

A quantitative model of sovereign debt, bailouts and conditionality

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A B S T R A C T

In times of sovereign debt crises, International Financial Institutions provide temporary financial support contingent on the implementation of specific macroeconomic policies. This paper develops a model of sovereign debt and default with endogenous participation rates in bailout programs. Conditionality enters as a constraint on fiscal policy. In the model, the insurance character of bailouts generates incentives for debt accumulation. Quantitative results suggest that bailouts prevent sovereign defaults in the short-run but may come at a cost of a greater default probability in the long-run. Increasing the intensity of conditionality lowers the bailout participation rate and generates a hump-shaped pattern of sovereign default risk.

Keywords:

Sovereign debt
Sovereign default risk
Bailouts
Conditionality
Fiscal policy

1. Introduction

In times of sovereign debt crises, International Financial Institutions (IFIs) provide temporary financial assistance and require the debtor to meet specific conditions on macroeconomic policy. Although over the past 40 years conditionality has been attached to IFI loans and countries have frequently utilized bailout programs, sovereign defaults occurred on a number of occasions, in particular in emerging market economies.¹

This paper analyzes the interaction of bailouts, conditionality, and sovereign debt and addresses three important questions. First, do bailouts prevent sovereign defaults in the short- and long-run? Second, is conditionality effective in reducing sovereign default risk? Third, what are the welfare effects of conditional bailouts? To study these questions, this paper develops a dynamic stochastic model of sovereign debt that features endogenous default probabilities as well as endogenous participation rates in bailout programs.

Our model builds on the classic contribution by Eaton and Gersovitz (1981) and the recent quantitative sovereign debt literature initiated by Aguiar and Gopinath (2006) and Arellano (2008). We assume a small open economy that is inhabited by a representative household who

consumes and works. The government finances government consumption by raising consumption taxes and by issuing external debt. International financial markets are incomplete and external debt contracts are not enforceable. If the country defaults on its outstanding debt it is temporarily excluded from credit markets and faces a loss in output. Risk-neutral international creditors incorporate the default risk into their pricing decision and charge a country risk premium. In addition to external debt provided by private creditors, an (unmodeled) IFI provides loans below the market rate but imposes macroeconomic conditions that restrict the set of fiscal policies. In contrast to external private sector debt, IFI loans are perfectly enforceable.² In each period, conditional on being in a good credit standing, the government decides whether to fulfill its repayment obligations to international private creditors or to default. Moreover, taking as given the restrictive fiscal target, the government chooses whether to make use of a conditional bailout program. We consider two types of conditionality: conditionality enters either as a constraint on government spending or as a constraint on tax revenues. Debt policy remains unrestricted and is an endogenous outcome in our theoretical framework.

In a quantitative exercise we apply our theoretical framework to the Argentine economy. Our model accounts for several empirical business

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¹ See Bird (2007) for a detailed discussion of conditionality, Bird et al. (2004) and Conway (2007) for empirical evidence regarding the use of bailouts, and Reinhart and Rogoff (2008) for an extensive analysis of sovereign defaults.

² This assumption is in line with Jeanne and Zettelmeyer (2001) who report rather low default risks on IFI loans.

cycle facts of emerging market economies, in particular procyclical fiscal policy (Talvi and Vegh, 2005; Ilzetzki and Vegh, 2008; Kaminsky et al., 2004) and countercyclical interest rates (Neumeier and Perri, 2005; Uribe and Yue, 2006). For our benchmark calibration with conditionality restricting government spending, the simulated model predicts a bailout probability of 36% and a default probability of 2.88%. The empirical counterparts equal 24 and 3%, respectively. In a policy experiment with conditionality on tax revenues, the model generates a bailout probability of 26% and a default probability of 3.88%. According to our simulations, constraints on government spending as well as on tax revenues reduce the ratio of external private sector debt to GDP during bailout programs. While restricting government spending helps to promote the endogenous recovery of the economy, forcing tax revenues to increase depresses output.

Our quantitative findings indicate that bailouts reduce sovereign default risk in the short-run. However, for our benchmark calibration, preventing defaults in the short-run comes at a cost of a greater default probability in the long-run. Since bailouts provide additional insurance, international private lenders are more willing to provide credit to an indebted government. The government takes advantage of lower interest rates and accumulates more external private sector debt. In the long-run, a higher level of external debt increases the risk of sovereign default.³ The benchmark calibration predicts that bailouts raise sovereign default risk by 1 percentage point if conditionality restricts government spending and by 2 percentage points if tax revenues are constrained.

To analyze the effectiveness of conditionality, we explore how different intensities of conditionality affect sovereign default risk in the long-run. The simulated default probability turns out to be hump-shaped in the strength of the fiscal constraint. For very weak conditionality, the participation rate in bailout programs is 100% and there is no sovereign default risk. Severe conditionality prohibits bailouts and generates a default probability of 1.87% which coincides with the one implied by our model in the absence of IFI loans. If the tightness of the fiscal constraint on government spending (tax revenues) is varied, the maximum default probability is 3.85 (4.66)%. The hump-shaped pattern of the default risk reflects two opposing forces of conditionality: On the one hand, stricter conditionality adversely affects the insurance character of bailouts since tighter fiscal constraints make IFI loans less attractive for the government. Consequently, the probability of entering or staying in a conditional bailout program decreases and the default probability increases. On the other hand, tighter fiscal constraints make the government more borrowing-constrained such that debt accumulation is limited which reduces the risk of default. Our simulation results suggest that bailouts reduce sovereign default risk both in the short-run and in the long-run only if the attached conditionality is sufficiently weak. In this case, however, bailout participation rates are above 50% implying that the IFI provides prolonged rather than temporary financial assistance.

Since the use of IFI loans is a choice variable of the government who maximizes the expected lifetime utility of the representative household, bailouts are welfare improving for the recipient country. For our benchmark calibration, bailouts generate a welfare gain measured in equivalent variation in consumption of 0.35 (0.31)% if conditionality restricts government spending (tax revenues). Relaxing conditionality increases welfare gains since the government is less constrained in its fiscal policy choice and bailout participation rates increase. Our analysis abstracts from welfare effects on the part of the IFI since we do not model the IFI's objective function. Accounting for the underlying rationale for the provision of conditional bailouts and incorporating interest earnings on IFI loans as well as potential political costs may substantially affect overall welfare.

³ This finding is in line with the empirical study by Jorra (2012) who reports that IMF lending programs raise the probability of a sovereign debt crisis.

Our paper builds on the recent quantitative sovereign debt literature,⁴ in particular Cuadra et al. (2010) who develop a model with endogenous default risk and endogenous fiscal policy to rationalize the empirical fact that fiscal policy tends to move procyclically in emerging markets. Aguiar and Gopinath (2006) and Roch and Uhlig (2014) analyze the impact of bailouts on sovereign default risk where the latter focus on bailout guarantees in sovereign debt crises. While Aguiar and Gopinath (2006) and Roch and Uhlig (2014) abstract from conditionality, Boz (2011) rationalizes the quantitative properties of conditional IFI lending within a model of sovereign debt. To model conditionality she assumes that the government acts under a higher rate of time preference leading to a more conservative debt policy. In a similar framework, Kirsch and Rühmkorf (2013) consider conditional financial assistance in a model of sovereign borrowing which features self-fulfilling expectations of default. Recent discussions of austerity programs in the context of the European Debt crisis can be found in e.g. Juessen and Schabert (2013) and Müller et al. (2015). Aguiar and Gopinath (2006), Roch and Uhlig (2014), Boz (2011), and Kirsch and Rühmkorf (2013) all consider endowment economies and abstract from endogenous fiscal policy. In contrast, our paper develops a production economy in which fiscal policy is explicitly modeled to allow for an endogenous dynamic interaction of conditional bailouts, fiscal policy, and sovereign default risk. Importantly, to model conditionality we leave the government's preferences unchanged and, instead, impose a constraint that restricts the set of fiscal policies. Our study contributes to the literature by focusing on the impact of conditional bailouts on sovereign default risk in the short- and long-run as well as the effectiveness of conditionality.

Our paper is related to the extensive literature that investigates the role of the International Monetary Fund (IMF). In this strand of literature, most attention is devoted to the determinants of participation in IMF programs, the macroeconomic effects of IMF supported structural programs as well as on the compliance rates of conditionality. For a discussion of the empirical findings concerning IMF programs we refer to the excellent surveys by Bird (2001), Joyce (2004), Bird (2007), and the references therein. Finally, our paper is linked to the foreign aid literature that models conditionality as a limited enforceable contract, e.g., Svensson (2003), Cordella et al. (2003), Cordella and Dell'Ariccia (2007), Scholl (2009) and Scholl (2013). These studies analyze the properties of optimal self-enforcing contracts in different setups and with different focuses.

The remainder of the paper is structured as follows. In Section 2 we describe the empirical characteristics of bailout programs and focus on the lending conditions and the properties of structural conditions. In Section 3 we lay out the theoretical framework. Section 4 deals with the calibration, presents the quantitative properties of the theoretical framework and discusses the effectiveness of conditionality. Finally, Section 5 concludes.

2. IMF programs and conditionality

In this section, we take the International Monetary Fund (IMF) as a representative of the IFIs and describe the main characteristics of IMF-supported programs. The empirical facts will guide us in our modeling choices in Section 3.

With 187 member countries, the IMF belongs to the most important international intergovernmental organization. According to its Articles of Agreement, the IMF provides temporary financial and technical

⁴ Papers that analyze different features in quantitative sovereign debt models are, e.g., Cuadra and Sapriza (2008), Hatchondo et al. (2009) and Scholl (2015) who study the role of political uncertainty, Yue (2010) who focuses on debt renegotiations and Mendoza and Yue (2012) who analyze the interaction of endogenous output costs and business cycles in emerging markets. Durdu et al. (2013) study the role of news shock while Hatchondo and Martinez (2009), Arellano and Ramanarayanan (2012) and Chatterjee and Eyigungor (2012) explore the importance of the maturity structure of bonds. Bai and Zhang (2012) analyze financial integration and international risk sharing in a model of sovereign default.

assistance to member countries that experience balance-of-payments problems. An IMF-supported program typically consists of two parts: IMF lending conditions and IMF conditionality.

IMF lending conditions specify the amount, interest and duration of the bailout program. The major part of IMF assistance is provided through Stand-By-Arrangements (SBA) that typically have a duration of 12–36 months. As [Boz \(2011\)](#) points out, the IMF lending rate is determined by the Special Drawing Rights (SDR) interest rate, the margin, burden sharing, service fees, and surcharges. The SDR interest rate is a weighted average of the T-bill rates with short maturity of developed countries. The margin covers intermediation costs of the IMF while the burden sharing accounts for losses resulting from overdue obligations to the IMF. Surcharges depend on the size of the loan and are applied if the loan is larger than the country's quota. [Table 1](#) reports the IMF lending rate in comparison with the interest rate of the United States and the Emerging Market Bond Index EMBI. Since private international financial markets incorporate default risks and charge country risk premia, the IMF lending rate is considerably lower than the EMBI.

