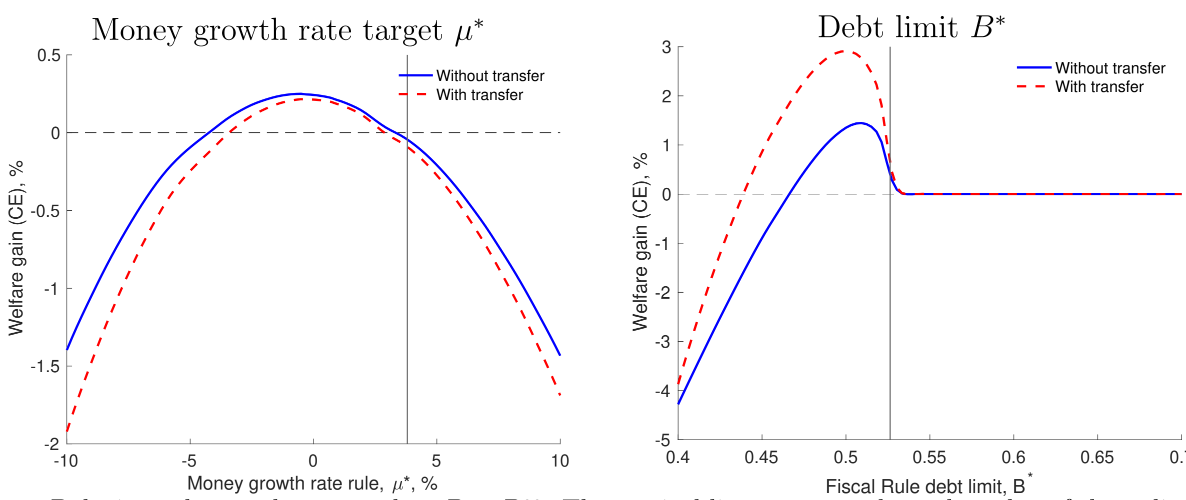
C.1 Alternative welfare measure

Define a compensating transfer to international investors as $T^R(B)=b\left(Q^R(b)-Q(B)\right)$ where (Q^R,Q) denote the bond price in a setting with a rule $R=\{\mu^*,B^*\}$ and the discretionary economy, respectively. Then, the alternative measure of the equivalent compensation Δ solves

$$\mathcal{V}(B, \Delta) = \mathcal{V}^R\left(B - T^R(B)\right)$$

Figure 6 compares our benchmark welfare criterion (without compensating transfers) and the alternative welfare criterion described above (with welfare transfers). As we can see, though welfare measures can differ, especially for the debt limit, the optimal constraint is very similar for fiscal and monetary rules under either criterion.

Figure 6: Welfare gains Δ as a function of rule



Note: Debt is at the steady state value, $B = B^{ss}$. The vertical line corresponds to the value of the policy in a steady state without rules.

C.2 Expected shocks

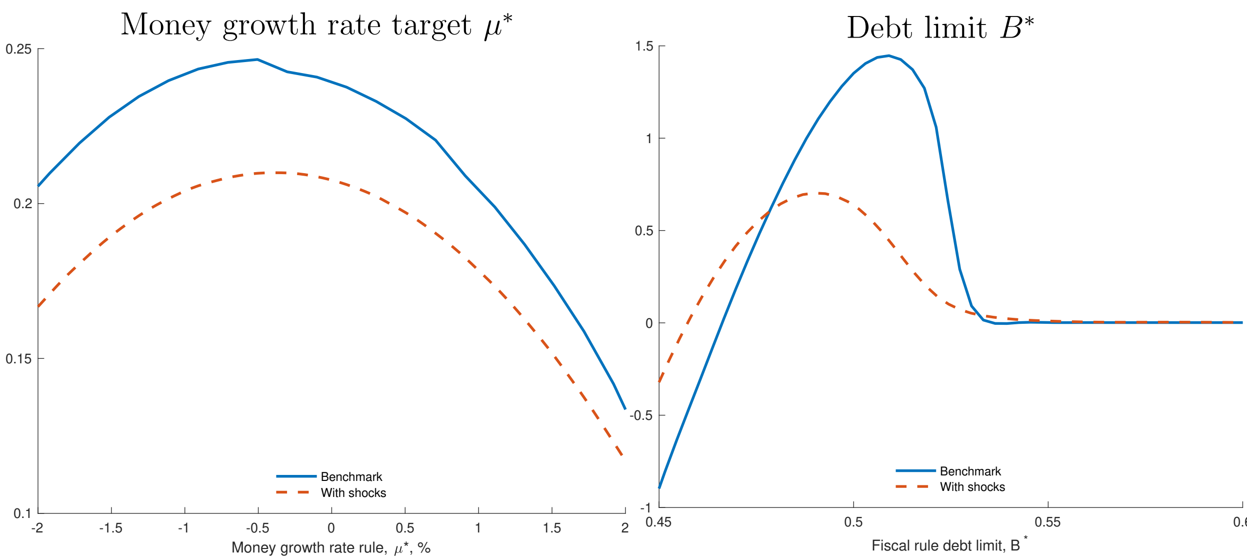
Here, we extend the benchmark model to include expected shocks to the terms of trade. In order to perform this exercise, we use the same calibration as in the benchmark model. We assume that terms of trade shocks, p_t^T, follows a stochastic process AR(1) represented as

