

Fuentes, Raúl

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## Aid, Policies and Growth: A Non-Canonical Alternative for solving This Puzzle.

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# Aid, Policies and Growth: A Non-Canonical Alternative for solving This Puzzle.

Raúl FUENTES\*

Preliminary version  
Comments Welcome!

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## Abstract<sup>†</sup>

This paper presents a two-sector small semi-open economy Ramsey growth model involving foreign aid as an input in the production function. An activist government allocates this input endogenously across sectors and optimizes policies in a non-standard way. Once calibrated, mainly on countries exhibiting medium relative prices values, the model reproduces the main stylized facts outlined in the literature and suggests a strategy that could make aid work.

*JEL classification:* E62; F35 ; O11; O23; O41

*Key words:* Foreign aid; Economic development; Economic growth; Quantitative approach

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\* Fuentes: Department of Economics, Université catholique de Louvain, Place Montesquieu 3, B-1348 Louvain la Neuve, Belgium. Tel: (32-10) 473572; Fax: (32-10) 473945; E-mail: fuentes@ires.ucl.ac.be

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*“Economic research on foreign aid effectiveness and economic growth frequently becomes a political football.”*

*“But I am glad that some aid dollars can reach some very needy people some of the time”*

*William Easterly (2003).*

## **1. Introduction**

The two quotations above come from an expert on aid effectiveness and growth, and they seem to reflect the current state of economic research on this topic: a state of clinical death. Here are some symptoms supporting this diagnosis.

Since massive foreign aid programs were launched in the 1960s, a great deal of empirical works has been done and all of it seems to converge to the same point. I may sum up the findings of this research by saying, firstly, that aid has gone to consumption rather than to investment. Secondly, when positive long-run variations in output have been observed these have been driven by consumption. Lastly, aid has not significantly increased investment, either in the long- or the short-run.<sup>1</sup>

In addition, in the words of Easterly (2003), *“the empirical literature on the connection between aid and economic growth has been hampered by the lack of a clear theoretical model by which aid would influence growth and which could pin down the empirical specification of the aid-growth relationship”*. However, there is more to say about this link. First, I observe that there is not only a lack of “a” clear theoretical model but also, surprisingly, a lack of *any* theoretical models connecting aid and growth. Second, and more importantly, all the quantitative predictions suggested so far by authors of this scarce theoretical literature have been derived from models lacking a major ingredient, namely, a government making decisions about how aid should be allocated in order to spur economic growth. Consequently, the credibility of these predictions is limited.<sup>2</sup>

In this context, it is not surprising that since the 1990s the debate has been concentrated much more on qualitative aspects of this puzzle. Accordingly, the famous ‘good’ policies *à la* Burnside and Dollar (2000) have become almost universally accepted as *the* reference points considered by donors providing aid and, more importantly, as guidelines to be followed by recipients needing this aid.<sup>3</sup> Nevertheless, as is cogently pointed out by Przeworski and Vreeland (2000) and Easterly (2003), there is a lack of serious economic robustness analyses supporting either the choice of these policies or the authors’ findings. As a consequence, it seems that ideology was the cornerstone underlying the donors’ decision-making process *vis-à-vis* recipient countries.

Last but not least, non-economic literature has also amassed vast quantities of information on this puzzle, which confirms the findings that most of the empirical studies have spelt out.

In the light of all these considerations, I may conclude that aid seems not to be working in terms of poverty alleviation or growth enhancement. The reasons underlying this poor performance are still in question among economists, notably from the macroeconomic perspective.

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<sup>1</sup> See, for example, Boone (1996), Easterly (1999), Pzeworski and Vreeland (2000), among many others. A positive association between aid and investment for the case of Pakistan is found in McGillivray’s (2000) study.

<sup>2</sup> See, for example, Gong and Zou (2001), Obstfeld (1999).

<sup>3</sup> The empirical work by Svensson (1999) should be regarded as complementing the Burnside and Dollar’s (2000) work.

This paper enters into this muddy environment. My hope is to contribute to the foreign aid literature by proposing a new quantitative framework, which is described briefly below.

The main points to be addressed in my model are twofold. First, like Fuentes (2004), I claim that a comprehensive analysis of the macroeconomic impact of aid should take into account the sectoral composition of the economy. Up to now, the classical way of formally tackling this kind of problem has been to use a one-sector model in which aid is taken as an exogenous variable.<sup>4</sup> In the spirit of Benhabib and Farmer (1996), I follow a different approach and propose a two-sector, small, semi-open economy, Ramsey growth model involving capital and labor as the primary factors of production. In addition, this time following the spirit of Barro (1990), I assume that private production requires the provision of public services, which, for the purposes of the paper, are provided entirely from foreign aid. Even though aid is a source of funds that can be allocated to different uses, I think the way aid is introduced into my model is fully appropriate because it captures the main goals of my research. More precisely, I want to know (1) whether aid dollars have been used for consumption rather than for investment (or vice-versa), and (2) how distortionary policies can spur ‘good’ growth in the economy (i.e. enhance the production of *durable* goods).

Second, I claim that, based on the presumption that aid is intermediated by recipient governments, any serious theoretical insights or predictions concerning the connection between aid, policies and economic growth, must be supported by models which include activist governments. Like Burnside and Dollar (2000), I also identify governments as the major agents responsible for the successes or failures in making aid work. Nevertheless, my thoughts and research supporting this evaluation are intended to be notably different from theirs. To be more precise, my model includes a government making *simple* and *tangible* policies and allocating aid across sectors. I characterize the way these decisions may be made in accordance with my second goal. Yet the way the government enters into the model could seem, *a priori*, inappropriate: I allow the government not to consider consumers’ optimization plans into its optimization program. Even though this assumption could seem as “weak” in terms of the logic underlying the model, I suggest that this is an acceptable price to “pay” to gain some possible (quantitative) insights into the aid-policy-growth puzzle. In other words, I suggest that the strategy for solving the government’s problem assumed in this paper *is* appropriate because it allows the model to be *tested* under rational expectations. And this property should be at the center of any economic theory.

In short, the outcome of the paper seems to suggest that the framework chosen here is a serious alternative for solving this puzzle. It will be shown that my model, once calibrated, reproduces the main “stylized facts” mentioned above. In addition, it will be seen that the model offers a possibility for making aid work. Nevertheless, this possibility is subject to the identification of the *right incentives* to be given (and driven) by the government at the *right time*.

Finally, although one of the goals of the present study is to develop concepts and methods that can be applied, it is hoped, to a larger class of situations, the analysis will proceed by studying a particular example. The model can however be extended to cover more countries, especially those not exhibiting high values of relative prices.

The remainder of this paper is organized as follows. Section 2 specifies the structure of the model. A calibration is offered in Section 3, while Section 4 is devoted to the dynamics of the model. Some concluding remarks are given in Section 5 and a few possible but significant extensions are introduced at the end of the paper.