The second essential part of an IMF-supported program is conditionality. The IMF provides temporary financial support only if the recipient government agrees to implement pre-defined economic policies which are designed according to the objectives of the IMF. Following the IMF's Articles of Agreement conditional lending is required for two reasons: IMF conditionality is supposed to help countries to overcome the problems that led to its financial problems and to ensure that loans are repaid.⁵ The [Independent Evaluation Office \(2007\)](#) highlights that adjustments in the public sector belong to the main tasks that have to be undertaken if the IMF intervenes. To illustrate this fact, [Table 2](#) considers selected emerging market economies that had several default episodes and presents data on the structural conditions attached to SBAs using the Monitoring of Fund Arrangements (MONA) 1993 and 2003 data bases provided by the IMF. We categorize the structural conditions into four main economic sectors: fiscal policy, public enterprises, monetary policy, and the financial sector.⁶ We show the sectoral distribution as percentage share of total structural conditions per program and report averages per country. In Argentina, for instance, more than 50% of the structural conditions were imposed on fiscal policy. Across countries, on average 38.59% of the structural conditions contained fiscal policy measures. According to the [Independent Evaluation Office \(2007\)](#) most of the fiscal conditions affected government spending and tax revenues. Therefore, in our theoretical framework, we model conditionality as a constraint on fiscal policy that restricts either government spending or tax revenues.

3. The model

3.1. The environment

We consider a small open economy inhabited by a representative household whose preferences are given by

$$E_0 \sum_{t=0}^{\infty} \beta^t [\alpha v(g_t) + (1-\alpha)u(c_t, l_t)], \quad (1)$$

where $\beta \in (0, 1)$ denotes the rate of time preference and c_t and l_t indicate consumption and labor supply, respectively. The per period utility $u: \mathbb{R}_+^2 \rightarrow \mathbb{R}$ is continuous, twice differentiable in both arguments, strictly increasing in c_t , strictly decreasing in l_t , jointly strictly concave in c_t and l_t and satisfies the Inada conditions. g_t denotes government consumption and $\alpha \in (0, 1)$ is a preference weight. The per-period utility $v: \mathbb{R}_+ \rightarrow \mathbb{R}$ is continuous, twice differentiable, strictly increasing in g_t , strictly concave

Table 1
Interest rates: IMF vs. U.S. treasury bonds.

| | IMF | U.S. treasury bonds | | | EMBI |
|-------------|------|---------------------|--------|--------|--------|
| | | 1-year | 3-year | 5-year | Global |
| 1990–1999 | 5.75 | 5.38 | 6.01 | 6.31 | 14.03 |
| 2000–2010 | 3.44 | 2.82 | 3.32 | 3.76 | 8.70 |
| Full sample | 4.54 | 4.04 | 4.60 | 4.98 | 9.61 |

Notes: Data are taken from the IMF database and Datastream. The interest rate of the IMF is the IMF's Adjusted Rate of Charge. Interest rates on US Treasury securities are at constant maturities. The EMBI Global Composite time series starts in 1997.

in g_t and satisfies the Inada conditions. The household's budget constraint reads as

$$(1 + \tau_t)c_t = y_t, \quad (2)$$

where τ_t denotes the consumption tax raised by the government.⁷ Output y_t uses labor l_t and is subject to productivity shocks:

$$y_t = z_t l_t.$$

Productivity $z_t \in \mathcal{Z}$ is assumed to have a compact support, $\mathcal{Z} = [z, \bar{z}] \subset \mathbb{R}_+$, and to follow a Markov process with a Markov transition function $\mu(z_{t+1}, z_t)$.

The government is benevolent and finances government consumption via external debt and taxes. The government has access to incomplete financial markets where it can issue non-contingent one-period bonds $b_{t+1} \in [b, \bar{b}] \subset \mathbb{R}$ held by international private creditors. Let q_t^b denote the bond price of a financial contract with face value b_{t+1} issued by the government that experiences a productivity shock z_t . When the government borrows it receives $q_t^b b_{t+1} < 0$ at date t and promises to repay b_{t+1} at $t+1$. International private debt contracts are not enforceable and the government may choose to default. International private creditors are assumed to be risk-neutral and financial markets are perfectly competitive. We follow [Arellano \(2008\)](#) and assume that the costs of default consist of two components. First, the defaulting government is temporarily excluded from international financial markets, i.e., the government stays in financial autarky and is allowed to re-enter international financial markets with an exogenous probability θ . Second, there occur direct output costs $\delta(z_t)$ such that $\delta(z_t)l_t \leq z_t l_t$ holds in financial autarky.

If the government does not default on its external private sector debt, it has access to IFI loans $a_{t+1} \in \mathcal{A} = [a, \bar{a}] \subset \mathbb{R}_-$, but is required to implement pre-specified macroeconomic conditions. Conditional on being in a good credit standing, the government decides whether to enter, to exit or to remain in a bailout program. The government's budget constraint reads as

$$g_t = \tau_t c_t + (b_t - q_t^b b_{t+1})(1-d_t) + a_t - h_t q_t^a a_{t+1}, \quad (3)$$

where d_t and h_t denote indicator variables. d_t takes the value of 1 if the government defaults on its external private sector debt and 0 otherwise. h_t is equal to 1 if the government accepts a bailout program. $a_{t+1} < 0$ denotes IFI loans provided at time t at the price q_t^a . We follow [Boz \(2011\)](#) and assume that the price of IFI loans is given by:

$$q_t^a(a_{t+1}) = \frac{1}{1 + r^f - \phi a_{t+1}}, \quad \phi > 0. \quad (4)$$

In line with [Section 2](#), Eq. (4) reflects the fact that the IFI lending rate is determined by the risk-free rate. In addition, the lending rate

⁵ For a broader debate on the rationale for conditionality we refer to [Bird \(2007\)](#).

⁶ Details of the categorization are provided in [Appendix A](#). The sector monetary policy includes exchange rate policies and conditions that foster central bank reform.

⁷ We follow [Cuadra et al. \(2010\)](#) and assume that the government taxes private consumption. This assumption is in line with the empirical findings of [Gavin and Perotti \(1997\)](#) and [Talvi and Vegh \(2005\)](#) who report that tax revenues in Latin America depend heavily on indirect taxes like taxes on goods and services.

Table 2
IMF stand-by-arrangements, structural conditions and defaults, 1976–2012.

| | Structural conditions by sector | | | | | No. of SBAs | Default dates |
|----------------------|---------------------------------|---------------|----------------------|------------------|--------------|-------------|----------------|
| | Fiscal | Public policy | Monetary enterprises | Financial policy | Other sector | | |
| Argentina | 52.78 | 0 | 5.16 | 24.40 | 17.66 | 11 | 82, 89, 01 |
| Bolivia | 65.12 | 0 | 4.65 | 30.23 | 0 | 3 | 80,86,89 |
| Brazil | 45.83 | 8.33 | 6.02 | 27.31 | 12.50 | 5 | 80,86,89 |
| Central African Rep. | 66.67 | 0 | 0 | 0 | 33.33 | 7 | 81,83 |
| Costa Rica | 12.50 | 12.50 | 32.50 | 32.50 | 10.00 | 10 | 81,83,84 |
| Dominican Rep. | 43.46 | 14.45 | 15.61 | 26.48 | 0 | 6 | 82,05 |
| Ecuador | 42.83 | 9.86 | 0 | 29.57 | 17.74 | 9 | 82,99 |
| Egypt | 12.50 | 25.00 | 0 | 25.00 | 37.50 | 4 | 84 |
| El Salvador | 32.00 | 4.00 | 18.67 | 45.33 | 0 | 10 | – |
| Guatemala | 20.37 | 0 | 0 | 79.63 | 0 | 7 | 86,89 |
| Hungary | 30.26 | 15.13 | 0 | 42.11 | 12.50 | 7 | – |
| Indonesia | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 1 | 98,00,02 |
| Mexico | 66.67 | 0 | 0 | 33.33 | 0 | 3 | 82 |
| Nigeria | 66.67 | 0 | 0 | 0 | 33.33 | 4 | 82,86,92,01,04 |
| Pakistan | 50.00 | 8.33 | 0 | 33.33 | 8.33 | 6 | n.a. |
| Panama | 38.19 | 21.53 | 10.42 | 18.06 | 11.81 | 10 | 83,87 |
| Peru | 54.94 | 16.67 | 0 | 28.39 | 0 | 8 | 76,78,80,84 |
| Philippines | 25.00 | 25.00 | 25.00 | 25.00 | 0 | 7 | 83 |
| Poland | 22.50 | 38.75 | 16.25 | 16.25 | 6.25 | 3 | 81 |
| Romania | 36.44 | 38.42 | 1.73 | 19.05 | 4.36 | 11 | 81,86 |
| Russia | 25.00 | 8.33 | 25.00 | 8.33 | 33.33 | 3 | 91,98 |
| Turkey | 39.92 | 22.03 | 2.56 | 23.88 | 11.61 | 9 | 82,87 |
| Uruguay | 31.03 | 5.79 | 1.63 | 54.96 | 6.59 | 15 | 83,87,90,03 |
| Zimbabwe | 27.14 | 21.43 | 17.14 | 17.14 | 17.14 | 4 | 00 |
| Mean | 38.59 | 15.36 | 6.78 | 29.24 | 10.03 | 6.79 | |

Notes: The table is constructed using data from the data set in Conway (2007) as well as the IMF databases MONA 1993 and MONA 2003. The number of default events are taken from Reinhart and Rogoff (2008). “–” indicates no default episodes; “n.a.” indicates no data available. The sectoral distribution of the conditions is shown as percentage share of total structural conditions per program and shows averages per country. The mean in the last row refers to the average over all programs across countries. Statistics on the structural conditions refer to IMF Stand-By Arrangements based on MONA 1993 and MONA 2003.

includes surcharges that depend on the size of the loan but not on the riskiness of the sovereign. We assume that the government cannot default on IFI loans, i.e., if the government decides to leave the bailout arrangement the outstanding IFI debt a_t has to be repaid. This assumption is line with the empirical evidence presented in Jeanne and Zettelmeyer (2001) who analyze the empirical repayment history of IMF loans and report rather low default risks. Moreover, we assume that no IFI loans are provided in times of default, thus, if $d_t = 1$ it follows that $h_t = 0$.

If the government makes use of financial assistance, the IFI imposes fiscal conditions that restrict the government’s set of policy choices. In our benchmark model, we focus on conditions that restrict government spending and limit the size of the public sector relative to the private sector⁸:

$$\frac{g}{c} \leq \bar{G} \quad \text{if } h_t = 1. \quad (5)$$

As a policy experiment, we consider the following condition that affects tax revenues:

$$\frac{\tau c}{y} \geq \bar{T} \quad \text{if } h_t = 1. \quad (6)$$

Note that in our theoretical framework the government’s borrowing policy remains an endogenous outcome since conditionality restricts government spending and tax revenues rather than debt.