$$ln(p_{t+1}^T) = \rho ln(p_t^T) + \epsilon_{t+1}$$

where $\epsilon_t \sim N(0, \sigma^2)$ for all t. We follow the calibration in EKMS to set the autocorrelation coefficient and the variance so that $\rho = 0.880$ and $\sigma = 0.075$.

The results below show that adding terms-of-trade shocks to the benchmark model does not qualitatively change the welfare implications of the policy rules. Figure 7 shows that adding terms of trade shocks to the model does not qualitatively alter the shape of the welfare figure as a function of the policy rules.

Figure 7: Welfare gains Δ: Expected shocks



Note: Debt is at the steady-state value, $B = B^{ss}$.

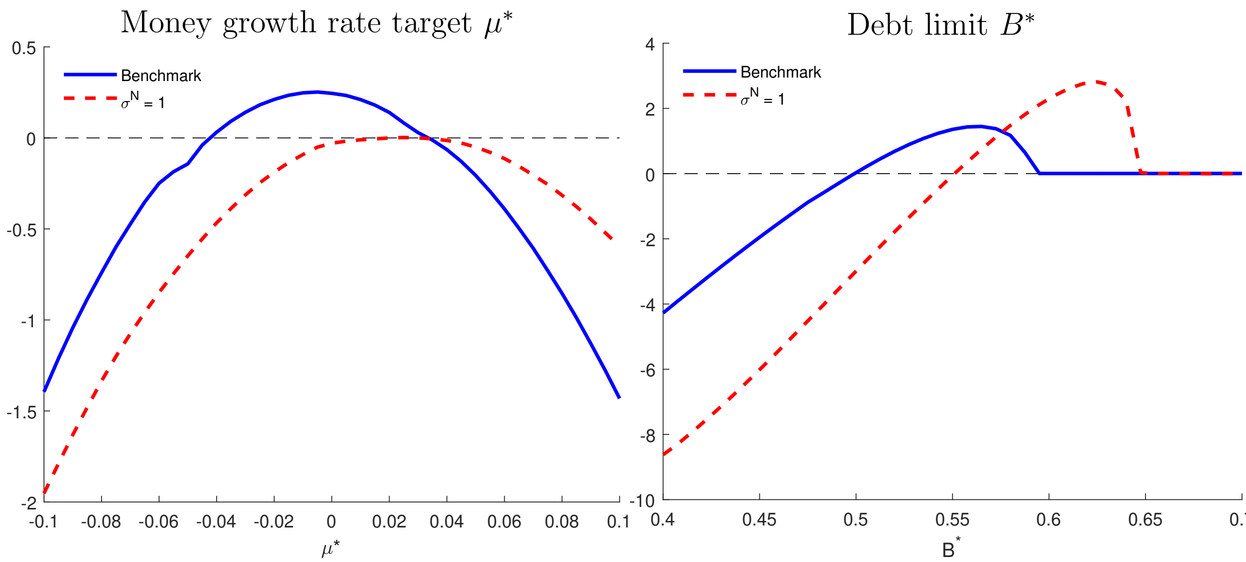
C.3 Money demand

Assume

$$u(c^N, c^T) = \alpha^N \frac{\left(c^N\right)^{1-\sigma^N}}{1-\sigma^N} + \alpha^T \frac{\left(c^T\right)^{1-\sigma^T}}{1-\sigma^T}$$

