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## **When Does Foreign Aid Work?**

### Abstract

This paper examines the effectiveness of foreign aid in a growing economy that is subject to institutional failings, proxied by public sector corruption. The results suggest that aid is actually more effective in the presence of corruption due to the greater scope for improvement that is consequently available. Simply put, this means the greater the need, the greater the benefits of foreign aid.

Foreign aid, especially that given by international agencies like the World Bank, has sometimes been remarkably successful, while at other times aid has been a spectacular failure. Sometimes the successes and failures have even occurred in the same country and at the same, though in different projects. Even the generally accepted conclusion that aid only works when given to countries with sound institutions has come into question. Given the magnitude of foreign aid as well as its potential in alleviating poverty and stimulating economic growth, it is essential to better understand the conditions under which aid does work – and under which it does not work.

### Classification

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### Keywords

Endogenous Growth, Corruption, Foreign Aid

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## I. Introduction

Foreign aid, especially that given by international agencies like the World Bank, has sometimes been remarkably successful, while at other times aid has been a spectacular failure. Sometimes the successes and failures have even occurred in the same country and at the same, though in different projects. The reasons for this extreme diversity in performance have recently begun to attract attention, and there is now a growing empirical literature that attempts to determine the conditions under which aid can be most successful.<sup>1</sup> Two particularly influential pieces are Dollar and Pritchett's World Bank report, *Assessing Aid* (1998), and Burnside and Dollar (2000). Both come to the general conclusion that aid helps growth only when given to countries with sound institutions. However, this conclusion is still quite controversial, and the issue remains unsettled.<sup>2</sup> Given the magnitude of foreign aid, as well as its potential in alleviating poverty,<sup>3</sup> it is essential to better understand the conditions under which aid does work – and under which it does not work.

This paper examines the effectiveness of foreign aid using an alternative approach. In particular, this project uses a variant on the endogenous growth model of Barreto (2000) and Barreto and Alm (2003) to examine the conditions under which foreign aid is more likely to increase growth and/or increase social welfare. An important and novel feature of our analysis is the presence corrupt government sector, which is represented by the self-seeking nature of public agents. It is through the

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<sup>1</sup> See Hansen and Tarp (2000) for a survey of the literature.

<sup>2</sup> Morrissey (2004) finds that aid contributes positively to growth performance, and such aid effectiveness is independent of policy. Easterly, Levine and Roodman (2003) and Hansen and Tarp (2001) are critical of the conclusions in Burnside and Dollar (2000), while Hansen and Tarp (2000) are critical of the conclusions in Dollar and Pritchett's *Assessing Aid* (1998).

<sup>3</sup> The conclusion is *Assessing Aid* regarding aids' ability to alleviate poverty is questioned in Lensink and White (2000).

presence of corruption that we are able to examine the role that “sound institutions” play in determining the effectiveness of foreign aid.

In our theoretical model, the government is assumed to provide two kinds of public goods, one that enters the utility function of individuals as a consumption good and one that is used as an input in private production.<sup>4</sup> There are two agents, one public and one private, and each maximizes a utility function that depends upon consumption of the public good and the private good. The government finances its activities via taxation on consumption and income. Importantly, we assume that the public agent has the ability to exploit monopoly rents in the provision of a public good to private industry; that is, there is corruption institutionalized within the public sector. The model explicitly accounts for a government’s natural monopoly over the provision of many publicly provided goods and services, such as property rights, law and order, and contract enforcement, which may in many instances be exploited by self-seeking public officials abusing their public position for personal gain. These actions include such behavior as demanding bribes to issue a license, awarding contracts in exchange for money, extending subsidies to industrialists who make contributions, stealing from the public treasury, and selling government-owned commodities at black-market prices. In their entirety, these actions can be characterized as abusing public office for private gain, or “corruption” (see Shleifer and Vishney, 1993), and these practices can become ingrained and systemic in a society’s institutions.<sup>5</sup>

Within this general framework, we introduce several different types and magnitudes of foreign aid: “Aid for General Government Support” versus “Aid for Capital Projects” versus “Aid for Consumption”; “One-shot Aid” versus “Continuous

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<sup>4</sup> For a general discussion of endogenous growth models, see Barro and Sala-i-Martin (2003). For growth models that examine the role of the public sector, see for example Barro (1990). Endogenous growth models that address rent-seeking behavior include Pecorino (1992).

<sup>5</sup> A review of the corruption literature can be found in Jain (2001).

Aid”; and “Large Aid” versus “Small Aid” (where aid is measured as a percent of output). We also examine the impacts of aid in several different institutional settings: a “High Corruption” versus a “Low Corruption” scenario; a “Large Government Sector” versus a “Small Government Sector” (where government is measured as a percent of output), and “All Income Tax Finance” versus “All Consumption Tax Finance” versus “Equal Shares of Income and Consumption Tax Finance”. In all cases, we examine the impact of aid on the growth rate of the economy and also on social welfare, where social welfare is defined simply as the unweighted sum of utilities of the two agents. Given the complexity of the theoretical model, we use numerical simulations to track the various dynamic effects of aid.

Our results indicate that, regardless of how foreign aid is given – as general budget support, as capital support, or as consumption support – aid as a one-shot deal has no effect on the long run balanced growth path of consumption or growth. However, even one-shot aid can have significant effects on welfare and growth during the transition period from the time the aid arrives and the time horizon across which it is felt by the economy. Furthermore, the duration of the transition back to the long run balanced growth path differs across scenarios. When aid is given at every period, the result is a new long run equilibrium as well as the consequent path to that new equilibrium. Since the path is unique, one may track the effects of the aid on consumption, welfare, and growth. Interestingly, foreign aid is much more effective in economies that are corrupt than those that are not. In more corrupt economies, the price of government outputs are, in some sense, “too high” and foreign aid can have a direct and immediate impact on public goods provision.<sup>6</sup> In these settings, both the

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<sup>6</sup> The fungibility of aid and its impact on public sector behaviour are considered by McGillivray and Morrissey (2000), while Franco-Rodriguez (2000) considers the importance of fiscal response of a recipient government to aid.

growth effect and the welfare effect of foreign aid are greater than in economies that are less corrupt.

The next section presents our model and discusses its solution. Section III examines our results, and our conclusions are in Section IV.

## **II. A Theoretical Model of Endogenous Growth with a Corrupt Government**

Consider a simple endogenous growth model of a closed economy with a public good sector and two representative agents, one representing the public sector and one the private sector. The government is assumed to provide a public good for private consumption and one also for private production. In the latter case, the public agent is assumed to have the ability to exploit the potential for monopoly rents in the provision of the public good. These rents are, by assumption, are reinvested within the economy, thus there is no leakage. The government finances its production with separate taxes on consumption and on income; the government also receives foreign aid of several different types. The public and private agents optimize intertemporally, and the government maximizes social welfare, defined as the unweighted sum of individual utilities.

Government can be viewed as providing two kinds of public goods.<sup>7</sup> Public goods are nonrival and nonexclusive, and, as such, they can serve two basic and distinct functions. One is to give utility to consumers by providing them with certain goods that they value but that are unlikely to be provided in efficient amounts by private markets. The classic example of this type of public good is national defense; other examples include public parks, swimming pools, and similar kinds of public

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<sup>7</sup> See Barreto and Alm (2001) for details.

facilities. We denote this type of public good a *public consumption good*, or  $G_{st}$ , where the subscript  $t$  represents the time period.

A second function of public goods is to facilitate private production. Contract enforcement falls into this category, as does much public infrastructure like roads and bridges. This type of public good may therefore be thought of as an intermediate good in the production process. We call this type of public good a *public production good*, or  $g_t$ . Production of this good depends upon the amount of effective public capital  $k_{gt}$ . The public production good  $g_t$  is assumed to be an input in the production of the private output, which is denoted  $y_t$ . Private production also requires the use of effective private capital, or  $k_{yt}$ .<sup>8</sup>

There are two agents. Agent 1 is assumed to be the public agent, and Agent 2 is the private agent. Following Barreto (2000), corruption is introduced by allowing the public agent to control the production and distribution of the public production good  $G_t$ ; that is, the public agent is assumed to derive revenue, or corruption income  $Y_t$ , by the ability to extract monopoly rents from the sale of the public production good  $G_t$  to private industry.<sup>9</sup> Production of  $G_t$  requires allocations of labor  $L_{gt}$  and capital  $K_{gt}$ . The private agent controls production of the private good  $Y_t$ , which is produced with capital  $K_{yt}$ , the public production good  $G_t$  and labor  $L_{yt}$ . Capital and labor are mobile between the sectors.

