Fiscal rules and the sovereign default premium

Juan Carlos Hatchondo Leonardo Martinez Francisco Roch
Indiana U. and Richmond Fed IMF IMF

Preliminary and Incomplete

Abstract

We study the effects of introducing fiscal rules—understood as constraints on the decision-making ability of current and future governments—using a model of sovereign default. We first calibrate the benchmark model without a fiscal rule using as a reference an economy that pays a significant sovereign default premium. We then study the effects of introducing different sequences of debt ceilings. We show that the government would benefits from committing to a sequence of debt ceilings that eventually reduces its level of indebtedness enough to bring the sovereign default premium to negligible levels. With this commitment the government (and lenders) may benefit immediately (before any fiscal adjustment) from almost eliminating the exposure to default risk. Benefits from imposing a fiscal rule arise even if the government is not shortsighted. Assuming that the government is shortsighted implies even larger debt reductions. Lower debt levels also allow the government to implement a less procyclical and eventually a countercyclical fiscal policy that reduces consumption volatility. Welfare gains from committing to a fiscal rule could be substantial.

JEL classification: F34, F41.

Keywords: Fiscal Rules, Debt Ceiling, Fiscal Consolidation, Default, Sovereign Default Premium, Debt Exchange, Countercyclical Policy, Endogenous Borrowing Constraints, Long-term Debt, Debt Dilution.

*For comments and suggestions, we thank Gaston Gelos, Jorge Roldos, and seminar participants at the 2012 Sovereign Debt Workshop at the Federal Reserve Bank of Richmond, the 2011 European Economic Association and Econometric Society Meeting, and the IMF Institute and Strategy, Policy, and Review departments. Remaining mistakes are our own. The views expressed herein are those of the authors and should not be attributed to the IMF, its Executive Board, or its management, the Federal Reserve Bank of Richmond, or the Federal Reserve System.

E-mails: hatchondo@gmail.com; leo14627@gmail.com; froch@imf.org.
1 Introduction

This paper studies the optimality of fiscal rules and measures their aggregate effects using a baseline sovereign default framework. Fiscal rules are restrictions imposed (often in laws or in the constitution) to the future governments’ ability to conduct fiscal policy. We abstract from fiscal rules enforcement issues and focus on the effects that a fiscal rule would have if the government could commit to enforce it.\(^1\) Thus, our analysis is likely to present an upper bound of the benefits derived from fiscal rules.

A consensus has emerged among policymakers about the desirability of fiscal rules targeting low sovereign debt levels that help deter fiscal crises and facilitate implementing more countercyclical fiscal policies.\(^2\) Nevertheless, significant uncertainty remains about the optimal value of fiscal rules’ targets. For instance, Blanchard (2011) asks: “what levels of public debt should countries aim for? Are old rules of thumb, such as trying to keep the debt to GDP ratio below 60 percent in advanced countries, still reliable?”

This paper intends to shed light on the optimal value of fiscal rules’ targets and to quantify the effects of introducing optimal fiscal rules. To that end, we study a sovereign default framework à la Eaton and Gersovitz (1981). This framework is commonly used for quantitative studies of sovereign debt.\(^3\)

First, we calibrate the benchmark model without a fiscal rule using as a reference an economy paying a significant sovereign default premium (Argentina before the 2001 default). The calibrated model generates plausible values for debt levels and the mean and standard deviation

---

\(^1\)Some countries have mitigated enforcement limitations, for instance, by granting constitutional status to their fiscal rules. For instance, Germany (in 2009) and Spain (in 2011) amended their constitutions to introduce fiscal rules. The super-majorities, referendums, or waiting periods typically required to amend a constitution limit the discretionary power of policymakers in office (see IMF (2009) and Schaechter et al. (2012)).

\(^2\)For instance, in an IMF Staff Position Note, Blanchard et al. (2010) argue that “A key lesson from the crisis is the desirability of fiscal space to run larger fiscal deficits when needed.” They also note that “Medium-term fiscal frameworks, credible commitments to reducing debt-to-GDP ratios, and fiscal rules (with escape clauses for recessions) can all help in this regard.” Discussions about the overhaul of the fiscal rules in the Eurozone provide other examples of this view.

\(^3\)See, for instance, Aguiar and Gopinath (2006), Arellano (2008), Benjamin and Wright (2008), Boz (2011), Lizarazo (2005, 2006), and Yue (2010). These models share blueprints with the models used in studies of household bankruptcy—see, for example, Athreya et al. (2007), Chatterjee et al. (2007), Li and Sarte (2006), Livshits et al. (2008), and Sanchez (2010). There are also sovereign default studies that assume non-strategic defaults (see for example Bi (2011) and Bi and Leeper (2012)).
of the interest rate spread paid by the sovereign—i.e., the difference between the sovereign bond yield and the risk-free interest rate.

We then search for the optimal value of fiscal rules’ targets to be implemented in the benchmark no-rule economy. We assume that a rule consists of a sequence of debt ceilings. According to the IMF fiscal rules database, sixty-two of the eighty-two countries with fiscal rules had debt-to-GDP ceilings in their rules in 2009. Reasons for using other forms of fiscal rules (such as limits to the fiscal deficit) have to do with operational challenges of implementing debt ceilings (e.g., dealing with currency depreciation or financing operations; see Schaechter et al. (2012)) that are not present in our model and, therefore, are beyond the scope of this paper.

Since the implementation of fiscal rules is likely to require fiscal adjustments, and this is the case in this paper, it is natural that we study sequences of debt ceilings, which determine the speed of fiscal adjustments. The optimal speed of fiscal adjustment is a common theme in discussions on the current European fiscal crises. Our contribution is to highlight the effects of the speed of fiscal adjustments on the sovereign default premium. Furthermore, transition periods are often part of fiscal rules. For instance, Germany amended its constitution in 2009 to introduce a fiscal rule to be enforced after 2016 for the federal government and after 2020 for regional governments. Similarly, Spain amended its constitution in 2011 to introduce a fiscal rule to be enforced after 2020. While we focus the discussion on fiscal rule, lessons from our analysis could be more generally interpreted as relevant for the design of fiscal adjustments (that could be enforced, for instance, by supranational authorities).

The first contribution of this paper is to help answering the question of what levels of public debt should countries aim for. Our analysis suggests that governments should target debt levels that eventually reduce the sovereign spread to negligible levels (0.5 percent in the exercise we present). Furthermore, the optimal sequence of debt ceilings is such that most of the spread reduction occurs at the time this sequence is announced (in the exercise we present, the spread declines from 7.4 percent to 0.5 percent with the rule announcement). Thus, our results indicate

Most of these discussions center around the value of fiscal multipliers. Estimates of fiscal multipliers range from significant positive numbers to also significant but negative numbers (see, for instance, IMF (2012)). In this paper, we abstract from the discussion of the relevant value of fiscal multipliers by studying an stochastic exchange economy (as in Eaton and Gersovitz (1981)).
that if after a fiscal adjustment program is announced in a country facing a sovereign default premium the sovereign spread is not reduced significantly, this fiscal adjustment is either insufficient or it is not credible.