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<sup>4</sup> As far as I know, the only exception is the empirical work by Svensson (1999) which explicitly considers the level of aid as an endogenous variable.

## 2. The model economy

A short description of my model follows. It depicts a two-sector, discrete-time, small, semi-open-economy Ramsey growth model with three agents: households, firms and an “activist” government. Domestic households (or consumers) and firms are restricted to the same conditions as in the standard closed-economy version of the Ramsey model (i.e. no private assets claimed either by foreigners on the domestic economy, or by domestic residents on foreign economies). Hence, the only interaction with abroad is through the government *via* foreign aid. The sectors included in the economy are consumption and investment. They both use the usual private inputs such as capital and labor. In addition, a social input called “aid” is required by firms to complete their production technologies. The government, in a dynamic optimization, organizes the allocation of this latter input. Further, policies are also optimized by the government *vis-à-vis* its objectives and their consequences on growth.

### 2.1. Technology

Following Benhabib and Farmer (1996), I assume a two-sector economy producing at each period of time both an investment good,  $I_t^o$ , and a consumption good  $C_t^o$ .<sup>5</sup> To produce these goods, capital  $k_t$  and labor  $L_t$  are needed as the primary factors of production. Fractions of  $\mu_{k,t}, \mu_{L,t}$  units of capital and labor are used in the consumption goods industry. In addition, I assume that private production requires the provision of public services, which, for the purposes of the paper are taken to be provided entirely from foreign aid through government decisions. For concreteness, I can think here of aid not only as “law and order” services (see Alesina and Rodrik, 1994), but also as foreign technical assistance, and so on. Hence, by imposing the assumption of constant returns-to-scale in both private and social inputs, this paper adopts a modified version of the formulation provided by Barro (1990) and Barro and Sala-i-Martin (1995) to yield the aggregate production functions:

$$C_t^o = A_t (\mu_{k,t} k_t)^\alpha (\mu_{L,t} L_t)^{1-\alpha} (\mu_{F,t} F_t)^{1-\alpha} \quad (1)$$

$$I_t^o = B_t (\{1 - \mu_{k,t}\} k_t)^\alpha (\{1 - \mu_{L,t}\} L_t)^{1-\alpha} (\{1 - \mu_{F,t}\} F_t)^{1-\alpha} \quad (2)$$

Here  $A$  and  $B$  are the technological parameters,  $0 < \alpha < 1$  is the capital share,  $F$  is the level of aid and  $\mu_F$  is the share of this aid in the consumption goods industry, which is taken as an exogenous variable at the level of firms.<sup>6</sup> Notice that the two technologies are identical with the exception of the two scaling factors  $A$  and  $B$ . A bit more has to be said about the role that aid plays in Equations (1) and (2). Firstly, unlike Barro (1990) and Barro and Sala-i-Martin (1995), the possibility of endogenous growth is ruled out by assuming aid is not proportional to capital stock (i.e. the imposition of constant returns-to-scale in both private and social inputs is guaranteed). Secondly, by assuming the private sector has no control over any decisions related to aid, the role of aid at this level is reduced to that of a pure externality, not appropriated by firms. In other words, aid is totally controlled by governmental decisions. I will return to this point in Section 2.3. Let us move now to the firm’s maximization problem.

As usual, the assumption of free entry into the two sectors implies that profits must be equal to zero in each industry. Furthermore, capital accumulation in the consumption (investment) sector is

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<sup>5</sup> Henceforth, the superscript “o” means “offered”, i.e quantity of goods offered.

<sup>6</sup> Henceforth, the subscripts are omitted when there is no possibility of confusion.

subsidized by the government at the rate  $\beta_{C,t}(\beta_{I,t}) > 0$ , so that the representative firm in each sector faces, at each point in time, the discount rate  $r_i^* - \beta_{i,t}$ ,  $i = C, I$ , where the world interest rate  $r_i^*$  is assumed here to be exogenous. By assuming further free capital mobility across sectors, the first-order conditions for profit maximization in each industry can be combined to demonstrate that these conditions imply that  $\mu_{k,t} = \mu_{L,t} = \mu_t$  and  $\beta_{C,t} = \beta_{I,t} = \beta_t$ . In words, private factor shares will be the same for the two technologies. The same applies for the level of subsidy in each sector.<sup>7</sup>

Following Benhabib and Farmer (1996), Equation (1) and (2) can be rewritten in terms the common factor share  $\mu$  and find an expression for the production possibilities frontier (ppf):<sup>8</sup>

$$C_t^o + (A/B) \cdot \left( \frac{\mu_{F,t}}{(1-\mu_{F,t})} \right)^{(1-\alpha)} I_t^o = C_t^o + p_t I_t^o = A_t k_t^\alpha L_t^{(1-\alpha)} (\mu_{F,t} F)^{(1-\alpha)} \equiv Y_t \quad (3)$$

In Equation (3),  $Y$  denotes aggregate output and  $p$  the relative price of the investment good.

It should be noted that, from the definition above, the four first-order conditions for the firm's problem can be reduced to two equations, namely, one equation for the level of wages and another representing the production possibilities frontier (the ppf). In formal terms,<sup>9</sup>

$$w_t = (1-\alpha) \frac{p_t I_t^o}{(1-\mu_t)} = (1-\alpha) Y_t \quad \text{and} \quad \frac{\mu_t}{(1-\mu_t)} = \frac{C_t^o}{p_t I_t^o} \quad (4)$$

These equations show that the choice of the policy  $\mu_F$  affects the level of prices. Actually, the relative price, as well as the level of wages, are both dependent on the value of  $\mu_F$  at any date. Wages increase with  $\mu_F$  because the aggregate output  $Y$  is affected positively by this government instrumental. Clearly, this positive link is bad from the firms' point of view. However, this "lose" may be partially compensated for by the positive relationship between the relative price and the aid-consumption share. In words, the higher  $\mu_F$  the higher the *rate of exchange* (relative price) between consumption and investment goods.

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<sup>7</sup> Letting  $R_i = r_i^* + \delta - \beta_i$  be the rental price, where  $\delta$  represents the rate of depreciation,  $w$  the wage in units of the consumption good, and  $p$  the price of the investment good, the first-order conditions for profit maximization in the two sectors imply at each point in time that the marginal productivity of capital (labor) must be equal to the corresponding user cost:

$$(i) f'(\mu_k k) = \frac{\alpha C}{\mu_k k} = R_C, \quad (ii) f'((1-\mu_k)k) = \frac{\alpha p I}{(1-\mu_k)k} = R_I, \quad (iii) \frac{(1-\alpha)C}{\mu_L L} = w, \quad (iv) \frac{(1-\alpha)pI}{(1-\mu_L)L} = w$$

Free capital mobility implies that  $R_C = R_I$ , i.e.  $\beta_C = \beta_I$ . Taking the ratios of (i) to (ii) and (iii) to (iv) it follows that  $\mu_C = \mu_I$ . Of course, these results are technology dependent in the sense that they only apply when factor intensities are identical across sectors.

