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# Debt Relief and Incentive-Compatible Conditionality

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preliminary and incomplete draft

## Abstract

This paper analyzes the effectiveness of grants, concessional loans and debt relief in a neo-classical framework with a conflict of interest between the donor and the recipient government. Conditionality is modeled as a dynamic contract that is enforceable only by the threat of a permanent cutoff from development assistance. Quantitative results show that grants and concessional loans in isolation imply very different incentive structures. While in the short-run concessional loans are more effective in raising the recipient's capital stock than grants, the opposite is true in the long-run. The optimal contract is given by a combination of both aid instruments. Incentive-compatible contracts require that less patient and less benevolent recipient governments receive more grants but less concessional loans.

JEL: E13, F35, O11, O19.

Keywords: foreign aid, concessional lending, debt relief, conditionality, limited enforceability, dynamic contracts, neoclassical growth

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# 1 Introduction

Many of the poor countries are also highly indebted. Motivated by the concern to reduce worldwide poverty, the International Monetary Fund and the World Bank founded the Initiative for Heavily Indebted Poor Countries (HIPC) in 1996 that was supplemented by the Multilateral Debt Relief Initiative in 2005. The objective of the Initiative is to forgive debt to ensure that poor countries do not face unsustainable debt burdens. In 2007, total costs of debt relief are estimated at \$ 71 billions.<sup>1</sup>

The idea of debt relief, however, is not new: figure 1 shows that already the 1980s and 1990s were characterized by large amounts of concessional lending. The replacement of market debt by concessional debt can be interpreted as an alternative form of debt relief. The concern about the high levels of debt in the HIPC led to the idea of a 'once-and-for-all program' implying a total cancelation of debt and providing aid in form of grants only from then onwards.<sup>2</sup>

Two arguments establish the perception that a reduction in debt promotes economic growth and reduces poverty. Firstly, debt relief reduces debt servicing obligations so that the recipient government has free resources to finance growth-enhancing investments and efficient economic policies. Secondly, poor countries regain access to international credit markets facilitating higher investment. However, many recipient countries are characterized by weak political institutions: instead of implementing efficient policies, the recipient government may divert development assistance from its intended use and follow poor or wasteful economic policies. To prevent this from happening, it has become a common policy to impose conditionality.<sup>3</sup> However, the sovereign recipient government may not be willing to keep the conditions.

This paper analyzes the optimal design of development assistance and incentive-compatible

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<sup>1</sup>IMF Factsheet (2010).

<sup>2</sup>For a critical review of the history of debt relief see e.g. Easterly (2002).

<sup>3</sup>To be considered for the HIPC Initiative assistance countries must meet certain criteria, e.g. countries must have developed a Poverty Reduction Strategy Paper.

conditionality in the light of weak political institutions in the recipient country. We analyze the interaction and effectiveness of grants, concessional lending, and debt relief and derive implications for the optimal design of conditionality. Thereby, building on Scholl (2009) conditionality is modeled as an imperfectly enforceable dynamic contract between the donor and the recipient country. To ensure that the recipient government fulfills the conditions and uses development assistance for economic policies that coincide with the donor's intention, the donor threatens with aid sanctions. Conditionality is defined to be self-enforcing if, at any point in time, it is supportable by the threat of a permanent cutoff from development assistance from then onward.

To study the question at hand, we develop a neoclassical growth model of a small open economy. The government finances non-productive government consumption by issuing foreign debt and raising taxes. In addition, the government receives development assistance in form of concessional loans and grants. To reflect the risk of sovereign default on non-concessional debt, interest rates are assumed to be increasing in the debt-to-capital ratio and, therefore, limit the access to international credit markets. The donor provides costly development assistance and cares solely about the welfare of the poor. In contrast, the recipient government also values non-productive government consumption. In addition, the government discounts the future at a higher rate than the donor which can be interpreted as a short-hand for political economy factors that lead to e.g. overspending, see Easterly (2002). The conflict of interest between the donor and the recipient government raises the issue of conditionality. We define aid conditionality as an imperfectly enforceable dynamic contract that maximizes the donor's preferences subject to the optimal decision rules of the households and the government budget constraints. Thereby, the donor offers to provide development assistance and, in return, expects the government to implement fiscal as well as debt policies that coincide with the donor's intention. Conditionality is self-enforcing if the contract generates at least the same value as the punishment value associated to a permanent cutoff from any development assistance.

Our quantitative results show that governments that discount the future at larger rates are heavily indebted and face high market interest rates in the absence of development assistance. The high country risk premia imply high debt service obligations that limit the access to international credit markets. Moreover, these economies are characterized by high tax rates, high government consumption shares and low production. Governments that substantially value non-productive government consumption are characterized by high government consumption shares and high income taxes. Hence, these recipient economies suffer from low capital stocks and limited access to private international credit markets.

Our quantitative results suggest that incentive-compatible conditional development assistance substantially stimulates capital accumulation and increases consumption. It turns out, however, that grants and concessional loans in isolation imply very different incentive structures. If the donor provides solely grants to the recipient government, aid funds are decreasing as capital increases. Thus, the donor uses aid to reduce non-concessional debt and to lower taxes in order to stimulate investment. As capital increases and debt decreases, the recipient government faces higher incentives to default on the aid contract since a cutoff from development assistance is becoming less threatening. Therefore, incentive-compatibility requires that government consumption is increasing until the new steady state is reached. Importantly, the long-run equilibrium is characterized by a permanent provision of grants to ensure that the recipient government continues to implement efficient economic policies.

It turns out that, in the short-run, concessional loans increase capital and consumption more than grants do. Since in the short-run the recipient government is suffering from high non-concessional debt and low capital, the country risk premium on market debt is high. This limits the access to international credit market and, thus, makes the provision of concessional loans very valuable to the recipient government. Consequently, the weak incentives to default on the aid contract allow the donor to impose a stronger conditionality on aid funds. However, as capital increases and market debt decreases, the wedge between the market interest rate and the concessional interest rate shrinks. Hence, the incentives to default on the aid contract

increase over time. It turns out that in the long-run capital increases by less if loans are given instead of grants since the recipient government has higher incentives to default on the contract.

The optimal combination of concessional loans and grants outperforms both instruments in isolation. Interestingly, but in line with our reasoning above, grants are increasing as capital grows and market debt falls. Since the falling country risk premium makes the outside option more attractive to the recipient government, the donor has to increase grants to raise the value of the contract. Our results suggest that incentive-compatibility requires that impatient and less benevolent recipient governments receive more grants but less concessional loans.

Clearly, the 'once-for-all-program' implying a total cancelation of debt and providing aid in form of grants only from then onwards is outperformed by the optimal self-enforcing mix of grants and concessional loans. However, one might argue that it is difficult for donors to implement the optimal combination of aid instruments. If development assistance is either provided in form of grants or concessional loans in isolation, our results support the hypothesis that debt relief in combination with grants is more effective than concessional loans.

The theoretical literature on the macroeconomic effects of debt relief as well as the interaction with grants is rather limited. Early discussions on the efficiency of debt relief and the consequences of a debt overhang can be found in Sachs (1989) and Krugman (1988). More recently, Arslanalp und Henry (2004, 2005, 2006) argue verbally and empirically that debt reduction is ineffective in promoting growth since recipient countries suffer from weak political institutions and fail to provide public goods such as education and infrastructure. However, there is no formal theoretical analysis of optimal aid policy and the design of conditionality. Our paper combines three strands of literature. Firstly, we build on the literature that focuses on the link between foreign aid and economic growth, e.g. Chenery and Strout (1966), Boone (1996), Chatterjee, Sakoulis and Turnovsky (2003, 2007) and Dalgaard, Hansen and Tarp (2004).<sup>4</sup> These studies, however, abstract from international debt as well as incentive

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<sup>4</sup>There is a large empirical literature on aid and economic growth, e.g. Burnside and Dollar (2000, 2004), Hansen and

compatibility issues and do not derive optimal aid policies. Secondly, our paper builds on the literature that uses stylized static or two-period game-theoretic models to study incentive compatibility, moral hazard and informational problems, e.g. Murshed and Sen (1995), Svensson (2000a, 2000b, 2003), Pedersen (1996, 2001), Federico (2001). Hagen (2006) and Cordella et al. (2003). Thirdly, our paper is linked to the literature on sovereign debt. In particular, our paper is related to Aguiar und Amador (2009) who develop a political economy model of sovereign debt and show that unconditional aid and debt relief have no long-run effects. However, since their focus is the analysis of debt default, they do not analyze the issue of optimal conditional development assistance.

Our paper builds on Scholl (2009) who abstracts from international debt and analyzes the optimal provision of grants in the light of incentive compatibility problems. The present paper contributes to the literature by jointly analyzing the short- and long-run properties of grants, loans and debt relief as well as the implied incentive-compatibility requirements.