The two representative agents receive income from separate sources. The private agent owns all of society's capital and receives wage income in addition to income from the production of the private good  $Y_t$ . In contrast, the public agent receives her wage income as well as income  $y_t$  from the ability to exercise market

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<sup>8</sup> All lower case letters refer to effective per capita terms (i.e.  $y_t = \frac{Y_t}{A_t L_{yt}}$ )

<sup>9</sup> For a similar approach, see Cheung (1996).

power over the distribution of the public production good  $G_t$  to private industry. Both agents spend their respective unsaved incomes on private output.<sup>10</sup> The straightforward intuition follows Shleifer and Vishny (1993). Private industry requires some degree of services, or cooperation, from the public sector in order to produce anything (e.g., licenses, contract enforcement, public infrastructure). However, these services are ultimately in the hands of individuals within government, and these officials need not provide their services free of charge. In fact, since private industry really may have no choice but to accept whatever degree of public cooperation that is offered at whatever price is asked, a public official may act as a monopolist over the administration of this particular arm of the government. The implication is that the public agent receives the monopoly rent, or corruption income  $Y_t$ , from the provision of the public production good.

Although their income sources differ, the agents are faced with similar intertemporal utility functions, in which utility depends upon the per capita consumption of the private consumption good  $C_{it}$  and the public consumption good  $G_{St}$ , over an infinite planning horizon, where  $i$  denotes Agent 1 or 2. Each agent's utility function takes the general form:

$$\begin{aligned} \text{Max } W &= \int_{t=0}^{\infty} U \left( \frac{C_{it} G_{St}^f}{L_{it}} \right) \cdot L_{it} \cdot e^{-rt} dt \\ &= \int_{t=0}^{\infty} \frac{C_{it}^{1-q} G_{St}^{f(1-q)}}{1-q} \cdot A_0^{1-q} \cdot L_{i0} \cdot e^{[n+(1-q)m-r]t} dt \end{aligned} \quad , \quad i=1,2 \quad (II.1)$$

where  $r$  is the pure rate of time preference,  $f$  measures the impact of public consumption on the welfare of the individual agent,  $q$  is the coefficient of relative risk

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<sup>10</sup> The fact that there is no leakage limits the consistency of the model's results with the stylized facts. For example, in some African countries such as Zaire under Mobuto Sese Seko, corruption rents mostly left the country. While in Southeast Asian and Latin American countries, corruption rents primarily remain in the country.

aversion,  $A_t$  is the level of technology that grows at rate  $m$ , labor grows at rate  $n$ , and  $c_{it}$  is the consumption per effective capita of agent  $i$ .<sup>11</sup>

The government derives revenue from taxes on income and consumption. The public revenue is used to subsidize the publicly produced good,  $g_t$ , such that in a perfect world where taxes are set optimally, the user cost of  $g_t$  is zero. The income of the private agent derived from the ownership of all of society's capital in addition to the production income of private good  $Y_t$ . He is taxed at rate  $t$ . The public agent has two sources of income, taxed wages and untaxed corruption income. In contrast, consumption expenditures of both agents are taxed at rate  $w$ . Total government tax revenue is denoted by  $T_t$ , where

$$T_t = w \cdot (C_{1t} + C_{2t}) + t \cdot (Y_t + rK_{Gt} + wL_{Gt}) \quad (II.2)$$

The first term is consumption taxes and the second term is income taxes. The user cost of  $G_t$  is determined by its private demand subsidized by tax revenues such that

$$G_t = \tilde{G}_t + \frac{T_t}{P_{Gt}} = K_{Gt}^g (A_t L_{Yt})^{1-g} + \frac{T_t}{P_{Gt}} \quad (II.3)$$

where  $\lim_{T \rightarrow T^*(t,w)} P_G = 0$ . This is to say there must exist a continuum of tax mixes

$T = T^*(t, w)$  that satisfy the optimality condition of zero user cost to publicly produced goods.<sup>12</sup> Any tax mix, not on the optimal continuum, will necessarily lead to a positive user cost of public goods as well as give the public agent latitude for corruption.<sup>13</sup>

Foreign aid enters the economy via one of three ways: as general budget support for the government, as a capital support to private sector production, or as a

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<sup>11</sup> The functional form is similar to that found in Turnovsky (1996), although we conform more to the standard growth literature that follows Lucas (1988) by explicitly including labor as well as technology.

<sup>12</sup> See Barreto and Alm (2001) example of this continuum.

<sup>13</sup> The obvious implication here is that corruption may be eliminated entirely by the planner with perfect information. Similarly, fiscal policy may be tailored to increase the availability of corrupt rents.

consumption support to both agents. Aid may be given as one-shot foreign aid versus as annual injections of foreign aid; continuous aid is defined as

$$a_t = \mathbf{u} \cdot Y_{t-1} \forall t$$

while one-shot aid is given by

$$a_t = \begin{cases} \mathbf{u} \cdot Y_{t-1} & \forall t = 0 \\ 0 & \forall t \neq 0 \end{cases}$$

The one-shot aid may be interpreted as the instant in time that the aid dries up; continuous aid is assumed to be a function of output. With aid given as general budget support, the government's budget constraint becomes increased by the amount of foreign aid  $a_t$ ; with aid given as capital support, the aid affects the private production process by increase the amount of the private sector capital stock; and with aid given as consumption support, the aid enters directly into the consumption (and utility function) of the two agents.

Aggregate public goods  $G_{St}$  are subject to congestion, represented as

$$G_{St} = G_t^d \left( \frac{G_t}{Y_t} \right)^{1-d} = G_t Y_t^{d-1} \quad (II.4)$$

where  $d$  is the congestion coefficient and  $Y_t$  is aggregate private output. In order for the level of public services  $G_{St}$  available to the individual to be constant over time, it must be the case that:

$$\frac{\dot{G}_{St}}{G_{St}} = (d-1) \frac{\dot{Y}_t}{Y_t} + \frac{\dot{G}_t}{G_t} \quad (II.5)$$

where a dot over a variable denotes a time derivative. By representing public goods in this manner, less than perfect degrees of non-excludability and non-rivalness may be considered. Analytically, congestion affects the growth rate and therefore the model's

solution through the term for the marginal utility of capital that appears in the Euler equations.<sup>14</sup>

The public agent maximizes utility, subject to the following constraints:

$$\Psi_t = P_{Gt}G_t - r_tK_{Gt} - w_tL_{Gt} \geq 0 \quad (II.6)$$

$$\Psi_t + wL_G(1-t) = P_Y \cdot C_{1t}(1+w) + S_{1t} \quad (II.7)$$

$$G_t = \tilde{G}_t + \frac{T_t}{P_{Gt}} = K_{Gt}^g (A_t L_{Gt})^{1-g} + \frac{T_t}{P_{Gt}} \quad (II.8)$$

$$K = K_{Yt} + K_{Gt} \quad (II.9)$$

$$L_t = L_{Yt} + L_{Gt} \quad (II.10)$$

$$\dot{K}_t = S_{Yt} + S_{Gt} \quad (II.11)$$

where

$P_{Gt}$  = price of the public production good  $G$  at time  $t$

$P_Y$  = price of the private good  $Y$  (constant)

$C_{it}$  = agent  $i$ 's consumption at time  $t$ ,  $i = 1, 2$

$S_{it}$  = agent  $i$ 's saving at time  $t$ ,  $i = 1, 2$

$Y_t$  = corruption at time  $t$

$r_t$  = competitive return on capital at time  $t$

$w_t$  = competitive return on labor at time  $t$

$K_{Gt}$  = capital used in the public sector production function at time  $t$

$K_{Yt}$  = capital used in the private sector production function at time  $t$

$t$  = income tax rate

$w$  = consumption tax rate

Equation (II.6) defines the income of the public agent, Agent 1, equation (II.7) is the public agent's budget constraint, equation (II.8) denotes a non-linear technology for the public production good, equation (II.9) and (II.10) shows the total supply of capital and labor, and equation (II.11) is the equation of change for total capital. The private agent, Agent 2, faces a similar set of constraints:

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<sup>14</sup> By explicitly considering congestion within the utility function, the marginal utility of capital becomes non-zero; an additional implication is that another element enters each agent's Euler equation. The presence of congestion in endogenous growth models is discussed in Barro and Sala-i-Martin (1992).

$$Y_t = K_{Y_t}^a G_t^b (A_t L_{Y_t})^{1-a-b} \quad (II.12)$$

$$Y_t = r_t K_{Y_t} + w_t L_{Y_t} + P_{G_t} \bar{G}_t \quad (II.13)$$

$$(Y_t + r K_G)(1-t) = P_Y \cdot C_{2t} (1+w) + S_{2t} \quad (II.14)$$

$$K = K_{Y_t} + K_{G_t} \quad (II.15)$$

$$L_t = L_{Y_t} + L_{G_t} \quad (II.16)$$

$$\dot{K}_t = S_{Y_t} + S_{G_t} \quad (II.17)$$

Equation (II.12) and (II.13) specify the production technology for total output, and equation (II.14) is the private agent's budget constraint. A bar over a variable signifies that the variable is fixed and given for the agent. Other equations are identical to those of Agent 1.

The two agents engage in a simple sequential game.<sup>15</sup> At any given time, say  $t=0$ , there exists some total supply of capital  $K_{t=0}$  and labor  $L_{t=0}$ . Agent 1, the public agent, is assumed to go first by choosing the amount of  $K_{G_{t=0}}$  and  $L_{G_{t=0}}$  that is needed to produce the desired amount of the public production good  $G_{t=0}$ . However, Agent 1 is a monopolist in the provision of the public production good to Agent 2, and limits the amount of  $G_{t=0}$  available to the economy in order to raise its price. The public agent maximizes utility by choosing allocations of labor and capital by weighing the benefits of imperfect competition with the costs in terms of less over all output. In other words, the greater the degree of corruption, the lower the private output, thereby effectively giving the public agent a larger slice of a smaller pie. Corruption income  $Y_{t=0}$  is paid in final goods. The corrupt agent may devote income toward consumption  $C_{1t=0}$  or saving  $S_{1t=0}$ .

