Foreign Aid, Incentives and Efficiency: Can Foreign Aid Lead to Efficient Level of Investment?

Alok Kumar*

August 2013

Abstract

This paper develops a two-period-two-country model in which an altruistic donor faces Samaritan's Dilemma to address two important policy questions: (i) whether foreign aid can lead to efficient level of capital investment in the recipient country and (ii) how does the form (e.g. budgetary transfers, capital transfer) and the timing of aid affect the recipient's financial savings and capital investment. It finds that the capital transfer makes financial savings more attractive relative to the capital investment for the recipient and exacerbates the free rider problem. The capital transfer can lead to efficient level of capital investment. But in this case, it completely crowds out the recipient's own capital investment. In *the absence of capital transfer*, the multi-period budgetary transfers not only lead to the efficient level of capital investment by the recipient, but also achieve the same allocation as under *commitment*. By tying its hands in the sense of forgoing capital transfer, the donor can give aid more efficiently.

Keywords: Foreign Aid, Capital Investment, Financial Savings, Budgetary Transfers, Capital Transfer, Fungibility

JEL Code: J22, I20, D60

Address: $*$ Department of Economics, University of Victoria, Victoria, British Columbia, Canada, V8W 2Y2, Email: kumara@uvic.ca. I thank the participants of the CEA 2013 meeting in Montreal for their thoughtful comments. This research is supported by the Social Sciences and the Humanities Research Council (Canada). The usual disclaimer applies.

1 Introduction

One of the key objectives of many donor countries and aid organizations is to promote investment, growth, and efficient level of investment in the recipient countries. The effectiveness of aid in achieving its goals has been a major concern for donors, policy makers, and researchers. There is a voluminous literature which examines its effects on investment, growth, poverty reduction and development in general. This literature finds mixed evidence with regard to its effectiveness in achieving its stated goals (e.g. Boone 1996, Burnside and Dollar 2000, Hansen and Tarp 2001, Collier and Dollar 2000, Easterly 2003, Kanbur 2004, Rajan and Subramaniam 2008, 2011, Temple 2010).

The weak effect of aid, in part, is attributed to the incentive problems associated with the strategic interactions among the donors and the recipients. It has been argued that aid by altruistic donors induces recipients to reduce their own contribution to development efforts in order to elicit more aid from donors. Donors face a Samaritan's Dilemma and may not be able to deter recipients (through some conditionality) from indulging in such strategic behavior due to time-inconsistency and credibility problems (Buchannan 1975, Assar and Weibull 1988). Empirical evidence also suggests that conditionality does not work and there is a weak relationship between aid disbursement by the donors and the implementation of required conditions or institutional reforms by the recipients (see Svensson 2003, Kanbur 2004 and Temple 2010 for a review of evidence).

It is increasingly being realized by policy makers that different instruments of aid affect the incentives of the recipients in different ways and the use of appropriate instruments can improve effectiveness of aid (World Bank 1998, 2005, OECD 2007). Donors provide aid in multiple ways with the capital financing and the general budgetary support being the two main instruments. It has been argued that the general budgetary support may be a superior instrument of disbursing aid compared to the capital financing as it allows for better alignment of goals of the donor and the recipient and lowers the inefficient use of resources, particularly when the recipient receives aid from multiple sources (World Bank 2005, OECD 2007).

This paper develops a two-period-two-country model to address three important policy questions. Firstly, whether foreign aid can lead to efficient level of capital investment in the recipient country. Secondly, whether the form of aid transfer (e.g. budgetary transfer, direct financing of capital investment) and its timing matter for the efficiency of the capital investment.

Thirdly, what instruments can be used to mitigate the problems of dynamic inconsistency? There are two key aspects of the model: (i) the donor country is altruistic and behaves as a Stackelberg follower similar to Assar and Weibull (1988), Pedersen (2001), Svensson (2000), Torsvik (2005), and Hagen (2006) and (ii) the recipient country can make both the financial and the capital investment.

In the model, there is one donor country and one recipient country. The recipient faces borrowing constraint and is unable to borrow from the international financial markets. The donor is altruistic and cares about the welfare of the recipient country. It can provide aid to the recipient through the general budgetary transfers in both periods and the capital transfer (direct financing of capital investment). The capital transfer is earmarked for capital investment. However, it is still fungible as the recipient can adjust its own contribution to the capital investment. The recipient possesses a production technology which is increasing and concave in the capital investment. It faces a portfolio choice problem and can allocate its savings between financial savings at a fixed rate of interest and the capital investment.