The government benefits from committing to lower future debt levels because this commitment mitigates a debt dilution problem. With the promise of fiscal adjustments that come primarily in the future, the government benefits immediately from a reduction in sovereign risk (that allows it to roll over its debt at a lower rate). This makes having access to credit markets more attractive, which in turn makes defaulting—that would trigger a period of exclusion from credit markets—a less desirable option. Thus, the commitment to future fiscal adjustments weakens incentives to default immediately, which leads to a further reduction in sovereign spreads. This explains how imposing a debt ceiling creates new borrowing opportunities for the government: for a given borrowing level, the government pays a lower interest rate after the imposition of a fiscal rule because of the expectation of lower future debt levels. The sharp reduction in spreads implied by the fiscal rule allows the government to lower its debt level significantly with a relatively mild reduction in its borrowing.

The second contribution of this paper is to show that intermediate targets play a crucial role in the implementation of fiscal rules or, more generally, fiscal adjustment programs. Without intermediate targets, the government chooses (sequentially) to delay fiscal adjustments, which is suboptimal from an ex-ante perspective. Furthermore, without intermediate targets it would be optimal for the government to choose shorter fiscal adjustment periods and weaker adjustments, maintaining a significant level of default risk. Since the government has a tendency of delaying fiscal adjustments, choosing a long adjustment period would imply that the adjustment would start far in the future and, therefore, would be heavily discounted by lenders. Since the government is restricted to a shorter adjustment period, it chooses a more moderate adjustment.

For instance, we present an exercise in which the government is constrained to choose a debt target and a period after which this target will start being enforce, but cannot choose intermediate

5There is debt dilution in our framework because we assume long-term debt. Chatterjee and Eyigungor (2012) and Hatchondo and Martinez (2009) show that long-term debt is essential for accounting for interest rate dynamics in a framework with sovereign defaults.
debt ceilings. The government chooses a debt reduction of 8 percent of trend annual income to be implemented in four years. This results in an spread reduction of 1.4 percent at the moment of the rule announcement and a long-run average spread of 3.6 percent. The government chooses to delay the bulk of the debt reduction until the last year of the four years adjustment period. In contrast, if the government is allowed to choose intermediate debt ceilings that force a debt reduction of 2 percent per year, it chooses an adjustment period of nine years (reducing its debt level 18 percent). This results in an spread reduction of 6.9 percent at the moment of the rule announcement and a long-run average spread of 0.5 percent.

The third contribution of this paper is in the study of the effects of fiscal rules on the procyclicality of fiscal policy. In our benchmark economy without rules, borrowing becomes more expensive when income is low. Because of this, the government borrows less when income is low, and thus, it conducts a procyclical fiscal policy (see Cuadra et al. (2010)). As the fiscal rule forces the debt level to decline, both the level and the volatility of the sovereign spread decline, and the optimal policy becomes less procyclical. As long as default risk is significant, the government prefers a procyclical debt ceiling that implies a larger reduction of the default probability at the expense of a higher consumption volatility. Only after the debt level is reduced enough to make default risk insignificant, the government would prefer a countercyclical debt ceiling that allows for a countercyclical fiscal policy.

The fourth contribution of this paper is to study the trade-off between bondholders’ capital gains and the transition cost implied by a stronger fiscal adjustment. The government gains from the fiscal adjustments described above even when we assume the government does not benefit from the (foreign) lenders’ capital gains. With a rule imposing a faster or a stronger fiscal adjustment, creditors enjoy a larger capital gain derived from the increase in the market value of their bond holdings. If the government conducts a voluntary debt restructuring that enables it to capture these capital gains, it chooses an even stronger and faster fiscal adjustments. Bondholders

\footnote{This is consistent with evidence for emerging economies, as documented by Gavin and Perotti (1997), Ilzetzki et al. (2012), Kaminsky et al. (2004), Talvi and Végh (2009), and Végh and Vuletin (2011).}

\footnote{Again, one may see our analysis of the cyclicality of fiscal policy as limited because in our model fiscal policy does not play a role in stabilizing aggregate income. However, evidence of negligible or even negative fiscal multipliers for highly indebted countries (see, for instance, Ilzetzki et al. (2012)) reinforces our result about the ex-ante optimality of procyclical fiscal policy in the presence of significant default risk.}
are willing to forgive a fraction of the government’s debt in exchange for the implementation of the rule. This fraction is increasing with respect to the pre-rule interest rate spread. For instance, with a pre-rule spread of 5 (15) percent, bondholders are willing to forgive up to 21 (44) percent of the government’s debt. Welfare gains from implementing both the restructuring and the rule are also increasing with respect to the pre-rule spread, and amount to a permanent consumption increase ranging from 1.0 to 2.3 percent.

The fifth contribution of this paper is to illustrate the important but also secondary role of government’s myopia in designing and justifying fiscal rules. The optimality of strong fiscal adjustments that lower the sovereign default premium to negligible levels described above arises even when we assume that the government is not shortsighted (what would by itself lead to overborrowing). To gauge the role of government’s myopia we search for the optimal fiscal rule giving more weight to future periods than the government. Of course, when the rule chosen giving more weight to future periods imposes stronger fiscal adjustments.

For instance, suppose the rule is chosen discounting next-period utility with 0.99 instead of with our benchmark value of 0.96 (in a quarterly model). Suppose the rule establish a sequence of debt ceilings that decreases 0.5 percent of trend annual income each quarter, thus forcing an average fiscal adjustment of at least 0.5 percent per quarter, until a target debt level is reach. With 0.96, the optimal rule prescribes 9 years of adjustments (a debt reduction of 18 percent of trend income) that implies a spread reduction of 6.9 percent at the moment of the rule announcement and a long-run average spread of 0.5 percent. With 0.99, the optimal rule prescribes 14 years of adjustments (a debt reduction of 28 percent) that implies a spread reduction of 7.2 percent at the moment of the rule announcement and a complete elimination of default risk in the long run. The main difference from using 0.99 instead of 0.96 is in the computation of the welfare gain that increases from 0.25 percent to 3.5 percent of permanent consumption when more weight is given to future periods.
1.1 Related Literature

In spite of the great interest on fiscal rules among policymakers, theoretical studies on fiscal rules are relatively scarce. Several theoretical studies focus on the desirability of a balanced-budget rule for the U.S. federal government (see Azzimonti et al. (2010) and the references therein). Garcia et al. (2011) compare a balanced budget rule with a structural surplus rule. Beetsma and Uhlig (1999) show how by imposing lower debt levels, the Stability and Growth Pact may help control inflation in the European Monetary Union. Beetsma and Debrun (2007) discuss how additional flexibility in the Stability and Growth Pact may improve welfare. Pappa and Vassilatos (2007) and Poplawski Ribeiro et al. (2008) find that debt ceilings may be preferable over constraints on the government’s deficit. Medina and Soto (2007) use a model of the Chilean economy to show that a structural balanced fiscal rule mitigates the macroeconomic effects of copper-price shocks.