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<sup>15</sup> In order that Agent 2 accept the level of corruption as given, it is easier to assume a sequential game. Also, if the agents move sequentially, it is the case that  $dk_2/dk_1 = dk_1/dk_2 = 0$ .

Then, the private agent (Agent 2) maximizes utility, deriving revenue from the production of the composite output  $Y_{t=0}$  and the ownership of capital. The private agent accepts the price,  $P_{G_{t=0}}$ , and quantity,  $\bar{G}_{t=0}$ , of public production good, as set by Agent 1; recall that a bar over a variable means that this variable is fixed and given to the agent. Given this amount of the public production good,  $\bar{G}_{t=0}$ , Agent 2 devotes all remaining capital  $k_{Y_{t=0}}$  to the production of the composite final good  $y_{t=0}$ .

The allocation of effective capital between the two sectors is demonstrated in Figure 1.<sup>16</sup> Here,  $D_{k_G}$  and  $D_{k_Y}$  represents the demand for per effective capita capital by the public and private sectors respectively,  $MR_{k_G}$  is the corresponding marginal revenue of public sector capital, and  $r$  denotes its return. If the public agent were to behave competitively, capital would be allocated between the sectors so as to equalize the returns to capital in each sector at  $r_{pc}$ . However, with monopolistic power, the public agent restricts the allocation of capital to the public sector, thereby generating a monopoly rent of  $(MPk_G - r_Y) k_G$ .<sup>17</sup> Note that although point 1 is certainly optimal from the private agent's perspective, point 2 is not the public agent best choice. Since both agents combined consumption is limited by the amount of private output, define by the shaded area, the public agent prefers an intermediate, "knife edge" production point along  $MC_{k_Y}$  defined somewhere between  $\{k_G, k_Y\}_m$  and  $\{k_G, k_Y\}_{pc}$ .<sup>18</sup> Thus the public agent's goal is to maximize, in absolute terms, her consumption share of private output.

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<sup>16</sup> Note that Figure 1 is in  $k_t = \frac{K_t}{A_t L_t}$  space such that  $z_L = \frac{L_{Gt}}{L_t}$  and  $(1 - z_L) = \frac{L_{Yt}}{L_t}$ .

<sup>17</sup> Note that Agent 1's saving  $s_{1t}$  is not directly associated with  $k_{1t}$ , and Agent 2's saving  $s_{2t}$  is also not directly associated with  $k_{1t}$ . This occurs because of the relationships

$$\dot{K}_t = S_{Gt} + S_{Yt} = \dot{K}_{Gt} + \dot{K}_{Yt} \quad S_{1t} \neq \dot{K}_{Gt} \quad S_{2t} \neq \dot{K}_{Yt},$$

which mean that agents' consumption decisions are independent of their capital allocation decisions.

<sup>18</sup> See Barreto (2000) for details of the equilibrium.

Recall that Agent 1 goes first by choosing  $k_{gt}$  and  $c_{1t}$ . More formally, Agent 1 maximizes with respect to  $k_{gt}$  and  $c_{1t}$  the present value Hamiltonian, defined as

$$L = U(c_g G_S^f) + U(c_y G_S^f) + \mathbf{m}(\dot{k}) + \mathbf{I}_t [k - k_y(1 - z_L) - k_g z_L] \quad (II.18)$$

This optimization defines the resulting growth path by its Euler equation,

$$\frac{\dot{c}_{1t}}{c_{1t}} = \frac{1}{\mathbf{q}} \left\{ \begin{aligned} & P_Y \frac{B_L \mathbf{b} g y}{k_g} + P_Y \mathbf{f} g [1 + \mathbf{b}(\mathbf{d} - 1)] (1 + \mathbf{w}) \frac{[z_L c_g + (1 - z_L) c_y]}{z_L k_g} \\ & + \mathbf{f}(1 - \mathbf{q}) \left[ \frac{\dot{G}}{G} + (\mathbf{d} - 1) \frac{\dot{Y}}{Y} \right] - \mathbf{r} - \mathbf{q} m \end{aligned} \right\} \quad (II.19)$$

$$= IES (MPk_g + MUK_g + Gr\_rate\_pub\_goods - \mathbf{r} - \mathbf{q} m)$$

where the first term marginal product of  $k_{Gt}$ , the second term is the marginal utility of  $k_{Gt}$ , and the third term is the growth rate of public goods.

The private agent accepts the public agent's choice of  $k_{Gt}$  and consequently accepts the levels of  $G_t$  and  $Y_t$ . Agent 2 then optimizes the same present value Hamiltonian as Agent 1, except she does so with respect to  $c_{2t}$  and  $k_{yt}$ , to yield a similar Euler equation.

$$\frac{\dot{c}_{2t}}{c_{2t}} = \frac{1}{\mathbf{q}} \left\{ \begin{aligned} & P_Y \frac{\mathbf{a} y}{k_y} + P_Y \mathbf{f} \mathbf{a} (\mathbf{d} - 1) (1 + \mathbf{w}) \frac{[z_L c_g + (1 - z_L) c_y]}{(1 - z_L) k_y} \\ & + \mathbf{f}(1 - \mathbf{q}) \left[ \frac{\dot{G}}{G} + (\mathbf{d} - 1) \frac{\dot{Y}}{Y} \right] - \mathbf{r} - \mathbf{q} m \end{aligned} \right\} \quad (II.20)$$

$$= IES (MPk_y + MUK_y + Gr\_rate\_pub\_goods - \mathbf{r} - \mathbf{q} m)$$

The balanced growth equilibrium is determined by  $\frac{\dot{c}_{1t}}{c_{1t}} = \frac{\dot{c}_{2t}}{c_{2t}} = \mathbf{x}$ .

$$\mathbf{x} = \frac{(1 - z_L)(1 - z_K) \{ [1 + \mathbf{f}(\mathbf{d} - 1)] P_Y r - \mathbf{r} - \mathbf{q} c + \mathbf{f}(1 - \mathbf{q}) \mathbf{d} (m + n) \} - \mathbf{f} \mathbf{a} (\mathbf{d} - 1) (m + n)}{\mathbf{f} \mathbf{a} (\mathbf{d} - 1) + (1 - z_L)(1 - z_K) \{ \mathbf{q} - \mathbf{f}(1 - \mathbf{q}) [\mathbf{g} + (\mathbf{d} - 1) (\mathbf{a} + \mathbf{b} \mathbf{g})] \}} \quad (II.21)$$

The growth rates of consumption of the two agents are necessarily equal at all times; intuitively, this insures against a situation in which one agent owns all of the assets.

This function describes the growth rate as either agent approaches the respective, as well as the necessarily different, steady state level of consumption. A positive (or negative) growth rate occurs at every possible capital labor ratio except that which yields the zero growth steady state. The steady state occurs at the uniquely determined capital labor ratio where endogenously determined saving creates exactly enough capital for all present and future members of society to enjoy maximum welfare.

The growth rate of capital is given by equation (22).

$$\frac{\dot{k}}{k} = P_Y \frac{y(1-z_L) - (1+w)[c_y(1-z_L) + c_g z_L]}{k} - (m+n) \quad (\text{II.22})$$

Therefore, for any given effective capital labor ratio, there will be an endogenously determined growth rate as defined (II.21). The steady state effective capital stock is determined by equality of (II.21) and (II.22), such that  $k = k^* \mid \dot{k} = \dot{c} = 0$ . Any value of  $k$  that is less than the steady state  $k^*$  leads to positive growth; any value greater than  $k^*$  leads to negative growth.

The basic solution is illustrated by Figure 2, which depicts a simple Ramsey-Cass-Koopman's type of growth model.<sup>19</sup> To better understand the dynamics of the model, compare an economy subject to corruption to one that is not. We may choose any set of coefficient values and simulate the results. Figures 3 charts actual simulation results. There are a few points worth noting. First, the steady state equilibrium consumption per effective capita as well as capital per effective capita are both lower in the presence of corruption. Thus corruption has a negative long run effect on the steady state welfare, which is determined at a lower per capita capital stock. Second, the growth path is steeper in the presence of corruption. Intuitively, this means that a shock in the presence of corruption will have a shorter albeit more dramatic dynamic

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<sup>19</sup> This is also typically referred to as a Lucas Model after Lucas (1988).

adjustment. Third, corruption does not necessarily harm the transitional growth rate as much as it does the eventual long run equilibrium to which the economy is heading.