The main findings of this paper are as follows. Firstly, the capital transfer distorts the relative rate of return between the financial savings and the capital investment and makes financial savings more attractive to the recipient. This distortion exacerbates the free rider problem. The result is that the capital transfer can lead to efficient level of capital investment. But in this case, it completely crowds out the recipient's own capital investment.

Secondly, the first period budgetary transfer has a positive incentive effect and the second period budgetary transfer has a negative incentive effect on the capital investment by the recipient. The multi-period budgetary transfers (or transfers in both periods) can be used to balance out their positive and negative incentive effects on the capital investment by the recipient. In *the absence of capital transfer*, multi-period budgetary transfers not only lead to the efficient level of capital investment by the recipient, but also achieve the same allocation as under *commitment*. Finally, between the capital transfer and the second period budgetary transfer, the capital transfer has a larger disincentive effect on the recipient.

The reason that the capital transfer makes financial savings more attractive to the recipient than the capital investment is as follows. An increase in the recipient's capital investment reduces the marginal benefit of capital transfer to the donor for two reasons: (i) it increases the second period consumption of the recipient and thus reduces the marginal utility of con-

sumption in the second period as perceived by the donor and (ii) it reduces the marginal product of capital and thus the rate of return from the capital transfer declines. On the other hand, an increase in the recipient's financial savings reduces the capital transfer only by reducing the marginal utility of consumption in the second period as perceived by the donor.

The distortion in the rates of return from financial savings and the capital investment caused by the capital transfer induces the recipient to divert more resources towards the financial savings. The result is that in the presence of capital transfer, when the capital investment is at the efficient level, it is completely financed by the capital transfer. When there is no capital transfer, this distortion disappears and the donor can achieve the same allocations as under commitment using the multi-period budgetary transfers.

For a similar reason, the capital transfer has a larger disincentive effect on the recipient's capital investment compared to the second period budgetary transfer. As discussed above, an increase in the recipient's capital investment reduces the capital transfer both by lowering the marginal utility of consumption in the second period and the marginal productivity of capital. However, a higher capital investment by the recipient reduces the marginal benefit of the second period budget transfer to the donor only by lowering the marginal utility of consumption in the second period as perceived by the donor.

The analysis suggests that in an environment where the donor faces Samaritan's dilemma, tying the hands of the donor in the sense of foregoing the use of capital transfer as an instrument of aid can mitigate the incentive of the recipient to free ride on the concerns of the donor. General budgetary transfers can be more efficient instruments of giving aid than the capital transfer.

While the analysis is done in the context of foreign aid to a country, it is applicable in other contexts such as provision of aid to encourage human capital investment. Poor individuals may under-invest in their human capital due to imperfect financial markets. An altruistic aid agency may have to decide whether to provide income support (budgetary transfer) or subsidize the cost of human capital (capital transfer).

This paper relates to various strands of literature on foreign aid. There are studies which examine the role of tournament (Svensson 2000), delegation (Svensson 2003, Hagen 2006), and co-operation among donors (Torsvik 2005) in mitigating time-inconsistency problems. None of these papers address the question of incentive effects of different instruments, efficiency of capital

investment and the portfolio choice.

There is a nascent theoretical literature (Cordella and Ariccia 2007 and Jelovac and Vandeninden 2008), which examines the incentive effects of different instruments (e.g. general budgetary support, capital financing) in the contract-theoretic framework. These papers address the question of what is the most efficient instrument to disburse a *fixed* amount of aid. None of these papers address the question of efficiency of capital investment and the portfolio choice in an environment with time-inconsistency problem.

This paper also relates to a large theoretical literature which examines the effect of aid on development in general, (e.g. Azam and Laffont 2003, Pedersen 2001) and on investment and growth in particular (e.g. Pedersen 1996, Obstfeld 1999, Arellano et. al. 2009). However, none of these papers examine the issue of whether aid can lead to efficient level of capital investment, whether the form of transfer and its timing matters, and how they affect the allocation of resources between capital investment and financial savings.