The studies mentioned in the previous paragraph abstract from the effect that the expectation about future indebtedness may have on the default premium (the main focus of our analysis). In these studies, rules may be beneficial because of a conflict of interest between the government and private agents (for instance, because the government is myopic or because of political polarization), or because of a conflict of interest among governments of different countries (for instance, in a monetary union). In contrast, we study a model with benevolent governments but in which there is a conflict between current and future governments induced by the inability to commit to repay debt claims. There may be path realizations for which the current government would prefer the debt to be repaid but a future government will decide that it is best to default on the debt. As a consequence, the current governments pays a higher default premium and/or cannot borrow as much as it would prefer. We show that introducing government myopia would strengthen our main findings.

Several empirical studies analyze the relationship between fiscal rules and fiscal policy (for instance, Poterba (1996) reviews the literature for U.S. states, and Debrun et al. (2008) present evidence for Europe), and between fiscal rules and the government’s financing costs (see, for example, Eichengreen and Bayoumi (1994), Heinemann et al. (2011), Iara and Wolff (2011),
Lowry and Alt (2001), and Poterba and Rueben (1999)). However, difficulties in identifying the effects of fiscal rules are well documented (see, for instance, Poterba (1996) and Heinemann et al. (2011)). We measure these effects through the lens of a default model. When comparing predictions in this paper with past experiences with fiscal rules, one should keep in mind that we are assuming that the government can commit to enforcing a rule while this is not necessarily the case in reality.

In this paper, fiscal rules are shown to be an effective way of dealing with the debt dilution problem. An extensive literature discusses the importance of this problem in sovereign debt markets (see Hatchondo et al. (2010b) and the references therein). Within this literature, Dilution and in a Model of Defaultable Sovereign Debt (2012) and Hatchondo et al. (2010b) present the studies that are closer to this paper. As we do, they study the quantitative effects of remedies to the dilution problem. However in contrast with this paper, they deal with the dilution problem through improvements in sovereign debt contracts (Dilution and in a Model of Defaultable Sovereign Debt (2012) introducing a seniority structure and Hatchondo et al. (2010b) introducing floating-rate debt with coupon payments indexed to the default premium). This makes the solutions proposed by Dilution and in a Model of Defaultable Sovereign Debt (2012) and Hatchondo et al. (2010b) fundamentally different to the one studied in this paper: improvements in sovereign debt contracts bring about an increase in the equilibrium level of indebtedness and we study the effect of introducing fiscal rules that reduce the level of indebtedness. Since this paper deals with debt reduction, we pay a lot of attention to transitions and the speed of fiscal adjustments, which Dilution and in a Model of Defaultable Sovereign Debt (2012) and Hatchondo et al. (2010b) left unexplored. Fiscal rules also seem to be the instrument countries are choosing to deal with sovereign debt problems (see Schaechter et al. (2012)).

The exercises presented in this paper also illustrate how a sovereign default framework à la Eaton and Gersovitz (1981) can be used to evaluate fiscal consolidation programs and the implied sovereign debt dynamics. An alternative approach is to use the debt sustainability framework (see Adler and Sosa (2013), Ghosh et al. (2011), Tanner and Samaké (2006), and the references therein) commonly used for policy analysis (see, for instance, IMF Article IV country reports). Our analysis complements the sustainability analysis by presenting endogenous
sovereign spreads (that, for instance, capture the effects of expectation of future adjustments), endogenous borrowing policies (that react to future debt limits), a welfare criteria to discuss optimal policy, the identification of optimal debt limits (in contrast with debt thresholds that signal crises often included in sustainability discussions), and optimal cyclical adjustments. This allows us to better capture the effects of imposing fiscal rules.

The rest of the article proceeds as follows. Section 2 introduces the model. Section 3 discusses the calibration. Section 4 presents the results. Section 5 concludes.

2 The model

There is a single tradable good. The economy receives a stochastic endowment stream of this good \( y_t \), where

\[
\log(y_t) = (1 - \rho) \mu + \rho \log(y_{t-1}) + \varepsilon_t,
\]

with \(|\rho| < 1\), and \( \varepsilon_t \sim N(0, \sigma^2_\varepsilon) \).

The government's objective is to maximize the present expected discounted value of future utility flows of the representative agent in the economy, namely

\[
E \left[ \sum_{t=0}^{\infty} \beta^t u(c_t) \right],
\]

where \( E \) denotes the expectation operator, \( \beta \) denotes the subjective discount factor, and the utility function is assumed to display a constant coefficient of relative risk aversion denoted by \( \gamma \). That is,

\[
u(c) = \frac{c^{1-\gamma} - 1}{1 - \gamma}.
\]

As in Hatchondo and Martinez (2009) and Arellano and Ramanarayanan (2010), we assume that a bond issued in period \( t \) promises an infinite stream of coupons, which decreases at a constant rate \( \delta \). In particular, a bond issued in period \( t \) promises to pay one unit of the good in period \( t + 1 \) and \((1 - \delta)^{s-1}\) units in period \( t + s \), with \( s \geq 2 \).

Each period, the government makes two decisions. First, it decides whether to default. Second, it chooses the number of bonds that it purchases or issues in the current period.
As previous studies of sovereign default, we assume that the recovery rate for debt in default—i.e., the fraction of the loan lenders recover after a default—is zero and that the cost of defaulting is not a function of the size of the default. The second assumption implies that, as in Arellano and Ramanarayanan (2010), Chatterjee and Eyigungor (2012) and Hatchondo and Martinez (2009), when the government defaults, it does so on all current and future debt obligations. This is consistent with the behavior of defaulting governments in reality. Sovereign debt contracts often contain an acceleration clause and a cross-default clause. The first clause allows creditors to call the debt they hold in case the government defaults on a payment. The cross-default clause states that a default on any government obligation also constitutes a default on the contracts containing that clause. These clauses imply that after a default event, future debt obligations become current.

There are two costs of defaulting in the model. First, a defaulting sovereign is excluded from capital markets. Once excluded, the country regains access to capital markets with probability $\psi \in [0, 1]$. Second, if a country has defaulted on its debt, it faces an income loss of $\phi (y)$ in every period in which it is excluded from capital markets. Following Chatterjee and Eyigungor (2012), we assume a quadratic loss function $\phi (y) = d_0 y + d_1 y^2$.

Following Arellano and Ramanarayanan (2010), we assume that the price of sovereign bonds satisfies a no-arbitrage condition with stochastic discount factor $M(y', y) = \exp(-r - \alpha \varepsilon' - 0.5\alpha^2 \sigma^2)$, where $r$ denotes the risk-free rate at which lenders can borrow or lend. This allows us to introduce a risk premium. Several studies document that the risk premium is an important component of sovereign spreads and that a significant fraction of the spread volatility in the data is accounted for by the volatility in the risk premium (see, for example, Borri and Verdelhan (2009), Broner et al. (2007), Longstaff et al. (2011), and González-Rozada and Levy Yeyati (2008)).