### III. Simulation Results

All simulations are done with the following coefficient values:

$a$  = coefficient on private capital in private production = 0.35

$b$  = coefficient on government in private production = 0.30

$g$  = coefficient on public capital in public production = 0.50

$t$  = income tax rate = 0.10

$w$  = consumption tax rate = 0.05

$f$  = welfare elasticity of public goods = 0.25

$d$  = congestion coefficient = 0.75

$q$  = coefficient of relative risk aversion = 0.99

$r$  = discount rate = 0.03

$m$  = technology growth rate = 0.02

$n$  = population growth rate = 0.02

The choice of these specific coefficient values follow Turnovsky (1996) and serve only as a benchmark. This arbitrary tax mix yields positive user cost of public goods,  $P_G = .51$ , and is therefore sub-optimal. Other reasonable coefficient values, for the most part, change the results only quantitatively.

a) Low versus High Corruption Economies. Consider first the growth and welfare performance of a low (or zero) corruption economy versus that of a high corruption economy given sub-optimal taxation. We start at an arbitrary starting point that puts the economy on a saddle path; as we change aspects of the model (e.g., the corruption coefficient), the modified golden rule changes the steady state capital/labor ratio, the steady state consumption per capita changes, which in turn implies welfare changes, and the slope of the saddle path increases or decreases. Figures 3 represent a zero corruption economy (“1”) versus a high corruption economy (“2”). It is apparent that corruption has a negative welfare effect, that there is also a steeper saddle path due

to corruption (e.g. a small move away from steady state has a large growth effect), and that corruption implies a lower steady state capital/labor ratio.

These results may be quantified quite succinctly. At the steady state, corruption is associated with an effective capital labor ratio that is 37% lower and a per effective capita consumption that is 17% lower. Furthermore, consumption per effective capita in the face of corruption, is everywhere less elastic with respect to change in the capital labor ratio than consumption without corruption. On the other hand, the growth rate is more elastic with respect to changes in the capital labor ratio in the face of corruption.<sup>20</sup> In other words, corruption avails the economy to more pronounced growth effects but dampened welfare effects resulting from a fundamental shift in the steady state such as results from foreign aid given permanently.

It should be remembered that Figures 3 represent the growth path of the economy as a whole. Since the agents are separable, we may wish to look at the private agent versus the public agent, especially when we alter foreign aid.

**b) One-time versus Permanent Foreign Aid.** A foreign aid shock will necessarily change the steady state levels of consumption and capital and consequently change the path to the new point. Unless the shock is permanent, it can have no permanent effects. Nevertheless, aid can have very different effects on welfare and on growth during the transition period within which the aid arrives, the time horizon during which the impacts of aid are felt, and the duration of the transition back to the long run balanced growth path; in all cases, these effects depend largely on the level of corruption in the economy.

For simplicity, consider foreign aid given directly to the governments of a low (or zero) corruption economy (“1”) versus aid given to the government of a high corruption economy (“2”). Assume that each economy grows for 50 periods and then receives an amount of aid

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<sup>20</sup> The elasticity of growth with respect to changes in the capital labor ratio, to the left of the steady state, is higher in the presence of corruption while it is lower to the right of the steady state

equal to 20 percent of its current GDP ( $a_t = .2y_t$ ) for 1 period. Further assume that the aid dissipates at 10% per year after its initial infusion until the public budget goes back to normal. Admittedly, this represents an enormous amount of aid, but it is useful to exaggerate the aid in order to get a clearer picture of the effects. The income tax rate is assumed to equal 0.10, and the consumption tax rate is 0.05, so that these economies may be considered “low tax” economies.

As shown in Figures 4 and 5, aid is much more effective in the corrupt economy (2) than in the clean economy (1). This is because the price of the public good in the corrupt economy is “too high”, and in such an institutional setting, aid has a very direct effect on the cost of the public good. Quantitative comparisons support this contention. In the three periods immediately following a relatively equal injection of foreign aid to the government, private consumption per effective capita rise by 5%, 3% and 2% in the presence of corruption versus 3%, 2% and 1% without corruption. The growth rate with corruption increases by 16% and then 4% before resuming its decline to the steady state while growth only increases by 8% and 1% before resuming its decline without corruption. From figure 6, in the first two period after the aid is given, the price of publicly produced goods falls by 10% and 5% with corruption versus 6% and 3% without corruption. As a result, both the growth effect and the welfare effect of aid are greater in the presence of corruption.

c) Foreign Aid as Capital Support. Consider foreign aid given as a capital support to the private sector. Aid of this type has no effect on the path to the steady state save that it would bring the economy to the equilibrium more quickly. To see why, simply consider the result of giving capital to an economy that is already at the steady state. Recall that the steady state is defined by an equilibrium effective capital labor ratio, therefore additional capital would move

the economy to the right of the steady state, still along the growth path. The growth rate would go from zero to a negative value.

When aid is given as capital support, although it has no discernable effect upon the balanced growth rate, it would have welfare implications. Since the steady state represents optimal welfare, getting there quicker can only be considered positive. Unfortunately, if the additional capital were to move the economy beyond the steady state effective capital labor ratio (i.e. to the right of  $k^*$ ), it is quite possible for there to be negative welfare effects.

**d) Foreign Aid as Consumption Support.** Aid given as consumption support also has no discernable effect on the growth rate. However, such aid clearly affects the welfare of whichever agent receives the support (Figures 7).

Whether aid is more or less effective due to corruption depends if the magnitude of the aid is determined as a proportion of GDP, as we have generally assume herein, or is simply an arbitrarily determined value. Given that relative GDP is higher in a clean economy than in a corrupt one, all else equal, the consequent proportionate amount of aid will also be higher. If instead we consider some absolute quantity of aid to two hypothetical economies, which differ only in their respective degrees of corruption, the opposite would be true. In such a scenario, the aid, although equal in absolute terms, is relatively greater to the corrupt economy and consequently has a greater impact on agents.

**e) Foreign Aid as General Budget Support.** The only significant way in which aid may affect the growth rate is if it is given as government support. Aid in this case is very effective in increasing the growth rate. However, the greater the corruption, the more disproportionate is the share of the aid that ends up in the hands of corrupt public

sector agents. If the welfare of the country is of greater concern, aid as a consumption support is more effective. This is apparent from comparison of Figures 5 and 7.

The five hypothetical aid situations, (a) through (e), provide some general rules governing the effects of aid. As corruption distorts prices, foreign aid necessarily lessens the distortion. Thus the greater the distortion, the more effective aid has the potential to be. Aid given directly to the government, irrespective of its degree of corruption, is the most effective medium to effect growth and welfare. As a final investigation into the dynamic properties of aid, one might consider some stylized facts regarding developing countries that would further influence aid's effectiveness. For example, governments of developing countries generally impose a lower tax burden. Within the model, this implies greater scope for rent extraction as the tax mix moves away from its optimal level. Figures 8 exemplifies the magnitude of better tax policy and combined with corruption. Optimal tax policy pushes the user of cost of capital toward zero, which not only may render the foreign aid shock all but indiscernible, but also significantly raises the steady state levels of consumption and capital.

#### **IV. Conclusions**

Regardless of how foreign aid is given, one-shot foreign aid has no effect on the long run steady state equilibrium consumption or capital labor ratio. However, one-shot aid can have significant effects on welfare and growth during the transition period from the time the aid arrives and the time horizon across which it is felt by the economy. Furthermore, the duration of the transition back to the long run balanced growth path differs across scenarios. When aid is given at every period, the resulting

new balanced growth path may be compared quantitatively as well as qualitatively to the growth path without the aid.

It is especially noteworthy that foreign aid is more effective in economies that are corrupt than those that are not. Since the growth path of consumption is necessarily steeper due to corruption, aid given to a corrupt government will have a more dramatic albeit shorter-lived effect on the growth and welfare of the economy than aid given to a clean economy. The simulation results confirm this assertion. Furthermore, aid has a more significant impact on the price of government output in the presence of corruption. Therefore, at the theoretical level, both the growth effect and the welfare effect of foreign aid are magnified by corruption. Although this result counters much of the current thinking about foreign aid, it is not so counter intuitive. Corruption here leads to a second-best equilibrium. Therefore, the further the economy is from its first-best, no corruption equilibrium, the more scope there necessarily exists for aid to be effective.