3.2. Equilibrium

This section defines and characterizes the dynamic recursive equilibrium of the theoretical model. Given the aggregate state (b, a, z) , the equilibrium is determined by the policy functions of the private sector as well as the public sector and the bond price function.

3.2.1. Private sector

In equilibrium, the representative household takes the public sector policies as given and chooses private consumption and labor effort by maximizing expected discounted life-time utility (Eq. (1)) subject to the household’s budget constraint (Eq. (2)). The optimality conditions of the private sector are described by

$$-\frac{u_l(c, l)}{u_c(c, l)} = \frac{z}{(1 + \tau)}, \quad (7)$$

and the budget constraint (Eq. (2)). u_c and u_l denote the marginal utility of consumption and labor, respectively.

3.2.2. Public sector

In each period, conditional on being in a good credit standing and taking as given the international bond price and the price of IFI loans, the realization of the productivity shock, and the amount of outstanding external private sector debt and IFI debt, the government decides whether to fulfill its repayment obligations or to default. Moreover, taking as given the fiscal constraint, the government chooses between entering, continuing or exiting a conditional bailout program. The government determines its optimal choices by maximizing households preferences (Eq. (1)) subject to the government budget constraint (Eq. (3)), the optimality conditions of the private sector (Eqs. (2) and (7)) and, in case of a bailout, subject to conditionality (Eq. (5) or Eq. (6)).

Given outstanding external private sector debt b , outstanding IFI debt a and the technology realization z , let $V^0(b, a, z) : \mathcal{B} \times \mathcal{A} \times \mathcal{Z} \rightarrow \mathbb{R}$ be the value function when the government has access to international financial markets. The government determines its optimal choices by comparing the value functions of three options:

$$V^0(b, a, z) = \max \{ V^R(b, a, z), V^D(a, z), V^C(b, a, z) \}. \quad (8)$$

⁸ Note that restricting g/y would lead to very similar results.

$V^R(b, a, z) : \mathcal{B} \times \mathcal{A} \times \mathcal{Z} \rightarrow \mathbb{R}$ denotes the government's value function of repayment, i.e., it honors its outstanding external private sector debt. $V^D(a, z) : \mathcal{A} \times \mathcal{Z} \rightarrow \mathbb{R}$ is the value function of defaulting on the entire amount of external private sector debt and being punished by a temporary stay in financial autarky and an output loss. $V^R(b, a, z)$ and $V^D(a, z)$ both assume that no financial assistance is provided by the IFI and the government is unrestricted in designing its fiscal policies. In contrast, $V^C(b, a, z) : \mathcal{B} \times \mathcal{A} \times \mathcal{Z} \rightarrow \mathbb{R}$ refers to the value function associated with a bailout program where the government acts subject to conditionality. Note that the value functions depend on a since outstanding IFI loans have to be repaid.

If the government does not take new IFI loans and honors its debt obligations, the government is unrestricted in its fiscal policy choices. The government takes the bond price $q^b(b', a' = 0, z)$ as given and solves the following maximization problem:

$$V^R(b, a, z) = \max_{g, \tau, b', c, l} \left\{ \alpha v(g) + (1-\alpha)u(c, l) + \beta \int_{z'} V^0(b', 0, z') \mu(z', z) dz' \right\} \quad (9)$$

subject to

$$\begin{aligned} g &= \tau c + b - q^b(b', 0, z) b' + a, \\ (1 + \tau)c &= z l, \\ \frac{u_l(c, l)}{u_c(c, l)} &= \frac{z}{(1 + \tau)}. \end{aligned}$$

The government may have been using IFI loans before that have to be repaid ($a \leq 0$).

If, instead, the government defaults on its external private sector debt, it relaxes its budget constraint by not repaying its debt but faces costs arising from the temporary exclusion from international financial markets and the direct output loss represented by $\delta(z)$. In this case, the maximization problem is given by:

$$V^D(a, z) = \max_{g, \tau, c, l} \left\{ \alpha v(g) + (1-\alpha)u(c, l) + \beta \int_{z'} [\theta V^0(0, 0, z') + (1-\theta)V^D(0, z')] \mu(z', z) dz' \right\} \quad (10)$$

subject to

$$\begin{aligned} g &= \tau c + a, \\ (1 + \tau)c &= \delta(z) l, \\ \frac{u_l(c, l)}{u_c(c, l)} &= \frac{\delta(z)}{(1 + \tau)}. \end{aligned}$$

θ denotes the exogenous re-entry probability to international financial markets.

If the government makes use of IFI loans, the IFI imposes conditionality by restricting fiscal policies. In this case, the government compares the costs of conditionality and the benefits of receiving loans at a lower IFI interest rate that relaxes the budget constraint. The optimal choices are the outcomes of the following maximization problem:

$$V^C(b, a, z) = \max_{g, \tau, b', a', c, l} \left\{ \alpha v(g) + (1-\alpha)u(c, l) + \beta \int_{z'} V^0(b', a', z') \mu(z', z) dz' \right\} \quad (11)$$

subject to

$$\begin{aligned} g &= \tau c + b - q^b(b', a', z) b' + a - q^a(a') a', \\ (1 + \tau)c &= z l, \\ \frac{u_l(c, l)}{u_c(c, l)} &= \frac{z}{(1 + \tau)}, \\ \frac{g}{c} &\leq \bar{G} \text{ or } \frac{\tau c}{z l} \geq \bar{T}. \end{aligned}$$

In the following, we characterize the government's default and bailout policies and default and bailout sets. Let $\mathcal{D}(b, a)$ denote the set of productivity realizations $z \in \mathcal{Z}$ for which default is optimal given b and

a , and let $\mathcal{H}(b, a)$ denote the set of productivity realizations $z \in \mathcal{Z}$ for which entering a bailout program is optimal given b and a .

The government's default policy is characterized by

$$d(b, a, z) = \begin{cases} 1 & \text{if } \max\{V^R(b, a, z), V^C(b, a, z)\} < V^D(a, z) \\ 0 & \text{else} \end{cases}$$

implying the default set $\mathcal{D}(b, a) = \{z \in \mathcal{Z} : d(b, a, z) = 1\}$.

The government's bailout policy is characterized by

$$h(b, a, z) = \begin{cases} 1 & \text{if } \max\{V^R(b, a, z), V^D(a, z)\} < V^C(b, a, z) \\ 0 & \text{else.} \end{cases}$$

The bailout set is given by $\mathcal{H}(b, a) = \{z \in \mathcal{Z} : h(b, a, z) = 1\}$.

3.2.3. International private creditors

Conditional on being in a good credit standing, the government is able to borrow from a large number of identical infinitely lived risk-neutral international private creditors. International private creditors have perfect information about the productivity realization and they can borrow or lend from international capital markets at the constant risk-free rate r^f . Expected profits Π account for the risk of default:

$$\Pi = -q^b b' + \frac{1 - \lambda(b', a', z)}{1 + r^f} b'.$$

The endogenous default probability $\lambda(b', a', z)$ is related to the default set according to

$$\lambda(b', a', z) = \int_{\mathcal{D}(b', a')} \mu(z', z) dz'. \quad (12)$$

Competitive risk-neutral pricing implies the following bond price function

$$q^b(b', a', z) = \frac{1 - \lambda(b', a', z)}{1 + r^f}. \quad (13)$$

This optimality condition states that bond prices lie in the closed interval $q^b \in [0, (1 + r^f)^{-1}]$. The sovereign's interest rate is given by the relation $r(b', a', z) = 1/q^b(b', a', z) - 1$ while the interest rate spread is described by $s(b', a', z) = r(b', a', z) - r^f$.

3.2.4. Recursive equilibrium

Given the specification of the decision problems of the agents in the economy, we define the recursive equilibrium as follows.

Definition 1. *The recursive equilibrium for this small open economy is defined as*

1. a set of policy functions for household's consumption $c(b, a, z)$ and labor $l(b, a, z)$,
2. a set of policy functions for the government's debt policy $b'(b, a, z)$ and $a'(b, a, z)$, government consumption $g(b, a, z)$, and tax policy $\tau(b, a, z)$,
3. the default set $\mathcal{D}(b, a)$ and the bailout set $\mathcal{H}(b, a)$,
4. the price function for external private sector debt $q^b(b', a', z)$,
5. a set of value functions $V^0(b, a, z)$, $V^R(b, a, z)$, $V^D(a, z)$, and $V^C(b, a, z)$

such that

1. taking as given the government policies, household's consumption $c(b, a, z)$ and labor $l(b, a, z)$ satisfy the optimality condition (7) and the household's budget constraint (2),
2. taking as given the bond price function $q^b(b', a', z)$ and the IFI price function $q^a(a')$, the optimal policies of the household, and conditionality described by constraint (5) or (6), the government's policy functions $b'(b, a, z)$, $a'(b, a, z)$, $g(b, a, z)$, $\tau(b, a, z)$, the default set $\mathcal{D}(b, a)$, and the bailout set $\mathcal{H}(b, a)$ solve Eqs. (8), (9), (10), and (11),

3. bond prices $q^b(b', a', z)$ fulfill Eq. (13) such that risk-neutral international private creditors earn zero expected profits.

4. Quantitative analysis

4.1. Data

In our quantitative analysis, we apply our model to Argentina to study the dynamic interaction of conditional bailout programs, fiscal policy, and default episodes. Argentina is a typical emerging market economy that frequently made use of IMF conditional lending facilities but experienced several sovereign debt crises in the past, see Table 2 as well as [Beim and Calomiris \(2001\)](#) and [Reinhart and Rogoff \(2008\)](#). Most recently, in 2001, Argentina defaulted on its public external debt after having accumulated large fiscal deficits in the 1990s. At the beginning of the 1990s, Argentina's economy was characterized by high inflation rates and economic stagnation. To achieve price stability, the convertibility regime was adopted that pegged the peso to the US Dollar. The loss of monetary policy increased the importance of fiscal policy to react to adverse shocks, however, Argentina was characterized by fragile political institutions, weak fiscal discipline, and a severe dependence on external borrowing ([Independent Evaluation Office, 2004](#)). According to [Mussa \(2002\)](#), the inability of the government to maintain a sustainable fiscal policy was the primary root of this debt crisis. In early 2000, the IMF approved a three-year Stand-By-Arrangement in which structural fiscal reform and fiscal consolidation were the main program goals. But, as the [Independent Evaluation Office \(2004\)](#) emphasizes, the conditional bailout program was not successful in promoting economic recovery and lowering interest rates. In December 2001, the fifth review of the program was not approved because of substantial discrepancies between the IMF staff and Argentina's authorities ([Independent Evaluation Office, 2004](#)). On December 23, Argentina defaulted on its public external debt.

The first column of Table 4 summarizes business cycle statistics for the Argentine economy from 1993:1 to 2010:IV.⁹ The interest rate series is the JP Morgan Emerging Markets Bond Index (EMBI Global) for Argentina. The trade balance is given as a percentage of output. The series are de-trended using the Hodrick–Prescott filter with a smoothing parameter of 1600. As reported by [Aguilar and Gopinath \(2006\)](#) and [Arellano \(2008\)](#), output is negatively correlated with the interest rate spread, consumption is more volatile than output, and the trade balance is countercyclical.

