

A Quantitative Model of Sovereign Debt, Bailouts and Conditionality*

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Abstract

International Financial Institutions provide temporary financial support contingent on the implementation of specific macroeconomic policies. While several emerging markets repeatedly used conditional assistance, sovereign defaults occurred. This paper develops a dynamic stochastic model of a small open economy with endogenous default risk and endogenous participation rates in bailout programs. Conditionality enters as a constraint on fiscal policy. In a quantitative application to Argentina the model mimics the repeated and prolonged use of third-party assistance. Bailouts generate incentives for debt accumulation and extend the risk of sovereign default. Stricter conditionality decreases bailout participation rates and increases macroeconomic volatility and default probabilities.

Keywords: sovereign debt, sovereign default, interest rate spread, fiscal policy, bailouts, conditionality

JEL-Codes: E44, E62, F34

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1 Introduction

International financial markets have experienced sovereign debt crises throughout history. In times of balance-of-payment problems International Financial Institutions (IFIs) provide temporary financial assistance and require the debtor to meet specific conditions on macroeconomic policy. While over the past 40 years conditionality attached to IFI loans has become increasingly important and countries frequently utilized bailout programs, sovereign defaults occurred on a number of occasions, in particular in emerging market economies.¹ Moreover, empirical evidence indicates that some countries are recidivist borrowers who make repeated and prolonged use of IFI loans (Bird et al., 2004; Conway, 2007).

This paper develops a dynamic stochastic model of a small open economy that addresses these facts. The model features endogenous default risk as well as endogenous participation rates in bailout programs and assumes that conditionality restricts fiscal policy in the recipient country. We analyze the impact of bailouts on sovereign default risk and evaluate the effectiveness of conditionality by varying the type as well as the strength of the macroeconomics conditions attached to IFI loans.

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 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 lenders 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 private international creditors or to default. Moreover, taking as given the restrictive fiscal target, the government chooses whether to make use of a conditional bailout program.

In a quantitative exercise we apply our model to the Argentine economy and show that our theoretical framework replicates the empirical probability of participating in a conditional bailout program quite well. Our simulation results suggest that the presence of IFI interventions make international private lenders more willing to provide credit to an indebted government since bailout programs provide

¹See Bird (2007) for a detailed discussion of conditionality and Reinhart and Rogoff (2008) for an extensive analysis of sovereign defaults.

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

additional insurance. The government takes advantage of lower interest rates on external credit and accumulates larger levels of external debt. In equilibrium, the availability of conditional bailout programs increases sovereign default risk. 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. In addition, our model accounts for the key empirical patterns in emerging market business cycles, 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](#)).

We employ our theoretical framework to analyze the macroeconomic impact of two different types of conditionality. As a benchmark, we consider conditions that limit the size of the public sector by restricting government spending. We contrast our benchmark economy with an alternative setup in which conditionality affects tax revenues rather than government spending. Importantly, debt policy remains unrestricted and is an endogenous outcome in our theoretical framework. Our simulation results show that during bailouts both types of conditionality reduce the ratio of external debt to GDP. While restricting government spending helps to promote the endogenous recovery of the economy, increasing tax revenues depresses output and generates greater default risks. In addition, our quantitative findings suggest that tighter constraints decrease the participation rates in bailout programs generating higher macroeconomic volatility and larger default probabilities.

Our paper builds on the recent quantitative sovereign debt literature, 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. [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 the dynamic pattern of the economy as well as the effectiveness of different types of conditionality.

Papers that analyze different features in quantitative sovereign debt models are, e.g., Cuadra and Sapriza (2008) and Hatchondo et al. (2009) 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.

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) and 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 frequency and duration as well as 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 model 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, because with 187 member countries it belongs to the most important international intergovernmental organization. According to its Articles of Agreement, the IMF provides temporary financial and technical 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 reported in table 1 the IMF lending rate is similar to the interest rate of the United States. Since private international financial markets incorporate default risks and charge country risk premia, the IMF lending rate is considerably lower than the country-specific interest rate measured by the Emerging Market Bond Index EMBI. A further important aspect of IMF lending is

Table 1: Interest Rates: IMF vs. U.S. Treasury Bonds

	IMF	U.S. Treasury bonds			EMBI Global
		1-year	3-year	5-year	
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.

discussed by [Jeanne and Zettelmeyer \(2001\)](#) who analyze the empirical repayment history of IMF loans and report rather low default risks on IMF loans.

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.³ [Bird \(2007\)](#) reports that in the last decades the average number of conditions attached to an IMF-supported program has risen indicating that conditionality has become increasingly important.⁴ 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.⁵ 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 percent of the structural conditions were imposed on fiscal policy. Across countries, on average 38.59 percent 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. This finding guides us when modeling conditionality in our theoretical framework. The extensive literature on the role of the IMF emphasizes two phenomena related to conditional IMF-supported programs. First, some member countries are recidivist borrowers, i.e., they tend to return frequently to the IMF. Second, and related to the first phenomenon, there is evidence on prolonged

³Following the IMF’s Articles of Agreement conditional lending is required for two reasons: IMF conditionality helps countries to overcome the problems that led to its financial problems and it ensures that IMF loans are repaid. For a broader debate on the rationale for conditionality we refer to [Bird \(2007\)](#).