The paper is structured as follows. In section 2 we develop a neoclassical framework of a small open economy with a conflict of interest between the donor and the recipient government. In section 3 we analyze quantitatively the dynamic properties of incentive-compatible grants and concessional loans by studying transition paths and long-run properties. Moreover, we study the dynamic interaction of the different aid policy instruments. Finally, section 4 concludes.

## **2 The Model**

### **2.1 The Environment**

In the following, we consider a small open developing economy that is inhabited by a large number of infinitely-lived households who maximize lifetime utility. Preferences of the rep-

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Tarp (2000, 2001), Dalgaard and Hansen (2001), Dalgaard, Hansen and Tarp (2004, 2001), Guillaumont and Chauvet (2001), Lensink and White (2001), Devarajan, Dollar and Holmgren (2000), Collier and Dollar (2001, 2002), Easterly, Levine and Roodman (2004) and Easterly (2003). According to a recent contribution by Raghuram und Subramanian (2008) there seems to be no robust evidence concerning the interaction of foreign aid, sound economic policies and growth.

representative household are given by

$$\sum_{t=0}^{\infty} \beta_p^t u(c_t), \quad 0 < \beta_p < 1, \quad (1)$$

where  $c_t$  denotes household consumption at time  $t$ . The utility function  $u(c_t)$  satisfies  $u_c(c_t) > 0$  and  $u_{cc}(c_t) < 0$ .

The household produces the consumption good and saves by investing in the capital stock  $k_t$ .

The households' budget constraint is given by

$$c_t + k_t = (1 - \tau_t)y_t + (1 - \delta)k_{t-1}, \quad (2)$$

The capital stock depreciates at rate  $0 \leq \delta < 1$ .  $y_t$  denotes production at time  $t$  and  $\tau_t$  is the income tax raised by the government. Note that we assume that households do not have access to international credit markets.

The household produces  $y_t$  by employing the production function

$$y_t = F(k_{t-1}, n_t) \quad (3)$$

The production function has constant returns to scale in capital and labor  $n_t$ . In the following, we normalize labor  $n_t \equiv 1$ , for all  $t$ , such that  $F(k_{t-1}, 1) \equiv f(k_{t-1})$ .

Preferences of the government are given by

$$\sum_{t=0}^{\infty} \beta_g^t v(c_t, g_t), \quad 0 < \beta_g < 1, \quad (4)$$

where the utility function  $v$  satisfies  $v_c(c_t, g_t) > 0$  and  $v_{cc}(c_t, g_t) < 0$  and  $v_g(c_t, g_t) > 0$  and  $v_{gg}(c_t, g_t) < 0$ . We label unproductive government consumption by  $g_t$  and interpret it as e.g. expenditures supporting the political elite. Importantly, we allow that the government discounts the future at a different rate than the public,  $\beta_g \leq \beta_p$ . The higher discount rate can be interpreted as short-hand for political economy factors that lead to e.g. overspending, see Easterly (2002).<sup>5</sup>

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<sup>5</sup>This assumption is standard in the literature on sovereign debt, see e.g. Auguiar and Amador (2009).



The recipient government finances non-productive government consumption by raising income taxes and issuing foreign debt  $d_t \geq 0$  at the market interest rate  $r_t$  and by receiving development assistance. Aid can take the form of grants  $a_t$  and concessional lending  $\ell_t \geq 0$  at the concessional rate  $\bar{r}$ . The government's budget constraint is given by

$$g_t + (1 + r_t)d_{t-1} + (1 + \bar{r})\ell_{t-1} = \tau_t y_t + d_t + \ell_t + a_t \quad (5)$$

The market interest is assumed to take the form  $r_t = \Phi\left(\frac{d_{t-1}}{k_{t-1}}\right)$  with  $\Phi(0) = r^*$  and  $\Phi'\left(\frac{d_{t-1}}{k_{t-1}}\right) > 0$ . Thus, the market rate is at least as large as the world interest rate  $r^*$  and is assumed to be strictly increasing in the debt to capital ratio reflecting the risk of sovereign default. Hence, the country risk premium is given by  $r_t - r^* \geq 0$ . The concessional interest rate is assumed to be lower than the world interest rate,  $\bar{r} < r^*$ .

We assume that there is a representative altruistic donor who cares about the welfare of the households and provides costly development assistance in form of grants as well as concessional loans.<sup>6</sup> By offering concessional loans at an interest rate lower than the market rate,  $\bar{r} < r^*$ , the donor faces opportunity costs  $q_t = (r_t - \bar{r})\ell_t$ . The donor's preferences are given by

$$\sum_{t=0}^{\infty} \beta_p^t [u(c_t) - h(a_t, q_t)]. \quad (6)$$

The cost function  $h(a_t, q_t)$  satisfies  $h(a_t, q_t) > 0$  if  $a_t$  or  $q_t$  are strictly greater than zero  $h(a_t, q_t) = 0$  if  $a_t = q_t = 0$ . Moreover,  $h_a(a_t, q_t) > 0$ ,  $h_{a,a}(a_t, q_t) \geq 0$  and  $h_q(a_t, q_t) > 0$  and  $h_{q,q}(a_t, q_t) \geq 0$ .

## 2.2 Conditional Development Assistance as Self-Enforcing Contract

Since the recipient government discounts the future at a higher rate than the donor and, in addition, finances unproductive government consumption, there is a conflict of interest between the donor and the recipient government. Thus, the recipient government may use development assistance to implement policies that do not coincide with the donor's intention. To

<sup>6</sup>Here, we abstract from strategic reasons for giving aid. By assuming an altruistic donor we take the most optimistic view on development assistance.

prevent the government from doing so, the donor may impose conditions on development aid. However, the recipient government may not be willing to fulfill these conditions.

In the following, we define aid conditionality as a dynamic contract between the donor and the recipient country that specifies development assistance and fiscal policies in such a way that the donor's preferences are maximized subject to the competitive equilibrium and the government budget constraints. We interpret the specification of debt and fiscal policies as conditionality. However, the contract is imperfectly enforceable since the sovereign recipient government can always dishonor the conditions and implement ineffective fiscal and debt policies. We assume that in this case the donor responds with aid sanctions.

We build on Scholl (2009) and Cordella et al. (2003) and describe conditionality as an imperfectly enforceable dynamic contract between the donor and the recipient country. Conditional development assistance constitutes a self-enforcing contract between the donor and the recipient government only if, at any point in time, the conditions are supportable by the threat of a permanent exclusion from development assistance from then onwards. Note that we assume that the threat is fully credible so that we interpret the associated self-enforcing allocation as the best achievable outcome.

In the absence of development assistance, the government chooses its tax and debt policies optimally. Thereby, the donor takes as given the optimal consumption and investment choices of the households that are characterized by:

$$u_c(c_t) = \beta_p u_c(c_{t+1}) [1 - \delta + (1 - \tau_{t+1}) f_k(k_t)] \quad (7)$$

together with the budget constraints of the households and the government, (2) and (5). (7) is the usual Euler equation that connects the marginal rate of substitution between consumption today and tomorrow with the rate of return  $[1 - \delta + (1 - \tau_{t+1}) f_{kp}(k_t)]$ .

The default value of the recipient government is characterized by the following maximization

problem:

$$\begin{aligned} & \max_{\{c_t, g_t, k_t, d_t, \tau_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta_g^t v(c_t, g_t) & (8) \\ & \text{s.t.} \\ & (2), (5) \text{ and } (7) \end{aligned}$$

given  $k_{-1} > 0$  and  $d_{-1}$  and  $\ell_t = a_t = 0$ , for all  $t \geq 0$  and  $\ell_{-1} \geq 0$  reflecting repayment obligations of concessional loans that have been offered in the past. The optimality conditions are given in the appendix.

When choosing aid policies that maximize the donor's preferences, the donor needs to ensure that the conditions imposed on the contract are enforceable, i.e. the recipient government's value of honoring the conditions is required to be at least as large as the recipient government's value of default. The self-enforcing conditional aid contract is specified by the solution to the following maximization problem:

$$\begin{aligned} & \max_{\{c_t, g_t, k_t, d_t, \tau_t, a_t, \ell_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta_p^t [u(c_t) - h(a_t, q_t)] & (9) \\ & \text{s.t.} \\ & \sum_{j=0}^{\infty} \beta_g^j v(c_{t+j}, g_{t+j}) \geq D(k_{t-1}, d_{t-1}, \ell_{t-1}) & (10) \\ & (2), (5) \text{ and } (7) \end{aligned}$$

given  $k_{-1} > 0$ .  $D(d_{t-1}, k_{t-1}, \ell_{t-1})$  is the solution to the government's maximization problem (8) taking into account that concessional loans provided in the last period are repaid. By assuming that the repayment obligations are fulfilled, we focus solely on the enforceability of aid conditionality and abstract from issues related to default on concessional debt. In our quantitative analysis we provide some sensitivity analysis allowing for default on repayment obligations.