Since data on tax rates are not available,¹⁰ we follow [Talvi and Vegh \(2005\)](#) who take the behavior of the inflation tax as also capturing the cyclical properties of other taxes. The inflation tax is constructed as $\tau = \frac{\pi}{1+\pi}$ where π denotes CPI inflation.¹¹ Table 4 shows that the tax rate is negatively correlated with output indicating procyclical fiscal policy in Argentina which is in line with the empirical evidence reported in [Talvi and Vegh \(2005\)](#), [Ilzetzki and Vegh \(2008\)](#) and [Kaminsky et al. \(2004\)](#).

To analyze the cyclical properties of external private sector debt flows and IFI debt flows, we consider external public and publicly guaranteed debt held by international private creditors and the Use of IMF Credit from 1970 to 2010. The annual series are de-trended using the Hodrick–Prescott filter with a smoothing parameter of 100. Public debt held by international private creditors amounts up to 20% of GDP whereas IFI debt is modest and is equal to 2.21% of GDP on average. Concerning the cyclicity of debt flows, we find procyclical external debt flows to international private creditors which indicates financial

Table 3
Calibration.

| Parameter | Description | Value | Empirical target |
|--|-------------------------------------|-------|---------------------------|
| <i>Parameters selected directly</i> | | | |
| γ | Risk aversion | 2 | |
| $1/\psi$ | Labor elasticity | 2.22 | |
| r^f | Risk-free rate | 0.01 | |
| <i>Parameters selected by matching targets</i> | | | |
| α | Preference weight | 0.57 | Mean of g/c if $a = 0$ |
| \bar{G} | Conditionality | 0.19 | Mean of g/c if $a < 0$ |
| η | Default penalty | 0.97 | Default frequency |
| β | Discount factor | 0.931 | Mean of a/y |
| θ | Re-entry probability | 0.10 | Volatility of net exports |
| ϕ | IFI interest premium | 0.09 | Mean of IMF interest rate |
| ρ_z | Autocorrelation | 0.85 | Autocorrelation of GDP |
| σ_ε | Standard deviation of ε | 0.011 | Volatility of GDP |

inflows in good times. In contrast, IFI debt flows are countercyclical which implies that the country makes more use of IMF resources in recessions. These findings are in line with [Boz \(2011\)](#) who concludes that this pattern holds for many emerging market economies.

Between 1970 and 2010 Argentina faced a probability of 24% of being in a Stand-By-Arrangement provided by the IMF. As discussed in Section 2, structural conditions were attached to the provision of the temporary financial assistance. These structural conditions may be reflected by the mean value of $\frac{g}{c}$ that is lower in times of IMF credit, $(g/c)_{a < 0} = 18.97\%$, than otherwise, $(g/c)_{a = 0} = 23.63\%$.

4.2. Functional forms and calibration

To calibrate the model to the Argentine economy we specify functional forms and choose parameter values on a quarterly basis. Table 3 summarizes the set of parameters and indicates whether the parameter values are chosen directly or calibrated to match empirical targets.

We employ the following per-period utility functions ([Greenwood et al., 1988](#)):

$$u(c, l) = \frac{\left(c - \frac{l^{1+\psi}}{1+\psi}\right)^{1-\gamma}}{1-\gamma},$$

$$v(g) = \frac{g^{1-\gamma}}{1-\gamma},$$

where $\gamma > 0$ denotes the parameter of relative risk aversion and $\frac{1}{\psi}$ is the intertemporal labor elasticity. Note that this specification implies that the marginal rate of substitution between private consumption and labor is independent of consumption. We follow [Mendoza \(1991\)](#), [Neumeyer and Perri \(2005\)](#) and [Cuadra et al. \(2010\)](#) and set $\frac{1}{\psi}$ equal to 2.22. The parameter of relative risk aversion is set to 2. The preference parameter α that specifies the weight on government consumption is set to 0.57 to match the empirically observed average ratio of government consumption to private consumption in times when no IFI credits are used (23.63%).

Productivity is assumed to follow an AR(1) process:

$$\log(z_t) = \rho_z \log(z_{t-1}) + \varepsilon_t,$$

with ε_t is i.i.d. $N(0, \sigma_\varepsilon^2)$. The parameters of the productivity shock process are set as to match the autocorrelation and standard deviation of Argentine real GDP series.

We follow [Arellano \(2008\)](#) and assume that if the country defaults it is temporarily excluded from international financial markets. In financial autarky the country faces asymmetric output costs:

$$\delta(z) = \begin{cases} \eta E(z) & \text{if } z > \eta E(z) \\ z & \text{else,} \end{cases}$$

⁹ The exact sources, transformations and descriptions are presented in [Appendix B](#).

¹⁰ For the Mexican economy [Cuadra et al. \(2010\)](#) employ the method of [Mendoza et al. \(1994\)](#) to calculate an effective tax rate. Unfortunately, for Argentina the necessary data series are not available.

¹¹ Note that the inflation tax should not be interpreted as a step-in for the consumption tax.

with $\eta \in (0, 1)$. We set the default penalty η equal to 0.97 to match a default probability of 3% (Arellano, 2008). The probability θ of re-entering international financial markets is set to 0.10 to replicate the volatility of the trade balance, which is in line with values that have been used in previous studies.¹² We assume that the rate of time preference β takes the value 0.931 to match the average ratio of IFI debt to GDP of 2.21%.

The quarterly world risk-free interest rate r^f is set to 1% which is a standard value in quantitative business cycle studies. We set the parameter that determines the price of IFI loans $\phi = 0.09$ so that the average IMF interest rate of 4.54% is replicated in our simulations of the model.

To determine the strength of conditionality we restrict $\frac{g}{c}$ to $\bar{G} = 0.19$ if the government enters a bailout program with an IFI. This value corresponds to the empirical mean value in times of use of IMF credits, see first column of Table 4. We consider this as our benchmark calibration but also allow for different intensities of conditionality. The impact of restricting tax revenues rather than government spending is analyzed in Section 4.3.4. We analyze variations of \bar{G} and \bar{T} in Section 4.3.5.

4.3. Results

In this section, we study the quantitative predictions of our theoretical economy in which conditional bailout programs provide financial assistance but impose restrictions on the size of government spending, $g/c \leq \bar{G}$. We refer to this setup as our benchmark economy. To highlight the impact of conditional bailout programs on sovereign default risk and fiscal policy, we facilitate a comparison with a policy experiment in which no IFI is present and no financial assistance is available.¹³ Moreover, we contrast our benchmark economy with a policy experiment in which tax revenues are restricted, $\tau c/y \geq \bar{T}$, rather than government spending. Finally, we analyze the effectiveness of conditionality by varying the strength of the conditions imposed on fiscal policy.

4.3.1. Policy functions

Before presenting the cyclical properties of our theoretical economy, we first shed light on the optimal decision of the government regarding whether to repay outstanding external private sector debt, or to default, or to make use of a conditional bailout program. The left (right) panel of Fig. 1 considers a severe (moderate) realization of the productivity shock of 6% (3%) below the trend and visualizes the optimal government policy as a function of external private sector debt and IFI debt. If debt levels are within the white area, the government chooses to fulfill the external private sector debt obligations. Within the black area the government finds it optimal to default. If debt levels are within the grey area, the government enters or remains in a conditional bailout program. The policy functions reveal that for very low levels of external private sector debt the government always prefers to repay its outstanding debt. In contrast, if the government is strongly indebted to international private creditors while having no or moderate repayment obligations to the IFI, the government finds it optimal to default rather than to enter a bailout program which implies that the costs of conditionality dominate the costs of a default. For external debt levels of intermediate size, the government finds it optimal to make use of conditional IFI loans accepting the constraint on fiscal policy. If the productivity shock is less severe, the areas of conditionality as well as of default become smaller and the area of repayment increases.

Fig. 2 considers two realizations of productivity (severe and moderate) and plots the bond price $q^b(b', a', z)$ on external debt owed to private creditors. The first (second) panel takes as given the level of IFI debt (external private sector debt). The third panel compares the bond price of the benchmark economy with the bond price that would arise in an environment in which no IFI is present. It is evident that, first, the lower the indebtedness to international private creditors, the

Table 4
Business cycle statistics.

| | Argentine | No | Conditionality | |
|--|-----------|-------|----------------|----------|
| | Data | IFI | Spending | Revenues |
| <i>Sample standard deviations (in %)</i> | | | | |
| $\sigma(y)$ | 4.09 | 4.93 | 4.14 | 6.43 |
| $\sigma(s)/\sigma(y)$ | 2.02 | 1.73 | 5.91 | 4.11 |
| $\sigma(c)/\sigma(y)$ | 1.15 | 1.08 | 1.22 | 1.20 |
| $\sigma(g)/\sigma(y)$ | 0.53 | 1.89 | 3.02 | 1.51 |
| $\sigma(nx/y)/\sigma(y)$ | 0.39 | 0.27 | 0.33 | 0.24 |
| $\sigma(\Delta b/y)/\sigma(y)$ | 0.31 | 0.37 | 0.40 | 0.30 |
| $\sigma(\Delta a/y)/\sigma(y)$ | 0.25 | – | 0.25 | 0.14 |
| <i>Sample correlations</i> | | | | |
| $\rho(c, y)$ | 0.98 | 0.99 | 0.95 | 0.99 |
| $\rho(g, y)$ | 0.59 | 0.80 | 0.35 | 0.43 |
| $\rho(nx/y, y)$ | 0.91 | 0.53 | 0.36 | 0.25 |
| $\rho(\tau, y)$ | 0.41 | 0.53 | 0.40 | 0.76 |
| $\rho(s, y)$ | 0.69 | 0.36 | 0.18 | 0.24 |
| $\rho(\Delta b/y, y)$ | 0.41 | 0.47 | 0.12 | 0.34 |
| $\rho(\Delta a/y, y)$ | 0.10 | – | 0.25 | 0.26 |
| <i>Sample means (in %)</i> | | | | |
| s | 12.54 | 2.30 | 3.90 | 4.25 |
| r^{IFI} | 4.54 | – | 4.62 | 4.44 |
| $g/c, I_a = 0$ | 23.63 | 24.18 | 23.35 | 23.55 |
| $g/c, I_a < 0$ | 18.97 | – | 18.54 | 24.45 |
| b/y | 20.00 | 11.29 | 14.26 | 14.69 |
| a/y | 2.21 | – | 2.30 | 1.93 |
| <i>Sample probabilities (in %)</i> | | | | |
| Default | 3.00 | 1.87 | 2.88 | 3.88 |
| Bailout | 24.00 | – | 36.14 | 25.67 |

Notes: The simulation results are averages over 500 simulations. Each simulation has a sample size of 160 quarters. The series are HP-filtered with a smoothing parameter of 1600. y denotes production, c and g are private and public consumption, respectively. τ refers to the tax rate, b and a denote external debt owed to private creditors and IFI debt, respectively. nx is the trade balance. s denotes the interest spread charged by international private creditors. r^{IFI} denotes the IFI interest rate. 'Spending' refers to the benchmark specification of conditionality (5); 'Revenues' refers to the specification (6). The results refer to the benchmark calibration with $\bar{G} = 0.19$ and $\bar{T} = 0.24$.

higher the bond price. For very low levels of debt the government always repays and the bond price is equal to the inverse of the risk-free rate. Higher levels of external debt owed to private creditors make repayment less attractive and default incentives rise. Since international private creditors incorporate the default probability in their pricing decision they charge higher risk premia. Second, the bond price decreases for more severe realizations of the productivity shock. A country that experiences an adverse economic shock is less able to service its external private sector debt obligations. Due to a higher default risk, the premium charged by international private creditors increases so that the government becomes more borrowing-constrained during recessions. Third, the bond price is increasing in the level of IFI debt since high IFI debt reduces the risk of default on external debt owed to private creditors. Fourth, the presence of an IFI increases the bond price. The intuition is straightforward: Since international private creditors anticipate IFI support in times of economic crisis, they are more willing to provide credit to indebted countries and charge lower risk premia. The pattern of the bond price implies that the economy is less borrowing-constrained compared to an economy in which no IFI is present.