⁴The [Independent Evaluation Office \(2007\)](#) concludes that there seems to be no reduction in the number of conditions after the introduction of the streamlining initiative.

⁵Details of the categorization are provided in Appendix A. The sector monetary policy includes exchange rate policies and conditions that foster central bank reform.

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 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 the databases MONA 1993 and MONA 2003.

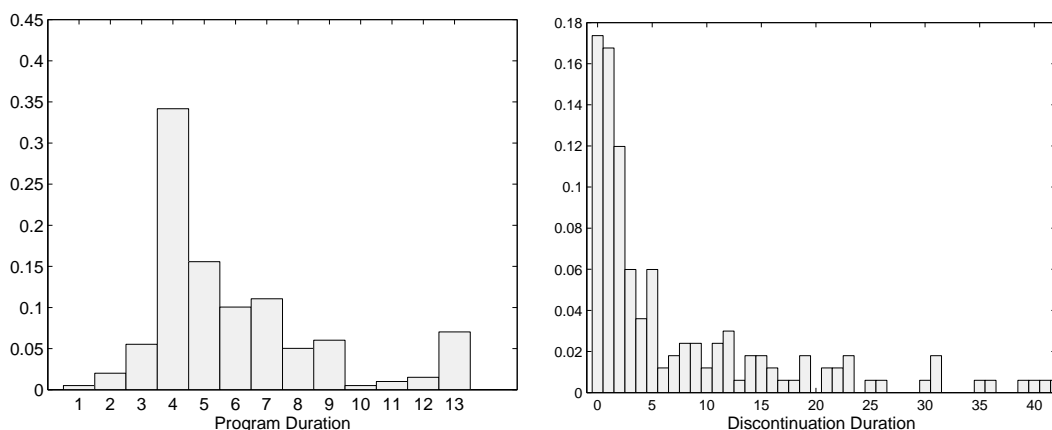


Figure 1: Empirical Distribution of IMF Programs, 1976-2012

Notes: The figures shows the empirical distribution of IMF programs and uses the data set provided by Conway (2007) and the MONA database. It refers to IMF Stand-By Arrangements. Horizontal axis: quarters; vertical axis: frequency.

use of IMF resources calling the temporary nature of IMF lending into question (see Bird et al. (2004) and Conway (2007)). Table 2 and figure 1 illustrate these empirical findings. Using data provided by Conway (2007), the MONA data base and Reinhart and Rogoff (2008), the last two columns of table 2 reveal that several emerging market economies defaulted frequently on their external debt obligations while repeatedly making use of IMF fund resources. For instance, during the years from 1976 to 2010, Argentina had 11 IMF-supported economic stabilization programs but at the same time there were three default episodes. Most countries are characterized by similar properties. The left panel of figure 1 shows the distribution of IMF-supported programs by duration considering the countries listed in table 2. Roughly 35 percent of all programs lasted for 4 quarters. Conway (2007) points out that countries tend to repeatedly negotiate economic programs with the IMF that begin just as the previous program has ended. The right panel of figure 1 illustrates this by displaying the distribution of successive programs that are interrupted by discontinuation periods of different length. Between 1976 and 2012 around 34 percent of programs were consecutive agreements that were interrupted by at most one quarter indicating a high rate of recidivism.

To summarize, in times of economic crisis the IMF provides temporary financial assistance in form of conditional loans below market rate. The empirical evidence suggests that emerging market economies made repeatedly use of IMF loans, however sovereign defaults occurred nonetheless. The majority of the structural conditions attached to the provision of loans were imposed on fiscal policy. To analyze the dynamic interaction of sovereign default risk, IFI loans and conditionality we develop a model with endogenous participation rates in bailout programs and endogenous default rates. Conditionality enters as a constraint on fiscal policy.

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 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.⁶ Output y_t is produced via a constant returns to scale production function $f(l_t)$, $f : \mathbb{R}_+ \rightarrow \mathbb{R}_+$, and is subject to productivity shocks:

$$y_t = z_t f(l_t).$$

Productivity $z_t \in \mathcal{Z}$ is assumed to have a compact support, $\mathcal{Z} = [\underline{z}, \bar{z}] \subset \mathbb{R}_+$, 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 debt and taxes. The government has access to incomplete financial markets where it can issue non-contingent one-period bonds $b_{t+1} \in \mathcal{B} = [\underline{b}, \bar{b}] \subset \mathbb{R}$ 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 $\delta(z_t)f(l_t) \leq z_t f(l_t)$ holds in financial autarky.

⁶We 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.