The solution to the maximization problem (9) is an allocation  $\{c_t, g_t, k_t\}_{t=0}^{\infty}$  and policy actions  $\{a_t, \ell_t, \tau_t, d_t\}_{t=0}^{\infty}$  that can be interpreted as the outcome of conditionality. The donor

offers aid flows  $\{a_t, \ell_t\}_{t=0}^{\infty}$  and in return expects the recipient government to implement tax and debt policies  $\{\tau_t\}_{t=0}^{\infty}$  and  $\{d_t\}_{t=0}^{\infty}$  that are associated with the allocation  $\{c_t, g_t, k_t\}_{t=0}^{\infty}$ . In the spirit of Marcet and Marimon (2010), to solve the donor's maximization problem, we introduce an additional co-state variable  $\mu_t$  that measures the binding pattern of the enforcement constraint. The donor's maximization problem (9) can be transformed into the following saddle-point formulation:<sup>7</sup>

$$\min_{\{\gamma_t > 0\}_{t=0}^{\infty}} \max_{\{c_t, g_t, k_t, d_t, \tau_t, a_t, \ell_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta_p^t \left[ u(c_t) - h(a_t, q_t) + \mu_t v(c_t, g_t) - \gamma_t D(k_{t-1}, d_{t-1}, \ell_{t-1}) \right] \quad (11)$$

s.t.

$$\mu_t = \left( \frac{\beta_g}{\beta_p} \right) \mu_{t-1} + \gamma_t, \quad \mu_{-1} = 0 \quad (12)$$

(2), (5) and (7).

This formulation shows clearly that the additional co-state variable  $\mu_t$  enters as a weight on government's preferences. If the dynamic incentive constraint is never binding,  $\gamma_t = 0$ , for all  $t$ , the weight on government's preferences is zero,  $\mu_t = 0$ , for all  $t$ , and the donor can enforce the first best solution. If the recipient government has an incentive to default on the aid contract, constraint (10) is binding,  $\gamma_t > 0$ . If  $\gamma_t > \frac{\beta_g}{\beta_p} \mu_{t-1}$ , the weight on government's preferences  $\mu_t$  increases and raises the government's value of honoring the contract.

The optimal development assistance contract is characterized by the following first order

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<sup>7</sup>The details are given in the appendix.

conditions:

$$\begin{aligned}\zeta_t &= u_c(c_t, g_t) + \mu_t v_c(c_t, g_t) + u_{cc}(c_t) \lambda_{t-1} \left[ (1 - \tau_t) f_k(k_{t-1}) + 1 - \delta \right] \\ &\quad - \lambda_t u_{cc}(c_t)\end{aligned}\tag{13}$$

$$\begin{aligned}\zeta_t &= \beta_p \left[ \lambda_t u_c(c_{t+1}) (1 - \tau_{t+1}) f_{k,k}(k_t) + \zeta_{t+1} \left( (1 - \tau_{t+1}) f_k(k_t) + 1 - \delta \right) \right. \\ &\quad \left. + \mu_{t+1} v_g(c_{t+1}, g_{t+1}) \tau_{t+1} f_k(k_t) - \gamma_{t+1} D_k(k_t, d_t, \ell_t) \right]\end{aligned}\tag{14}$$

$$\mu_t v_g(c_t, g_t) = \beta_p \left( \mu_{t+1} v_g(c_{t+1}, g_{t+1}) (1 + r_{t+1}) + \gamma_{t+1} D_d(k_t, d_t, \ell_t) \right)\tag{15}$$

$$\mu_t v_g(c_t, g_t) = \beta_p \left( \mu_{t+1} v_g(c_{t+1}, g_{t+1}) (1 + \bar{r}) + h_\ell(a_{t+1}, q_{t+1}) \right)\tag{16}$$

$$\zeta_t f(k_{t-1}) = \mu_t v_g(c_t, g_t) f(k_{t-1}) - \lambda_{t-1} u_c(c_t) f_k(k_{t-1})\tag{17}$$

$$h_a(a_t, q_t) = \mu_t v_g(c_t, g_t)\tag{18}$$

$$0 = \gamma_t \left( \sum_{j=0}^{\infty} \beta_g^j v(c_{t+j}, g_{t+j}) - D(d_{t-1}, k_{t-1}, \ell_{t-1}) \right)\tag{19}$$

together with (2), (5) and (7).  $\lambda_t$  denotes the Lagrange multiplier on the Euler equation and measures its tightness while  $\zeta_t$  is the Lagrange multiplier of the budget constraint. (19) is the complementary slackness condition. Equation (13) determines the optimal choice of households' consumption. Equation (14) relates the marginal costs and benefits of investing one additional unit in the capital stock. Note that if capital is increased by one unit, the recipient's incentive to default on the contract increases, reflected by the term  $\gamma_{t+1} D_k(k_t, d_t, \ell_t)$ . Equation (22) can be interpreted as the government's Euler equation since it relates the marginal costs and marginal benefits of issuing one additional unit foreign debt. Here, the increasing market debt lowers the recipient values of default reflected by the term  $\gamma_{t+1} D_d(k_t, d_t, \ell_t)$ . Equation (16) determines the optimal concessional loans by relating marginal benefits and marginal costs. Equation (17) describes optimal taxes. Equation (16) characterizes optimal grants by equalizing the marginal cost of grants,  $h_a(a_t, q_t)$ , to the the weighted marginal utility with respect to government consumption  $\mu_t v_g(c_t, g_t)$ .

The constraints (2), (5) and (7), the optimality conditions (13) to (18) and the complementary slackness condition (19) form a system of highly nonlinear equations that depend on the state

variables  $k_t$ ,  $d_t$ ,  $\ell_t$ ,  $\lambda_t$  and  $\mu_t$ . Since no analytical closed-form solution can be derived, we solve the model numerically to study transition paths and steady states.

Since there exists a finite constant  $\bar{D}$  such that  $\bar{D} \geq D(k_{t-1}, d_{t-1}, \ell_{t-1})$ ,  $\mu_t$  will grow until it reaches a level such that  $\sum_{j=0}^{\infty} \beta_g^j v(c_{t+j}, g_{t+j}) = \bar{D}$ . The co-state variable will be constant from then onwards,  $\mu_t = \bar{\mu}$ , i.e.  $\bar{\gamma}$  must compensate the differences in the time discount factors of the donor and the recipient government. From then onwards, the donor's maximization problem is a standard Ramsey problem with a fixed utility weight  $\bar{\mu}$ . Since the model assumes no exogenous growth, we suppose that the economy converges to a steady state that is characterized by a constant weight  $\bar{\mu}$ , a constant allocation  $(\bar{c}, \bar{g}, \bar{k})$  and constant policies  $(\bar{\tau}, \bar{a}, \bar{d}, \bar{\ell})$  that fulfill the optimality conditions associated to the donor's maximization problem (9).

In the following, we rely on numerical simulations to analyze the dynamic properties and the interaction of grants, concessional loans and debt relief. Since there is no uncertainty we use a backward procedure to solve for the transitional dynamics. The numerical algorithm is described in the appendix.

### 3 Quantitative Results

#### 3.1 Calibration

As initial situation we suppose that the recipient economy does not receive any development assistance so that the optimal choices of the recipient government are characterized by the solution to the government's maximization problem (8). We consider this as our benchmark and choose the parameters of the model as to mimic the empirical facts observed in the HIPC. As a benchmark we consider the year 1980 before the increase in concessional lending and debt relief has taken place.

We assume that the household and the government have logarithmic utilities:

$$u(c_t) = \ln c_t$$

$$v(c_t, g_t) = \ln c_t + \alpha \ln g_t$$

where  $\alpha > 0$  is the weight that the recipient government puts on its non-productive consumption  $g_t$ . It measures the benevolence of the government and determines the government consumption share. We consider the values  $\alpha = 0.2$ ,  $\alpha = 0.4$  and  $\alpha = 0.6$ .

We set the private rate of time preferences  $\beta_p = 0.95$  and define  $r^* = 1/\beta_p - 1$  so that the world interest rate equals 5.26 percent. The market interest rate is assumed to be strictly increasing in the debt-to-capital ratio  $r_t = r^* + e^{\frac{\phi d_{t-1}}{k_{t-1}}} - 1$  with  $\phi = 0.05$ . We assume that the recipient government discounts the future at a higher rate reflecting political instability leading to overspending and debt accumulation. Since  $\beta_g$  determines the debt share in the economy, we analyze its impact by assuming the values 0.86, 0.88 and 0.90.

The production function is assumed to be  $f(k_{t-1}) = k_{t-1}^\theta$  with  $\theta = 0.3$ . The capital stock depreciates at the rate  $\delta = 0.1$ .