4.3.2. Cyclical properties of the theoretical economy

Table 4 reports the cyclical properties of simulated times series. The business cycle statistics are based on average values over 500 simulations of 160 quarters. According to our simulation results, the benchmark economy (restriction on spending) predicts a bailout probability of 36% while the empirical value is 24%. The theoretical economy accounts for the key business cycle statistics in emerging market economies. In particular, consumption is more volatile than output and the trade balance and the interest rate spread are countercyclical. The benchmark model matches the empirically observed cyclical pattern

¹² Aguiar and Gopinath (2006) set θ to 0.10 while Arellano (2008) choose 0.282.

¹³ The model without an IFI is similar to the one in Cuadra et al. (2010).

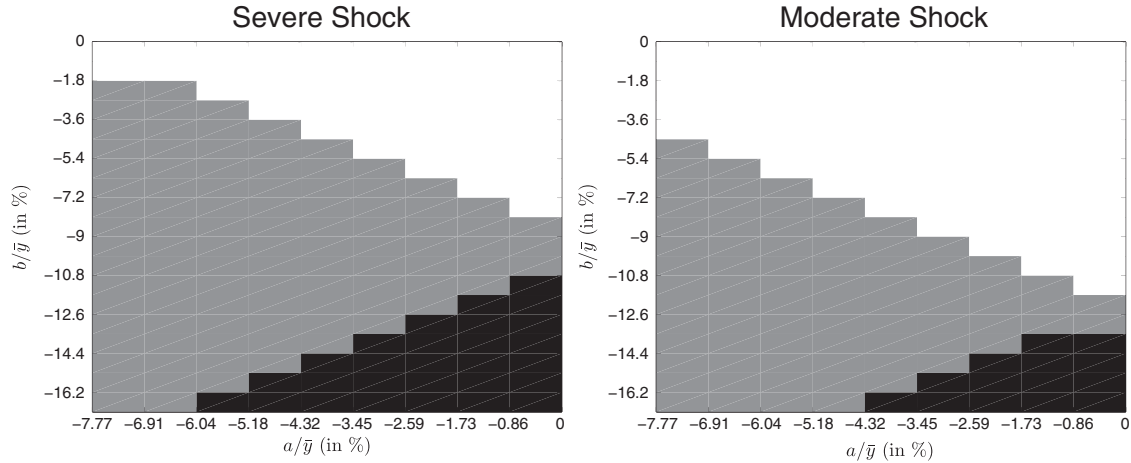


Fig. 1. Decision of the government. *Notes:* This figure refers to the benchmark specification of conditionality (5) and shows the optimal government decision regarding whether to repay, or to default, or to make use of a conditional bailout program. White: repayment, grey: conditional bailout, black: default. Left panel: productivity is 6% below trend; right panel: productivity is 3% below trend. b/\bar{y} refers to external debt owed to private creditors as percentage of mean output; a/\bar{y} refers to IFI debt as percentage of mean output.

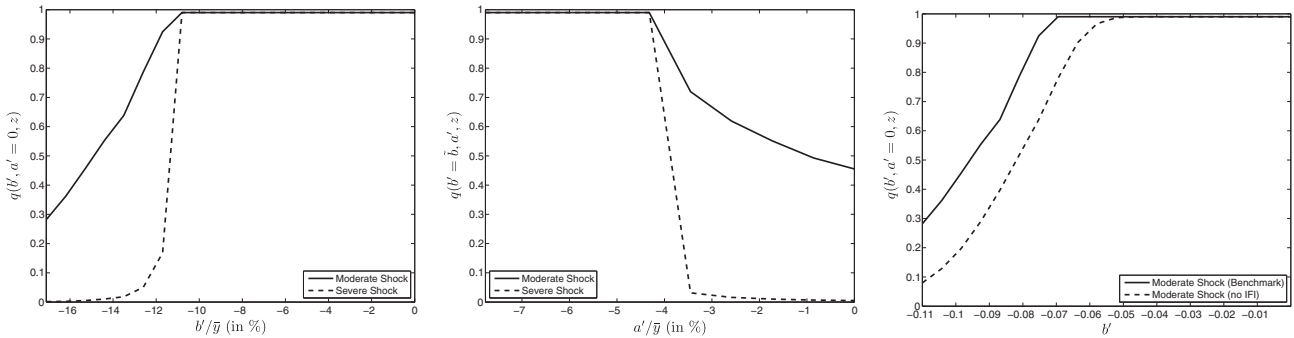


Fig. 2. Bond price function. *Notes:* This figure refers to the benchmark specification of conditionality (5). Severe shock refers to a productivity realization of 6% below trend; moderate shock refers to a productivity realization of 3% below trend. b/\bar{y} refers to external debt owed to private creditors as percentage of mean output; a'/\bar{y} refers to IFI debt as percentage of mean output. \bar{b}/\bar{y} is set to 15%.

of external debt flows to international private creditors indicating-financial inflows in good times. The correlation reflects the pattern of the bond price shown in Fig. 2 and implies that the economy is borrowing-constrained in bad times. Our benchmark economy predicts procyclical IFI debt flows as share of output. Since this is at odds with the data we analyze the underlying mechanisms in detail in Section 4.3.4. As in Cuadra et al. (2010), tax rates behave countercyclically reflecting the fact that in bad economic times borrowing becomes more expensive so that the government finances its consumption mainly by taxing its citizens. The model accounts well for the empirical fact that public consumption is less procyclical than private consumption. However, since the benchmark model restricts government spending during bailouts, the model overstates the volatility of public consumption.¹⁴ Moreover, the benchmark model generates interest rate spreads on private sector debt that are too volatile compared to the data because the economy frequently enters and exits bailout programs.

4.3.3. The impact of bailouts on sovereign default risk in the short- and long-run

A comparison of the benchmark model in which government spending is restricted via condition (5) and the model without an IFI reveals that for the benchmark calibration bailout programs increase the mean of the interest rate spread and, thus, the default risk in the economy, see Table 4. Moreover, the ratio of external private sector debt to

output increases from 11.29 to 14.26% if the government has access to conditional financial assistance. In view of the bond price function shown in Fig. 2, these findings indicate that the availability of bailouts provide additional insurance such that the government takes advantage of lower interest rates and accumulates more external private sector debt. In equilibrium, a higher level of debt generates a greater default probability.

This finding contradicts the view that IFIs provide temporary financial assistance in times of economic crisis in order to prevent sovereign defaults. To analyze the short-run impact of bailouts on the risk of default, we perform the following exercise in Fig. 3. We simulate the model without an IFI and collect the events in which a default occurs. We take the associated productivity sequences and feed them into our benchmark model with bailouts to analyze whether the provision of IFI loans reduces sovereign default risk in the short-run. In particular, we consider three quarters prior to the default and take the corresponding average external private sector debt level as initial situation. Given the initial debt level and the productivity sequence, we simulate the model with bailouts and analyze the optimal decision of the government. The upper left panel of Fig. 3 shows the percentage of cases in which the government chooses to default ('D', solid line), to enter a conditional bailout ('C', dashed line), or to repay ('R', dashed-dotted line). The model predicts that in 50% of the cases a default occurs also in the presence of bailouts. In approximately 20% of the cases the government chooses to make use of IFI loans. In approximately 30% of the cases the government fulfills the outstanding debt obligations without entering a bailout program.

¹⁴ Note that the model without an IFI overstates the volatility of government spending as well which can be explained by the preference specification.

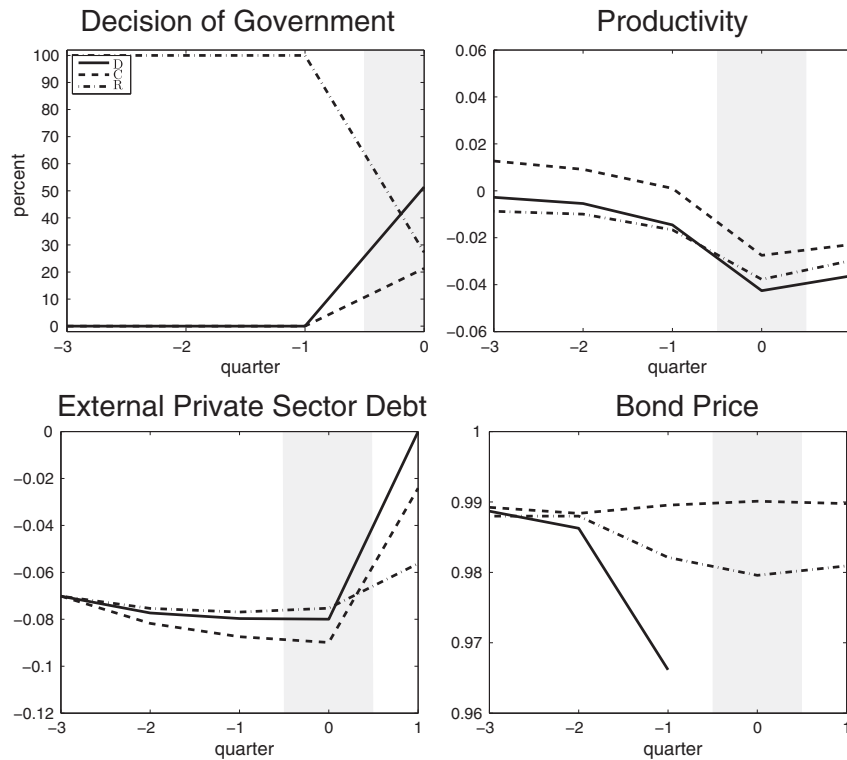


Fig. 3. The impact of bailouts on sovereign default risk in the short-run. *Notes:* This figure refers to the benchmark specification of conditionality (5). We simulate the model without an IFI 500 times (sample size 160 quarters) and collect the events in which a default occurs at time $t = 0$. We take the associated productivity sequences and feed them into our benchmark model with bailouts. We consider three quarters prior to the default and take the corresponding average external private sector debt level as initial situation. Given the initial debt level and the productivity sequence, the model with bailouts is simulated. The upper left panel of this figure shows the percentage of cases in which the government chooses to default ('D', solid line), to enter a conditional bailout ('C', dashed line), or to repay ('R', dashed-dotted line) at date $t = 0$. The other panels show the dynamics of productivity, external private sector debt, and the bond price and plot the mean values associated with each of the cases D, C, and R.