If the government does not default on its external private sector debt, it has access to IFI loans $a_{t+1} \in \mathcal{A} = [\underline{a}, \bar{a}] \subset \mathbb{R}_-$, 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 depends on the risk free rate r^f and the size of the loan:

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

In accordance with the empirical evidence provided by [Jeanne and Zettelmeyer \(2001\)](#) 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. 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 sector:⁷

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

As a variation 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 public spending and 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 pricing decision rules for bonds by international private creditors.

⁷Note that restricting g/y would lead to very similar results.

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 (1) subject to the household's budget constraint (2). The optimality conditions of the private sector are described by

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

and the budget constraint (2). u_c and u_l denote the marginal utility of consumption and labor, respectively, and f_l refers to the marginal product of labor.

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 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 (1) subject to the government budget constraint (3), the optimality conditions of the private sector (2) and (7) and, in case of a bailout, subject to conditionality (5) or (6).

Given an outstanding external private sector debt amount of b , the outstanding IFI debt a and a technology realization of 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:

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

$V^R(b, a, z) : \mathcal{B} \times \mathcal{A} \times \mathcal{Z} \rightarrow \mathbb{R}$ 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

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

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

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

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 outcome 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

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

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 . Foreign creditors incorporate the risk of default and price bonds accordingly. Expected profits Π are given by

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

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 $q \in [0, (1 + r^f)^{-1}]$. 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 effort $l(b, a, z)$,*
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 international 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 effort $l(b, a, z)$ 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 (8), (9), (10) and (11),*
3. *bond prices $q^b(b', a', z)$ fulfill equation (13) such that risk-neutral international creditors earn zero expected profits.*

4 Quantitative Analysis

4.1 Data

In our quantitative analysis we apply our model to Argentina to study the 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:I to 2010:IV.⁸ For the consumption tax τ we use an inflation tax as a proxy due to the lack of adequate data. The inflation tax is constructed as $\tau = \frac{\pi}{1+\pi}$ where π denotes CPI inflation.⁹ The interest rate series is the JP Morgan Emerging Markets Bond Index (EMBI Global) for Argentina. External debt is measured by public and publicly guaranteed debt held by international private creditors whereas IFI debt data is the Use of IMF Credit. The trade balance is given as a percentage of output. Any series, if necessary, is 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. The mean interest rate spread is 12.54 percent and the volatility amounts to 8.28 percent. Consumption is more volatile than output and the trade balance is countercyclical. The tax rate is negatively correlated with output indicating procyclical fiscal policy which is in line with the empirical study of [Talvi and Vegh \(2005\)](#). For the time span from 1970 to 2010, public debt held by international private creditors amounts up to 20 percent of GDP whereas IFI debt is modest and is equal to 2.21 percent of GDP on average. Concerning the cyclicity of debt flows, we find procyclical external debt flows to international private creditors which indicates financial inflows in good times. In contrast, IFI debt flows are countercyclical which implies that in recessions the country makes more use of IMF resources. 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 percent 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

⁸The exact sources, transformations and descriptions are presented in Appendix B.

⁹[Talvi and Vegh \(2005\)](#) argue that in developing and emerging market countries tax rates are often based on consumption taxes. Thus, an inflation tax as a proxy for tax rates seems to be appropriate.

Table 3: Calibration

Parameter	Description	Value	Empirical Target
<i>Parameters selected directly</i>			
σ	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 r^{IFI}
ρ_z	autocorrelation	0.85	autocorrelation of GDP
σ_ε	standard deviation of ε	0.011	volatility of GDP

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 percent).

As in Cuadra et al. (2010) the production function is assumed to be linear in labor, $f(l) = l$. 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:

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

with $\eta \in (0, 1)$. We set the default penalty η equal to 0.97 to match a default probability of 3 percent (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.¹⁰ 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 percent.

The quarterly world risk-free interest rate r^f is set to 1 percent 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 percent 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.

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, $g/c \geq \bar{G}$. We refer to this setup as our benchmark economy. To highlight the impact of conditional bailout programs on the risk of sovereign default and fiscal policy, we facilitate a comparison with a model economy in which no IFI is present and no financial assistance is available.¹¹ Moreover, we contrast our benchmark economy with an alternative setup 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.

¹⁰ Aguiar and Gopinath (2006) set θ to 0.10 while Arellano (2008) choose 0.282.

¹¹ The model without an IFI is similar to the one in Cuadra et al. (2010).