Table 1 summarizes the steady state properties for these functional forms and parameter values. Our calibration generates private consumption shares between 52 and 68 percent while government consumption shares range between 12 and 32 percent, depending on the parameter  $\alpha$ . Investment shares vary between 12 and 17 %, respectively. In the year 1980, the HIPC are characterized by median consumption, government and investment shares of approximately 74, 14 and 15 percent, respectively, but as the minimum and maximum values across countries show, they exhibit a large variation. Note that we slightly underestimate private consumption shares since we assume that the recipient government receives no development assistance. In the year 1980, however, median grants and concessional debt as share of the recipient's GDP were equal to approximately 4 and 15 percent.

The assumptions with respect to the market interest rate on foreign debt as well as government preferences generate debt-to-output ratios between 14 and 34 percent with country

risk premia between 5 and 11 percent. These numbers square well with the debt shares we observe in the data.

It is evident that the larger  $\alpha$ , i.e. the less benevolent the recipient government, the larger the income taxes, the lower investment shares and, thus, the poorer the economy in terms of capital and output levels. The government consumption share is increasing while the private consumption share is decreasing in  $\alpha$ . Moreover, debt as share of total output is decreasing in  $\alpha$  reflecting the fact that poor countries have limited access to international debt markets.

With respect to  $\beta_g$ , our theoretical economy implies that that recipient governments that discount the future at higher rates accumulate more debt leading to higher risk premia issued by international credit markets. The more indebted countries face considerable debt service obligations and suffer from lower capital levels and higher tax rates as well as higher government consumption and lower private consumption shares.

We consider the steady state without development assistance as the initial situation and, in the following, consider the short- and long-run effects of the provision of conditional aid in form of grants, concessional lending as well as debt relief. In our analysis of the effectiveness of different aid instruments we assume that the donor's preferences  $h(a_t, q_t)$  are described by a quadratic cost function:  $h(a_t, q_t) = \kappa(a_t^2 + q_t^2)$ .  $\kappa$  is chosen in such a way that steady state values of of grants and concessional lending mimic the situation of the HIPC in the year 2000. At that time the HIPC have received substantial amounts of concessional lending but the HIPC-initiative was not yet implemented.

## **3.2 Incentive-Compatible Conditional Development Assistance**

### **3.2.1 Grants Only**

We first analyze the short- and long-run impact of optimal development assistance under the assumption that the donor gives grants only. Table 2 summarizes the long-run properties of self-enforcing conditional grants in isolation. To show that our model delivers realistic values, we summarize data statistics for the HIPC for the year 2000. Clearly, the effectiveness



of optimal incentive-compatible grants is high: across parameterizations tax cuts are substantial greatly promoting private investment. Moreover, government consumption shares can be substantially reduced. Instead of using grants for wasteful policies, development aid is used to lower tax distortions and to considerably reduce debt shares. However, in order to ensure that the recipient government fulfills the conditions imposed on development assistance, the donor has to permanently transfer aid funds of approximately 5 to 7 percent of the recipient's GDP. If recipient governments do not receive permanently positive grants, they have an incentive to default on the aid contract and to return to their poor economic policies. As the weight on government's preferences,  $\bar{\mu}$ , shows, less benevolent and more impatient recipient governments have the highest incentives to default on the conditions imposed on grants. Therefore, incentive-compatibility requires that these recipients receive higher grants in return to a less severe conditionality. Those economies, that suffer from 'bad' governments, are characterized by higher tax distortions, lower capital, lower consumption and higher government consumption shares. Moreover, the higher  $\alpha$  and the lower  $\beta_g$  the higher the debt share and, thus, the higher the country risk premium. Interestingly, although countries with less benevolent and more impatient recipient governments are still the poorest, optimal incentive-compatible grants help to reduce cross-country differences in capital levels and consumption shares.

The first column of figure 2 analyzes the short-run properties of optimal, incentive-compatible conditional grants. We assume that the economy is initially in its steady state that would occur in the absence of development assistance and plot the transition paths of private and government consumption, capital as well as the debt share, taxes and grants. All variables are normalized by their respective initial steady state values except grants that are normalized by the steady state value of output that would occur in the absence of development assistance. To analyze the dynamic properties of conditional grants we take  $\alpha = 0.4$  as an example and consider  $\beta_g = 0.86$  and  $\beta_g = 0.90$ . Overall, the general pattern of conditional grants is characterized by high transfers in the short-run to reduce tax distortions and to stimulate in-

vestment and capital accumulation. As capital grows over time, optimal grants decrease to the new steady state level. In addition, grants are used to decrease the share of non-concessional debt over time until the new steady state level is reached.

Interestingly, for  $\beta_g = 0.86$  taxes are increasing while for  $\beta_g = 0.90$  they are decreasing over time. Since impatient governments are characterized by substantial debt shares, high debt service obligations do not allow initial tax cuts that are as large as for  $\beta_g = 0.90$ . Instead, taxes are needed to service debt and to decrease indebtedness over time. In contrast, for  $\beta_g = 0.90$ , on impact the tax cut is very large to stimulate investment. Interestingly, debt is initially increasing. Since patient governments are characterized by low debt-to-capital ratios, the market interest rate on debt is low. Thus, to stimulate the economy, it is optimal to decrease taxes and to raise investment at the expense of higher but relatively 'cheap' debt. Over time, taxes are increasing and debt is decreasing to its new steady state level.

By presenting the variables in normalized terms, the figure highlights that government consumption is increasing more for 'bad' governments since they have the highest incentives to dishonor the contract. However, since these economies are also the poorest, grants are more effective. The welfare analysis summarized in table 5 shows that welfare gains vary around 34 percent for the households and 24 percent for the donor, reflecting the costs of aid.

### **3.2.2 Concessional Loans Only**

Table 3 and the second column of figure 2 summarize the short- and long-run properties of self-enforcing conditional loans under the assumption that no grants were given by the donor. The long-run equilibrium reveals that, in comparison with the previous experiment, reductions of taxes as well as government consumption are lower, and, hence capital and private consumption increase less. The recipient governments are characterized by substantial concessional debt shares replacing non-concessional lending, in line with the situation of the HIPC in the year 2000. Note, however, that non-concessional debt shares are higher compared to the scenario where the donor offers grants only. This is due to the fact that if the

donor offers soft loans in isolation, recipient governments have high incentives to dishonor the policy conditions that are imposed on aid flows. The reason is that reduced levels of market debt together with improved levels of capital reduce the wedge between market interest rates and concessional interest rates and, hence, reduce the benefits of concessional debt. Thus, the outside option gets less severe. This is reflected by the fact that, in comparison to the previous experiment, the donor has to place a higher weight on government preferences,  $\mu$ . As before,  $\mu$  is increasing in  $\alpha$  and decreasing in  $\beta_g$ .

The second column of figure 2 shows the transitional dynamics of optimal, incentive-compatible concessional loans. As before, we assume that the economy is initially in its steady state that would occur in the absence of development assistance. The transition paths of private and government consumption, capital as well as the debt share, taxes and concessional debt are plotted. All variables are normalized by their respective initial steady state values except concessional debt that is normalized by the steady state value of output that would occur in the absence of development assistance. As in the previous experiment, we consider  $\alpha = 0.4$  and  $\beta_g = 0.86$  and  $\beta_g = 0.90$ . It is evident that as the additional weight on government's preferences  $\mu$  increases over time, concessional debt is increasing and replacing non-concessional debt. The growing capital stock as well as the decreasing level of non-concessional debt lower market interest rates and, thus, lower the wedge between market and concessional interest rates. Thus, the incentives to break the aid contract increase over time requiring higher levels of non-concessional lending to ensure self-enforceability. Interestingly, in the short-run, incentives to default on the contract are lower with concessional lending than with grants: in the short-run the donor has to place a lower weight on government's preferences. Therefore, tax cuts associated to soft loans are higher, in particular for  $\beta_g = 0.90$ . Again, this is due to the fact, that initially, recipient governments face high country-risk premia such that the outside option is not attractive to choose. Crucially, and in contrast to the previous experiment, in this setup the 'good' governments receive more development assistance: concessional debt is much larger for  $\beta_g = 0.90$  than for  $\beta_g = 0.86$ . By providing less soft

loans to the 'bad' governments, the relative increase in capital is smaller implying lower decreases in the country risk premium. Hence, the donor avoids that falling market interest rates generate incentives to choose the outside option.

The welfare gains summarized in table 5 shows that the long-run effect dominates: welfare gains are lower compared to previous experiment where we consider grants only. The households' and donor's welfare gains vary between 22 and 27 percent and 21 and 25 percent, respectively, and are increasing in  $\beta_g$  reflecting that the provision of concessional loans to more patient recipient economies generate higher relative increases in consumption and capital.