The rest of the paper is organized as follows. Section 2 describes the model and derives the optimal choices of the donor and the recipient. Section 3 characterizes the optimal strategies of the donor and the recipient. Section 4 characterizes the equilibrium and constructs some illustrative examples. Section 5 discusses the policy implications. Section 6 analyzes the case when there is conflict between the objectives of the donor and the recipient and the capital expenditure financed by the capital transfer and the domestic capital have differential productivity. This is followed by concluding section.

2 Model

There are two-periods and two countries: one donor (d) and one recipient (r). The inhabitants of each country are identical and the government in each country maximizes the utility of its representative inhabitant. Let y_i^j be the endowment income (income without capital investment) of country $j = d, r$ in period $i = 1, 2$. Normalize the rate of discount to be one.

Apart from the endowment income, the recipient country also possesses a production technology, $f(k)$, which is increasing and concave in the capital investment, k:[1]

[1]Throughout the paper for any function $z(x)$, $z_x(x)$ and $z_{xx}(x)$ denote the first and the second derivative respectively.

$$f(k) \text{ with } f_k(k) > 0,\ f_{kk}(k) < 0 \ \&\ \lim_{k \to 0} f_k(k) \to \infty. \tag{2.1}$$

The production $f(k)$ takes place in period 2 and the capital investment, k, is undertaken in period 1. The recipient country chooses its consumption, c_i^r for $i = 1, 2$, and financial savings, s^r, and capital investment, k^r, in the first period to maximize its utility[2]

$$U(c_1^r) + U(c_2^r), \text{ with } U_c() > 0,\ U_{cc}() < 0. \tag{2.2}$$

Assume that the international financial markets are imperfect and the recipient country is not able to borrow and thus $s^r \geq 0$. Normalize the interest rate on financial savings to be one. Also assume that $k^r \geq 0$.

The donor country is altruistic and cares about the welfare of the recipient country. The donor can make two types of transfers to the recipient: (i) budgetary transfer in period 1 and 2, t_1 and t_2 respectively and (ii) capital transfer, k^d, in the first period.[3] The capital transfer is earmarked to finance the capital investment in the recipient country. These transfers are assumed to be non-negative, $t_1, t_2, k^d \geq 0$.

The donor (country) chooses its consumption, c_i^d, and budgetary transfers, t_i, in both periods and capital transfer, k^d, and financial savings, s^d, in the first period to maximize its utility

$$U(c_1^d) + U(c_2^d) + \lambda[U(c_1^r) + U(c_2^r)] \text{ with } U_c() > 0,\ U_{cc}() < 0 \tag{2.3}$$

where $0 < \lambda < 1$ is the degree of altruism and determines the relative weight which the donor puts on the welfare of the recipient (country). Assume that

[2]The model can be also interpreted as the recipient country having two sectors: one with the linear technology and the other with a technology which is increasing and concave in the capital investment. The capital investment in both sectors is financed by the resources of the recipient and the foreign aid. Assume that the sector with concave technology has a higher marginal productivity of capital compared to the other sector at low levels of capital investment and the donor makes capital transfer to a more productive sector. The results would be the same as long as we assume that the terms of trade between these two sectors are not affected by the capital investment.

[3]We assume that both the recipient and the donor countries produce and consume same commodity. Alternatively, one can assume that the recipient and the donor countries produce and consume two different goods, but these goods can be exchanged one to one in the competitive world market.

the donor does not face the borrowing constraint in the international financial markets.

The donor's budget constraints are

$$c_1^d = y_1^d - s^d - k^d - t_1 \ \& \tag{2.4}$$

$$c_2^d = y_2^d + s^d - t_2. \tag{2.5}$$

The recipient's budget constraints are

$$c_1^r = y_1^r - s^r - k^r + t_1 \ \& \tag{2.6}$$

$$c_2^r = y_2^r + s^r + t_2 + f(k) \tag{2.7}$$

where $k = k^r + k^d$ (sum of the capital investment financed by the recipient and the donor). Note that since the recipient can adjust its capital investment, k^r, the capital transfer by the donor, k^d, is fungible.