<sup>8</sup> Notice that by combining the ratios of (i) to (ii) and Equations (1) and (2), it follows that the relative price of the investment good at each point in time is given by

$$p = (A/B) \cdot \left( \frac{\mu_F}{(1-\mu_F)} \right)^{(1-\alpha)}$$

<sup>9</sup> Of course, the second equation in Equation (4) has two possible (indistinguishable) interpretations. We may look at it as an expression representing either the ppf or the relative price level.

As we shall see later in Section 2.3, this dependence of prices in terms of  $\mu_F$  will play a crucial role in the government's maximization problem and in turn in the choice of the kind of government assumed in this paper.

## 2.2. Households

As in the standard growth models with consumer optimization, an infinitely *representative dynasty* endowed with  $L > 0$  units of labor maximizes intertemporal utility. In addition, consumers face a set of flat tax rates  $\tau_{it}$ ,  $i = k, w$  on physical capital income and labor earnings. By assuming (1) a logarithmic utility function, (2) the same level of tax rates on both incomes, and (3) that labor is supplied inelastically, which allow us to set the economy's aggregate labor endowment  $L$  equal to unity, a two-sector version of the dynasty's problem follows:

$$\text{Max} \sum_{t=0}^{\infty} \rho_c^t \log C_t^c$$

This is subject to,

$$p_{t+1}k_{t+1} = (1+r_t^*(1-\tau_t))p_tk_t + (1-\tau_t)w_t + T_t - C_t^c \quad (5)$$

where  $\tau_t$  measures the level of taxes,  $\rho_c > 0$  denotes the consumers' rate of time preference,  $T_t > 0$  the exogenous transfers received from the government, and  $C_t^c$  the level of consumption goods demanded. Hence, the Euler equation related to this maximization problem is

$$\frac{C_{t+1}^c}{C_t^c} = \rho_c(1+(1-\tau_{t+1}) \cdot r_t^*) \quad (6)$$

## 2.3. The public sector

The government levies the same level of taxes ( $\tau_t$ ) on wages and capital income to finance public transfers, production subsidies ( $\beta_t$ ) and payments on public debt. The government budget constraint may thus be written as

$$\tau_t(r_t^*p_tk_t + w_t) + D_{t+1} - (1+r_t^*)D_t = T_t + \beta_t p_tk_t \quad (7)$$

where  $D_t$  denotes the public debt at the beginning of period  $t$ . For sake of simplicity, I assume here that  $D_t$  is equal to foreign aid.<sup>10</sup> In addition, I assume that the path of debt is given and the tax rate  $\tau_t$  adjusts to balance the budget.

Before presenting the government's problem formally, it is worth, at this point, introducing the relevant assumptions underlying this problem. In fact, it is far from easy to cope with this problem either methodologically or technically.

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<sup>10</sup> This assumption is not fully realistic because it is well-known that the level of public debt is much higher than the level of aid for all developing countries. However, since an exogenous path for this variable has been assumed here, we do not gain any relevant insights by setting public debt at more realistic values.

Technically, it is well-known that when one is dealing with governments pursuing activist policies in a rigorous utility maximizing framework under *rational expectations*, the problem becomes untraceable because of the emergence of backward endogenous variables.<sup>11</sup> And this is exactly what would happen here if I included the optimal consumers' response (Equation (6)) as a constraint in the government's program.<sup>12</sup> In order to surmount this difficulty I will omit this optimal condition. As a way of partially remedying this omission, I will then propose a government which looks after *consumers* by defining its objective as a function of the stream of consumption over time in terms of the government's decision variables.

Methodologically, the question is whether the government's program is intertemporal or not. This question arises as a direct consequence of the above considerations. And the answer is *yes*. More precisely, having a look at Equation (5) and Footnote (4), we note that the intertemporal dimension of the government's program may come from the dependence of the relative price on the aid-consumption share  $\mu_F$ . In other words, this paper assumes a government that, by choosing its policies, *directly* affects prices in the economy; in this case, the relative price and thus the level of wages.

Consequently, the government's maximization program is wholly defined as:

$$\text{Max}_{\{\mu_{F,t}, \tau_t, \beta_t\}} \sum_{t=0}^{\infty} \rho_g^t \log C_t^c$$

This is subject to,

$$p_{t+1}k_{t+1} = (1+r_t^*(1-\tau_t))p_tk_t + (1-\tau_t)w_t + T_t - C_t^c \quad (8)$$

$$\tau_t(r_t^*p_tk_t + w_t) + D_{t+1} - (1+r_t^*)D_t = T_t + \beta_t p_tk_t \quad (9)$$

$$w_t = (1-\alpha)p_tI_t^o / (1-\mu_t) \quad (10)$$

$$r_t^* + \delta - \beta_t = \alpha \cdot p_tI_t^o / ((1-\mu_t)k_t) \quad (11)$$

$$I_t^o = B_t(1-\mu_t)k_t^\alpha ((1-\mu_{F,t})F_t)^{(1-\alpha)} \quad (12)$$

$$p_t = (A_t / B_t) \cdot (\mu_{F,t} / (1-\mu_{F,t}))^{(1-\alpha)} \quad (13)$$

In this problem,  $\rho_g > 0$  measures the government's rate of time preference. Equations (8) and (9) are the households' and the government's budget constraint respectively. Equations (10) and (11) are the firm's optimal responses, both written as functions of the government's instruments. Equations (12) and (13) are respectively the technology constraint and the relative price. As anticipated, this last equation contains the assumption of a government which affects prices directly.

By defining  $\tilde{p}_t = \partial p_t / \partial \mu_{F,t}$ , the interior solution for this optimization problem is characterized by the first-order conditions:

<sup>11</sup> See Bénassy (2001) for further discussion of this point.

<sup>12</sup> The first government program to come to mind is, of course, a program in which the government announces its policies taking into account, *inter alia*, the optimal responses by all the other agents participating in the economy; in this case, firms and consumers.



$$\lambda_{t+1} = \frac{1}{C_t^c} \quad (14)$$

and

$$\begin{aligned} \frac{k_t}{C_{t-1}^c} \tilde{p}_t = & \rho_g \left[ (1 + (1 - \tau_t) r_t^*) k_t \tilde{p}_t + (1 - \tau_t) I_t^o \frac{(1 - \alpha)}{(1 - \mu_t)} \left( \tilde{p}_t - \frac{(1 - \alpha)}{(1 - \mu_{F,t})} p_t \right) \right] \\ & + \rho_g \lambda_{t+1} \left[ \tau_t (r_t^* k_t \tilde{p}_t + \frac{(1 - \alpha) I_t^o}{(1 - \mu_t)} \frac{(1 - \alpha)}{(1 - \mu_t)} \left( \tilde{p}_t - \frac{(1 - \alpha)}{(1 - \mu_{F,t})} p_t \right) - (r_t^* + \delta) k_t \tilde{p}_t + \frac{\alpha p_t I_t^o}{(1 - \mu_t)} \left( 2 \tilde{p}_t - p_t \frac{(1 - \alpha)}{(1 - \mu_{F,t})} \right) \right] \end{aligned} \quad (15)$$

where  $\lambda$  is the multiplier associated with the government budget condition written as a function of the other constraints. It should be noted that Equation (15) gives the optimal intertemporal allocation of the aid-consumption share plan. Unfortunately, due to the complex form of this equation, no insights can be gained from it!