## Bibliography

- Barreto, Raul A. (2000). "Endogenous Corruption in a Neoclassical Growth Model", *The European Economic Review*, 44 (1), 35-60.
- Barreto, Raul and James Alm (2003). "Corruption, Optimal Taxation, and Growth", forthcoming in *Public Finance Review*.
- Barro, Robert J. (1990). "Government Spending in a Simple Model of Economic Growth", *The Journal of Political Economy*, 98 (5, Part 2), S103-S125.
- Barro, Robert J. and X. Sala-i-Martin (1992). "Public Finance in Models of Economic Growth", *Review of Economic Studies*, 59, 645-661.
- Barro, Robert J. and Xavier Sala-i-Martin (2003). *Economic Growth: Second Edition* (M.I.T. Press.).
- Burnside, C. and D. Dollar (2000). "Aid, policies and growth", *The American Economic Review*, September 2000.
- Cheung, Stephen N. S. (1996). "A Simplistic General Equilibrium Theory of Corruption", *Contemporary Economic Policy*, 14 (3), 1-5.
- Dollar, David and Lant Pritchett (1998). *Assessing Aid*, A World Bank Policy Research Report, (Washington, D.C.: The World Bank).
- Easterly, W., R. Levine and D. Roodman (2003), "New data, new doubts: A comment on Burnside and Dollars 'Aid, Policies and Growth' (2000)", Unpublished manuscript.
- Franco-Rodriguez, S. (2000), "Recent developments in fiscal response with an application to Costa Rica", *Journal of International Development*, 12, 429-41.
- Hansen, H. and F. Tarp (2000), "Aid effectiveness disputed", *Journal of International Development*, 12, 375-98.
- Hansen, H. and F. Tarp (2001), "Aid and growth regressions", *Journal of Development Economics*, 64, 547-70.
- Jain, Arvind K. (2001). "Corruption: A Review", *Journal of Economic Surveys*, 15 (1), 71-121.
- Lensink, R. and H. White (2000). "Aid allocation, poverty reduction and the *Assessing Aid* report", *Journal of International Development*, 12, 399-412.
- Lucas, R. (1988). "On the mechanics of economic development", *Journal of Monetary Economics*, 22, 3-42.
- Mcgillivray, M. and O. Morrissey (2000). "Aid fungibility in *Assessing Aid*: red herring or true concern?" *Journal of International Development*, 12, 413-28.

- Morrissey, O. (2004), "Conditionality and aid effectiveness re-evaluated", *World Economy*, 27(2), 153-71.
- Pecorino, Paul (1992). "Rent Seeking and Growth: The Case of Growth Through Human Capital Accumulation", *Canadian Journal of Economics*, 25 (4), 944-56.
- Shleifer, Andrei and Robert W. Vishny (1993). "Corruption", *The Quarterly Journal of Economics*, 108 (3), 599-617.
- Turnovsky, Stephen J. (1996). "Optimal Tax, Debt, and Expenditure in a Growing Economy", *The Journal of Political Economy*, 60 (1), 21-44.

**Figure 1. The Allocation of Capital Between the Public and Private Sectors**

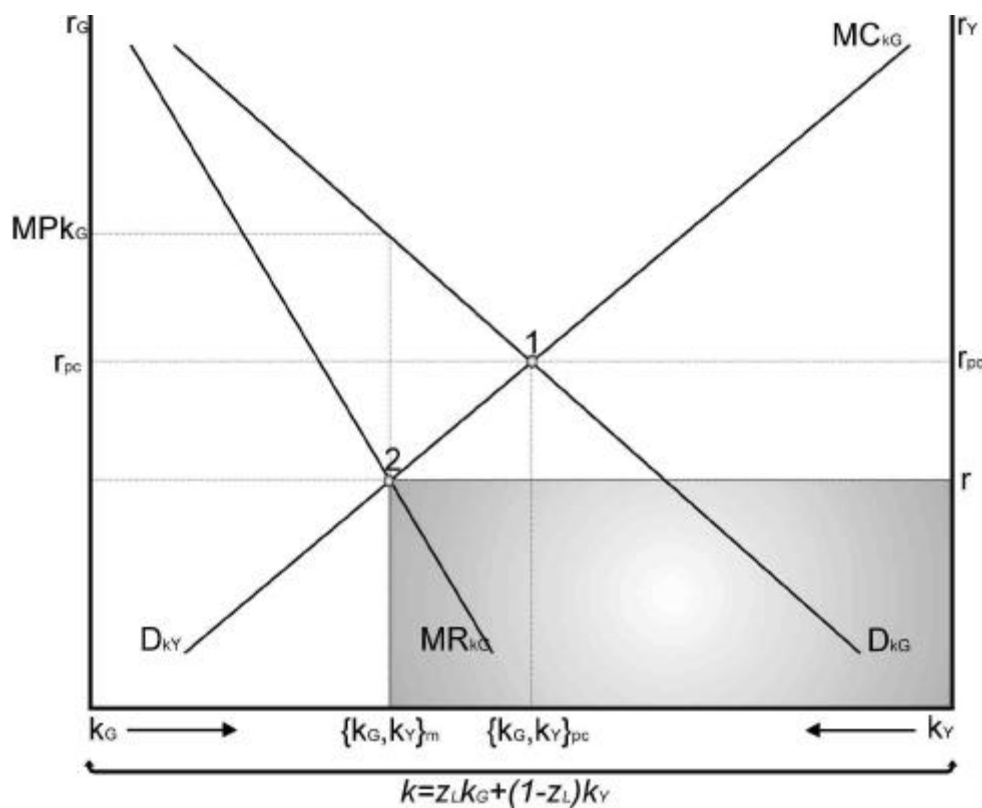
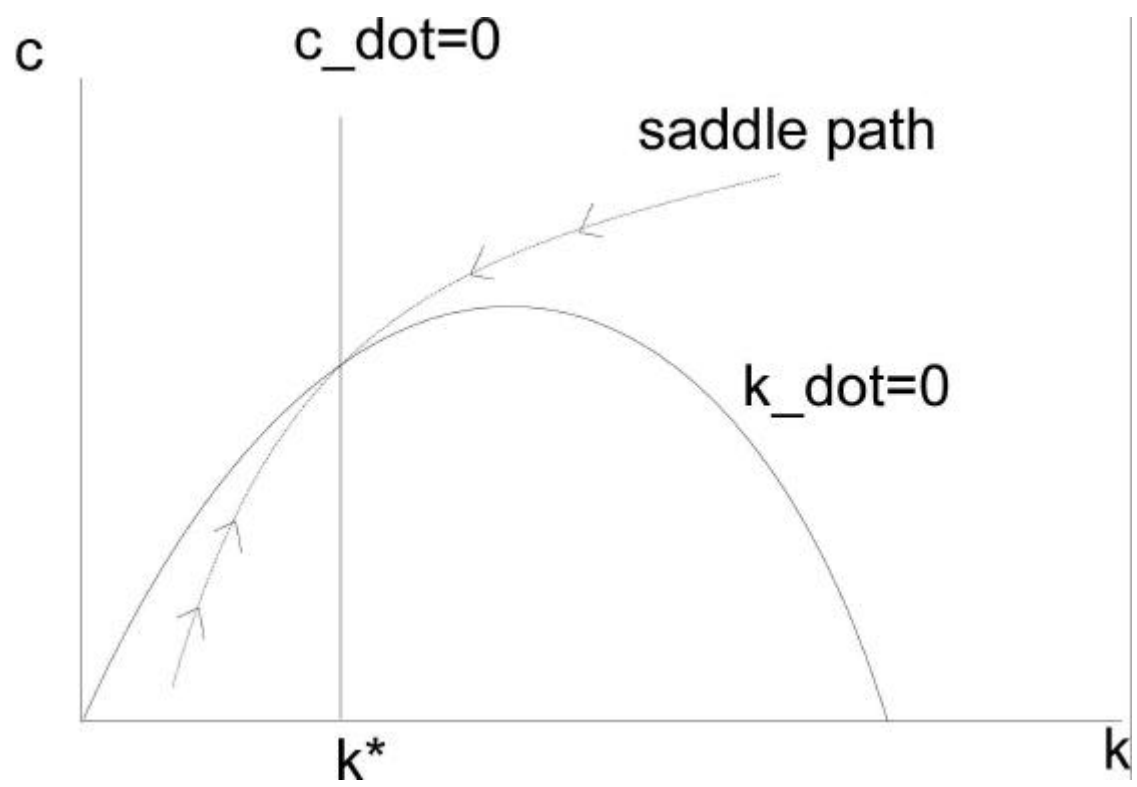
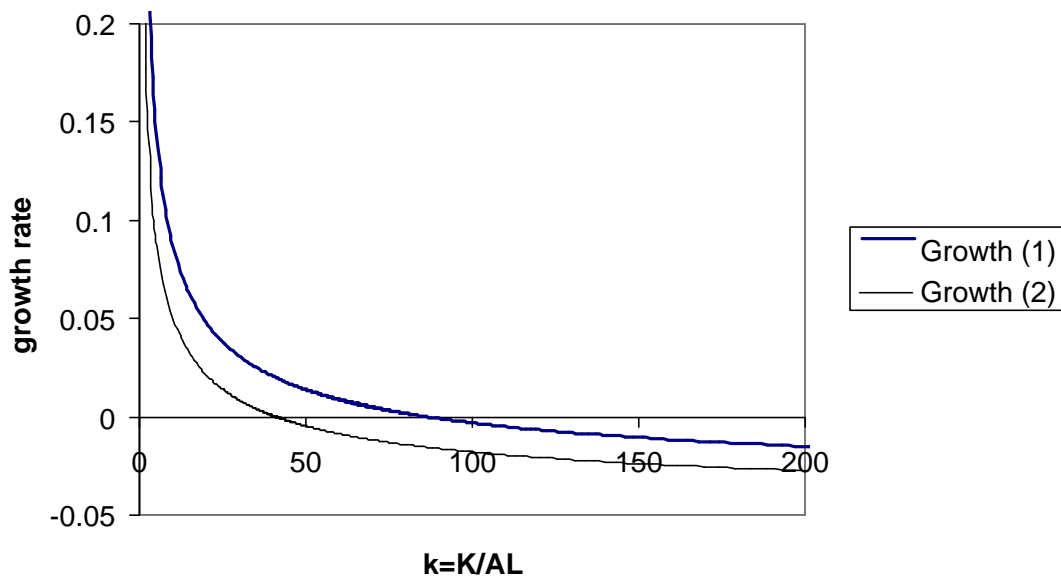
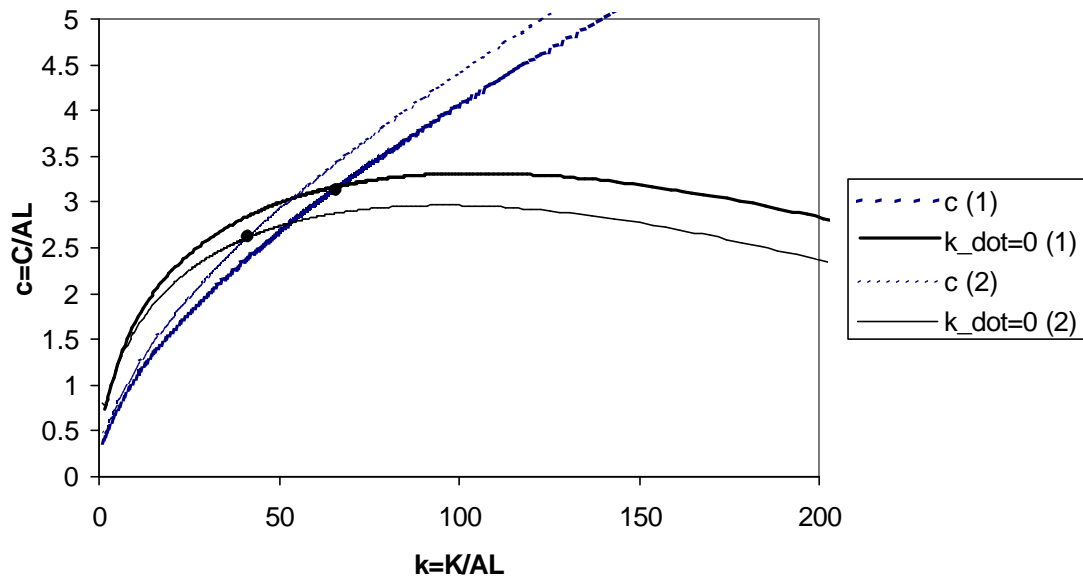