The model of the discount factor we use is a special case of the discrete-time version of the Vasicek one-factor model of the term structure (see Vasicek (1977) and Backus et al. (1998)). With this formulation, the risk premium is determined by the income shock in the borrowing

---

8Hatchondo et al. (2007) solve a baseline model of sovereign default with and without the exclusion cost and show that eliminating this cost affects significantly only the debt level generated by the model.
economy. It may be more natural to assume that the lenders’ valuation of future payments is not perfectly correlated with the sovereign’s income. However, the advantage of our formulation is that it avoids introducing additional state variables to the model. In this paper, benefits from introducing fiscal rules result from the mitigation of the debt dilution problem. Hatchondo et al. (2010b) show that the effects of debt dilution on default risk are robust to assuming that there is a shock to the cost of borrowing that is not perfectly correlated with the sovereign’s income, and to assuming that lenders are risk neutral.

We focus on Markov Perfect Equilibrium. That is, we assume that in each period, the government’s equilibrium default and borrowing strategies depend only on payoff-relevant state variables. As discussed by Krusell and Smith (2003), there may be multiple Markov perfect equilibria in infinite-horizon economies. In order to avoid this problem, we solve for the equilibrium of the finite-horizon version of our economy, and we increase the number of periods of the finite-horizon economy until value functions and bond prices for the first and second periods of this economy are sufficiently close. We then use the first-period equilibrium functions as an approximation of the infinite-horizon-economy equilibrium functions.

2.1 Recursive formulation of the no-rule benchmark

We first present the recursive formulation for the benchmark economy, in which there is no fiscal rule. Let $b$ denote the number of outstanding coupon claims at the beginning of the current period, and $b'$ denote the number of outstanding coupon claims at the beginning of the next period. A negative value of $b$ implies that the government was a net issuer of bonds in the past. Let $d$ denote the current-period default decision. We assume that $d$ is equal to 1 if the government defaulted in the current period and is equal to 0 if it did not. Let $V$ denote the government’s value function at the beginning of a period, that is, before the default decision is made. Let $V_0$ denote the value function of a sovereign not in default. Let $V_1$ denote the value function of a sovereign in default. Let $F$ denote the conditional cumulative distribution function of the next-period endowment $y'$. For any bond price function $q$, the function $V$ satisfies the following functional equation:
\[ V(b, y) = \max_{d \in \{0, 1\}} \{dV_1(y) + (1 - d)V_0(b, y)\}, \] (1)

where

\[ V_1(y) = u(y + \phi(y)) + \beta \int \left[ \psi V(0, y') + (1 - \psi) V_1(y') \right] F(dy' | y), \] (2)

and

\[ V_0(b, y) = \max_{b' \leq 0} \left\{ u(y + b - q(b', y)[b' - (1 - \delta)b]) + \beta \int V(b', y') F(dy' | y) \right\}. \] (3)

The bond price is given by the following functional equation:

\[ q(b', y) = \int M(y', y) [1 - h(b', y')] F(dy' | y) \]
\[ + (1 - \delta) \int M(y', y) [1 - h(b', y')] q(g(b', y'), y') F(dy' | y), \] (4)

where \( h \) and \( g \) denote the future default and borrowing rules that lenders expect the government to follow. The default rule \( h \) is equal to 1 if the government defaults, and is equal to 0 otherwise. The function \( g \) determines the number of coupons that will mature next period. The first term in the right-hand side of equation (4) equals the expected value of the next-period coupon payment promised in a bond. The second term in the right-hand side of equation (4) equals the expected value of all other future coupon payments, which is summarized by the expected price at which the bond could be sold next period.\(^9\)

Equations (1)-(4) illustrate that the government finds its optimal current default and borrowing decisions taking as given its future default and borrowing decision rules \( h \) and \( g \). In equilibrium, the optimal default and borrowing rules that solve problems (1) and (3) must be equal to \( h \) and \( g \) for all possible values of the state variables.

**Definition 1** A Markov Perfect Equilibrium is characterized by

1. a set of value functions \( V, V_1, \) and \( V_0 \)

2. a default rule \( h \) and a borrowing rule \( g \).

\(^9\)Assuming risk-neutral lenders, Chatterjee and Eyigungor (2012) demonstrate that an equilibrium bond price function exist and is decreasing with respect to the debt level.
3. a bond price function \( q \),

such that:

(a) given \( h \) and \( g \), \( V \), \( V_1 \), and \( V_0 \) satisfy functional equations (1), (2), and (3), when the government can trade bonds at \( q \);

(b) given \( h \) and \( g \), the bond price function \( q \) is given by equation (4); and

(c) the default rule \( h \) and borrowing rule \( g \) solve the dynamic programming problem defined by equations (1) and (3) when the government can trade bonds at \( q \).

### 2.2 Fiscal policy

Fiscal policy is very stylized in the sovereign default framework proposed by Eaton and Gersovitz (1981). The government may tax private agents in order to service its debt or may give transfers to private agents using resources it borrows. Each period, the government chooses the (possibly negative) level of tax revenues \( \tau \). When the country is in default, \( \tau = 0 \) and private agents consume all available resources \( c = y - \phi(y) \). When the country is not in default, private agents pay taxes \( c = y - \tau \) and the government uses tax revenues to service debt that is not rolled over, i.e., \( \tau = -b + q (b', y) [b' - (1 - \delta)b] \).

### 2.3 Fiscal rules

We introduce fiscal rules by assuming that, from the period \( t \) in which the rule is introduce, the government can commit to respect a debt ceiling that is a liner function of the current income:

\[
b_t(y_t) = a_t^0 + a_t^1 y_t,
\]

Thus, when the rule (i.e., the sequence of debt ceilings) is announced, the government’s maximization problem becomes non-stationary, until the debt ceiling stops changing with \( t \).
3 Calibration

As Hatchondo et al. (2010a), we solve the model numerically using value function iteration and interpolation.\textsuperscript{10} As in most previous quantitative studies on sovereign default, we use Argentina before the 2001 default as a case study. Recall that we assume that the government can commit to its preferred rule. Therefore, it is likely that the policies we study were not available to Argentina before the 2001 default. This paper should not be interpreted as discussing policy options for Argentina but as a quantification of the role that credible fiscal rules could play in countries that pay a non-negligible default premium. The choice of Argentina as a case study facilitates the comparison of our paper with existing studies of sovereign default.

Table 1 presents the calibration. We assume that the representative agent in the sovereign economy has a coefficient of relative risk aversion of 2, which is within the range of accepted values in studies of business cycles. A period in the model refers to a quarter. The risk-free interest rate is set equal to 1 percent. As in Hatchondo et al. (2009), parameter values that govern the endowment process are chosen so as to mimic the behavior of GDP in Argentina from the fourth quarter of 1993 to the third quarter of 2001. The parametrization of the income process is similar to the parametrization used in other studies that consider a longer sample period (see, for instance, Aguiar and Gopinath (2006)). As in Arellano (2008), we assume that the probability of regaining access to capital markets ($\psi$) is 0.282.

With $\delta = 0.0341$, bonds have an average duration of 4.19 years in the simulations of the baseline model.\textsuperscript{11} Cruces et al. (2002) report that the average duration of Argentinean bonds included in the EMBI index was 4.13 years in 2000. This duration is not significantly different from what is observed in other emerging economies. Using a sample of 27 emerging economies, Cruces et al. (2002) find an average duration of 4.77 years, with a standard deviation of 1.52.