To study the underlying determinants of the government's decision, the upper right and the lower left panels of Fig. 3 display the dynamics of productivity and external private sector debt and plot the mean values associated with each of the three cases. The economy that enters a bailout program at date $t = 0$ faces mildly positive productivity realizations and accumulates external private sector debt at dates $t < 0$ since the bond price function is increasing in productivity, see Fig. 2. At $t = 0$ the economy is hit by an adverse productivity shock such that debt repayment becomes costly. Consequently, the government chooses to make use of a conditional bailout. Due to the constraint on government spending, external private sector debt is reduced at date $t = 1$. The resulting flat bond price reflects the pattern of the productivity shocks as well as the optimal borrowing and bailout policies of the government. The economy that repays without making use of IFI loans is characterized by negative productivity realizations at dates $t < 0$ such that the government becomes borrowing-constrained. Although the economy is hit by an adverse shock at date $t = 0$, the government finds it optimal to repay since external private sector debt is low.¹⁵ The economy that still chooses to default although IFI loans are available, faces a severe productivity shock at date $t = 0$. In the quarters before the default, productivity realizations were only mildly negative such that the government was able to accumulate external private sector debt. At $t = 0$ the severe negative productivity shock in combination with the high level of debt induces the government to default. The resulting bond price reflects the decreasing productivity and the increasing level of external private sector debt.

Our findings suggest that bailouts reduce sovereign default risk in the short-run. However, this comes at a cost of a greater default probability in the long-run since bailouts provide additional insurance and generate incentives for debt accumulation, see Table 4.

¹⁵ In addition, note that the government faces higher bond prices compared to the scenario without an IFI such that debt repayment is less costly, see Fig. 2.

4.3.4. Spending versus revenues

In this section, we consider our benchmark calibration and perform an event study and show the macroeconomic dynamics of the economy prior to a bailout program in comparison to the dynamics of the economy prior to a default. We contrast the benchmark economy with an economy in which conditionality restricts tax revenues rather than government spending.

The left column of Fig. 4 refers to our benchmark economy that imposes restrictions on government spending. We simulate the model and collect the events in which the economy is in a good credit standing in $t < 0$ but either enters a conditional bailout program ('R to C') or defaults ('R to D') at date $t = 0$.¹⁶ The medians of the percentage deviations from the long-run trend are shown. The event study suggests that the economy chooses to default if it is hit by a severe adverse productivity shock and external debt owed to international private creditors is high. International private creditors incorporate the default risk in their pricing decision such that interest rate spreads are high. For less severe negative productivity shocks the government finds it optimal to make use of conditional IFI loans rather than to default. Since conditionality enters as a constraint on government spending, government consumption is reduced and debt as well as taxes decrease. The tax cut strongly stimulates production via labor supply, increases private consumption and lowers risk premia charged by international private creditors. Thus, if the economy is hit by a moderate adverse productivity shock the government makes use of bailout programs such that $\Delta a < 0$. However, conditionality stimulates production such that $\Delta a/y$ increases. This translates into procyclical IFI debt flows as share of output as shown in Table 4 and is at odds with the data.

¹⁶ We do not consider the case that the economy has been using a bailout program in $t < 0$ and defaults at date $t = 0$. Since conditionality endogenously reduces debt shares, default is not an optimal outcome after a bailout.

We consider a policy experiment in which we assume that conditionality restricts tax revenues ($\tau_c/y \geq \bar{T}$) rather than government spending. We choose $\bar{T} = 0.24$ but allow for lower and higher values in Section 4.3.5. The value $\bar{T} = 0.24$ generates average IFI debt to GDP and external private sector debt to GDP ratios that approximately correspond to the ones predicted by our benchmark model in which government spending is constrained. The last column of Table 4 shows the business cycle statistics while the right column of Fig. 4 reports the dynamics of the economy prior to a conditional bailout program and prior to a default. In comparison with the benchmark model (restriction on spending), the probability of making use of conditional bailout programs decreases from 36% to 26%. As a consequence, the economy becomes more volatile and the risk of default increases in comparison

with the benchmark model. Interestingly, the cyclical properties of IFI debt flows are in line with the empirical ones. The intuition is straightforward and shown in the right column of Fig. 4. In the presence of an adverse productivity shock, the economy experiences a recession and enters a bailout program. Since conditionality requires the government to raise tax revenues, the ratio of external private sector debt to GDP is lowered. However, taxes increase such that production is depressed even further. Consequently, taxes are strongly countercyclical and the correlations between $\Delta a/y$ and y are positive as observed in the data.

4.3.5. The effectiveness of conditionality

In this section, we focus on the impact of conditionality on sovereign default risk and discuss whether imposing tighter fiscal constraints is

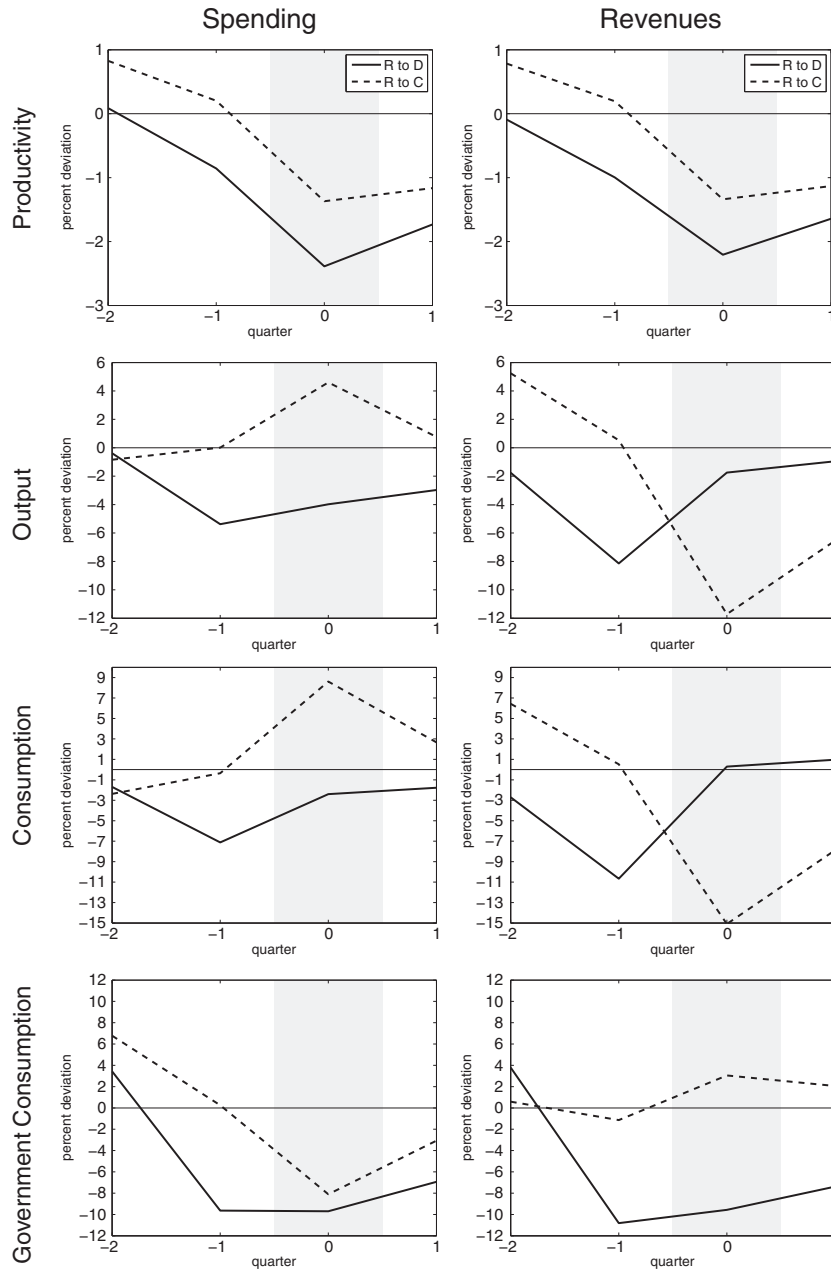


Fig. 4. Spending versus revenues. Notes: The figures plot the dynamic patterns of macroeconomic variables prior to a default or prior to a conditional bailout program. 'R to D' (solid line) refers to the scenario in which the country is in a good credit standing at date $t < 0$ and defaults at date $t = 0$; 'R to C' (dashed line) refers to the scenario in which the country is in a good credit standing at date $t < 0$ and enters a conditional bailout program at date $t = 0$. The left column 'Spending' refers to the benchmark specification of conditionality (5); the right column 'Revenues' refers to the specification (6). The panels show the medians of the percentage deviations (percentage points) from the HP-trend. Results refer to 500 simulations each having a sample size of 160 quarters.

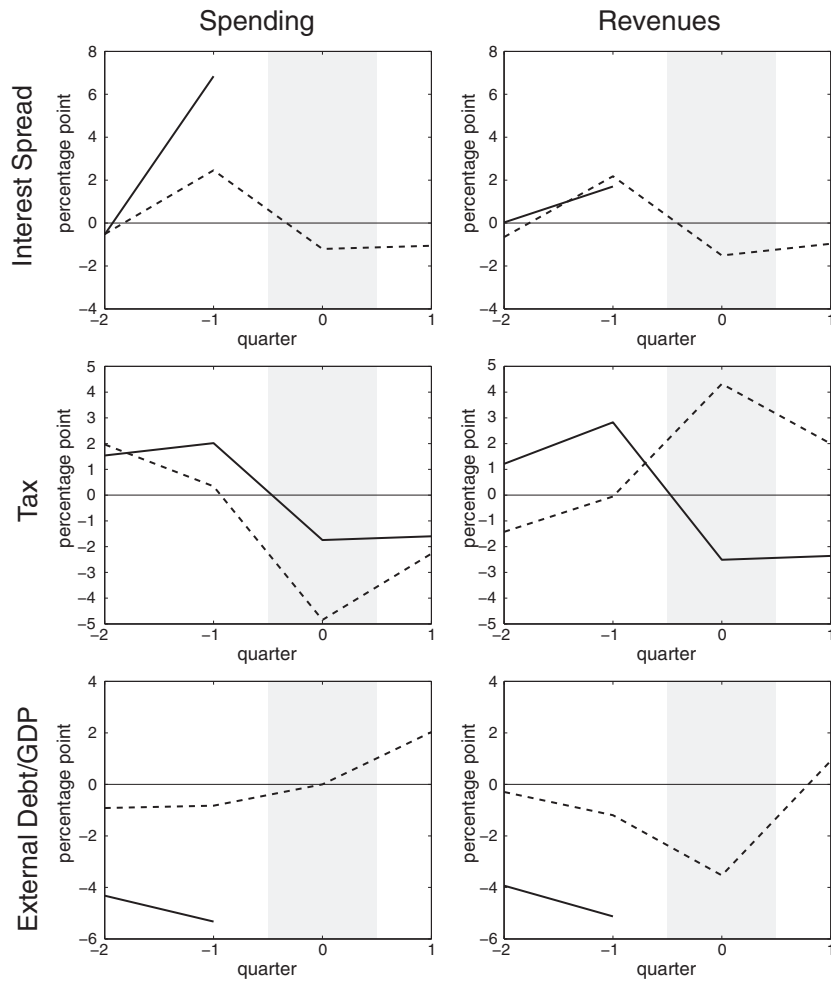


Fig. 4 (continued).

effective in reducing the default probability. In addition, we evaluate conditionality by discussing welfare effects and concerns related to IFI lending policies.