Similar to a large literature on aid (e.g. Buchanan 1975, Assar and Weibull 1988, Pederson 2001, Sevensson 2000, Torsvik 2005, Hagen 2006 etc.), we assume that the donor is a Stackelberg follower. In particular, we assume that aid is given by the donor after observing the recipient's choices of capital investment, k^r, and financial savings, s^r. The recipient exploits the donor's altruism. While making its decision, it takes into account how these decisions affect the level and the type of aid. We then have a sequential game with the recipient as the leader.

2.1 Donor's Problem

$$\max_{c_1^d, c_2^d, s^d, k^d, t_1, t_2} U(c_1^d) + U(c_2^d) + \lambda[U(c_1^r) + U(c_2^r)]$$

subject to the budget constraints (2.4) and (2.5) taking as given the choices of the recipient (c_i^r, s^r, k^r). Consumption of the donor in period 1 and 2 are given by (2.4) and (2.5) respectively. The first order conditions are

$$s^d : U_c(c_1^d) = U_c(c_2^d); \tag{2.8}$$

$$k^d : U_c(c_1^d) = \lambda U_c(c_2^r) f_k(k) \ \text{ if } k^d > 0; \tag{2.9}$$

$$k^d : U_c(c_1^d) \geq \lambda U_c(c_2^r) f_k(k) \text{ if } k^d = 0; \tag{2.9a}$$

$$t_1 : U_c(c_1^d) = \lambda U_c(c_1^r) \text{ if } t_1 > 0; \tag{2.10}$$

$$t_1 : U_c(c_1^d) \geq \lambda U_c(c_1^r) \text{ if } t_1 = 0; \tag{2.10a}$$

$$t_2 : U_c(c_2^d) = \lambda U_c(c_2^r) \text{ if } t_2 > 0 \ \& \tag{2.11}$$

$$t_2 : U_c(c_2^d) \geq \lambda U_c(c_2^r) \text{ if } t_2 = 0. \tag{2.11a}$$

(2.8) equates the marginal cost of financial savings to its marginal benefit. One additional unit of financial savings reduces the utility of the donor by $U_c(c_1^d)$ in the first period, but increases its utility by $U_c(c_2^d)$ in the second period.

(2.9) equates the marginal cost of capital transfer to its marginal benefit. One additional unit of capital transfer reduces the utility of the donor by $U_c(c_1^d)$ in the first period, but increases the output of the recipient by $f_k(k)$ and thus the utility of the donor by $\lambda U_c(c_2^r) f_k(k)$ in the second period. If the marginal cost of capital transfer is higher than its marginal benefit, the donor will not make capital transfer. (2.9a) characterizes this condition. This may occur if the degree of altruism and the first period endowment income of the donor and the marginal productivity of capital of the recipient are relatively low or the second period income of the recipient is relatively high.

Other first order conditions can be explained in a similar fashion. (2.10) equates the marginal cost and the marginal benefit of the first period budgetary transfer. If the marginal cost is higher than the marginal benefit, the donor will not make first period budgetary transfer. (2.10a) characterizes this condition. This may occur if the degree of altruism and the first period income of the donor are relatively low and the first period endowment income of the recipient is relatively high.

(2.11) equates the marginal cost and the marginal benefit of the second period budgetary transfer. If the marginal cost is higher than the marginal benefit, the donor will not make second period budgetary transfer. (2.11a) characterizes this condition. This may occur if the degree of altruism and the second period income of the donor are relatively low and the second period income of the recipient is relatively high.

From the partial differentiation of (2.9), (2.10), and (2.11), it follows that

$$\frac{dk^d}{dk^r} = -\frac{\lambda U_{cc}(c_2^r) f_k^2(k) + \lambda U_c(c_2^r) f_{kk}(k)}{U_{cc}(c_1^d) + \lambda U_{cc}(c_2^r) f_k^2(k) + \lambda U_c(c_2^r) f_{kk}(k)} < 0; \tag{2.12}$$

$$\frac{dk^d}{ds^r} = -\frac{\lambda U_{cc}(c_2^r) f_k^2(k)}{U_{cc}(c_1^d) + \lambda U_{cc}(c_2^r) f_k^2(k) + \lambda U_c(c_2^r) f_{kk}(k)} < 0; \tag{2.13}$$

$$\frac{dt_1}{dk^r} = \frac{\lambda U_{cc}(c_1^r)}{U_{cc}(c_1^d) + \lambda U_{cc}(c_1^r)} = \frac{dt_1}{ds^r} > 0; \tag{2.14}$$

$$\frac{dt_2}{dk^r} = -\frac{\lambda U_{cc}(c_2^r) f_k(k)}{U_{cc}(c_2^d) + \lambda U_{cc}(c_2^r) f_k(k)} < 0 \ \& \tag{2.15}$$

$$\frac{dt_2}{ds^r} = -\frac{\lambda U_{cc}(c_2^r)}{U_{cc}(c_2^d) + \lambda U_{cc}(c_2^r)} < 0. \tag{2.16}$$