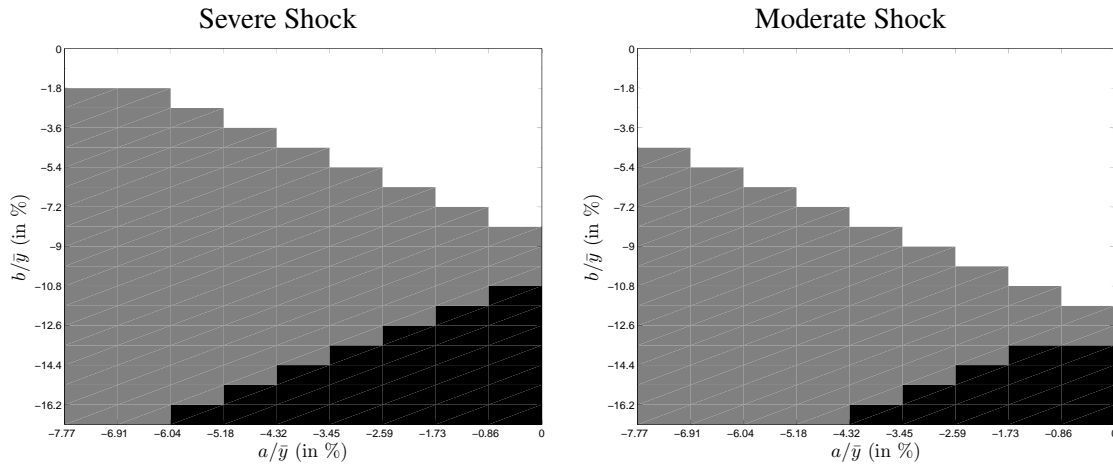


Figure 2: Decision of the Government

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 to private creditors as percentage of mean output; a/\bar{y} refers to IFI debt as percentage of mean output.

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 debt, or to default, or to make use of a conditional bailout program. The left (right) panel of figure 2 considers a severe (moderate) realization of the productivity shock of 6 percent (3 percent) below the trend and visualizes the optimal government policy as a function of external debt to private creditors and IFI debt. If the debt levels are within the white area the government chooses to fulfill the external debt obligations. Within the black area the government finds it optimal to default. If the existing 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 debt the government always prefers to repay its outstanding debt. In contrast, if the government is strongly indebted to 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.

Figure 3 considers two realizations of productivity (severe and moderate) and plots the bond price $q^b(b', a', z)$ regarding external debt to private creditors. The first (second) panel takes as given the level of IFI debt (private sector debt). The third panel compares the bond price of the benchmark

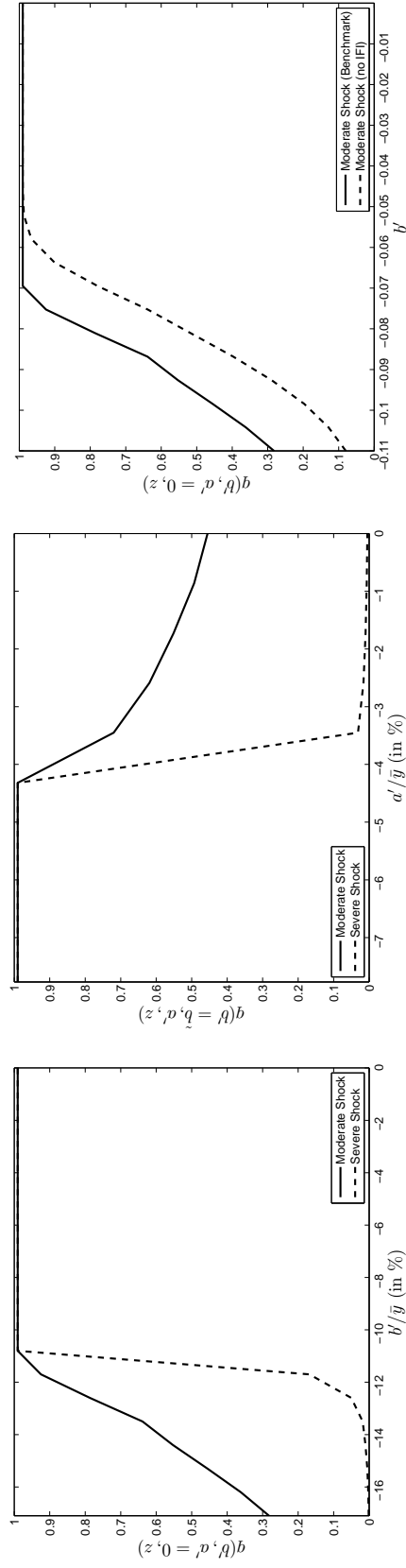


Figure 3: Bond Price Function

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 to private creditors as percentage of mean output; a/\bar{y} refers to IFI debt as percentage of mean output. b/\bar{y} is set to -15%.

economy to 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 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 debt to private creditors make repayment less attractive and default incentives rise. Since international 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 debt obligations. Due to a higher default risk the premium charged by 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 to private creditors. Fourth, the presence of an IFI increases the bond price. The intuition is straightforward: Since international 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 Properties of the Simulated Economy

Table 4 reports the cyclical properties of the empirical and simulated times series. The business cycle statistics are based on average values over 500 simulations of 160 quarters. The simulated series, if necessary, are de-trended using the Hodrick-Prescott filter with a smoothing parameter of 1600.

The simulation results show that the benchmark economy (spending) predicts a bailout probability of 36 percent which is fairly close to the empirical value of 24 percent. 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. These findings imply that the economy becomes more borrowing-constrained in times of recessions because of higher interest rate spreads (see also figure 3). 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.