However, substituting Equation (14) into Equation (15) and giving the value of  $\tilde{p}$  explicitly as a function of  $\mu_F$  yields the following implicit equation for  $\mu_F$ :<sup>13</sup>

$$\mu_{F,t} = \frac{(1 - \alpha) + \frac{(1 - \delta)(1 - \mu_t) k_t}{I_t^o} + 2\alpha p_t - \frac{(1 - \mu_t) C_t^c k_t}{\rho_g C_{t-1}^c I_t^o}}{\alpha p_t + (1 - \alpha)} \quad (16)$$

I will consider this more amenable equation in the next section.

## 2.4. General Equilibrium

In this section the general equilibrium is characterized and some analytical characterizations of the steady-state path are given.

### 2.4.1. Characteristics

Let us begin by stating a proposition summarizing the equilibrium and optimality conditions of the model. Equations (17) to (19) are respectively the optimal consumption and the optimal firm's responses. Equation (20) is the accumulation rule of capital. The government's budget constraint and its optimal response are summarized in Equations (21) and (22), respectively. Technologies are given by Equations (23) and (24). Equation (25) is the household's budget constraint. Equations (26) and (27) are respectively the market clearing condition for consumption and investment goods.

**Proposition 1.** *Given the initial condition  $k_0$ , an equilibrium is a path  $\{\tau_t, w_t, k_{t+1}, p_t, \mu_t, \beta_t, \mu_{F,t}, C_t^c, C_{t-1}^c, I_t^o, I_{t \geq 0}^c\}$  that satisfies the following conditions:*

$$\frac{C_{t+1}^c}{C_t^c} = \rho_c (1 + r_t^* (1 - \tau_{t+1})) \quad (17)$$

<sup>13</sup> Notice that, in order to show the intertemporality of the choice of the aid-consumption share, the ratio  $C_t^o / C_{t-1}^o$ , which corresponds to the optimal consumers' response, has so far been kept constant. See Section 2.2.

$$\frac{\mu_t}{(1-\mu_t)} = \frac{C_t^o}{p_t I_t^o} \quad (18)$$

$$w_t = (1-\alpha) \frac{p_t I_t^o}{(1-\mu_t)} \quad (19)$$

$$k_{t+1} = (1-\delta)k_t + I_t^c \quad (20)$$

$$\tau_t (r_t^* p_t k_t + w_t) + F_{t+1} - (1+r_t^*)F_t = \beta_t p_t k + T_t \quad (21)$$

$$\mu_{F,t} = \frac{(1-\alpha) + \frac{(1-\delta)(1-\mu_t)k_t}{I_t^o} + 2\alpha\varphi_t - \frac{\rho_c(1-\mu_t)}{\rho_g} (1+r_t^*(1-\tau_t)) \frac{k_t}{I_t^o}}{\alpha\varphi_t + (1-\alpha)} \quad (22)$$

$$C_t^o = A_t \mu_t k_t^\alpha (\mu_{F,t} F_t)^{(1-\alpha)} \quad (23)$$

$$I_t^o = B_t (1-\mu_t) k_t^\alpha ((1-\mu_{F,t}) F_t)^{(1-\alpha)} \quad (24)$$

$$C_t^c = (1+r^*(1-\tau_t)) p_t k_t + (1-\tau_t) w_t + T_t - p_{t+1} k_{t+1} \quad (25)$$

$$A_t (1-\mu_t) k_t^\alpha (\mu_{F,t} F_t)^{(1-\alpha)} = (1+r_t^*(1-\tau_t)) p_t k_t + (1-\tau_t) w_t + T_t - p_{t+1} k_{t+1} \quad (26)$$

$$I_t^o = I_t^c \quad (27)$$

Two facts are worth pointing out here. First, in Equation (22) the ratio  $C_t^c / C_{t-1}^c$  has been replaced by its corresponding value as given by Equation (6). Then, the possibility of backward endogenous variables has thus been removed. Second, the optimal consumer's condition, which was omitted in the government maximization's problem, appears as forming part of the general equilibrium. This latter inclusion is relevant in terms of the logic behind my model. In fact, it should be (and it is, indeed) considered as a compulsory requirement for the model which supports the argument that the non-canonical strategy assumed in Section 2.3 for solving the government's problem is appropriate and, more importantly, feasible to be *tested* under rational expectations.

#### 2.4.2. The steady state: its existence and some properties

**Proposition 2.** *If  $\rho_c > 1/(1+r^*)$ , a unique steady state equilibrium exists for my economy. The long-term levels for the set of all endogenous variables  $\{\hat{\tau}, \hat{w}, \hat{k}, \hat{p}, \hat{\mu}, \hat{\beta}, \hat{\mu}_F, \hat{C}_t^o, \hat{C}_t^c, \hat{I}_t^o, \hat{I}_t^c\}_{t \geq 0}$  are characterized by the following conditions:*

$$\hat{\tau} = 1 - \frac{1}{r^*} \frac{(1-\rho_c)}{\rho_c} \quad (28)$$

$$\hat{\mu} = \frac{\hat{C}_t^o}{\hat{p} \hat{I}_t^o} \quad (29)$$

$$\hat{w} = (1-\alpha) \frac{\hat{p}\hat{I}^o}{(1-\hat{\mu})} \quad (30)$$

$$\delta \cdot \hat{k} = \hat{I}^o \quad (31)$$

$$\hat{\tau}(r^* \hat{p}\hat{k} + \hat{w}) = r^* F + \hat{\beta} \cdot \hat{p}k + T \quad (32)$$

$$\hat{\mu}_F = \frac{(1-\alpha) + \frac{(1-\delta)(1-\hat{\mu})}{\delta} + 2\alpha\hat{p} - \frac{(1-\hat{\mu})}{\rho_g \delta}}{\alpha\hat{p} + (1-\alpha)} \quad (33)$$

$$\hat{C}^o = A\hat{\mu} \cdot \hat{k}^\alpha (\hat{\mu}_F F)^{(1-\alpha)} \quad (34)$$

$$\hat{I}^o = B(1-\hat{\mu}) \cdot \hat{k}^\alpha ((1-\hat{\mu}_F)F)^{(1-\alpha)} \quad (35)$$

$$\hat{C}^c = r^*(1-\hat{\tau})\hat{p}\hat{k} + (1-\hat{\tau})\hat{w} + T \quad (36)$$

$$A\hat{\mu} \cdot \hat{k}^\alpha (\hat{\mu}_F F)^{(1-\alpha)} = r^*(1-\hat{\tau})\hat{p}\hat{k} + (1-\hat{\tau})\hat{w} + T \quad (37)$$

$$\hat{I}^o = \hat{I}^c \quad (38)$$

*Proof:* The proof is trivial and it comes from manipulating the equations in Proposition 1 one by one.