\textsuperscript{10}We use linear interpolation for endowment levels and spline interpolation for asset positions. The algorithm finds two value functions, $V_1$ and $V_0$. Convergence in the equilibrium price function $q$ is also assured.

\textsuperscript{11}We use the Macaulay definition of duration, which with the coupon structure assumed in this paper is given by

$$D = \frac{1 + r^*}{\delta + r^*},$$

where $r^*$ denotes the constant per-period yield delivered by the bond.
We calibrate the discount factor, the income cost of defaulting (two parameter values), and the lenders’ risk premium parameter to target four moments: A mean spread of 7.4 percent, a standard deviation of the spread of 2.5 percent, a mean public external debt to (annual) GDP ratio of 40 percent in the pre-default samples of our simulations (the exact definition of these samples is presented in Section 4.1), and a default frequency of three defaults per 100 years. The first three targets are computed using Argentine data from 1993 to 2001. Even though it is not obvious which value for the default frequency one should target, we include the default frequency as a target in our calibration because it has received considerable attention in the literature, it is clearly influenced by lenders’ risk premium parameter, and it influences the welfare gains from the imposition of fiscal rules. We target a frequency of three defaults per 100 years because this frequency is often used in previous studies (see, for example, Arellano (2008) or Aguiar and Gopinath (2006)).

12 Hatchondo et al. (2010b) show that the effects of debt dilution are similar in model economies with three and six defaults per 100 years. The discount factor value we obtain is relatively low but higher than the ones assumed in previous studies (for instance, Aguiar and Gopinath (2006) assume $\beta = 0.8$). Low discount factors may be a
4 Results

First, we show that simulations of the benchmark economy fit the data reasonably well. Second, we show that the government can benefit from committing to a fiscal rule that establishes a sequence of debt ceilings that reduces the sovereign default premium to negligible levels. Third, we show that the government is worse off when it is restricted to choose among fiscal rules that do not establish intermediate fiscal adjustment targets. Fourth, we discuss the effects of fiscal rules on the procyclicality of fiscal policy. Fifth, as the value of previously issued debt appreciates upon the announcement of a rule, we discuss how the preferred rule depends on who appropriates those capital gains. Sixth, we discuss the robustness of our findings to assuming government myopia.

4.1 Benchmark economy

Table 2 reports moments in the data and in the simulations of the benchmark model (without a rule). As in previous studies, we report results for pre-default simulation samples. The exception is the default frequency, for which we use all simulated data. We simulate the model for a number of periods that allows us to extract 500 samples of 32 consecutive periods before a default. We focus on samples of 32 periods because we compare the data generated by the model with Argentine data from the fourth quarter of 1993 to the third quarter of 2001.

The moments reported in Table 2 are chosen so as to illustrate the ability of the model to replicate distinctive features of business cycles in emerging economies. These economies present a high, volatile, countercyclical interest rate, and high consumption volatility. The interest rate spread ($R_s$) is expressed in annual terms. The logarithm of income and consumption are denoted

---

result of political polarization in emerging economies (see Amador (2003) and Cuadra and Sapriza (2008))

The data for income and consumption is taken from the Argentine Finance Ministry. The spread before the first quarter of 1998 is taken from Neumeyer and Perri (2005), and from the EMBI Global after that. For the default frequency, we report the value we target, as discussed in Section 3.

The qualitative features of these data are also observed in other sample periods and in other emerging markets (see, for example, Aguiar and Gopinath (2007), Alvarez et al. (2011), Boz et al. (2011), Neumeyer and Perri (2005), and Uribe and Yue (2006)). The only exception is that in the period we consider, the volatility of consumption is slightly lower than the volatility of income, while emerging market economies tend to display a higher volatility of consumption relative to income.
Table 2: Business cycle statistics. The second column is computed using data from Argentina from 1993 to 2001. The third column reports the mean value of each moment in 500 simulation samples. Each sample consists of 32 periods before a default episode. The default probability is computed using all simulation data.

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E(R_s)$</td>
<td>7.44</td>
<td>7.42</td>
</tr>
<tr>
<td>$\sigma(R_s)$</td>
<td>2.51</td>
<td>2.52</td>
</tr>
<tr>
<td>Mean debt-to-income ratio</td>
<td>0.40</td>
<td>0.39</td>
</tr>
<tr>
<td>Defaults per 100 years</td>
<td>3.00</td>
<td>2.99</td>
</tr>
<tr>
<td>$\sigma(\tilde{c})/\sigma(\tilde{y})$</td>
<td>0.94</td>
<td>1.23</td>
</tr>
<tr>
<td>$\rho(\tilde{c}, \tilde{y})$</td>
<td>0.97</td>
<td>0.99</td>
</tr>
<tr>
<td>$\rho(R_s, \tilde{y})$</td>
<td>-0.65</td>
<td>-0.79</td>
</tr>
</tbody>
</table>

by $\tilde{y}$ and $\tilde{c}$, respectively. The standard deviation of $x$ is denoted by $\sigma(x)$ and is reported in percentage terms. The coefficient of correlation between $x$ and $z$ is denoted by $\rho(x, z)$. Moments are computed using detrended series. Trends are computed using the Hodrick-Prescott filter with a smoothing parameter of 1,600. Table 2 also reports the mean debt-to-income ratio, where the debt is calculated as $b/(\delta + r)$.

Table 2 shows that the baseline model matches the data reasonably well. As in the data, in the simulations of the baseline model consumption and income are highly correlated and the spread is countercyclical. Consumption volatility is higher than income volatility, which is consistent with the findings in Neumeyer and Perri (2005) and Aguiar and Gopinath (2007). The model also matches well the moments we targeted.

Figure 1 shows that fiscal policy is procyclical in the benchmark: Taxes tend to be higher (or transfers tend to be lower) when income is lower. This is consistent with the findings presented by Cuadra et al. (2010), who show that fiscal policy is procyclical in a sovereign default framework with a richer model of fiscal policy.

The intuition for the procyclicality of fiscal policy is the following: In bad times (output is low), the cost of borrowing is relatively high and the government chooses to finance more of its debt service obligations with taxes instead of new issuances. Figure 2 shows that the price at
which the government can sell bonds is lower in bad times and that taxes tend to be higher when the sovereign interest rate spread is higher.

4.2 Optimal fiscal rule

We next find the optimal rule to be implemented in the benchmark no-rule economy. We first consider only rules that impose sequence of debt ceilings that are not functions of aggregate income ($a_t^1 = 0$ in terms of equation (5)). In subsection 4.4 we discuss the effects of imposing cyclically adjusted ceilings. We first consider a pre-rule state characterized by a debt level of 38 percent of trend annual income and an income level that gives us a spread of 7.4 percent (the mean spread in the data and in our benchmark simulations). We assume that rules impose a transition period such that the debt ceiling in the first period is 37.5 percent and declines 0.5 percent per quarter after that. After the transition period, the debt ceiling stops declining and remains constant. We let the government choose the length of the transition period and, therefore, its long-run debt ceiling.