A comparison of the cyclical properties of the benchmark model in which government spending is restricted via condition (5) and the model without an IFI reveals that conditional bailout programs increase the mean of the interest rate spread and, thus, the default risk in the economy. Moreover, the ratio of external private debt to output increases from 11.29 to 14.26 percent if the government

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. Any series, if necessary, is 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 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 $\bar{T} = 0.24$.

has access to conditional financial assistance. These findings indicate that in the presence of an IFI the government takes advantage of lower interest rates (see figure 3) and accumulates more external private debt. In equilibrium, higher levels of debt lead to greater default probabilities. The simulated moments reveal that the model substantially overstates the interest rate spread on private sector debt. The high volatility of the spread can be explained as follows. First, the economy frequently enters and exits bailout programs. We discuss this feature in detail in section 4.3.3. Second, as argued before, the economy tends to over-borrow if its fiscal policy is not constrained by conditionality.

The benchmark model matches the empirically observed cyclical pattern 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 figure 3 and implies that the economy is borrowing-constrained in bad times. Our benchmark economy predicts procyclical IFI debt flows as share of output which is at odds with the data. To understand this property of our theoretical economy, in figure 4 we perform an event study and show the dynamics of the economy prior to a bailout program in comparison to the dynamics of the economy prior to a default. We assume that 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 $t = 0$.¹² The left column of figure 4 refers to our benchmark economy that imposes restrictions on government spending. 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 private international creditors is high. International 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 in the benchmark economy 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.

4.3.3 Spending versus Revenues

We contrast our benchmark economy to an alternative setup in which conditionality restricts tax revenues ($\tau c/y \geq \bar{T}$) rather than government spending. To facilitate meaningful comparisons we choose \bar{T} such that the average IFI debt to GDP ratio approximately corresponds to the one predicted by our benchmark model. The last column of table 4 shows the business cycle statistics while the second column of figure 4 report the dynamics of the economy prior to entering a conditional bailout

¹²We 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.