### 3.2.3 The Optimal Mix of Grants and Concessional Loans

Table 4 and the third column of figure 2 show the short- and long-run properties of the optimal, self-enforcing conditional policy mix. The long-run equilibrium reveals that, in comparison with the previous experiments, the optimal combination of grants and concessional loans outperforms the effectiveness of each instrument alone. The weight that the donor needs to place on government's preferences is low implying severe conditionality, i.e. high reductions of taxes as well as government consumption shares. Therefore, capital accumulation is substantially promoted leading to high private consumption. Moreover, low non-concessional debt shares are implying reduced country risk-premia. In the long-run, grants as share of output are increasing (decreasing) in  $\alpha$  ( $\beta_g$ ) while the share of concessional debt is decreasing (increasing) reflecting the basic mechanisms discussed in the previous two subsections.

Interestingly, the transitional dynamics shown in figure 2 reveal that grants are now increasing over time. In contrast, grants in isolation are decreasing as capital grows (first column). The economic intuition is straightforward: as non-concessional debt is reduced and capital increases, the wedge between market and concessional interest rates becomes smaller reducing the benefits of concessional loans. To ensure the enforceability of the aid contract, the donor increases the value of honoring conditionality by offering higher grants.

As before, the short- and long-run properties of the optimal mix shows that development assistance helps to reduce the variation in consumption and capital across political regimes. Thereby, the 'bad' governments characterized by high impatience and/or low benevolence need to receive more grants but less concessional loans to ensure the enforceability of conditionality. The welfare gains in table 5 confirm that the combination of the two instruments outperform each instrument in isolation.

#### **3.2.4 Debt Relief**

In this section we analyze the impact of an exogenous debt relief on self-enforceable aid contracts. Following the public discussion, we assume that donor follows the 'once-for-all-program': all concessional debt is forgiven and, from then onwards, only grants are provided to the recipient government and lending is left to international credit markets. Clearly, the 'once-for-all-program' is outperformed by the optimal self-enforcing mix of grants and concessional loans. However, one might argue that it is difficult to implement this optimal combination of aid instruments. Thus, as initial situation, we consider the steady state that would occur if only concessional loans were given to the recipient economy and set the level of concessional debt to zero. Figure 3 shows the transition paths of private and government consumption, capital as well as the debt share, taxes if only grants were provided. All variables are normalized by their respective steady state values that would occur in the absence of development assistance. As before, grants are normalized by the steady state value of output. The transition paths show that optimal grants are decreasing as capital grows. Substantial tax cuts boost capital accumulation and the economy is growing to the new steady state that is characterized by table 2. Interestingly, in the short-run, more external debt is accumulated since low market interest rates make it optimal to use external borrowing to finance investment. Thus, in the short-run debt relief may imply new debt accumulation.

### 3.2.5 Sensitivity Analysis

Table 6 assumes  $\alpha = 0.4$  and  $\beta_g = 0.86$  and considers two variations to analyze the robustness of our findings. In the first variation, we take into account that the recipient government may default on 50 percent of its concessional debt, in addition to violating the policy conditions imposed on aid funds. The second variation assumes that concessional loans imply a bad signal to private creditors and, therefore, increase market interest rates issued on non-concessional debt. As functional form we assume  $r_t = r^* + e^{\frac{\phi d_{t-1} + \phi_\ell \ell_{t-1}}{k_{t-1}}} - 1$  with  $\phi = 0.05$  and  $\phi_\ell = 0.01$ .

Table 6 summarizes the steady state values of debt, tax, household consumption, government consumption, capital and risk premium normalized by their respective steady state values that would occur in the absence of development assistance. Grants and concessional debt are normalized by their respective steady state values of output that would occur without development assistance. Clearly, default on concessional repayment obligations makes the outside option more attractive. Thus, the donor has to place a larger weight on government's preferences implying higher government consumption shares as well as higher grants and lower concessional debt levels. Consequently, the relative increase in capital and consumption is lower compared to the benchmark.

If market interest rates are increasing in concessional debt, incentives to default on the aid contract increase, generating lower reductions in government consumption. The economic intuition behind this finding is that the access to international credit markets is limited due to the bad market signal of concessional loans. Thus, the equilibrium market debt share is lower implying lower debt service obligations. Therefore, compared to the benchmark, higher tax cuts are feasible, generating higher increases in capital and private consumption.

## 4 Conclusions

This paper has analyzed the optimal design of development assistance and incentive-compatible conditionality in the light of weak political institutions in the recipient country. We have developed a neoclassical growth model of a small open economy with a conflict of interest between the donor and the recipient government. Instead of using aid funds for effective policies that coincide with the donor's intention, the government may divert development aid from its intended use and follow poor or wasteful economic policies. Conditionality has been modeled as an imperfectly enforceable dynamic contract between the donor and the recipient country. To ensure that the recipient government honors the conditions, the donor threatens with aid sanctions. Conditionality is defined to be self-enforcing if, at any point in time, it is supportable by the threat of a permanent cutoff from any development assistance from then onward.

Quantitative results have shown that incentive-compatible conditional development assistance substantially stimulates capital accumulation and increases consumption. It turns out, however, that grants and concessional loans in isolation imply very different incentive structures in the short- and in the long-run as well as across political institutions. The optimal combination of grants and loans outperform both aid instruments in isolation and incentive-compatibility requires that 'bad' governments receive more grants and less concessional loans.

One might argue that it is difficult for donors to implement the optimal combination of aid instruments. If development assistance is either provided in form of grants or concessional loans in isolation, our results support the hypothesis that debt relief in combination with grants is more effective than concessional loans. Debt relief without provision of additional grants, however, may not be incentive-compatible: recipient countries might violate conditionality and revert to poor or wasteful economic policies. In this case, debt relief is ineffective.

## A Optimality Conditions

### A.1 Unconditional Development Assistance

The optimality conditions associated to the recipient government's maximization problem (8) are:

$$\zeta_t = v_c(c_t, g_t) + \frac{\beta_p}{\beta_g} u_{cc}(c_t) \lambda_{t-1} \left[ (1 - \tau_t) f_k(k_{t-1}) + 1 - \delta \right] - \lambda_t u_{cc}(c_t) \quad (20)$$

$$\begin{aligned} \zeta_t = & \beta_g \left( \frac{\beta_p}{\beta_g} \lambda_t u_c(c_{t+1}) (1 - \tau_{t+1}) f_{k,k}(k_t) + \zeta_{t+1} \left( (1 - \tau_{t+1}) f_k(k_t) + 1 - \delta \right) \right. \\ & \left. + v_g(c_{t+1}, g_{t+1}) \tau_{t+1} f_k(k_t) \right) \end{aligned} \quad (21)$$

$$v_g(c_t, g_t) = \beta_g v_g(c_{t+1}, g_{t+1}) (1 + r_{t+1}) \quad (22)$$

$$\zeta_t f(k_{t-1}) = v_g(c_t, g_t) f(k_{t-1}) - \frac{\beta_p}{\beta_g} \lambda_{t-1} u_c(c_t) f_k(k_{t-1}) \quad (23)$$

where  $\zeta_t$  and  $\lambda_t$  are the Lagrange multipliers associated to the household's budget constraint and the Euler equation. Equation (20) determines the optimal choice of households' consumption. Equation (21) relates the marginal costs and benefits of investing one additional unit in the capital stock. Equation (22) can be interpreted as the government's Euler equation since it relates the marginal costs and marginal benefits of issuing one additional unit foreign debt. Finally, equation (23) determines the optimal tax choice.

### A.2 Self-Enforcing Conditional Development Assistance

The Lagrangian associated to the donor's maximization problem (9) is given by

$$L = \sum_{t=0}^{\infty} \beta_p^t \left[ u(c_t) - h(a_t, q_t) + \gamma_t \left( \sum_{j=0}^{\infty} \beta_g^j v(c_{t+j}, g_{t+j}) - D(k_{t-1}, d_{t-1}, \ell_{t-1}) \right) \right]$$

subject to (2), (5) and (7). It is straightforward to show that the following equality holds:

$$\sum_{t=0}^{\infty} \beta_p^t \gamma_t \sum_{j=0}^{\infty} \beta_g^j v(c_{t+1+j}, g_{t+1+j}) = \sum_{t=0}^{\infty} \beta_p^t \mu_t v(c_t, g_t)$$

s.t.

$$\mu_t = \left( \frac{\beta_g}{\beta_p} \right) \mu_{t-1} + \gamma_t, \quad \mu_{-1} = 0.$$



Thus, the Lagrangian becomes

$$L = \sum_{t=0}^{\infty} \beta_p^t \left[ u(c_t) - h(a_t, q_t) + \mu_t v(c_t, g_t) - \gamma_t D(k_{t-1}, d_{t-1}, \ell_{t-1}) \right]$$

s.t.

$$\mu_t = \left( \frac{\beta_g}{\beta_p} \right) \mu_{t-1} + \gamma_t, \quad \mu_{-1} = 0.$$

## B Numerical Algorithm

Due to the complexity of the model, we rely on numerical simulations to analyze the properties of different development aid policies. Since there is no uncertainty we use a backward procedure to solve for the transitional dynamics.