Figure 2.

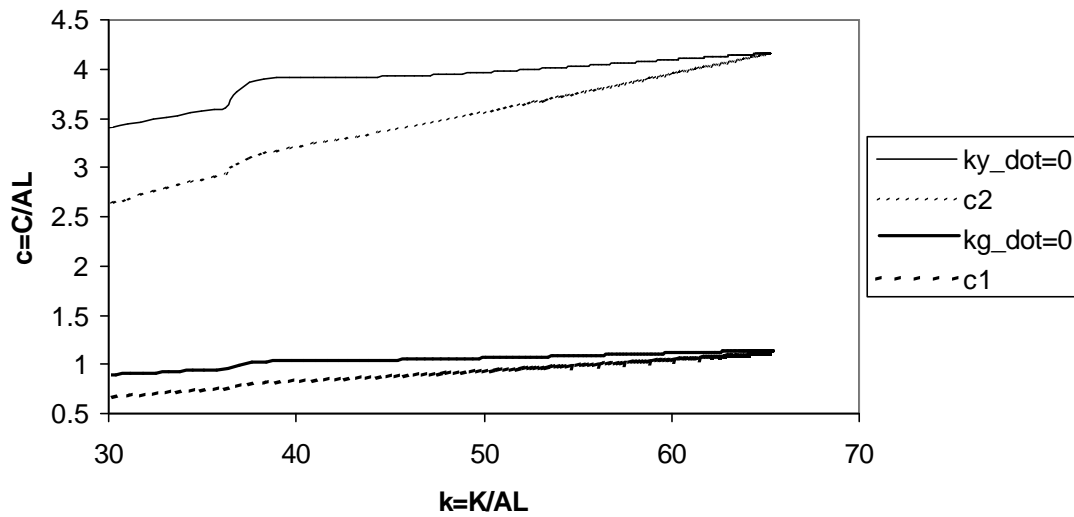


**Figures 3. Low (1) Corruption versus High (2) Corruption Economies**

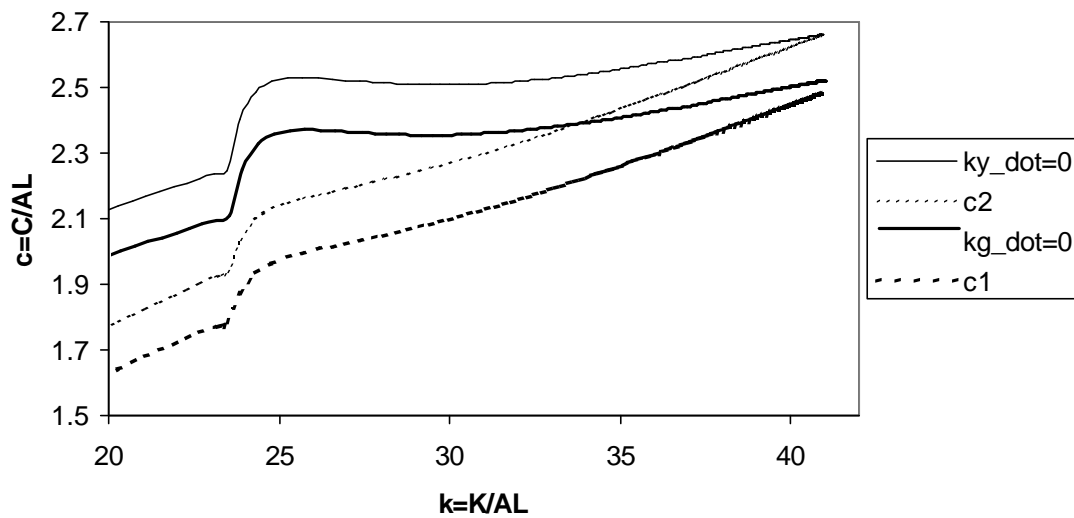


**Figures 4. One Shot Foreign Aid as Government Budget Support in a Low (1) vs. High (2) Corruption Economy**

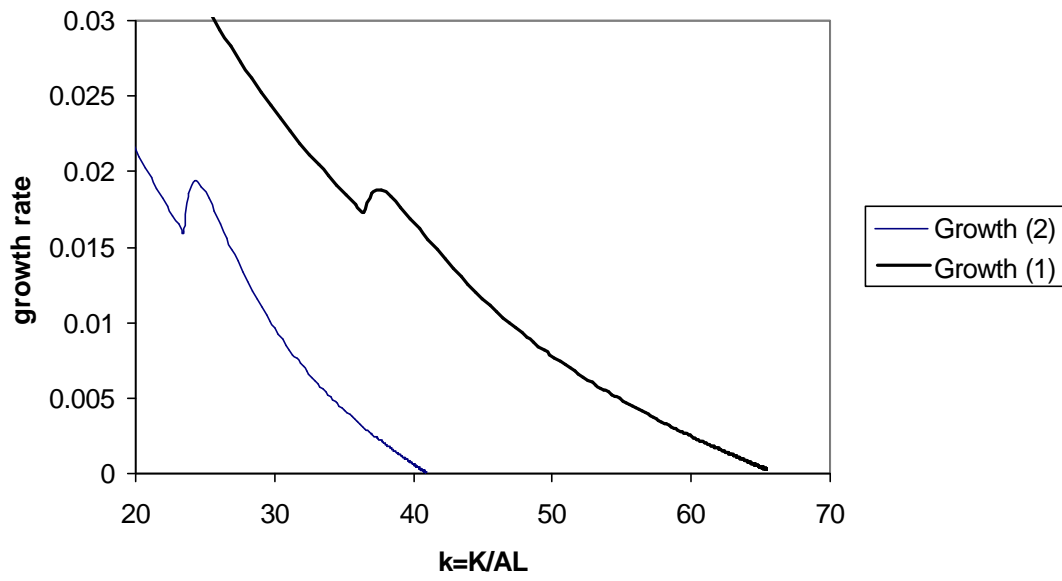
**Low Corruption (1)**



**High Corruption (2)**

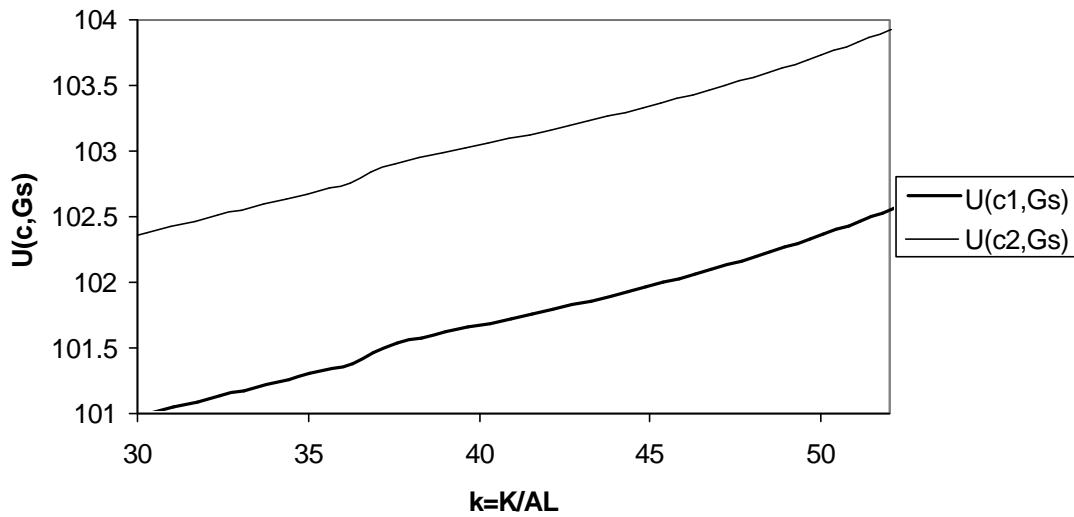


**Figures 4. One Shot Foreign Aid as Government Budget Support in a Low (1) vs. High (2) Corruption Economy (cont.)**

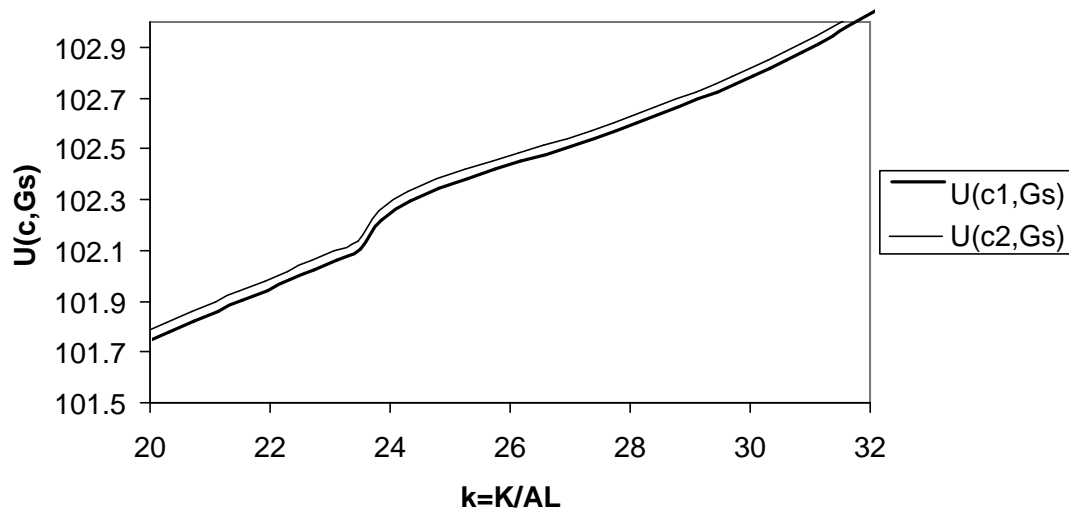


**Figures 5. One Shot Foreign Aid as Government Budget Support in a Low (1) vs. High (2) Corruption Economy**

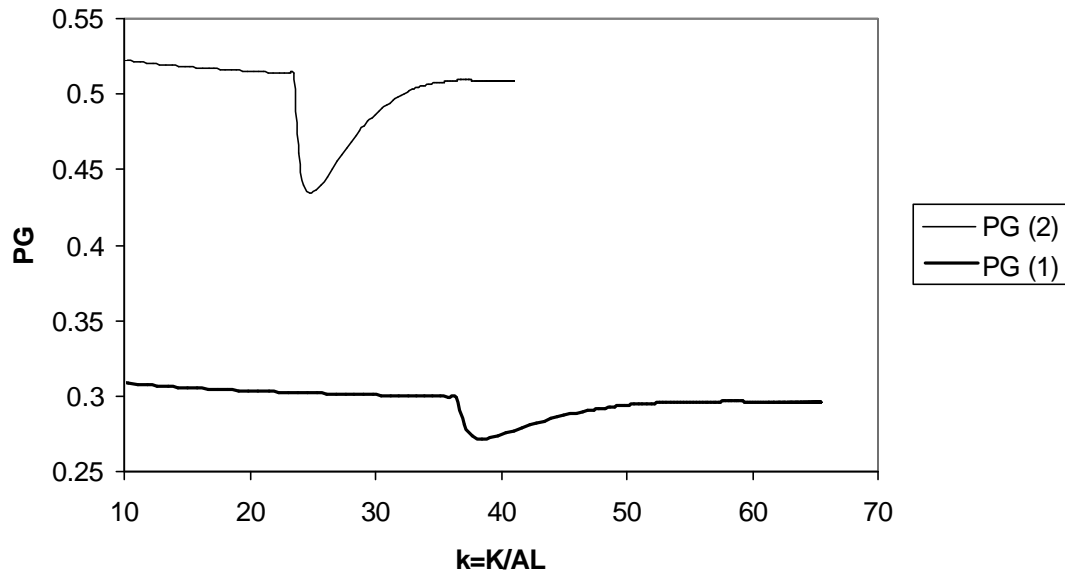
**Low Corruption (1)**



**High Corruption (2)**

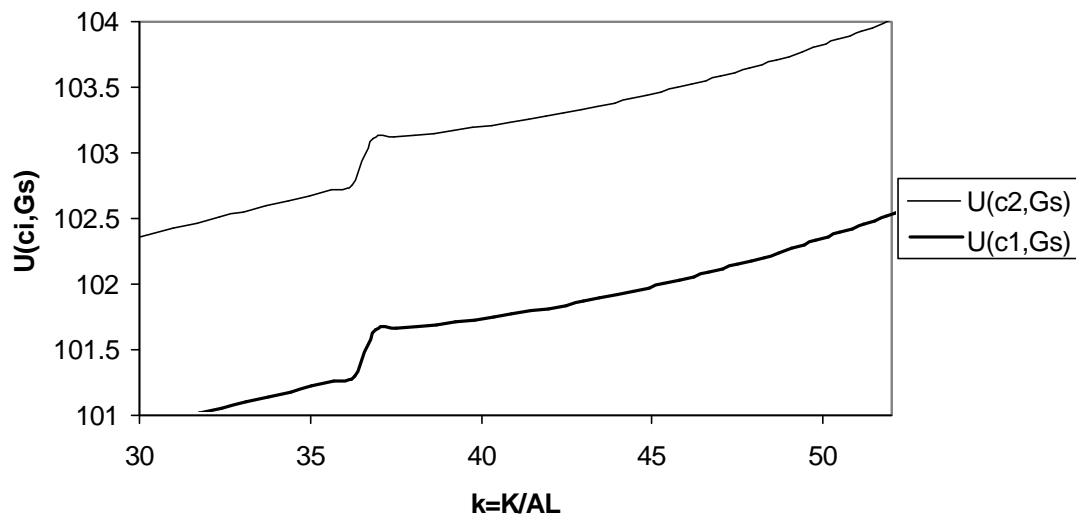