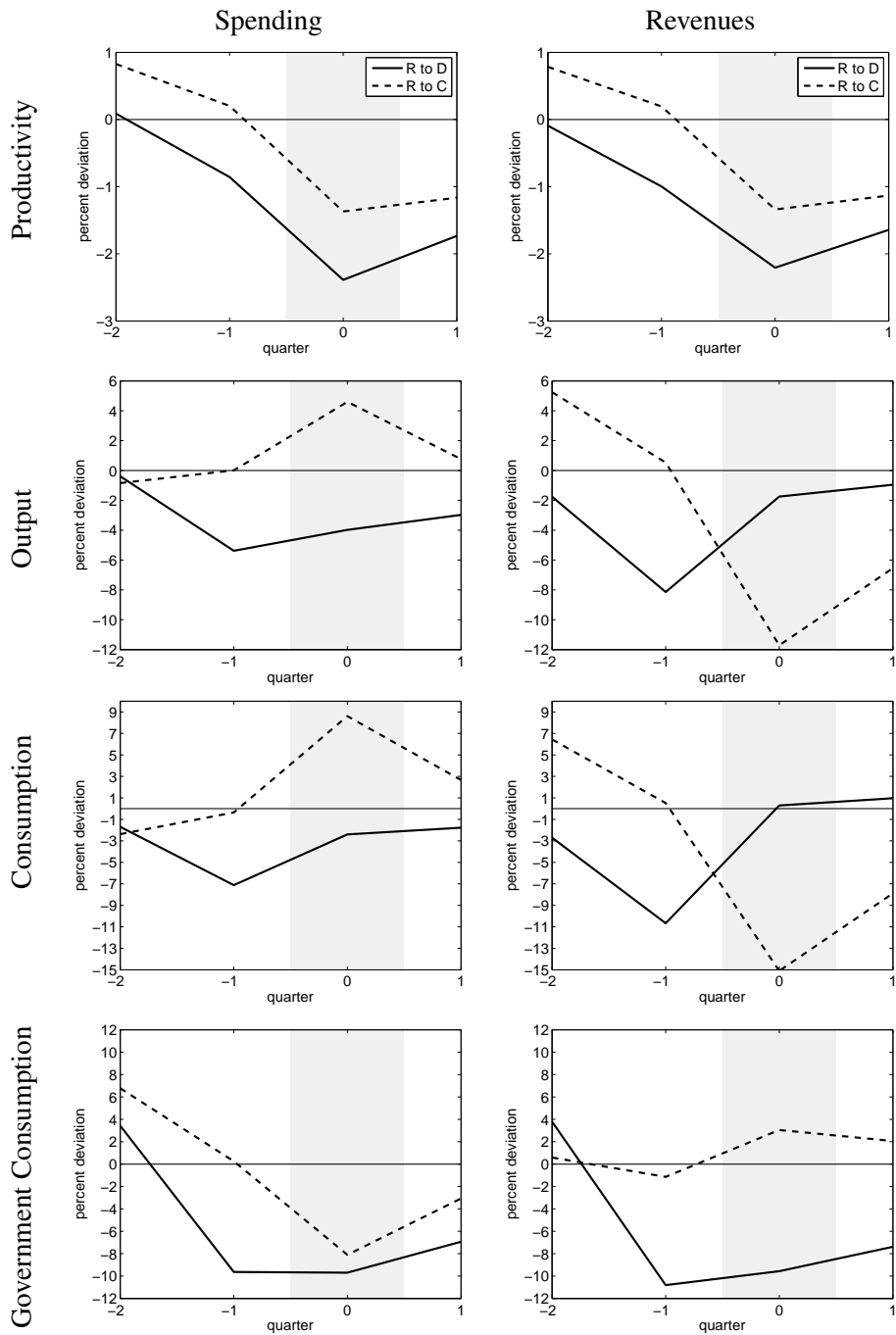
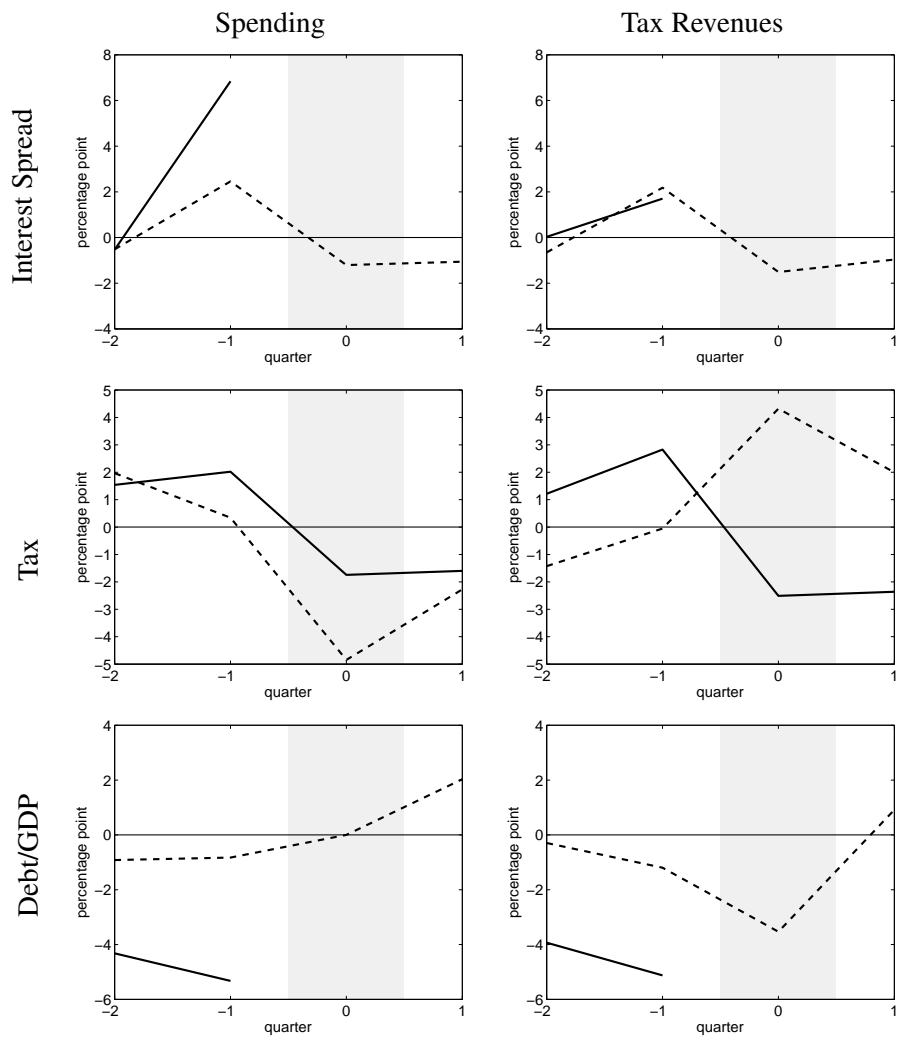


Figure 4: Event Study

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 trend.



Notes: figure 4 continued.