Considering the optimal value of default, the equilibrium is characterized by equations (2), (5), (7), (20) to (23). To make the system of equations finite dimensional we assume that the economy converges to the steady state in finitely many periods  $T + 1$ . Hence, as time starts in  $t = 0$ , in period  $T$  the state variables are given by their steady state values,  $k_T = \bar{k}$ ,  $d_T = \bar{d}$  and  $\lambda_T = \bar{\lambda}$ . Given the initial values  $k_{-1}$ ,  $d_{-1}$ , and  $\lambda_{-1}$ , we need to solve for  $\{c_t, g_t, \tau_t, \zeta_t\}_{t=0}^T$  and  $\{k_t, d_t, \lambda_t\}_{t=0}^{T-1}$ . To do so, we consider the equilibrium conditions (2), (5), (20) and (23) for  $t = 0, \dots, T$  and the equilibrium conditions (7), (21) to (22) that look forward to  $t + 1$  for  $t = 0, \dots, T - 1$ . Since we have as many unknowns as equations the system of nonlinear equations can be solved by employing a nonlinear numerical solver.

Considering the case of self-enforcing conditional development assistance, the absence of uncertainty implies that the enforcement is always binding until the steady state is reached. Hence, we can employ the same solution strategy as above. Note that the enforcement constraint requires the calculation of the default value  $D(k_{t-1}, d_{t-1}, \ell_{t-1})$  that includes the transitional dynamics to the steady state characterized by no development assistance. As before, to make the system of equations finite dimensional we assume that the economy converges to the steady state in finitely many periods  $T + 1$ . Hence, as time starts in  $t = 0$ , in period  $T$  the state variables are given by their steady state values,  $k_T = \bar{k}$ ,  $d_T = \bar{d}$ ,  $\ell_T = \bar{\ell}$ ,  $\mu_T = \bar{\mu}$

and  $\lambda_T = \bar{\lambda}$ . Given the initial values  $k_{-1}$ ,  $d_{-1}$ ,  $\ell_{-1}$ ,  $\mu_{-1}$  and  $\lambda_{-1}$ , we need to solve for  $\{c_t, g_t, \tau_t, \zeta_t\}_{t=0}^T$  and  $\{\hat{k}_t, d_t, \ell_t, \mu_t, \lambda_t\}_{t=0}^{T-1}$ . To do so, we consider the equilibrium conditions (2), (5), (13), (17) and (18) for  $t = 0, \dots, T$  and the equilibrium conditions (7), (14) to (16) that look forward to  $t + 1$  for  $t = 0, \dots, T-1$ . Since we have as many unknowns as equations the system of nonlinear equations can be solved by employing a nonlinear numerical solver.

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## Tables and Figures

Table 1: Steady State Properties, No Development Assistance

	$\bar{k}$	$\bar{\tau}$	$\bar{r} - r^*$	$\frac{\bar{d}}{\bar{y}}$	$\frac{\bar{c}}{\bar{y}}$	$\frac{\bar{g}}{\bar{y}}$	$\frac{\bar{x}}{\bar{y}}$
$\beta_g = 0.86$							
$\alpha = 0.2$	1.98	17.86	11.02	33.74	66.00	12.37	16.14
$\alpha = 0.4$	1.67	27.23	11.02	29.89	58.46	22.37	14.30
$\alpha = 0.6$	1.42	34.97	11.02	26.71	52.24	30.63	12.78
$\beta_g = 0.88$							
$\alpha = 0.2$	2.02	16.86	8.37	26.28	66.79	13.28	16.34
$\alpha = 0.4$	1.69	26.66	8.37	23.18	58.93	23.50	14.42
$\alpha = 0.6$	1.44	34.43	8.37	20.73	52.69	31.60	12.89
$\beta_g = 0.90$							
$\alpha = 0.2$	2.05	15.81	5.85	18.81	67.64	13.72	16.55
$\alpha = 0.4$	1.72	25.76	5.85	16.59	59.65	23.92	14.59
$\alpha = 0.6$	1.47	33.45	5.85	14.87	53.47	31.80	13.08
Data, 1980							
median	-	-	-	21.50	74.19	14.49	15.47
min	-	-	-	0.77	46.75	8.37	6.10
max	-	-	-	66.50	97.98	45.30	35.77

Notes:  $\bar{d}$ ,  $\bar{\tau}$ ,  $\bar{c}$ ,  $\bar{g}$ ,  $\bar{k}$ ,  $\bar{x}$ , and  $\bar{y}$  denote the steady state values of debt, tax, household consumption, government consumption, capital, investment and output, respectively.  $\bar{r} - r^*$  is the country risk premium. The tax rate, the country risk premium and the shares are given in percent. Data are taken from the World Bank and cover the HIPC.

Table 2: Steady State Properties, Conditional Grants

	$\bar{k}$	$\bar{\tau}$	$\bar{r} - r^*$	$\bar{\mu}$	$\frac{\bar{d}}{\bar{y}}$	$\frac{\bar{c}}{\bar{y}}$	$\frac{\bar{g}}{\bar{y}}$	$\frac{\bar{x}}{\bar{y}}$	$\frac{\bar{a}}{\bar{y}}$
$\beta_g = 0.86$									
$\alpha = 0.2$	2.54	2.13	4.04	0.57	15.24	78.63	6.08	19.24	5.65
$\alpha = 0.4$	2.32	8.22	5.22	0.69	18.36	73.74	12.85	18.04	6.71
$\alpha = 0.6$	2.15	13.13	5.77	0.72	19.17	69.79	18.46	17.07	7.44
$\beta_g = 0.88$									
$\alpha = 0.2$	2.56	1.62	3.13	0.56	11.92	79.04	6.00	19.34	5.65
$\alpha = 0.4$	2.35	7.46	3.99	0.69	14.24	74.35	12.69	18.19	6.69
$\alpha = 0.6$	2.17	12.26	4.40	0.71	14.84	70.50	18.21	17.25	7.39
$\beta_g = 0.90$									
$\alpha = 0.2$	2.58	1.14	2.23	0.56	8.55	79.43	5.87	19.43	5.63
$\alpha = 0.4$	2.38	6.74	2.81	0.69	10.15	74.93	12.42	18.33	6.64
$\alpha = 0.6$	2.21	11.39	3.08	0.70	10.56	71.19	17.82	17.42	7.31
Data, 2000									
median	-	-	-	-	17.66	82.87	12.51	16.01	8.41
min	-	-	-	-	0.03	29.12	7.22	3.45	1.56
max	-	-	-	-	110.10	99.99	25.84	26.55	29.70

Notes:  $\bar{d}$ ,  $\bar{\tau}$ ,  $\bar{c}$ ,  $\bar{g}$ ,  $\bar{k}$ ,  $\bar{x}$ , and  $\bar{y}$  denote the steady state values of debt, tax, household consumption, government consumption, capital, investment and output, respectively.  $\bar{r} - r^*$  is the country risk premium. The tax rate, the country risk premium and the shares are given in percent. Data are taken from the World Bank and cover the HIPC. Aid is measured by ODA provided by the OECD.



Table 3: Steady State Properties, Conditional Concessional Loans

	$\bar{k}$	$\bar{\tau}$	$\bar{r} - r^*$	$\bar{\mu}$	$\frac{\bar{d}}{\bar{y}}$	$\frac{\bar{\ell}}{\bar{y}}$	$\frac{\bar{c}}{\bar{y}}$	$\frac{\bar{g}}{\bar{y}}$	$\frac{\bar{x}}{\bar{y}}$	$\frac{\bar{q}}{\bar{y}}$
$\beta_g = 0.86$										
$\alpha = 0.2$	2.32	8.25	4.79	0.66	16.87	33.58	73.72	6.21	18.03	3.04
$\alpha = 0.4$	2.03	16.30	6.53	0.92	20.82	32.41	67.25	13.52	16.45	3.50
$\alpha = 0.6$	1.83	22.20	7.19	0.98	21.24	34.44	62.51	19.21	15.29	3.95
$\beta_g = 0.88$										
$\alpha = 0.2$	2.35	7.41	3.57	0.61	12.77	43.29	74.39	5.84	18.20	3.39
$\alpha = 0.4$	2.09	14.86	4.84	0.83	15.81	43.06	68.41	12.83	16.74	3.92
$\alpha = 0.6$	1.89	20.46	5.34	0.88	16.27	45.60	63.91	18.28	15.63	4.38
$\beta_g = 0.90$										
$\alpha = 0.2$	2.38	1.6.67	2.47	0.54	8.94	56.42	74.99	5.41	18.34	3.80
$\alpha = 0.4$	2.14	13.48	3.32	0.74	11.11	58.01	69.51	11.95	17.01	4.40
$\alpha = 0.6$	1.96	18.74	3.69	0.77	11.56	61.40	65.29	17.09	15.97	4.88
Data, 2000										
median	-	-	-	-	17.66	74.16	82.87	12.51	16.01	-
min	-	-	-	-	0.03	37.13	29.12	7.22	3.45	-
max	-	-	-	-	110.10	306.44	99.99	25.84	26.55	-

Notes:  $\bar{d}$ ,  $\bar{\tau}$ ,  $\bar{c}$ ,  $\bar{g}$ ,  $\bar{k}$ ,  $\bar{x}$ , and  $\bar{y}$  denote the steady state values of debt, tax, household consumption, government consumption, capital, investment and output, respectively.  $\bar{r} - r^*$  is the country risk premium. The tax rate, the country risk premium and the shares are given in percent. Data are taken from the World Bank and cover the HIPC.