**Figures 6. One Shot Foreign Aid as Government Budget Support in a Low (1) vs. High (2) Corruption Economy**

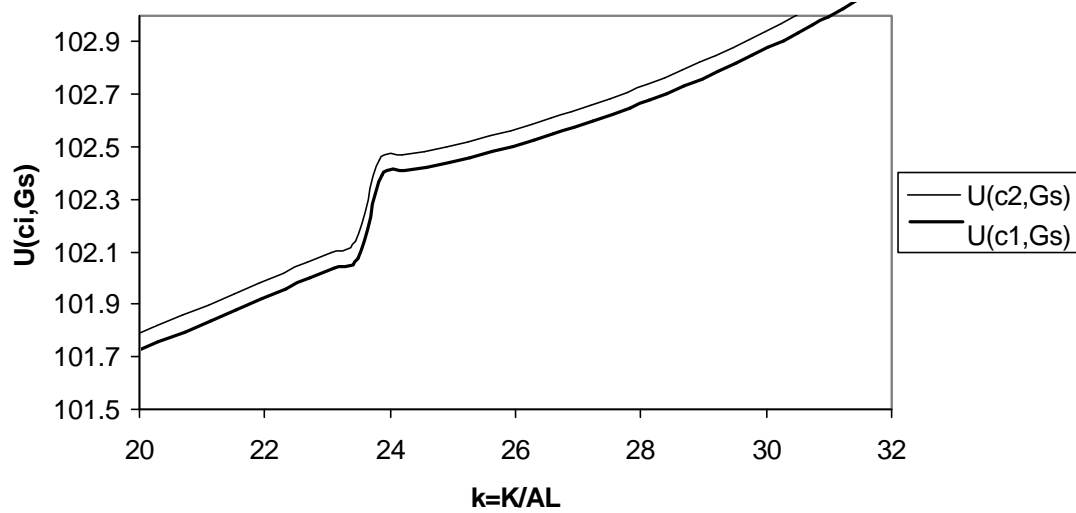


**Figures 7. One Shot Foreign Aid as Consumption Support in a Low (1) vs. High (2) Corruption Economy**

**Low Corruption (1)**

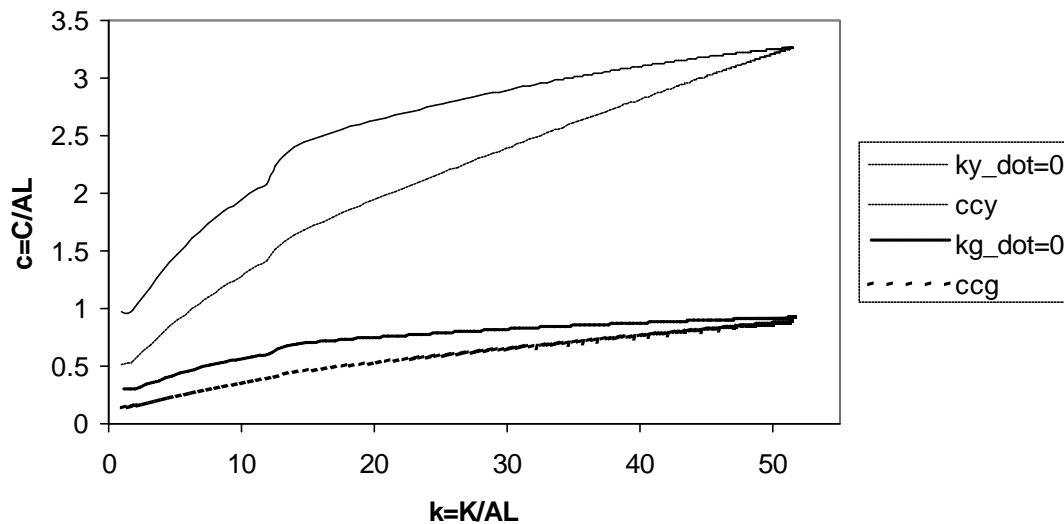


**High Corruption (2)**



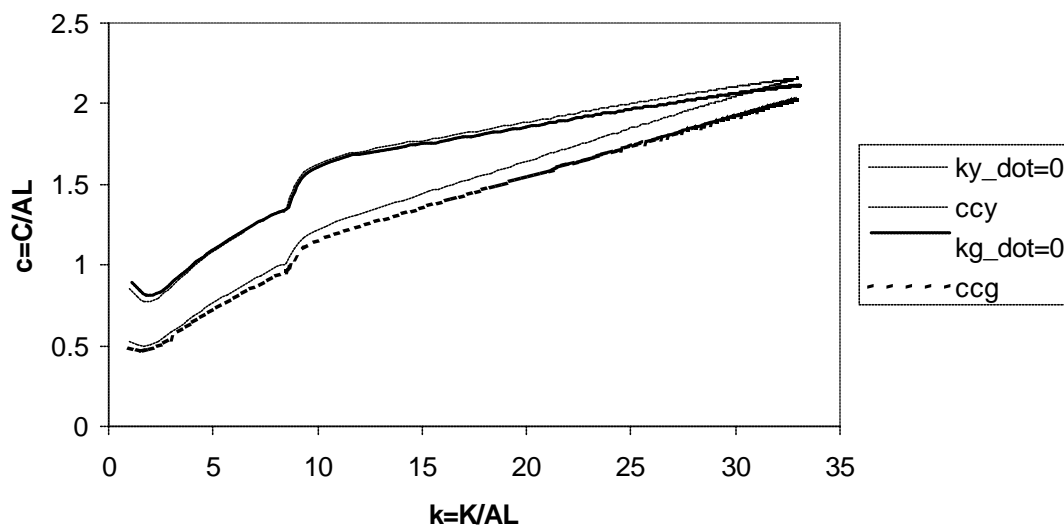
**Figures 8. One Shot Foreign Aid as government Support in economies with: Low Taxation - Low Corruption (1), Low Taxation - High Corruption (2), High Taxation - Low Corruption (3), and High Corruption - High Taxation (4)**

**Low Taxes - Low Corruption (1)**



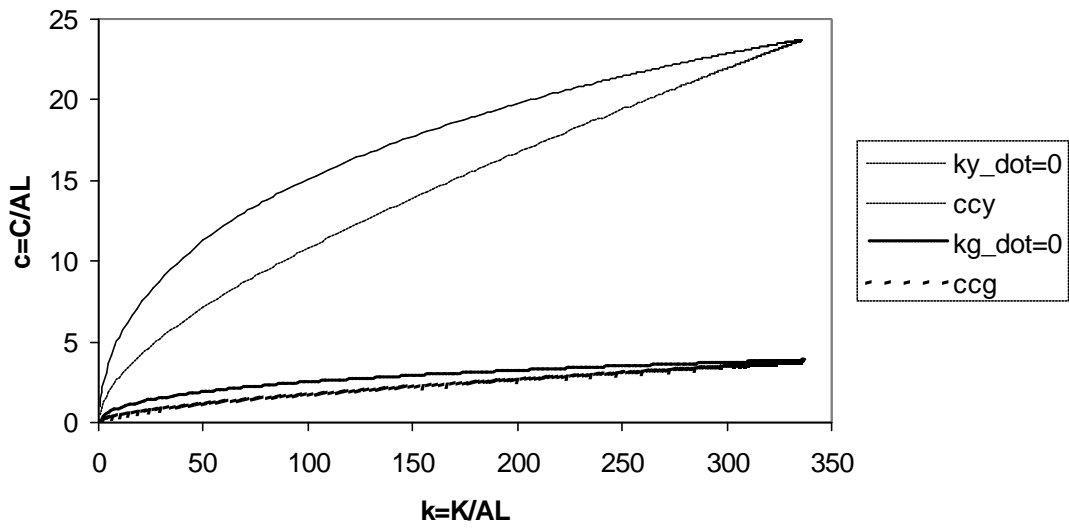
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**Low Taxes - High Corruption (2)**



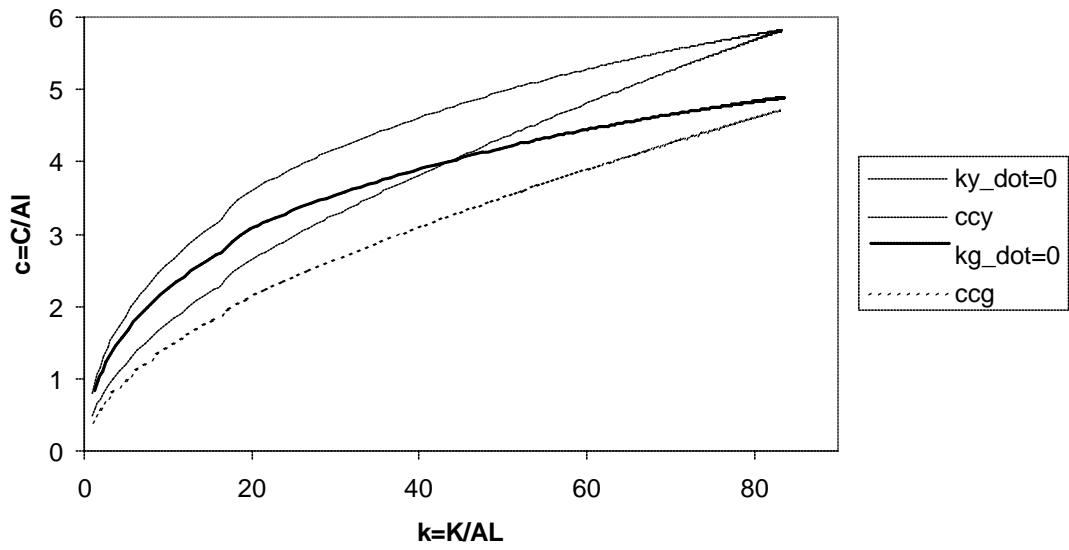
$t=0.05$  and  $w=0$  such that average relative tax burden,  $T/Y=0.058$

### High Taxes - Low Corruption (3)



$t=0.19$  and  $w=0.06$  such that average relative tax burden,  $T/Y=0.289$

### High Taxes - High Corruption (4)



$t=0.19$  and  $w=0.06$  such that average relative tax burden,  $T/Y=0.260$

**TABLE 1****% change in the long run balance growth rate**

Foreign aid, fixed at a % of GDP, is assumed to be provided forever

		foreign aid = % of GDP	
		10%	20%
Corruption =	0%	12.93%	22.43%
% of Govt Rev	15%	11.05%	19.48%
	25%	11.08%	19.54%

**TABLE 2****change in relative consumption**

Foreign aid, fixed at a % of GDP, is assumed to be provided forever

		10%				20%			
		c1/Y at t-1	% change	c2/Y at t-1	% change	c1/Y at t-1	% change	c2/Y at t-1	% change
Corruption =	0%	57.08%	-0.52%	0.00%		57.08%	-0.85%	0.00%	
% of Govt Rev	15%	63.68%	1.64%	3.36%	29.23%	63.68%	3.20%	3.36%	55.16%
	25%	66.35%	2.95%	5.65%	29.59%	66.35%	5.66%	5.65%	55.95%