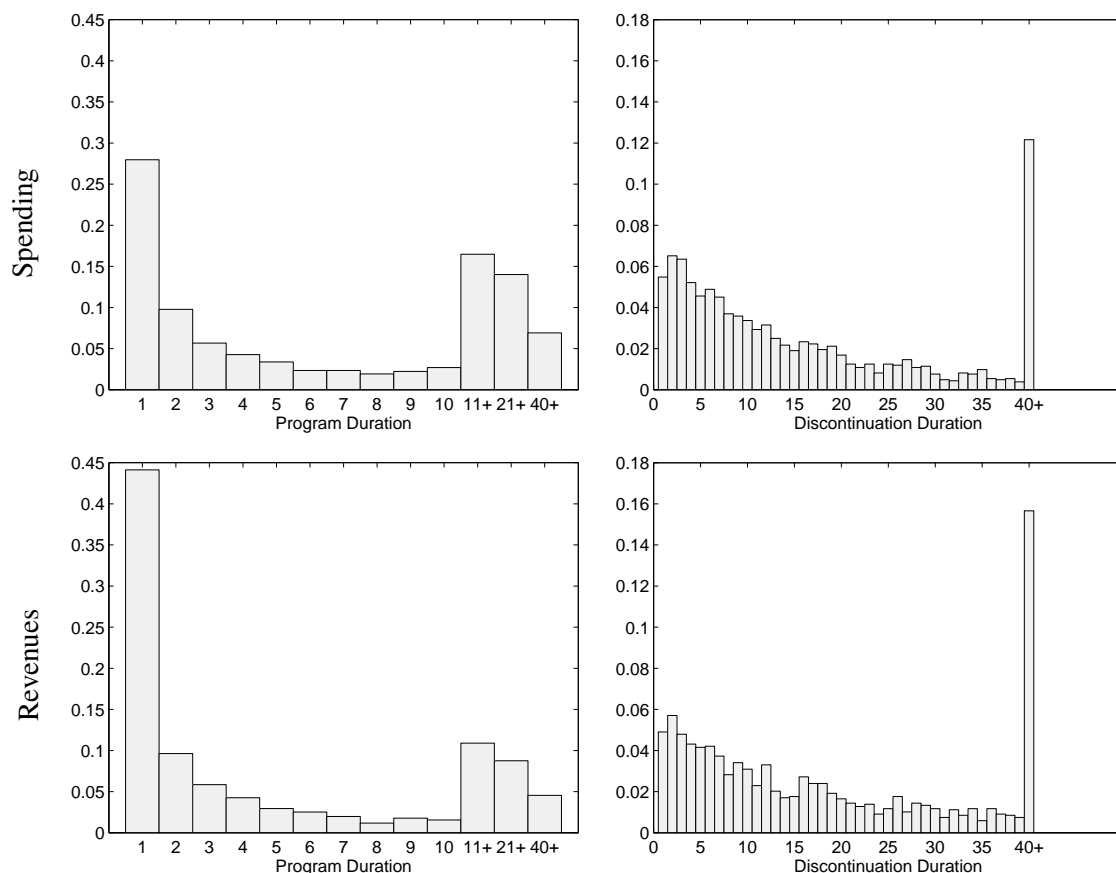


Figure 5: Theoretical Distribution of Bailout Programs

Notes: This figure shows the distributions of bailout programs implied by our theoretical framework. The first row “Spending” refers to the benchmark specification of conditionality (5); the second row “Revenues” refers to specification (6). Horizontal axis: quarters; vertical axis: frequency.

program and prior to a default.

In comparison to the benchmark model (spending), the probability of making use of conditional bailout programs decreases from 36 percent to 26 percent. As a consequence, the economy becomes more volatile and the risk of default increases. 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 figure 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 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.

Our theoretical model replicates fairly well the empirical probability of conditional bailout programs, i.e., the average fraction of total time spent in conditionality. As discussed in section 2, the empirical

literature emphasizes that some countries are recidivist borrowers who make repeated and prolonged use of third-party loans, see Bird et al. (2004), Bird (2002) and Conway (2007). To study the quantitative predictions of our model with respect to the duration and the persistence in the use of IFI loans we proceed as follows. First, in the left panel of figure 5, we show the distribution of conditional bailout programs by their duration. Second, in the right panel, we calculate the distribution of successive programs that are interrupted by discontinuation periods of different length. The first row considers the benchmark economy in which government spending is restricted while the second row refers to conditionality that affects tax revenues. The distributions reveal that a large fraction of programs runs for a short time period. Between 50 and 60 percent of all programs have a duration between one and four quarters. It turns out that conditions on tax revenues reduce the duration of bailout programs substantially. Our model predicts that the mass of successive programs have discontinuation periods of few quarters. More than 16 percent of all consecutive arrangements are interrupted by only one quarter indicating a high rate of recidivism and a prolonged use of IFI funds.

4.3.4 Effectiveness of Conditionality

In this section we discuss the effectiveness of conditionality by analyzing the impact of the strength of conditionality on the risk of default as well as on the volatility of the economy. Moreover, we calculate the economy's welfare gain of conditional bailout programs. We define five different intensities of conditionality, 'weak', 'low', 'medium', 'strong' 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, 1], respectively.

Table 5 summarizes the simulation results and suggests that for both types of conditionality raising the intensity from low to severe increases the overall volatility of the economy as well as the probability of default. Enhancing conditionality makes bailout programs less attractive for the recipient government since the costs of tighter fiscal constraints are more likely to outweigh the benefits of the financial assistance. This limits the effectiveness of conditionality in terms of reducing the default risk in the economy.