Table 4: Steady State Properties, Conditional Grants and Concessional Loans

	$\bar{k}$	$\bar{\tau}$	$\bar{r} - r^*$	$\bar{\mu}$	$\frac{\bar{d}}{\bar{y}}$	$\frac{\bar{\ell}}{\bar{y}}$	$\frac{\bar{c}}{\bar{y}}$	$\frac{\bar{g}}{\bar{y}}$	$\frac{\bar{x}}{\bar{y}}$	$\frac{\bar{a}}{\bar{y}}$	$\frac{\bar{q}}{\bar{y}}$
$\beta_g = 0.86$											
$\alpha = 0.2$	2.58	1.12	3.08	0.35	11.78	36.37	79.44	4.37	19.43	4.60	2.67
$\alpha = 0.4$	2.37	6.90	4.65	0.51	16.64	30.62	74.80	10.65	18.30	5.71	2.73
$\alpha = 0.6$	2.20	11.65	5.42	0.55	18.33	29.59	70.98	15.90	17.37	6.50	2.86
$\beta_g = 0.88$											
$\alpha = 0.2$	2.59	0.74	2.37	0.34	9.16	44.02	79.75	4.15	19.51	4.55	2.92
$\alpha = 0.4$	2.40	6.00	3.49	0.47	12.68	39.33	75.51	10.06	18.47	5.55	3.05
$\alpha = 0.6$	2.24	10.47	4.05	0.51	13.98	38.67	71.93	15.05	17.60	6.27	3.22
$\beta_g = 0.90$											
$\alpha = 0.2$	2.61	0.42	1.70	0.31	6.59	53.95	80.01	3.92	19.57	4.50	3.22
$\alpha = 0.4$	2.42	5.42	2.53	0.45	9.28	50.65	75.99	9.67	18.59	5.48	3.44
$\alpha = 0.6$	2.27	9.71	2.95	0.49	10.30	50.67	72.54	14.53	17.75	6.18	3.65
Data, 2000											
median	-	-	-	-	17.66	74.16	82.87	12.51	16.01	8.41	-
min	-	-	-	-	0.03	37.13	29.12	7.22	3.45	1.56	-
max	-	-	-	-	110.10	306.44	99.99	25.84	26.55	29.70	-

Notes:  $\bar{d}$ ,  $\bar{\tau}$ ,  $\bar{c}$ ,  $\bar{g}$ ,  $\bar{k}$ ,  $\bar{x}$ , and  $\bar{y}$  denote the steady state values of debt, tax, household consumption, government consumption, capital, investment and output, respectively.  $\bar{r} - r^*$  is the country risk premium. The tax rate, the country risk premium and the shares are given in percent. Data are taken from the World Bank and cover the HIPC. Aid is measured by ODA provided by the OECD.

Table 5: Welfare Gains

	Grants Only	Loans Only	Grants & Loans
$\beta_g = 0.86$			
Households	33.91	22.69	37.59
Donor	24.34	21.30	28.42
$\beta_g = 0.88$			
Households	34.67	25.28	37.98
Donor	24.68	23.74	28.63
$\beta_g = 0.90$			
Households	34.63	27.24	38.73
Donor	24.32	25.39	29.81

Notes: Results refer to  $\alpha = 0.4$ . Welfare gains are measured in terms of percentage deviation in certainty-equivalence consumption relative to the steady state that would occur in the absence of development assistance.

Table 6: Steady State Properties, Conditional Relative to No Development Assistance

	$\tilde{k}$	$\tilde{\tau}$	$\tilde{r} - r^*$	$\tilde{\mu}$	$\tilde{d}$	$\tilde{\ell}$	$\tilde{c}$	$\tilde{g}$	$\tilde{a}$
grants only	139.35	30.15	47.35	0.69	67.80	-	139.35	63.41	7.24
loans only	122.14	59.85	59.29	0.92	73.95	34.42	122.14	64.18	-
grants & loans	142.18	25.35	40.02	0.51	61.85	34.02	142.18	52.94	6.34
grants & loans, default	140.39	28.37	42.61	0.60	64.94	34.10	140.39	58.23	6.79
grants & loans, interest	142.90	24.15	40.19	0.53	39.67	34.03	142.90	54.43	6.37

Notes: The table entries refer to  $\beta_g = 0.86$  and  $\alpha = 0.4$ .  $\tilde{d}$ ,  $\tilde{\tau}$ ,  $\tilde{c}$ ,  $\tilde{g}$ ,  $\tilde{k}$  and  $\tilde{r} - r^*$  denote the steady state values of debt, tax, household consumption, government consumption, capital and risk premium normalized by their respective steady state values that would occur in the absence of development assistance. Grants and concessional debt are normalized by their respective steady state values of output that would occur without development assistance and are denoted by  $\tilde{a}$  and  $\tilde{\ell}$ .

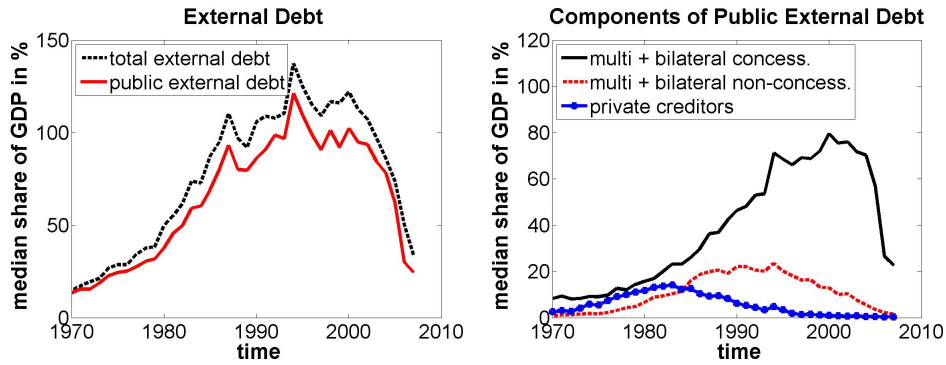


Figure 1: Public Debt in HIPC; Data are taken from the World Bank and cover the HIPC.