Table 3 presents the optimal fiscal rule and the effects of imposing this rule. The table shows that the government chooses a transition period of 36 quarters, which implies a long run debt ceiling of 20 percent of trend annual income. With the announcement of this rule, the spread
Figure 2: Borrowing cost and government transfers in the simulations of the benchmark economy. The left panel presents the menu of combinations of bond prices and next-period debt levels \( \left( \frac{b'}{\delta + r} \right) \) from which the government can choose. Solid dots illustrate the optimal decision of a government that inherits a debt level equal to the average debt observed in the simulations. The low (high) value of \( y \) corresponds to an endowment realization that is one standard deviation below (above) the unconditional mean. The right panel presents spreads and government transfers in the simulations.

immediately (before any fiscal adjustment) declines from 7.4 percent to 0.5 percent. In the long-run, the average spread of an economy with a 20 percent debt ceiling is also 0.5 percent.

Table 3 shows that with the promise of fiscal adjustments that come primarily in the future, the government benefits immediately from a reduction in sovereign risk. Lower sovereign risk makes having access to credit markets more attractive, which in turn makes defaulting a less desirable option. Thus, the commitment to future fiscal adjustments weakens incentives to default immediately, which leads to a further reduction in sovereign spreads.

We measure welfare gains as the constant proportional change in consumption that would leave domestic consumers indifferent between continuing living in the benchmark economy (without a fiscal rule) and moving to an economy with a fiscal rule. Let \( V^B \) and \( V^R \) denote the value functions in the benchmark economy and an economy with a fiscal rule, respectively. The welfare gain of moving from the benchmark economy to an economy with a fiscal rule is given by

\[
\left( \frac{V^R(b, y)}{V^B(b, y)} \right)^{\frac{1}{1-\gamma}} - 1.
\]
Announcement-period spread (pre announcement) 7.4%
Optimal transition length (quarters) 36
Optimal debt ceiling after the transition (% of trend annual income) 20%
Announcement-period spread (post announcement) 0.5%
Long-run average spread 0.5%
Welfare gain 0.25%

Table 3: Optimal fiscal rule.

The welfare gain from implementing the optimal fiscal rule studied in this subsection is equivalent to a permanent increase in consumption of around 0.25 percent (Table 3).

The government benefits from implementing a fiscal rule because the rule mitigates the debt dilution problem. A large literature discusses how, in the presence of default risk, the government could benefit from dealing with this problem (see Hatchondo et al. (2010b) and the references therein). The contribution of this paper is to present the benefits of dealing with debt dilution through fiscal rules that impose a sequence of fiscal adjustments. Figure 3 illustrates how the optimal rule creates new borrowing opportunities for the government. On the one hand, a debt ceiling limits the amount the government can borrow. On the other hand, limiting its future borrowing behavior enables the government to pay a lower interest rate for the same borrowing level. The figure also shows that the sharp reduction in spreads implied by the fiscal rule allows the government to lower its debt level significantly with a relatively mild reduction in its borrowing: while with the 20 percent ceiling implies a debt reduction of 18 percent of trend annual income, it only implies a reduction in loan values of about 5 percent of trend annual income.

4.3 Optimal fiscal rule without intermediate targets

This subsection illustrates the importance of intermediate targets for fiscal rules (and, more generally, for fiscal adjustment programs). We now assume that the government can choose the
Figure 3: Government’s borrowing opportunities with and without a debt ceiling. The left panel presents the menu of end-of-period debt \((-b'/4(\delta + r))\) and spread the government can choose from. The right panel presents the amount a government without debt could borrow as a function of its end-of-period debt.
length of the transition period and the long-run debt ceiling but, in contrast with Subsection 4.2, the government cannot choose intermediate debt ceilings. As in Subsection 4.2, we assume that debt ceilings are not a function of aggregate income.

We now consider three pre-rule states characterized by a debt level of 38 percent of mean income and by different income levels, which determine the level of the sovereign spread. The relatively low-risk state has a spread of 5.1 percent, the normal-risk state has a spread of 7.4 percent, and the high-risk state with has spread of 15 percent.

Table 4 presents the optimal fiscal rule in each of the three states described above. The table shows that the level of pre-rule default risk does not significantly affect the rule to which the government would like to commit. Welfare is maximized with a debt ceiling of 30 percent of mean income and a delay of four years between the rule announcement period and the period in which the ceiling starts being enforced.

<table>
<thead>
<tr>
<th>Announcement-period spread (pre announcement)</th>
<th>5.1%</th>
<th>7.4%</th>
<th>15.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal transition length (quarters)</td>
<td>18</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Optimal debt ceiling after the transition (% of trend annual income)</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Announcement-period spread (post announcement)</td>
<td>4.2%</td>
<td>6.0%</td>
<td>14.7%</td>
</tr>
<tr>
<td>Long-run average spread</td>
<td>3.6%</td>
<td>3.6%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Welfare gain</td>
<td>0.23%</td>
<td>0.23%</td>
<td>0.22%</td>
</tr>
</tbody>
</table>

Table 4: Optimal rules without intermediate targets for pre-rule states with different sovereign spreads. The debt level is constant across pre-rule states (38 percent of mean income) but income levels differ.

Table 4 shows that the lack of intermediate targets makes it optimal for the government to choose a shorter transition period and a higher long-run debt ceiling. This implies higher spreads both when the rule is announced and in the long run. Without intermediate targets, the government is forced to choose a shorter adjustment periods because it knows that fiscal adjustments will be delayed. Figure 4 presents the mean debt and spread levels after the the optimal rule announcement for transition paths in which the government does not default. Figure 4 shows that the government chooses to do the bulk of the debt reduction during the last year of
the four years transition period. During the first three years, the government benefits from lower spreads without reducing its debt level more than what it would have reduced it without a rule. Since the government has a tendency of delaying fiscal adjustments, choosing a long adjustment period would imply that the adjustment would start far in the future and, therefore, would be heavily discounted by lenders. Consequently, it is optimal for the government to choose shorter transition periods when the rule does not establish intermediate targets. Since the government is restricted to a shorter transition period, it is optimal to choose a more moderate adjustment.

Figure 4: Mean debt-to-income ratio \( \left( \frac{-M}{(\delta+r)4y} \right) \) and interest rate spread during transitions that follow the announcement of the optimal rule, for samples without defaults.

Figure 4 also shows that after the rule announcement, the spread is expected to decline faster when the pre-rule spread is higher. This explains why welfare gains from implementing the optimal rule are similar for the three cases consider in Table 4, in spite of a much lower announcement-period spread decline in the case with a 15 percent pre-rule spread.

4.4 Fiscal rules and the cyclicality of fiscal policy

We first show how lower debt levels implied by the imposition of a fiscal rule attenuates the procyclicality of fiscal policy. Recall that subsection 4.1 shows that fiscal policy is procyclical in the benchmark economy because in low-income periods, the higher cost of issuing debt induces
the government to finance more of its debt service obligations through tax revenues.