Recall that the model in which no IFI is present predicts a default probability of 1.87 percent. Only for very weak fiscal restrictions the default risk falls beyond this level. In these cases, however, the probability of making use of conditional bailout programs is above 55 percent implying that the IFI provides permanent rather than temporary financial support. Note that if conditionality is severe and the probability of entering a bailout program is close to zero, the default risk is higher than in the model in which no IFI loans are available. The reason is that the insurance provided by bailout programs is still available generating incentives for debt accumulation so that in equilibrium the default probability increases. Only if the conditions are so severe that there is no state of the world

Table 5: Varying the Intensity of Conditionality

	Spending					Revenues				
	low	weak	medium	strong	severe	low	weak	medium	strong	severe
<i>Sample standard deviations (in %)</i>										
$\sigma(y)$	3.99	4.11	4.05	4.30	4.79	4.93	6.23	6.34	6.43	4.93
$\sigma(c)/\sigma(y)$	1.06	1.22	1.23	1.15	1.08	1.08	1.19	1.20	1.21	1.09
$\sigma(g)/\sigma(y)$	1.34	2.42	2.82	2.81	2.44	0.94	1.23	1.30	1.51	3.18
<i>Sample correlations</i>										
$\rho(\tau, y)$	-0.07	-0.39	-0.39	-0.35	-0.46	-0.43	-0.75	-0.77	-0.76	-0.47
$\rho(s, y)$	-0.08	-0.09	-0.13	-0.16	-0.26	0.02	-0.17	-0.23	-0.23	-0.18
$\rho(\Delta b/y, y)$	0.03	-0.06	-0.23	-0.32	-0.48	-0.22	-0.18	-0.26	-0.34	-0.40
$\rho(\Delta a/y, y)$	0.02	-0.26	-0.29	-0.16	0.08	0.28	0.31	0.29	0.26	0.13
<i>Sample means (in %)</i>										
b/y	-16.50	15.47	-14.37	-13.75	-12.72	-19.25	-17.42	-16.39	-14.63	-12.70
a/y	-5.88	-3.88	-2.67	-1.44	-0.00	-7.33	-4.47	-3.26	-1.93	-0.00
<i>Sample probability (in %)</i>										
Default	0.12	1.42	2.52	3.25	3.85	0.14	1.86	2.03	3.53	4.75
Bailout	83.97	58.7	42.02	23.85	0.79	84.64	56.46	42.17	25.67	0.81
<i>Welfare Gain (in %)</i>										
Δ	0.82	0.41	0.35	0.35	0.34	0.66	0.32	0.31	0.31	0.44

Notes: The simulation results are averages over 500 simulations whereas each simulation has a sample size of 160 quarters. Any series, if necessary, is HP-filtered with a smoothing parameter of 1600. “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 probability of use of IFI funds as follows: low $\Pr(h = 1) \in [80, 85]$; weak $\Pr(h = 1) \in [55, 60]$; medium $\Pr(h = 1) \in [40, 45]$; strong $\Pr(h = 1) \in [20, 25]$; severe $\Pr(h = 1) \in [0, 1]$. The corresponding parameters vary between 0.1890 and 0.20 for \bar{G} and 0.23 and 0.242 for \bar{T} . y denotes production, c and g are private and public consumption, respectively. τ refers to the tax rate, b and a denote international private and IFI debt, respectively. s denotes the interest spread.

in which the government ever chooses to enter a conditional bailout program the default risk equals the one predicted by the model in which no IFI is present. In this case, private creditors anticipate that the government will never enter such a bailout program and they charge private risk premia that prevent over-borrowing.

In addition to evaluating the impact of conditionality on the risk of default and the volatility of the economy, we consider 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 shows that the welfare gains are between 0.82 and 0.31 percent. Since stricter conditionality decreases participation rates in bailout programs and increases the risk of default as well as the volatility of the economy, welfare gains are decreasing in the intensity of conditionality.

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. The model helps to rationalize the empirical fact that there is considerable recidivism and persistence in the use of third-party assistance. Moreover, in spite of conditionality, sovereign defaults occur.

Our findings suggest that conditional bailouts increase the risk of sovereign default as private international lenders are more willing to provide credit to indebted countries. The analysis of the macroeconomic impact of different types of conditionality suggests that reducing government spending helps to promote the endogenous recovery of the economy while increasing tax revenues depresses output and fosters sovereign default risk. Tighter constraints decrease participation rates in conditional bailout programs generating higher macroeconomic volatility, larger default probabilities and smaller welfare gains.

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 private international 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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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

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.

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

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.

HP filter with a smoothing parameter of 1600.

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 :

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

Equation (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 $V_{(0)}^R(b, a, z)$, $V_{(0)}^D(a, z)$, 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 $V_{(0)}^R(b, a, z)$, $V_{(0)}^D(a, z)$, 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. $V_{(0)}^0(b, a, z)$ satisfies equation (8). Given the initial guess, equations (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 $V_{(0)}^R(b, a, z)$, $V_{(0)}^D(a, z)$, and $V_{(0)}^C(b, a, z)$. We iterate until the value functions converge.