The stationary long-term system appears very messy. Nevertheless, the comparative static property in Proposition 3 with respect to the government's time preference parameter  $\rho_g$  can be proved analytically.

**Proposition 3.** The long-run value of the aid-consumption share  $\mu_F$  satisfies the comparative static property:

$$\frac{\partial \hat{\mu}_F}{\partial \rho_g} > 0 \quad (39)$$

The proof is trivial and it comes from Equation (33). Thus the more impatient the government the more its tendency to allocate aid in favor of consumption.

### 3. A calibration

One "real" model economy (Bolivia) is calibrated in order both to reproduce some characteristics of this country and gain insights from its behavior facing shocks. As usual, the calibration is focused on reproducing attributes of a given steady state. I will now describe the calibration process used in this paper.

### 3.1. Observed exogenous variables

**Aid.** Data on aid (as a fraction of output) is taken from Burnside and Dollar (2000), which is based on the database on aid developed by the World Bank (Chang et al., 1998). The countries covered in this data set are listed in Table 1 (Appendix A) and the time period covered is from 1960 to 1999.

**World interest rates.** Data on this variable is taken directly from World Bank databases, which is available on-line. Since I am aware that countries can negotiate bilaterally with International Financial Institutions such as the IMF or the World Bank, the value for this variable has to be considered just as a proxy.

**Relative price and capital-to-output ratio.** Data on both these variables is taken from a recent study by Castro (2005).<sup>14</sup>

### 3.2. Parameters

As usual, a set of parameters is set a priori. The consumers' rate of time preference  $\rho_c$  is fixed around its standard values and the homologous government's rate is fixed at the same rate. The values for capital share is taken from Barro and Sala-i Martin (1995)'s textbook. The rate of depreciation is fixed accordingly to existing data on both investment-to-output and capital-to-output ratios (see Table 1 (Appendix A)).

### 3.3. Unobserved exogenous variables

There are four unobserved exogenous variables: a set of two total factor productivity  $\{A, B\}$ , the level of aid  $F$ , and the amount of transfers  $T$ . These variables are chosen so as to match time series data either for some endogenous variables or for empirical evidence available on ratios which are closely related to the unknowns: the relative price, the capital- to-output ratio, the aid- to-output ratio and the transfers-to-output ratio (see Appendix A).

The values for all of these parameters are listed in Table2:

Table 2. Values of the parameters in the model

Parameter	Symbol	Value
Consumer's time preference	$\rho_c$	0.965
Government's time preference	$\rho_g$	0.965
Rate of depreciation of capital	$\delta$	0.15
Capital share	$\alpha$	0.66
Consumption total factor productivity	A	6
Investment total factor productivity	B	24
Level of aid	F	1
Level of transfers	T	6.78

As discussed in Section 2.2, this model does not allow for endogenous growth. This is quite reasonable taking into account that, according to the empirical evidence available, Bolivia's performance on growth since 1960 so far has been very weak: during almost a decade its rate of

<sup>14</sup> I would like to thank Rui Castro for kindly providing me with his database.

growth was even negative. On the other hand, in this model the world interest rate has been fixed at a value of 4.5% for the whole period since 1960 to 1985.

Recall that one of the main objectives of this paper is to investigate where aid dollars are used, i.e. whether aid has been used to produce more non-durable than durable goods, or, vice-versa. Thus it is worth presenting here the calibrated value for the aid-consumption share, as well as other endogenous variables and ratios. Table 3 summarizes these findings.<sup>15</sup>

From these results, we can see firstly, that the rate of subsidy is around 27% of the interest rate. This value is reasonably supported by personal information coming from local managers who negotiate the value of the rate with the government. Secondly, and more importantly, the high value for  $\mu_F$  suggests that aid funds would be allocated to produce many more non-durable goods than durable goods. As a consequence, aid dollars would have been used to the strong detriment of the investment sector. This result is in accordance with the findings in Boone (1996), which found that aid has mainly gone to consumption in most poor and developing countries.<sup>16</sup>

Table 3. Calibrated values from the model

Endogenous variable	Symbol	Value	Data
Aid-consumption share	$\mu_F$	0.879	
Capital-consumption share	$\mu$	0.65	
Relative price	$p$	0.743	0.75
Rate of taxes	$\tau$	0.194	0.18
Rate of subsidy	$\beta$	0.012	
<b>Ratios</b>			
Consumption/Output	$C/Y$	0.65	0.67
Capital/Output	$pk/Y$	2.37	2.33 <sup>17</sup>
Aid/Output	$F/Y$	0.017	0.018

Finally, notice that the value for the capital consumption share  $\mu$  is bigger than 0.5. Thus the consumption marginal productivity of aid (*CMPA*) is bigger than the investment marginal productivity of aid *IMPA*.<sup>18</sup> Put formally:

$$CMPA > IMPA \quad \text{for } \mu > 0.5 \quad (40)$$

This result therefore suggests that the way the government allocates new aid is detrimental to the investment sector. I will return to this later on.

It now remains to explore how and why we observe this pattern and how policies may or not affect so as to produce more “good” growth.

<sup>15</sup> The third column in this table shows the value for the corresponding variable extracted from the existing data (see Appendix A).

<sup>16</sup> The same conclusion can be found in Easterly (1999). However, his work only considers the short run impact of aid.

<sup>17</sup> According to Appendix A, the exact value for this ratio is 1.96. However, since this model does not consider public expenditure as forming part of the total output I have divided the value of this ratio by 0.84., which is equivalent to assuming a government expenditure-to-output ratio of 16%.

<sup>18</sup> Equations (34) and (35) and Footnote (4) are sufficient to demonstrate that  $\frac{\partial \hat{C}^o}{\partial F} = \left( \frac{\hat{\mu}}{(1-\hat{\mu})} \right) \frac{\partial \hat{I}^o}{\partial F}$ .

## 4. The dynamics of the model

In this section, I will present the results of dynamic simulations conducted on the calibrated model described above. The magnitude of all the shocks is set to 1%. This figure should be borne in mind when the quantitative results are being evaluated.<sup>19</sup>

### 4.1. Impulse vs. permanent aid shock

Let us first analyze how the economy reacts to an  $F$  shock. Figure 1 displays the results for the impulse case and Figure 2 for permanent aid. In both the Figures the vertical axe measures percentage variations with respect to the initial steady-state value.