As in the benchmark calibration, we keep $\sigma^T = \sigma$ and consider two cases: $\sigma^N = \sigma < 1$ and $\sigma^N = 1$. In the latter case, the intertemporal distortion in debt choice, which stems from a time-consistency problem due to the demand for money, disappears. Here, there are no benefits from targeting the money growth rate. See Figure 8.

Figure 8: Welfare gains Δ: $\sigma^N < 1$ vs. $\sigma^N = 1$



Note: Debt is at the steady-state value, $B = B^{ss}$.

C.4 Short-term debt

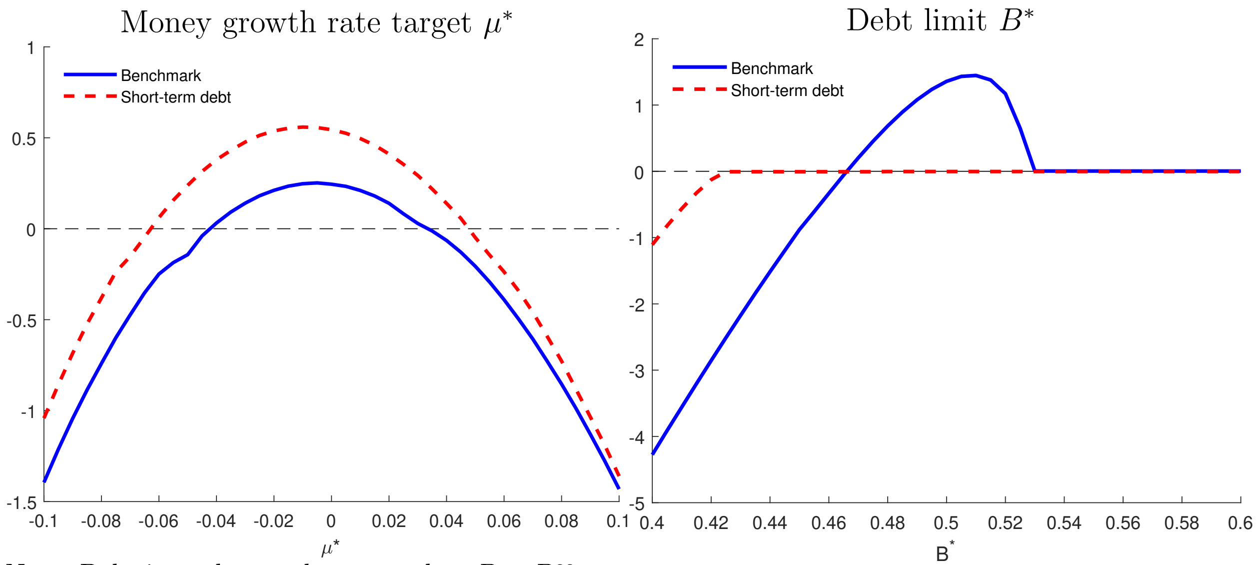
Figure 9 compares welfare under monetary and fiscal rules, for the cases with short- and long-term debt. Notably, there are no welfare gains from imposing a debt limit when debt maturity is one period, i.e., when the debt-dilution problem is absent. In contrast, monetary rules yield higher welfare gains with one-period debt.

D Policy response to COVID-19 in Latin America

Davoodi et al. (2022) shows how COVID-19 led to the wide use of escape clauses or the decision to impose ad hoc suspensions. The goal of these temporary suspensions limiting fiscal and monetary policy was to gain flexibility to support households and firms. In this section, we briefly present the evidence in Latin American countries.