Table 5 shows that by reducing default risk, the optimal debt-ceiling reduces both the mean spread and the responsiveness of the spread to income shocks, which is reflected in a lower standard deviation of the spread. A cost of borrowing that is less responsive to income shocks dampens the driving force behind the procyclicality of fiscal policy. In turn, a less procyclical fiscal policy is reflected in a lower volatility of consumption relative to income. These findings support the consensus among policymakers about the desirability of targeting low sovereign debt levels to create room for the implementation of countercyclical fiscal policy (see, for instance, Blanchard et al. (2010)).

We next discuss whether fiscal rules that allow for higher debt levels during low-income periods promote a more countercyclical fiscal policy, and whether such fiscal rules are desirable. This analysis allows us to shed light on the desirability of “escape clauses” that soften fiscal rules during recessionary periods. These clauses are commonly used in many countries (see IMF (2009)). Our findings serve as a warning against promoting these clauses in the presence of default risk.

We search for the optimal coefficients of rules like the ones specified in equation (5).\textsuperscript{15} For simplicity, we only consider ceilings that will be enforced immediately by a government that

\begin{table}[h]
\centering
\begin{tabular}{lccccc}
\hline
  & No ceiling & 35\% & 30\% & 25\% & 20\% \\
\hline
Defaults per 100 years & 2.99 & 2.86 & 1.33 & 0.42 & 0.09 \\
$E(R_s)$ & 7.42 & 6.64 & 3.6 & 1.66 & 0.54 \\
$\sigma(R_s)$ & 2.52 & 2.85 & 1.93 & 1.29 & 0.7 \\
$\sigma(c)/\sigma(y)$ & 1.23 & 1.12 & 1.08 & 1.05 & 1.02 \\
\hline
\end{tabular}
\caption{Simulation results for different debt ceilings.}
\end{table}

\textsuperscript{15}However, we still do not allow the government to issue income-indexed debt (see Hatchondo and Martinez (2012) and the references therein). The overwhelming majority of sovereign debt bonds are not GDP-indexed in part because of verifiability and moral hazard issues that are not present in our stylized model. One may think that these issues could also make it difficult to establish contingent fiscal rule targets. Nevertheless, contingent targets are common in fiscal rules. These targets are often implemented with the assistance of independent fiscal agencies (see Schaechter et al. (2012)).
currently does not have debt (since the initial debt is zero, there is no transition cost).

We find that the optimal rule is procyclical and imposes a limit on the debt-to-income ratio of 25 percent of annualized income \((a_1 = -1 \text{ and } a_0 = 0)\). Figure 5 shows that this rule implies a welfare gain equivalent to a permanent consumption increase of 0.63 percent.

![Figure 5: Welfare gain from implementing rules with an average debt ceiling of 25 percent of mean annual income and different slope coefficients.](image)

Table 6 presents business cycle statistics from simulations of economies with rules that imply an average ceiling of 25 percent of mean income. The table shows that the preferred rule prioritizes lowering the default probability over reducing private consumption volatility: It leads to a frequency of 0.12 defaults every hundred years (instead of 3 in the no-rule benchmark and 0.42 with the acyclical ceiling) and to a standard deviation of consumption that is 48 percent higher than the standard deviation of income (instead of 23 percent higher in the no-rule benchmark and 5 percent higher with the acyclical ceiling).

Table 6 shows that if instead of choosing an acyclical ceiling \((a_1 = 0)\), the government chooses countercyclical ceilings \((a_1 > 0)\) that allow for higher debt levels in periods of lower income, there are no significant changes in consumption volatility. During low-income periods, the default probability becomes more sensitive to changes in debt levels. Therefore, a countercyclical ceiling that allows for more debt in those periods loosens the government’s commitment to lower
future default probabilities. This contributes to increase the level and countercyclicalty of the government’s borrowing cost, making it more difficult to conduct countercyclical fiscal policy. The government prefers a countercyclical ceiling only when debt levels implied by the rule is low enough that it eliminates default risk and, consequently, the countercyclicalty of the borrowing cost.

### 4.5 Fiscal rules and debt holders’ capital gains

How would the choice of fiscal rule targets change if the government could benefit from the appreciation in the value of previously issued debt that is triggered by the implementation of a rule? Figure 6 illustrates how the spread in the announcement period and the welfare of domestic residents depend on the length of the transition period. The blue line shows that by choosing a shorter transition, the government could attain a larger reduction in the current spread. This would benefit holders of previously issued debt as they would experience a windfall gain (recall that the spread is a decreasing function of the bond price). But shorter transitions are costlier for the government because it cannot postpone and smooth out the cost of bringing down its debt level. This asymmetry raises a conflict of interest between the government and its creditors: Compared with the government, creditors prefer a shorter transition period and a lower debt ceiling.

In order to evaluate the importance of this conflict of interest, we assume the government extends a take-it-or-leave-it debt buyback offer promising that a rule will be implemented only

<table>
<thead>
<tr>
<th>Slope coefficient of debt ceiling rule</th>
<th>2</th>
<th>-1</th>
<th>-0.5</th>
<th>0</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defaults per 100 years</td>
<td>0.03</td>
<td>0.12</td>
<td>0.23</td>
<td>0.42</td>
<td>0.67</td>
<td>0.75</td>
<td>0.79</td>
</tr>
<tr>
<td>$E(R_s)$</td>
<td>0.10</td>
<td>0.68</td>
<td>1.07</td>
<td>1.66</td>
<td>2.13</td>
<td>2.41</td>
<td>2.63</td>
</tr>
<tr>
<td>$\sigma(R_s)$</td>
<td>0.03</td>
<td>0.55</td>
<td>0.85</td>
<td>1.05</td>
<td>1.43</td>
<td>1.41</td>
<td>1.47</td>
</tr>
<tr>
<td>$\sigma(c)/\sigma(y)$</td>
<td>1.82</td>
<td>1.48</td>
<td>1.25</td>
<td>1.05</td>
<td>0.98</td>
<td>1.04</td>
<td>1.05</td>
</tr>
</tbody>
</table>

Table 6: Simulation results with a debt ceiling $b(y) = a_0 + a_1 y$, for different values of $a_1$, and values of $a_0$ such that the average ceiling is equivalent to 25 percent of mean annual income.
Figure 6: Spread after the implementation of a rule with a ceiling of 30 percent of mean income, when the debt is 38 percent of mean income and the pre-rule spread is 7.4 percent.

if the offer is accepted. Thus, the government offers existing creditors to buy back previously issued bonds at the price that would have been observed if no rule is ever implemented. That price is lower than the post-rule price at which the government would be able to issue debt after implementing the rule (as illustrated in the right panel of Figure 4). This take-it-or-leave-it offer allows us to study the extreme case in which all capital gains created by the rule are reaped by the government. In previous subsections we studied the other extreme case in which the government does not benefit from these gains.

We find that when the government is the only one that benefits from the appreciation in the value of debt issued prior to the rule announcement, it chooses a lower debt ceiling with a shorter transition period. Table 7 shows that for three pre-rule states we consider, the government chooses a 25 percent ceiling that is enforced less than two years after its announcement.