Turning first to the impulse case, the main findings to be drawn from the simulations are:

- (i) The aid-consumption share  $\hat{\mu}_F$  and the relative price  $\hat{p}$  are incremented by 0.15% and 0.65%, respectively (see Figures 1(a) and 1(c)). The first result follows directly from Equation (40). Accordingly, the government uses new aid for consumption because the marginal productivity of aid there is greater. On the other hand, Footnote (4) is sufficient to explain the second result qualitatively.
- (ii) The capital-consumption share  $\hat{\mu}$  falls by 0.4% (see Figure 1(b)).
- (iii) Investment reacts in a striking way. It rises by 1.1% in the first period, which is markedly bigger than the increment in consumption, but then falls by 0.4% before returning to its initial steady-state value (see Figure 1(h)). I will return to this finding later on.
- (iv) Capital stock is incremented by 0.18% (see Figure 1(e)).
- (v) Subsidies  $\hat{\beta}$  and taxes  $\hat{\tau}$  show the same qualitative pattern. While subsidies fluctuate widely, first falling by 40% and then rising by 37%, taxes show a more moderate fall of 10% followed by a rise of 8% (see Figures 1(d) and 1(f)). Equation (11) evaluated at the steady state value is sufficient to understand the fall in subsidies qualitatively. Accordingly, the twofold effect of the increment in  $\hat{p}$  and the fall in  $\hat{\mu}$  provokes this result (see points (i) and (ii) above).<sup>20</sup> The subsequent rise must be analyzed in the general equilibrium context. It may be viewed as the government's response to a decline in investment (see Figure 1(h)). On the other hand, the behavior of taxes can be perfectly understood if we remember that they are, in fact, *the* instruments used by the government to balance its budget constraint. Accordingly, Equation (32) shows that the sharp fall in subsidies drives the government to reduce tax levels initially, which is also fully consistent with its objective. The subsequent rise in taxes is explained by the subsequent rise in subsidies. In other words, the more the government disburses *via* subsidies, the more it receives *via* taxes.
- (vi) The level of consumption increases by 0.15% (see Figure 1(g)).

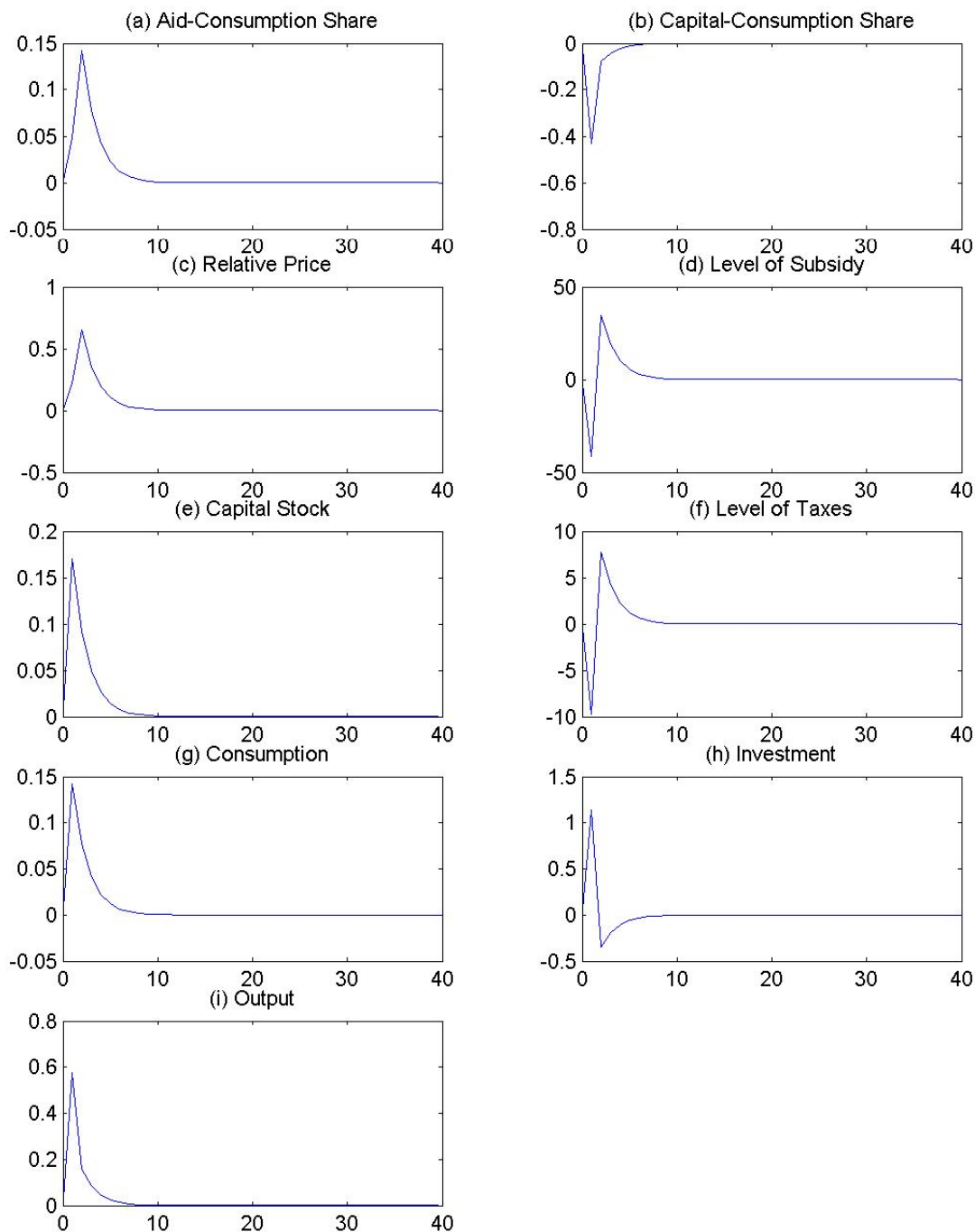
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<sup>19</sup> I use Dynare, the package developed by Juillard (2002), for the simulations and stability assessment of nonlinear forward-looking variables.

<sup>20</sup> From Equation (8) and Equation (31) it follows that  $\hat{\beta} = r^* + \delta - \alpha \hat{p} \delta / (1 - \hat{\mu})$ . An increase in  $\hat{p}$  plus a fall in  $\hat{\mu}$  thus clearly reduce the value for  $\hat{\beta}$ .

- (vii) Output and wages follow the same pattern, as expected given the Cobb-Douglas technology assumed in the model. Both of them show an increase of 0.6% (see Figure 1(i)).<sup>21</sup>

Figure 1: Responses to transitory F shock



Thus taking into account all these findings, the objective now is to describe how the whole model works. In other words, we will try to understand the rationale which each type of agent (consumers, firms and government) uses in operating its decision-making process.

<sup>21</sup> I have omitted in Figure 1 and Figure 2 the pattern for wages.