In Fig. 5 we vary the intensity of the fiscal constraint and plot the simulated sovereign default risk. The left panel assumes that conditionality restricts government spending while the right panel considers a constraint on tax revenues. For both types of conditionality, the default risk turns out to be hump-shaped in the tightness of the fiscal constraint. For weak conditionality, i.e., for high (low) values of \bar{G} (\bar{T}), the

default probability approaches zero. For strong conditionality, i.e., for low (high) values of \bar{G} (\bar{T}), the default probability approaches 1.87% which is the default risk of the model without an IFI. If the fiscal constraint restricts government spending (tax revenues), the maximum default probability is 3.85 (4.66) percent.

To illustrate the mechanisms at work, Fig. 6 assumes different intensities of conditionality and shows the associated optimal decision of the government whether to repay, to default, or to make use of a conditional bailout program. We consider $\bar{G} = 0.20$, $\bar{G} = 0.1916$, and $\bar{G} = 0.1820$,

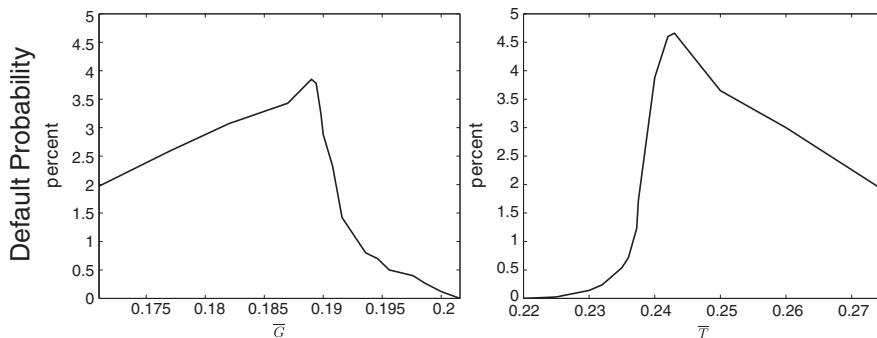


Fig. 5. The impact of conditionality on sovereign default risk. Notes: This figure shows the sovereign default probability for different intensities of conditionality \bar{G} and \bar{T} . Results refer to 500 model simulations each having a sample size of 160 quarters.

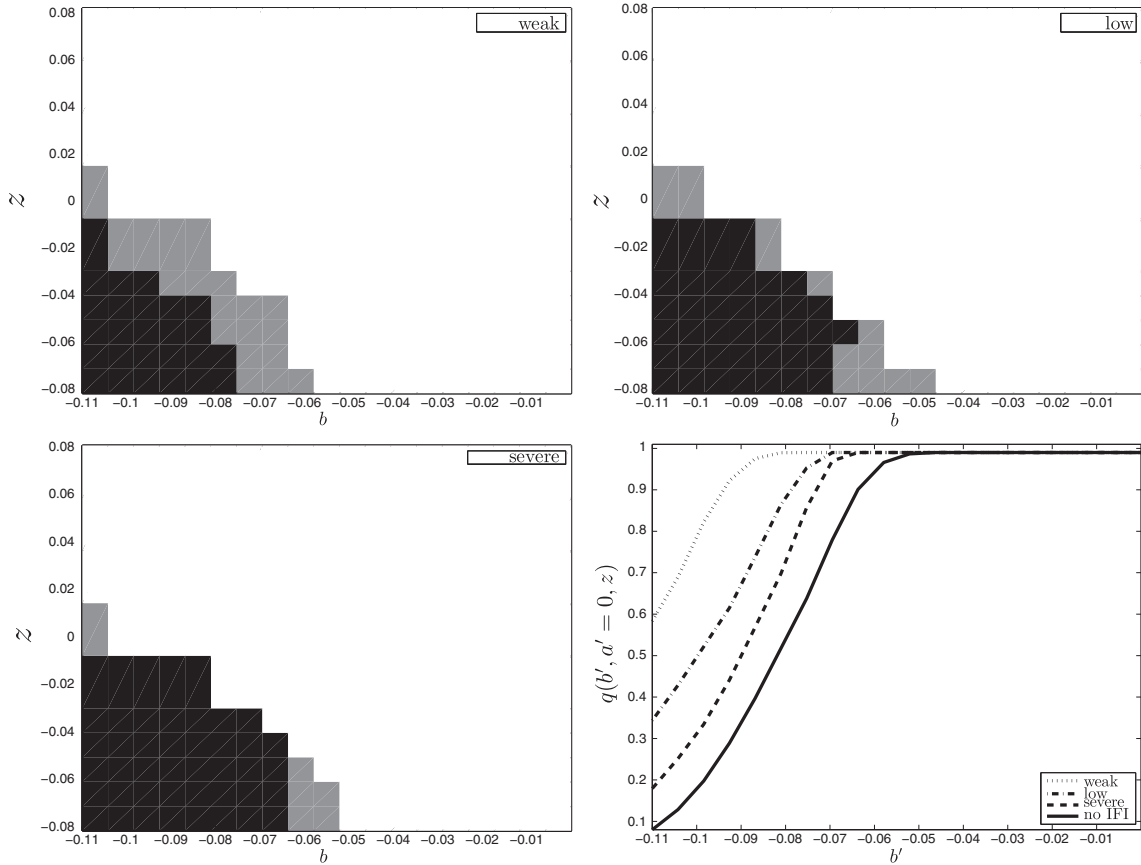


Fig. 6. The impact of conditionality on the decision of the government and the bond price. *Notes:* This figure refers to the benchmark specification of conditionality (5). The upper panels and the lower left panel show the optimal government decision regarding whether to repay, or to default, or to make use of a conditional bailout program for different intensities of conditionality given $a = 0$. Weak: $\bar{G} = 0.20$, low: $\bar{G} = 0.1916$, severe: $\bar{G} = 0.1820$. White: repayment, grey: conditional bailout, black: default. The lower right panel shows the associated bond prices considering a moderate productivity shock of 3% below the trend.

and label these scenarios as ‘weak’, ‘low’ and ‘severe’ conditionality, respectively.¹⁷ The figure assumes $a = 0$ and shows the government’s decision for different combinations of b and z . Clearly, for positive productivity realizations and moderate levels of external private sector debt, the government finds it optimal to repay without making use of IFI loans (white area). In contrast, if the government is highly indebted and the economy is hit by an adverse productivity shock, default turns out to be optimal (black area). The grey area shows the combinations of debt and productivity realizations that induce the government to enter a conditional bailout program. As the fiscal conditions become tighter, the grey area shrinks while the default area grows. If conditionality is severe, there are two scenarios in which the government still finds it optimal to enter a bailout program. In the first scenario, the level of external private sector debt is very high and the productivity shock is moderate. In the second scenario, the economy is moderately indebted but the economy is hit by a highly adverse productivity shock suggesting that even with severe conditionality the government prefers IFI loans in order to avoid a default and the costs that come along with it. The bond price function shown in the lower right panel reflects this pattern: While the provision of IFI loans provide insurance to international private creditors implying a higher bond price for a given level of debt compared to the situation without an IFI, stricter conditionality lowers the bond price and makes the government more borrowing-constrained.

In Table 5 we summarize simulation statistics for five different intensities of conditionality, ‘weak’, ‘low’, ‘medium’, ‘high’ and ‘severe’, by

choosing parameter values for \bar{G} and \bar{T} such that the percentage probability of using conditional bailout programs is in the interval [80,85], [55,60], [40,45], [20,25] and [0,0.5], respectively. The scenarios ‘weak’, ‘low’ and ‘severe’ correspond to those of Fig. 6. In line with Fig. 6, the simulation results reveal that stricter conditionality decreases the probability of a bailout and reduces external private sector debt as share of output. For low and weak conditionality, participation rates in bailout programs are above 50% and the default probability is below 1.87% which corresponds to the one observed in the model without an IFI. These findings suggest that bailouts reduce sovereign default risk both in the short-run and in the long-run only if the attached conditionality is sufficiently weak implying prolonged rather than temporary financial assistance. If conditionality is enhanced from low to high, the bailout probability decreases from approximately 59 (56) % to 24 (26) % and the default risk increases from 1.42 (1.23) % to 3.25 (3.88) % if conditionality restricts spending (tax revenues). If conditionality is enhanced from high to severe, the bailout probability falls to approximately 0.05 (0.07) % and the default risk decreases to 3.07 (3.65) %.

The hump-shaped pattern of the default risk reflects different mechanisms at work. As argued before, bailouts provide insurance such that for a given level of external private sector debt the bond price is larger than without IFI loans. Imposing conditionality generates two opposing effects: On the one hand, stricter conditionality adversely affects the insurance character of bailouts since tighter fiscal constraints make IFI loans less attractive for the government. The probability of entering or staying in a conditional bailout program decreases and the default probability increases. This mechanism dominates if conditionality is enhanced from weak to high. On the other hand, tighter fiscal constraints

¹⁷ Varying \bar{T} generates similar policy functions.