(2.12) shows that a higher capital investment by the recipient, k^r, reduces capital transfer, k^d. This happens because a higher k^r reduces the marginal benefit of capital transfer to the donor for two reasons: (i) it increases the second period consumption of the recipient and thus reduces the marginal utility of consumption in the second period as perceived by the donor and (ii) it reduces the marginal product of capital and thus the rate of return from the capital transfer declines. Since, a higher capital investment by the recipient, k^r, increases its second period consumption, it also reduces the second period budgetary transfer (2.15). For a similar reason, a higher financial savings, s^r, by the recipient reduces capital transfer (2.13) and the second period budgetary transfer (2.16).

Note that (2.12) and (2.13) imply that $|\frac{dk^d}{ds^r}| < |\frac{dk^d}{dk^r}|$ i.e. a unit increase in the recipient's capital investment has a larger negative effect on the capital transfer from the donor than a unit increase in the recipient's financial savings. As discussed above, an increase in the recipient's capital investment reduces the capital transfer due to decline in both its marginal utility of consumption in the second period and the marginal product of capital. On the other hand, an increase in the recipient's financial savings reduces only its marginal utility of consumption in the second period, but does not affect the marginal product of capital. As we will see below, the larger negative effect of the recipient's capital investment on the capital transfer induces the recipient to save more in terms of financial savings.

The effect of a higher k^r and s^r on the first period budgetary transfer, t_1, however, is completely different. A higher k^r and s^r leads to a larger first period budgetary transfer, t_1 (2.14). This happens because a higher k^r and s^r reduces the consumption of the recipient and thus increases the marginal utility of consumption in the first period as perceived by the donor. This induces the donor to increase its first period budgetary transfer.

While making its choices, the recipient takes into account the effects of its choices on the transfers made by the donor. As we will see below, the first period budgetary transfer reduces the marginal cost of financial savings and capital investment of the recipient. On the other hand, the capital transfer and the second period budgetary transfer reduce the marginal benefits of financial savings and capital investment of the recipient.

2.2 Recipient's Problem

$$\max_{c_1^r, c_2^r, s^r, k^r} U(c_1^r) + U(c_2^r)$$

subject to the budget constraints (2.6) and (2.7) and the strategies of the donor characterized in (2.9-2.11a). Consumption of the recipient in period 1 and 2 are given by (2.6) and (2.7) respectively. The first order conditions are

$$s^r : U_c(c_1^r)(1 - \frac{dt_1}{ds^r}) = U_c(c_2^r)\left[f_k(k)\frac{dk^d}{ds^r} + \frac{dt_2}{ds^r} + 1\right] \text{ if s}^\text{r} > 0; \tag{2.17}$$

$$s^r : U_c(c_1^r)(1 - \frac{dt_1}{ds^r}) \geq U_c(c_2^r)\left[f_k(k)\frac{dk^d}{ds^r} + \frac{dt_2}{ds^r} + 1\right] \text{ if } s^r = 0; \tag{2.17a}$$

$$k^r : U_c(c_1^r)(1 - \frac{dt_1}{dk^r}) = U_c(c_2^r)\left[f_k(k)(1 + \frac{dk^d}{dk^r}) + \frac{dt_2}{dk^r}\right] \ \& \tag{2.18}$$

$$k^r : U_c(c_1^r)(1 - \frac{dt_1}{dk^r}) \geq U_c(c_2^r)\left[f_k(k)(1 + \frac{dk^d}{dk^r}) + \frac{dt_2}{dk^r}\right] \text{ if } k^r = 0. \tag{2.18a}$$