The starting point from which this economy starts up is the government's reaction to aid shocks. As mentioned above, we know from Equation (40) that the consumption marginal productivity of aid is bigger for consumption than for investment. This property gives the government incentives to increase the aid-consumption share and in turn provoke an increase in the relative price. Firms observe this increment in prices and decide to put more resources into the investment sector by augmenting the investment-capital share  $(1-\mu)$ . The government reacts to this decision by reducing the level of subsidies, assuming firms have sufficient incentives to produce more durable goods. Next, the government decides to reduce taxes in order to both balance its budget constraint and benefit also consumers. Firms observe this rise in consumption demand, which discourages the production of durable goods in favor of the production of non-durable ones. Government observes this reaction and decides to increase subsidies financed by taxation.

Hence, the net outcome of process is an increase in the level of output in the first period driven mainly by the production of *durable* goods, which is followed by a *smooth* recovery path to its initial steady-state value.

Two main lessons may be learned from this exercise. The first is related to the allocation of aid and the role that policies could play in this allocation. More precisely, I have shown that, even though the government uses aid funds for consumption rather than investment, the right policies can play a positive role in spurring 'good' growth. However, policy effectiveness is conditional on the *correct* identification of the *correct* incentives. The model suggests that the relative price of durable goods should be at the center of the government's strategy.

The second lesson is related to policy and government involvement. This is, of course, a huge issue in Economics, and I do not pretend to tackle it rigorously in this paper. I just want to emphasize that, according to these results, distortionary policies seem to work well in terms of growth. The first step made by the government in order to enhance investment *via* relative price corresponds, precisely, to the correct identification of the correct incentive. When this incentive decreases, subsidies and taxes move affect each other in such a way as to smooth this fall. In short, government involvement is necessary and welcome.

Let us now see what happens when permanent aid shocks occur.

As can be seen in Figure 2, the outlook is not so encouraging. The main findings of this simulation are:

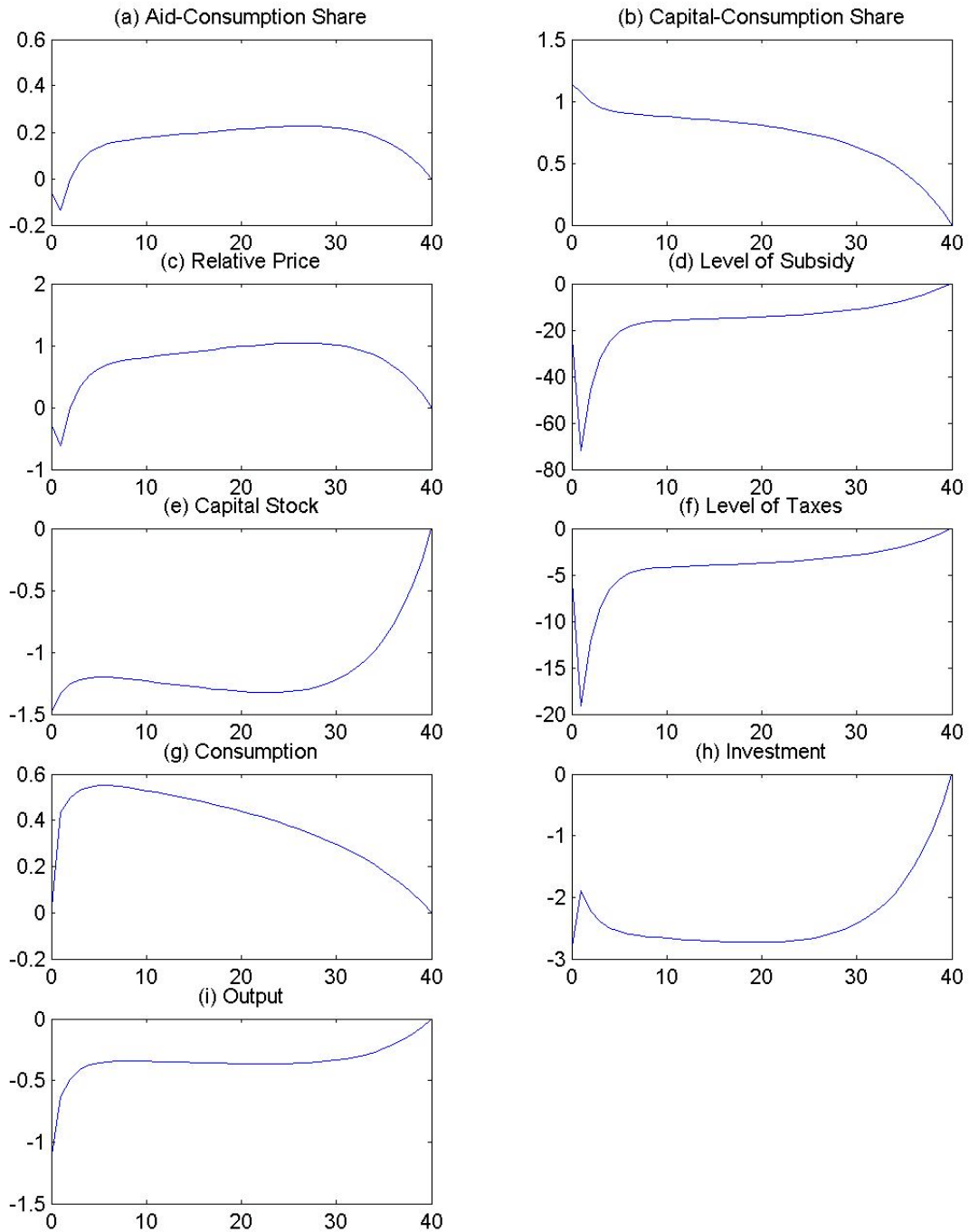
- (i) All the variables return to their initial steady-state values.
- (ii) A permanent increase in aid of 1% provokes an initial fall in the aid-consumption share of 0.12% and a subsequent rise by a maximum of 0.2%. Meanwhile, the capital-consumption share rises initially by 1.1% and then declines continuously (see Figures 2(a) and 2(b)).
- (iii) Relative price exhibits a quasi-concave pattern with an initial fall of 0.6% and a recovery of up to 1% (Figure 2(c)).
- (iv) Capital stock decreases markedly (by 1.5%) but eventually experiences a sharp rise to its initial steady-state value (see Figure 2(e)).
- (v) As in the transitory shock case, subsidies and taxes follow the same qualitative pattern. While there is an initial fall in subsidies of 70%, the initial fall in taxes is 'only' 18%.



However, unlike the transitory case, neither the changes in subsidies nor those in taxes ever reach positive values (see Figures (2d) and (2f)).

- (vi) Consumption shows quite a concave pattern, with a maximum increase of 0.55% (Figure 2(g)).
- (vii) Investment reacts initially by falling markedly (by 3%). It then recovers a bit and eventually accelerates to its initial steady-state value (Figure 2(h)).
- (viii) As expected, output and wages follow the same pattern. They both show an initial fall of 1% and never reach positive figures on the way to their initial steady-state values (Figure 2(i)).