In the years before the pandemic, Argentina introduced austerity measures, following an agreement with the IMF, severely restricting fiscal policy (see International Monetary Fund, 2018). Despite this reality, once the COVID-19 pandemic started, the national government incorporated protection measures for mitigation of the socio-economic consequences of the

Figure 9: Welfare gains Δ: long-term vs. short-term debt



Note: Debt is at the steady state value, $B = B^{ss}$.

pandemic. These programs included: health spending, support for workers and other vulnerable groups, support for firms in hard-hit sectors, and forbearance and credit guarantees for bank lending (International Monetary Fund, 2021). Argentina's central bank responded to COVID-19 directly financing expansionary fiscal policy. The country did not follow the inflation-targeting regime followed in previous years or the previous agreement with the IMF to limit the growth rate of monetary aggregates (International Monetary Fund, 2018; Roza, 2021).

In Brazil, Congress decided to lift the government's obligation to comply with the primary balance target for 2020 (CEPAL, 2020b) to tackle the pandemic. The Brazilian federal government set in motion a series of policies to protect the poorest workers and to keep businesses from failing. The central bank showed itself as flexible and pledged to "deploy its arsenal of monetary, exchange rate and financial stability policies to fight the current crisis." (McGeever, 2020). However, after the economy began a normalization path, most liquidity support measures were withdrawn in 2021. The interest rate was elevated to 4.25% by June (International Monetary Fund, 2021).

Before the COVID outbreak, Chile's robust macroeconomic framework was characterized by prudent fiscal policy and successful inflation-targeting monetary policy (OECD, 2021). Actions to tackle the pandemic crisis include higher healthcare spending, subsidies for vulnerable households and unemployment benefits, provision of food baskets and basic products for middle-class families, cash transfers, etc. (International Monetary Fund, 2021). Chile's central bank acted by using both conventional and non-conventional tools for countercyclical purposes. The first measure was reducing the monetary policy rate by 125 basis points (International Monetary Fund, 2021; KPMG, 2020). It was accompanied by a new funding facility and open-market operations. Once economic activity began picking up, the monetary authorities decided to raise the monetary policy rate to 0.75% (CEPAL, 2021)—arguably, a return to the inflation-targeting objective.

In Colombia, the fiscal rule, which was incorporated in 2011 to determine budget policy (Hernando Vargas-Herrera and Romero, 2022), was suspended in order to tackle the pandemic (International Monetary Fund, 2021). After the peak of the crisis, the government included in its 2021 budget measures to reactivate the economy and extend programs supporting households and firms, as well as infrastructure investment International Monetary Fund (2021). Colombia's central bank reduced interest rates starting in March 2020. This led to the lowest intervention interest rate in the history of Colombia at 1.75% (Bocanegra, 2022). Public and private bond purchases by the Bank of the Republic were part of a wider response to the Covid-19 shock (Hernando Vargas-Herrera and Romero, 2022).

Mexico's fiscal response to the COVID-19 shock was modest when compared with its peers (Hannan et al., 2022). Starting as early as March 2020, the Chamber of Deputies allowed the creation of the Emergency Prevention and Response Fund. In order to do this, the government was authorized to eliminate the totality of the primary surplus target set in 2020, which also amounted to 0.7% of GDP CEPAL (2021). Measures taken were aimed at ensuring sufficient financial resources for the Ministry of Health, support for households and firms, credit and liquidity strengthening, and proper functioning of financial markets (International Monetary Fund, 2021). The above-the-line fiscal measures in 2020 amounted to 0.7 percent of GDP while below-the-line measures in 2020 amounted to around 1.2 percent of GDP

International Monetary Fund (2021). Starting in February 2020, Mexico's central bank reduced its reference interest rate to 300bps through February 2021 (Banco de México, 2020). In terms of credit flows, the central bank reduced regulatory deposits and opened financial facilities for commercial and development banks with the hope of channeling resources to SMEs and individuals. Additionally, the authorities incorporated a new tool that permitted the central bank to intervene in offshore non-deliverable forward markets with foreign actors during European and Asian trading hours (International Monetary Fund, 2021). After the crucial moments of the pandemic, the central bank led a policy of rate hikes starting in June 2021 in response to inflation risks. As before, one could interpret this as a return to the central inflationary objective the authorities previously had.