The exercise presented in this subsection can be thought of as a voluntary debt restructuring in which creditors accept a haircut in the nominal value of their debt claims while the market value of these claims remains unchanged. Table 7 shows that in exchange for the implementation of

16We may overstate the benefits of a voluntary debt restructuring agreement because (i) we sidestep the cost of implementing such restructuring (see, for instance, Gulati and Zettelmeyer (2012)), (ii) we assume that there is no cost in terms of output or market access after the restructuring, and (iii) we assume that the government
Table 7: Optimal fiscal rules after a voluntary debt restructuring for pre-rule states with different sovereign spreads. These states have the same debt level (38 percent of mean income) and different income levels.

<table>
<thead>
<tr>
<th>Optimal debt ceiling (% of mean income)</th>
<th>5.1%</th>
<th>7.4%</th>
<th>15.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal transition length (quarters)</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
</tr>
<tr>
<td>Debt forgiveness</td>
<td>7</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Debt forgiveness</td>
<td>21%</td>
<td>25%</td>
<td>44%</td>
</tr>
<tr>
<td>Welfare gain</td>
<td>1.02%</td>
<td>1.29%</td>
<td>2.28%</td>
</tr>
</tbody>
</table>

the optimal rule, lenders would accept a substantial haircut.

Table 7 also shows that when the pre-rule spread is higher, the government chooses shorter transition periods, and the welfare gain from implementing the optimal rule after a voluntary debt restructuring is larger. This is consistent with the larger debt forgiveness observed for higher pre-rule spread: Lower post-debt-exchange debt levels increases welfare and facilitate reducing indebtedness to a level consisting with the ceiling.

4.6 Shortsighted governments

In this subsection we discuss the extent to which our finding would change in it is assumed that government are shortsighted. Shortsighted governments (for instance, because of political polarization and political turnover) are typically mentioned as a justification for fiscal rules that limit governments’ choices. We show that assuming shortsighted governments reinforce our results: it is optimal to enforce strong fiscal adjustments that lower the sovereign default premium to negligible levels (Subsection 4.2 shows that assuming shortsighted governments is not necessary to arrive to this conclusion).

To gauge the role of governments myopia we assume that the fiscal rule is chosen by a planner that discount the future with a $\beta$ higher than the one governments use each period when the can credibly commit to not announce a fiscal rule in the future if its current debt exchange offer is not accepted. The objective of this subsection is not to evaluate an implementable policy but to illustrate how the choice of fiscal rule targets would change if the government could appropriate the capital gains created by the rule.
choose their fiscal policy. For instance, one may think that the political coalition necessary to establish a fiscal rule in the constitution requires a majority that mitigates the effects of political polarization when discounting future outcomes (for a discussion of the effects of polarization on fiscal dynamics see Azzimonti (2011)). In particular, we assume that the planner discounts the future with $\beta = 0.99$ (while as in the benchmark governments maximize with $\beta = 0.961$). We repeat the exercise proposed in Subsection 4.2. That is, (i) we consider a pre-rule state characterized by a debt level of 38 percent of trend annual income and an income level that gives us a spread of 7.4 percent, (ii) we assume that rules impose a transition period such that the debt ceiling in the first period is 37.5 percent and later declines 0.5 percent per quarter until the transition period ends, after which it remains constant, and (iii) we let the government choose the length of the transition period and, therefore, its long-run debt ceiling.

Table 8 presents the optimal fiscal rule with shortsighted governments. Of course, when the rule chosen giving more weight to future periods imposes stronger fiscal adjustments. The main difference from using $\beta = 0.99$ instead of $\beta = 0.961$ is in the computation of the welfare gain that increases from 0.25 percent to 3.5 percent of permanent consumption when more weight is given to future periods.

<table>
<thead>
<tr>
<th></th>
<th>Governments</th>
<th>Planner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Announcement-period spread (pre announcement)</td>
<td>7.4%</td>
<td>7.4%</td>
</tr>
<tr>
<td>Optimal transition length (quarters)</td>
<td>36</td>
<td>56</td>
</tr>
<tr>
<td>Optimal debt ceiling after the transition (% of trend annual income)</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>Announcement-period spread (post announcement)</td>
<td>0.5%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Long-run average spread</td>
<td>0.5%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Welfare gain</td>
<td>0.25%</td>
<td>3.50%</td>
</tr>
</tbody>
</table>

Table 8: Optimal fiscal rule with shortsighted governments.
5 Conclusions

We use a standard sovereign default framework to show that there are gains from committing to a fiscal rule that establishes a sequence of debt ceilings that reduces the sovereign default premium to negligible levels. We also illustrate the importance of establishing intermediate fiscal adjustment targets. In addition, we show that as the fiscal rule lowers debt levels, both the level and the volatility of the sovereign spread decline, and the optimal policy becomes less procyclical. However, only after the debt level is reduced enough to make default risk insignificant, the government would prefer a countercyclical debt ceiling that allows for a countercyclical fiscal policy. We also show that assuming that the government can capture bondholders’ capital gains or that governments are shortsighted calls for fiscal rules that impose stronger fiscal adjustments.

We chose to make our analysis more transparent by respecting the simplifying assumptions commonly used in quantitative studies of sovereign defaults. Future work could enrich our analysis by relaxing these assumptions.

One interesting extension of our work could be to study the impact of less-than-perfectly-credible fiscal rules. For instance, we abstract from political shocks that could threaten the enforcement of a rule (Alfaro and Kanczuk (2005), Amador (2003), Cole et al. (1995), Cuadra and Sapriza (2008), D’Erasmo (2008), and Hatchondo et al. (2009) study sovereign default models with political shocks).

As in Chatterjee and Eyigungor (2012) and Hatchondo and Martinez (2009), we assumed that the government cannot choose the duration of its debt. Relaxing this assumption could enhance our understanding of the effects of fiscal rules but it would increase the computation cost significantly.\(^\text{17}\)

Extending our framework to include production could also improve the understanding of the effects of fiscal rules. We found large effects of fiscal rules on the level and volatility of

\(^{17}\text{In order to allow the government to choose a different duration of its debt, one would have to introduce bonds of different duration and keep track of how many of each of these bonds the government has issued (see Arellano and Ramanarayanan (2010)). The computation cost of including additional state variables may be significant (Hatchondo et al. (2010a) show that the computation cost of obtaining accurate solutions in default models may be significant, and Chatterjee and Eyigungor (2012) explain how the cost increases when long-duration bonds are assumed).}
interest rates. Several studies find significant effects of the interest rate on productivity (through investment and the allocation of factors of production), and of interest rate fluctuations on the amplification of shocks (see, for example, Mendoza and Yue (2012), Neumeyer and Perri (2005), and Uribe and Yue (2006)). Since there is no production in our setup, we do not allow for these channels. Furthermore, our analysis of the cyclicality of fiscal policy is limited because fiscal policy does not play a role in stabilizing aggregate income.

Studying a setup in which the sovereign simultaneously holds assets and liabilities may also be an interesting avenue for future research. Fiscal rules often aim at controlling the sovereign’s accumulation of both assets and liabilities. For simplicity, as is standard in default models, we assume that the government cannot simultaneously have assets and liabilities (Alfaro and Kanczuk (2009) and Bianchi et al. (2012) study a sovereign default model where the government can simultaneously hold assets and liabilities).
References


35