Figure 2: Responses to permanent F shock



The main lesson to be learned from this scenario seems quite clear. Permanent aid shocks tend to spur consumption much more than investment. At the beginning the government seems to neglect investment and, driven by its objective (i.e. maximize the stream of consumption over time) reduces the level of taxes markedly. This is followed by a reduction in the level of subsidies in order to balance its budget. This lack of concern makes the government inclined to “forget” about its own aid-incentives, and it allocates new aid in favor of the investment sector, which reduces the relative price of investment goods. Firms observe both the fall in prices and the rise in demand consumption

and decide to reallocate their capital stock in favor of consumption technology. This provokes, in turn, a reduction in the capital stock. The government realizes its “error” and tries to remedy the situation by giving a new impulse to investment by increasing the relative price. The story now continues as for the impulse shock. However it is too late. All the variables return to their steady-state values. But more than a decade has been lost!

## 5. Concluding remarks

This paper introduces foreign aid as a social input into a two-sector, small, semi-open economy Ramsey growth model. Furthermore, an activist government allocates this input endogenously across sectors and chooses policies maximizing the stream of households’ happiness over time. The model shows that, once calibrated, this kind of framework produces three main outcomes. First, aid is used much more for consumption than for investment. Second, transitory aid shocks are able to kick start the production of durable goods and in turn provoke gains in “good” growth. And this is possible because government involvement is focused in the right way, i.e. on giving the right incentives to the investment sector. Last, permanent aid shocks are harmful for investment and growth. The reason behind this finding may lie in the delay in giving the right incentives. And this delay may become irretrievable.

The model thus reproduces the main stylized facts outlined in the literature, namely, (1) that aid is used for consumption rather than investment; and (2) that aid viewed as permanent income by recipient countries has not had effect on growth. On the other hand, the model has a new and more optimistic side in that it shows a strategy that could make aid work. This finding *may* contribute to overcoming what Easterly (2003) calls the current *political football*-state of economic research on aid effectiveness and economic growth. Nevertheless, the model poses the big question of what form government involvement should take, regarding not only aid agencies but also its own internal decision-making mechanisms. As policy variables, taxes and subsidies are much simpler and tangibles than those proposed by the Washington Consensus. But their implementation in terms of timing and flexibility is not so evident.

The model suggests that more attention should be paid to be this dichotomy in order to ensure that *some aid dollars will reach **more** than some very needy people some of time.*<sup>22</sup>

## Further research

Among other minor suggestions, I offer here some ideas that may help to pave the way for further research on the problem tackled here. The first step is to endogenize public debt. This is easier said than done, taking into account that, as is well documented in the two-sector optimal growth literature, problems of indeterminacy must be dealt with.<sup>23</sup> The second step is to introduce *conditionality*. The model allows this to be done easily, and I plan run the simulations again including endogenized public debt and conditionality simultaneity. As well-known, conditionality plays a major role in the entire story of aid effectiveness and economic growth.

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<sup>22</sup> See the second quotation at the beginning of this article.

<sup>23</sup> See Weder (2001).

## Appendix A

Table 1: Country-Specific Summary Statistics

Country	C/Y (share of GDP)	I/Y (share of GDP)	K/Y	$p$ Relative Price	Aid (percent of GDP)
Argentina	0.67	0.33	1.87	1.59	0.02
Bolivia	0.67	0.33	1.96	0.75	1.80
Brazil	0.69	0.31	1.68	1.12	0.03
Chile	0.60	0.40	2.05	0.96	0.16
Colombia	0.73	0.27	1.43	1.19	0.12
Costa Rica	0.68	0.32	1.36	1.42	1.02
Dominican Republic	0.73	0.27	1.24	1.33	0.60
Ecuador	0.62	0.38	1.96	0.75	0.32
El Salvador	0.72	0.28	0.88	1.93	1.87
Guatemala	0.82	0.18	0.88	1.62	0.49
Guyana	0.67	0.33	2.96	0.96	3.74
Haiti	0.72	0.28	0.53	2.74	1.77
Honduras	0.72	0.28	1.32	1.38	2.19
Jamaica	0.58	0.42	2.70	1.22	1.42
Mexico	0.75	0.25	1.44	1.33	0.02
Nicaragua	0.77	0.23	1.11	1.72	3.14
Paraguay	0.69	0.31	1.03	1.65	0.69
Peru	0.64	0.36	1.71	1.28	0.41
Trinidad y Tobago	0.68	0.32	1.16	3.04	0.07
Uruguay	0.70	0.30	1.60	2.26	0.13
Venezuela	0.71	0.29	1.76	1.28	0.01
Syria	0.68	0.32	1.18	1.25	1.86
Turkey	0.77	0.23	N.A	N.A	0.33
Indonesia	0.71	0.19	1.16	1.17	0.39
South Korea	0.66	0.34	1.49	1.19	0.20

Table 1: Country-Specific Summary Statistics (Continuation)

<b>Country</b>	<b>C/Y</b> <b>(share of GDP)</b>	<b>I/Y</b> <b>(share of GDP)</b>	<b>K/Y</b>	<b><i>p</i></b> <b>Relative Price</b>	<b>Aid</b> <b>(percent of GDP)</b>
Philippines	0.71	0.29	1.35	1.64	0.44
Thailand	0.61	0.39	1.35	1.51	0.24
Malaysia	0.59	0.41	1.68	1.15	0.20
India	0.69	0.31	1.43	1.18	0.26
Pakistan	0.75	0.25	0.97	1.64	0.77
Sri Lanka	0.75	0.25	0.80	2.3	1.17
Botswana	0.51	0.49	1.47	1.51	5.12
Cameron	0.70	0.30	0.66	2.52	1.88
Côte d'Ivoire	0.70	0.30	1.06	2.43	0.85
Ethiopia	0.77	0.23	0.51	2.3	3.75
Gambia	0.73	0.27	0.77	3.47	7.08
Ghana	0.77	0.23	0.77	1.77	1.92
Kenya	0.86	0.14	1.51	1.48	2.34
Madagascar	0.83	0.17	0.16	7.37	2.70
Malawi	0.67	0.33	1.00	1.90	5.65
Mali	0.74	0.26	0.66	2.74	0.20
Niger	0.67	0.33	0.91	1.32	5.38
Nigeria	0.66	0.34	1.22	1.23	0.14
Senegal	0.72	0.28	0.6	2.60	3.63
Sierra Leone	0.69	0.31	N.A	N.A	1.70
Somalia	0.74	0.26	0.82	2.61	4.44
Tanzania	0.57	0.43	0.95	1.61	5.86
Togo	0.59	0.41	1.40	1.39	5.36
Zaire	0.75	0.25	0.39	2.95	2.35
Zambia	0.49	0.55	2.79	1.25	4.81
Zimbabwe	0.67	0.33	1.76	1.33	2.34

*Notes:* Most of the figures for *C/Y* and *I/Y* were taken mostly from the Penn Tables 6.1, although some of them come from Przeworski and Vreeland (2000)'s database. The figures for *K/Y* and *p* were taken from Castro's (2005) database and the figures for aid from Craig and Burnside (2000)'s database.

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