Peru was one of the countries where the virus hit the hardest (CEPAL, 2021; Jaramillo and Ñopo, 2020). It also had a strong policy response in 2020, as reflected in the increase of the non-financial public sector deficit in 2020, mainly explained by purchases of health-related goods and services, transfers to families, and other current expenditures (CEPAL, 2021). This was in line with the government's dismissal, supported by the Fiscal Council, of its budgetary fiscal rule and 30% of GDP debt limit for 2020-2021 (Fitch Ratings, 2020). Since the announcement of the national state of emergency, Peru's central bank took measures dedicated to the reduction of financing costs, liquidity provision, and reduction of interest rate volatility (Montoro et al., 2020). To that end, the authorities decided upon an unprecedented expansionary monetary policy, cutting the reference rate by 200 basis points to a historic low of 0.25%. The central bank also expanded the range of guarantees and collateral that financial entities could use for repo operations and extended the maturities of liquidity operations. Furthermore, the bank incurred monetary injections through two programs aimed at boosting credit conditions (Armas and Montoro, 2022). The central bank only increased the benchmark interest rate to 0.50% in August of 2021. Naturally, these measures are an alteration of the previous central bank's role (CEPAL, 2021).

In Uruguay, the new government took measures to address the health emergency. These include relaxation of rules for claiming unemployment insurance, expanded assistance to the most vulnerable groups, and expanded sick leave benefits (International Monetary Fund, 2021). Additionally, in April 2020, the government announced the creation of a coronavirus fund, drawn from public business contributions and salaries of public workers, as well as the implementation of an investment stimulus plan to keep money coming into Uruguay via tools such as tax exemptions for large-scale ventures (Horwitz, 2020). Furthermore, some tax and pension obligations were either postponed or reduced. The same goes for utility payments for some companies. Since the beginning of the virus outbreak, Uruguay's government debt began to rise. Nevertheless, prudent fiscal management and economic recovery helped to improve fiscal accounts—namely—lower the fiscal deficit in 2021 to below its 2019 level, despite increased COVID-19-related expenditures (World-Bank, 2022). Uruguay's central bank took measures to maintain an adequate level of liquidity by reducing reserve requirements for deposits in commercial banks (Fernández and Tiscornia, 2020) - as well as to avoid disruptions in the money market (International Monetary Fund, 2022). Another central aspect of the monetary policy implied the reduction of the reference interest rate (Bucacos et al., 2022), which goes in line with the expansionary monetary policy to maintain access to credit (CEPAL, 2020a). Later, the new authorities at the central bank announced a change to the monetary policy that put more weight against inflation and changed the prior monetary aggregates instrument for an interest rate instrument.

E Economic impact of COVID-19 in Latin America

This section presents the moments that are used to calibrate the large shock such that it resembles the COVID-19 crisis. Recall that the shock matches the economic impact of COVID-19 on five macro variables in 2020: (1) real GDP growth, (2) expenditures/GDP, (3) Imports growth, (4) inflation, and (5) credit spreads.

To obtain the targeted moments from the data, we compute the impact of the COVID-19 crisis on a given moment by computing the difference between the observed value for that moment and the forecast for that moment in the *IMF World Economic Outlook of October of 2019* (pre-pandemic). Table 8 shows, as an example, how the targeted impact on real

GDP growth in 2020 was obtained. On average, real GDP growth was -7.4% in 2020; but, since the WEO of October 2019, average real GDP growth was expected to be 2.1% in 2020, we estimate that the impact of COVID-19 on real GDP growth in 2020 was -9.5%. Note also that although there are differences in the impact across countries, ranging from -6.1% in Brazil to -14.6% in Peru, all countries suffered a deep contraction of real GDP as a consequence of COVID-19. This presents a perfect opportunity to evaluate the cost/benefits of temporary suspension of policy rules in emerging markets.

Table 8: Estimating COVID-19 impact on 2020 real GDP growth

Country	(1) Actual	(2) WEO forecast	(1) - (2) Impact
Argentina	-9.9	-1.3	-8.6
Brazil	-4.1	2.0	-6.1
Chile	-5.8	3.0	-8.9
Colombia	-6.8	3.6	-10.4
Mexico	-8.3	1.3	-9.6
Peru	-11.0	3.6	-14.6
Uruguay	-5.9	2.3	-8.2
Average	-7.4	2.1	-9.5

Source: Authors' estimations using data from the IMF WEO (October 2019).