Table 5
Varying the intensity of conditionality.

| | Spending | | | | | Revenues | | | | |
|--|----------|-------|--------|-------|--------|----------|-------|--------|-------|--------|
| | Weak | Low | Medium | High | Severe | Weak | Low | Medium | High | Severe |
| <i>Sample means (in %)</i> | | | | | | | | | | |
| b/y | 16.50 | 15.47 | 14.37 | 13.75 | 12.51 | 19.25 | 17.42 | 16.33 | 14.69 | 12.04 |
| a/y | 5.88 | 3.88 | 2.67 | 1.44 | 0.00 | 7.33 | 4.47 | 3.26 | 1.93 | 0.00 |
| r^{IFI} | 5.50 | 5.01 | 4.71 | 4.41 | 4.06 | 5.57 | 4.95 | 4.71 | 4.44 | 4.06 |
| <i>Sample standard deviations (in %)</i> | | | | | | | | | | |
| $\sigma(y)$ | 3.99 | 4.11 | 4.05 | 4.30 | 4.85 | 4.93 | 6.23 | 6.35 | 6.43 | 4.86 |
| <i>Sample probability (in %)</i> | | | | | | | | | | |
| Default | 0.12 | 1.42 | 2.52 | 3.25 | 3.07 | 0.14 | 1.23 | 1.72 | 3.88 | 3.65 |
| Bailout | 83.97 | 58.70 | 42.02 | 23.85 | 0.05 | 84.64 | 56.46 | 42.17 | 25.67 | 0.07 |
| <i>Welfare gain (in %)</i> | | | | | | | | | | |
| Δ | 0.82 | 0.41 | 0.35 | 0.35 | 0.26 | 0.66 | 0.32 | 0.31 | 0.31 | 0.25 |

Notes: The simulation results are averages over 500 simulations. Each simulation has a sample size of 160 quarters. 'Spending' refers to the benchmark specification of conditionality (5); 'Revenues' refers to the specification (6). The intensity of conditionality is set as to match the bailout probability as follows: weak $\Pr(h = 1) \in [0.80, 0.85]$; low $\Pr(h = 1) \in [0.55, 0.60]$; medium $\Pr(h = 1) \in [0.40, 0.45]$; high $\Pr(h = 1) \in [0.20, 0.25]$; strong $\Pr(h = 1) \in [0.00, 0.005]$. The corresponding parameters vary between 0.20 and 0.1820 for \bar{c} and 0.23 and 0.25 for \bar{y} . y denotes production, and b and a denote external private sector debt and IFI debt, respectively. r^{IFI} denotes the IFI interest rate.

make the government more borrowing-constrained such that debt accumulation is limited which reduces the risk of default. This mechanism dominates if the intensity of conditionality is increased from high to severe. For very strict conditionality, the government finds it never optimal to use IFI loans and the default probability approaches the one that the model predicts in the absence IFI loans, see Fig. 5.

In addition to evaluating the impact of conditionality on sovereign default risk, we consider the lifetime utility of the representative household and calculate the welfare gain generated by conditional bailouts. GHH-preferences $u(c_t, l_t) = u(c_t - L(l_t))$ allow us to follow Durdu et al. (2013) and to compute welfare as the equivalent variation in consumption net of disutility from labor:

$$E_0 \sum_{t=0}^{\infty} \beta^t [\alpha v((1 + \Delta)g_t^\dagger) + (1 - \alpha)u((1 + \Delta)(c_t^\dagger - L(l_t^\dagger)))] \\ = E_0 \sum_{t=0}^{\infty} \beta^t [\alpha v(g_t^*) + (1 - \alpha)u(c_t^* - L(l_t^*))].$$

' \dagger ' refers to the model in which no IFI is present and '*' considers the model in which the government has access to conditional IFI loans. Given our functional forms this expression can be rewritten to

$$\Delta = \left(\frac{V^0(*)}{V^0(\dagger)} \right)^{1/(1-\gamma)} - 1,$$

where V^0 denotes expected lifetime utility. The last row of Table 5 reports the welfare gains. Since the use of IFI loans is a choice variable of the government who maximizes the expected lifetime utility of the representative household, bailouts are welfare improving for the small open economy. However, welfare gains are adversely affected by stricter conditionality since the government is constrained in its fiscal policy choice and the bailout probability decreases. The quantitative results show that welfare gains are declining from 0.82 to 0.26% if conditionality is enhanced from weak to severe and government spending is constrained. If tax revenues are restricted, welfare gains are in the range between 0.66 and 0.25%.

Our welfare analysis focuses on the recipient country and abstracts from the fact that the IFI earns interest payments by providing loans at rates below the market rate but above the risk-free rate. Note that the theoretical framework assumes that IFI loans are always repaid so that the IFI does not face any default risk. Meanwhile, the IFI interest rate is an increasing function of the size of the loan. Consequently, as shown in Table 5, the mean interest rate charged by the IFI is higher

for less intense conditionality since weaker fiscal constraints imply higher bailout participation rates and a more prolonged use of IFI loans. We do not incorporate IFI earnings in our welfare analysis since we do not model the objective function of the IFI and the underlying rationale for the provision of conditional bailouts. The provision of IFI loans below the market rate on a prolonged rather than on a temporary basis is likely to create political costs on the part of the IFI and raises the concern of creating default risks on IFI debt. These costs may have substantial adverse effects on overall welfare which are not taken into account here.

5. Conclusions

In this paper we have developed a dynamic stochastic model of a small open economy to analyze the interactions between sovereign default, conditional bailouts, and fiscal policy. Our theoretical framework features endogenous default risk as well as endogenous participation rates in bailout programs and assumes that conditionality restricts fiscal policy.

Our quantitative findings indicate that preventing defaults in the short-run may come at the cost of a greater default probability in the long-run. Since bailouts provide additional insurance, international private lenders are more willing to provide credit to an indebted government. The government takes advantage of lower interest rates and accumulates more external private sector debt. In the long-run, a higher level of external debt increases sovereign default risk.

The default probability follows a hump-shaped pattern in the intensity of the fiscal constraint and reflects two opposing effects of conditionality: On the one hand, stricter conditionality adversely affects the insurance character of bailouts since tighter fiscal constraints make IFI loans less attractive for the government. Consequently, the probability of entering or staying in a conditional bailout program decreases and the default probability increases. On the other hand, tighter fiscal constraints make the government more borrowing-constrained such that debt accumulation is limited which reduces the risk of default.

This paper points out the importance of analyzing the dynamic interactions of bailouts and sovereign default risk to deepen our understanding of the effectiveness of conditionality. In this context it seems to be particularly interesting to study the impact of the so-called "lending into arrears" policy of the IMF that allows countries to access financial assistance while being in default to international private creditors. Moreover, it may be promising to study the

participation in bailout programs as a joint decision process of the debtor and the IFI. While in this paper we have taken the policies of the IFI as exogenously given, modeling the IFI as an endogenous decision-maker requires the specification of a rationale for conditionality and the definition of the objectives of the IFI. All these questions are, however, left for future research.

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Appendix A. IMF Conditionality

The MONA 1993 and 2003 data bases provide information on the structural conditions of IMF supported programs. The conditions are classified into categories that are different for the 1993 and 2003 data bases. Table A summarizes how we classify the MONA-categories into four main economic sectors: fiscal policy, public enterprises, monetary policy and the financial sector.

Table A-1
Classification of MONA categories.

| MONA categories | Economic sector |
|---|--------------------------------|
| MONA 1993 | |
| Exchange system | Monetary policy |
| Trade regime | Other |
| Capital account | Monetary policy |
| Pricing and marketing | Public enterprises and pricing |
| Public enterprises, reform and structuring | Public enterprises and pricing |
| Privatization | Public enterprises and pricing |
| Tax/expenditure reform | Fiscal policy |
| Social security system | Fiscal policy |
| Social safety net | Fiscal policy |
| Financial sector | Financial sector |
| Agricultural sector | Other |
| Labor market | Other |
| Economic statistics | Other |
| Systematic reform | Other |
| MONA 2003 | |
| General government | Fiscal policy |
| Central bank | Monetary policy |
| Civil service and public employment reforms | Fiscal policy |
| Pension and other social security reform | Fiscal policy |
| Public enterprise reform and pricing | Public enterprises and pricing |
| Financial sector | Financial sector |
| Exchange systems | Monetary policy |
| International trade policy | Other |
| Labor markets | Other |
| Economic statistics | Other |
| Other structural measures | Other |

Appendix B. Data

The business cycle statistics are based on the quarterly time series from 1993 to 2010. Output as well as private and government consumption are logged. The time series are de-trended by applying the HP filter with a smoothing parameter of 1600. Debt statistics are based on annual data and HP-filtered with a smoothing parameter of 100.

Table A-2
Data sources.

| | Source | Time span |
|--------------------------------------|----------------------|-----------------|
| <i>Argentine data</i> | | |
| Use of IMF credit | Worldbank | 1970–2010 |
| PPG, external private creditors | Worldbank | 1970–2010 |
| GDP (nominal) | Worldbank | 1970–2010 |
| EMBI Spread | JP Morgan (DS) | 1993:IV–2010:IV |
| GDP (real and nominal) | National source (DS) | 1993:I–2010:IV |
| Gov. consumption (real and nominal) | National source (DS) | 1993:I–2010:IV |
| Priv. consumption (real and nominal) | National source (DS) | 1993:I–2010:IV |
| Trade balance (nominal) | National source (DS) | 1993:I–2010:IV |
| CPI | IFS (DS) | 1993:I–2010:IV |
| <i>Other data</i> | | |
| EMBI global yield | JP Morgan (DS) | 1997:IV–2010:IV |
| IMF adjusted rate of charge | IMF | 1990:I–2010:IV |
| US Treasury yields | National source (DS) | 1990:I–2010:IV |

Notes: DS refers to Datastream and IFS to the International Financial Statistics Database from the IMF.

Appendix C. Numerical algorithm

The model is solved by using value function iteration. The numerical algorithm builds on [Hatchondo et al. \(2010\)](#) and employs cubic spline interpolations. We approximate the equilibrium as the equilibrium of the finite-horizon economy and iterate simultaneously on the value and the bond price functions.

Given our preference specification the household's optimality condition (7) yields optimal labor supply as a function of the tax rate τ :

$$l = \left(\frac{z}{1 + \tau} \right)^{\frac{1}{\psi}}. \quad (14)$$

Eq. (14) and the budget constraints (2) and (3) allow us to express optimal private and government consumption as functions of the decision variables b' , a' , and τ .

The following algorithm is used to solve the model. We define evenly distributed grid vectors for international bond holdings $b \in [\underline{b}, \bar{b}]$, IFI loans $a \in [\underline{a}, \bar{a}]$ and productivity realizations $z \in [\underline{z}, \bar{z}]$. Let $V_{(0)}^R(b, a, z)$, $V_{(0)}^P(a, z)$, and $V_{(0)}^C(b, a, z)$ denote the initial guesses for the value functions. For every grid point $(b, a, z) \in [\underline{b}, \bar{b}] \times [\underline{a}, \bar{a}] \times [\underline{z}, \bar{z}]$ and given the initial guesses $V_{(0)}^R(b, a, z)$, $V_{(0)}^P(a, z)$, and $V_{(0)}^C(b, a, z)$, we find optimal values for $\tau_{(0)}$, $b_{(0)'}$, and $a_{(0)'}$ via (9), (10), and (11) by employing a global search procedure. $V_{(0)}^R(b, a, z)$ satisfies Eq. (8). Given the initial guess, Eqs. (12) and (13) determine the default probability $\lambda_{(0)}(b_{(0)'}, a_{(0)'}, z)$ and the bond price function $q_{(0)}^b(b_{(0)'}, a_{(0)'}, z)$, respectively. Expected continuation values are computed using Gauss–Hermite quadrature points and weights. To evaluate the expected continuation values for policies and productivity realizations that do not lie on the grid we employ cubic spline interpolations using the FORTRAN routine by [Habermann and Kindermann \(2007\)](#). The solutions found at each grid point are used to update the value functions $V_{(0)}^R(b, a, z)$, $V_{(0)}^P(a, z)$, and $V_{(0)}^C(b, a, z)$. We iterate until the value functions converge.

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