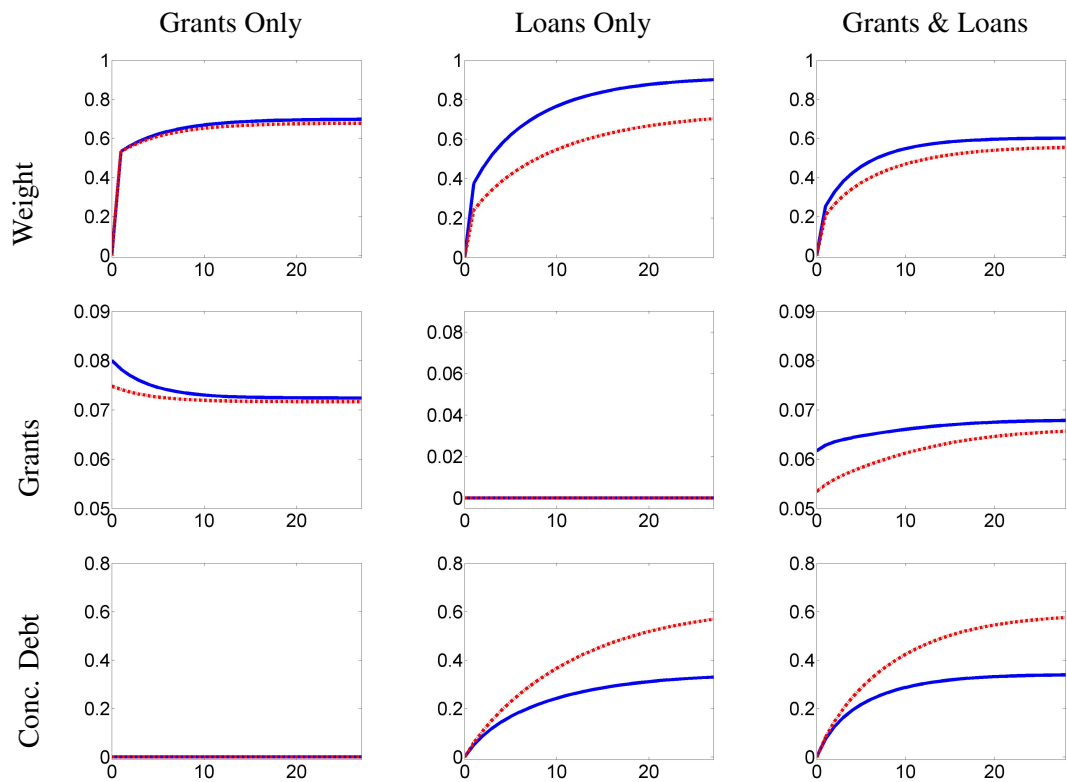


Figure 2: Transitional Dynamics of Self-Enforcing Conditional Development Assistance; The figure refers to  $\alpha = 0.4$ . The solid line refers to  $\beta_g = 0.86$  and the dotted line to  $\beta_g = 0.90$ . The weight on government preferences is given in levels. Grants and concessional debt are normalized by their respective steady state values of output that would occur in the absence of development assistance.

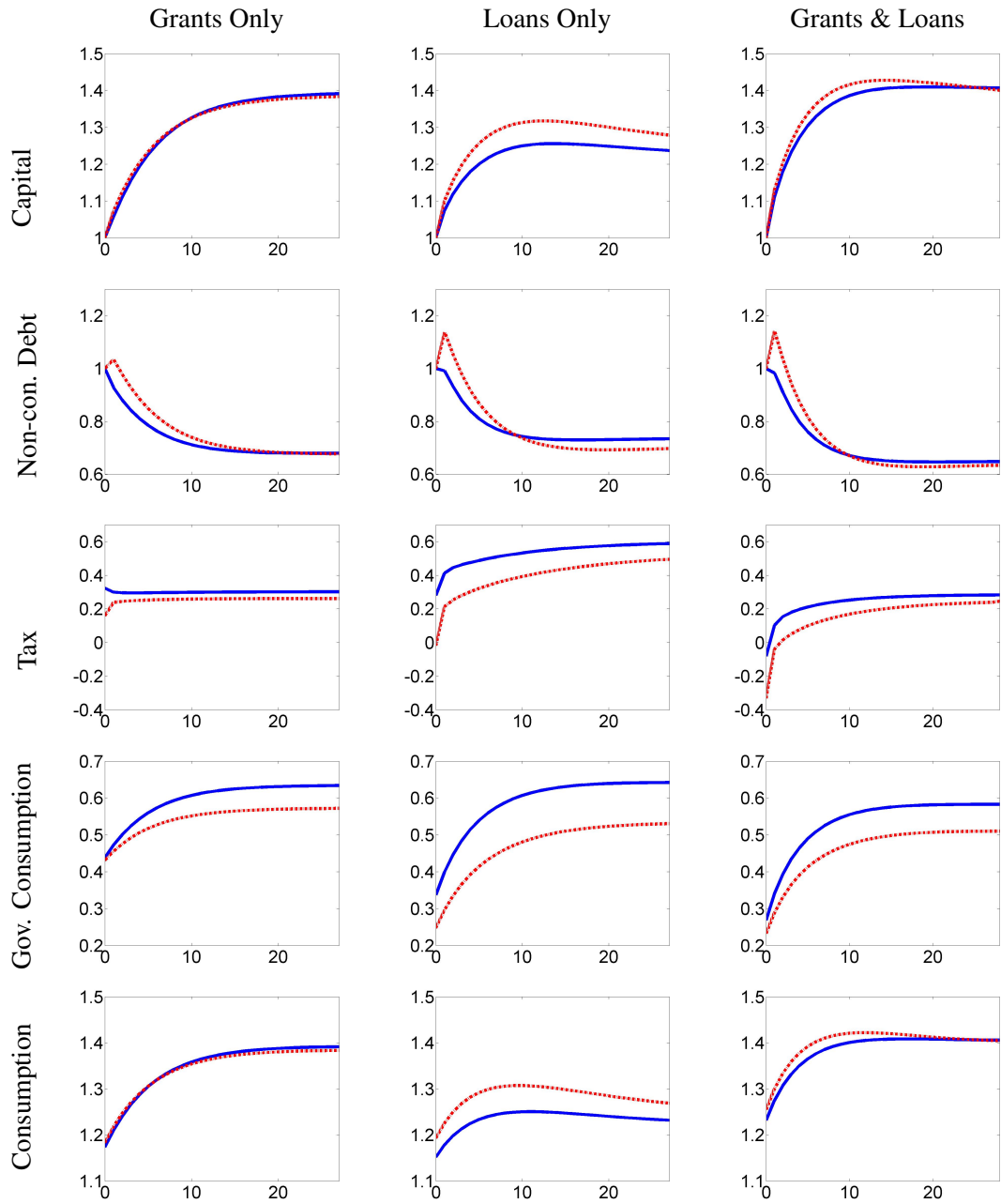


Figure 2 continued; The figure refers to  $\alpha = 0.4$ . The solid line refers to  $\beta_g = 0.86$  and the dotted line to  $\beta_g = 0.90$ . Debt, capital, tax rates, consumption and government consumption are normalized by their respective steady state values that would occur in the absence of development assistance.

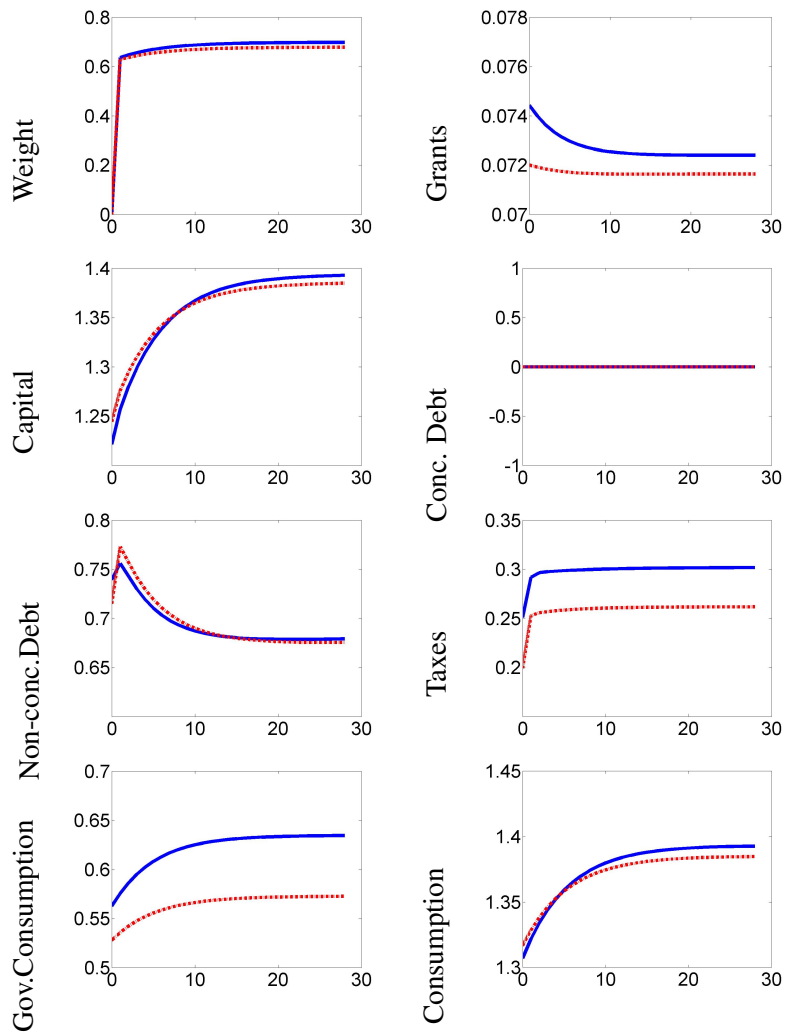


Figure 3: Transitional Dynamics of Debt Relief; The figure refers to  $\alpha = 0.4$ . The solid line refers to  $\beta_g = 0.86$  and the dotted line to  $\beta_g = 0.90$ . The weight on government preferences is given in levels. Grants and concessional debt are normalized by their respective steady state values of output that would occur in the absence of development assistance. The initial situation is given by the steady state values associated to the scenario where concessional loans are provided in isolation. The initial level of concessional debt is set to zero and it is assumed that from then onwards only grants are provided to the recipient economy.