(2.17) equates the marginal cost of financial savings to its marginal benefit. One unit increase in the financial savings reduces consumption of the

recipient in the first period by less than one unit as it increases the budgetary transfer by the donor in the second period. Thus, the net decline in consumption and utility in the first period are given by $1 - \frac{dt_1}{ds^r}$ and $U_c(c_1^r)(1 - \frac{dt_1}{ds^r})$ respectively. Since, an increase in the financial savings reduces the capital transfer and the second period budgetary transfer, the net benefit from one unit of financial savings in the second period is less than one. The net increase in consumption and utility in the second period are given by $f_k(k)\frac{dk^d}{ds^r} + \frac{dt_2}{ds^r} + 1$ and $U_c(c_2^r)\left[f_k(k)\frac{dk^d}{ds^r} + \frac{dt_2}{ds^r} + 1\right]$ respectively. If the marginal cost of financial savings is higher than its marginal benefit, the recipient will not save. (2.17a) characterizes this condition.

(2.18) can be interpreted in a similar way. It equates the marginal cost of capital investment to its marginal benefit. The first period budgetary transfer reduces the marginal cost of capital investment, but the capital transfer and the second period budgetary transfer reduce its marginal benefit. One unit increase in k^r increases production by less than the marginal product of capital as the donor reduces the capital transfer and the second period budget transfer. The net decline in the utility in the first period is given by $U_c(c_1^r)(1 - \frac{dt_1}{dk^r})$. The net increase in consumption and utility in the second period are given by $f_k(k)(1 + \frac{dk^d}{dk^r}) + \frac{dt_2}{dk^r}$ and $U_c(c_2^r)\left[f_k(k)(1 + \frac{dk^d}{dk^r}) + \frac{dt_2}{dk^r}\right]$ respectively. If the marginal cost of the capital investment is higher than its marginal benefit, the recipient will not invest. (2.18a) characterizes this condition.

Note that the first period budgetary transfer encourages financial savings and capital investment by the recipient for two reasons: (i) the first period resources of the recipient increases and (ii) a higher financial savings and capital investment and thus lower consumption in the first period by the recipient elicits larger first period budgetary transfer from the donor. Similarly, the second period budgetary transfer discourages financial savings and capital investment by the recipient for two reasons: (i) the second period resources of the recipient increases and (ii) a lower consumption in the second period by the recipient elicits more second period budgetary transfer from the donor.

3 Efficiency of Capital Investment

The efficient level of capital investment in the recipient country is characterized by

$$f_k(k) = 1. \tag{3.1}$$

(3.1) equates the marginal product of capital to the rate of interest. Let k^* denote the efficient level of capital investment in the recipient country.

3.1 Capital Investment Without Aid

In this case, $k^d, t_1, t_2 = 0$. If $s^r > 0$, then (2.17), (2.18), and the assumption that $\lim_{k\to 0} f_k(k) \to \infty$ imply that

$$f_k(k^r) = 1. \tag{3.2}$$

Thus, if the recipient can borrow then the capital investment is at the efficient level, $k^r = k^*$. However, if $s^r = 0$ then it is straightforward to show that

$$f_k(k^r) > 1 \ \& \ 0 < k^r < k^*. \tag{3.3}$$

In this case, (2.17a) imply that $c_1^r \leq c_2^r$.

In the rest of the paper, we assume that in the *absence* of aid, $s^r = 0$ and the recipient cannot achieve the efficient level of capital investment from its own resources. Let variables with $\hat{}$ denote the optimal choices when there is no foreign aid. It is straightforward to show that $\hat{c}_1^d = \hat{c}_2^d = \hat{s}d = \frac{y_1^d + y_2^d}{2}$ and $\hat{c}_1^r$, $\hat{c}_2^r$ & $\hat{k}^r$ satisfy (2.6), (2.7), and (2.18) respectively.

Next, we analyze the optimal strategies of the donor and the recipient when there is foreign aid.

3.2 Capital Investment With Aid

We first characterized the optimal strategies of the donor.

3.2.1 Optimal strategies of the donor

Before any aid is given, initial conditions should be such that the donor can increase its welfare by giving aid. We first characterize the initial conditions under which it is optimal for the donor to use various instruments.

$$U_c(\hat{c}_1^d) < \lambda U_c(\hat{c}_1^r), \text{ for } t_1 > 0; \tag{3.4}$$

$$U_c(\hat{c}_2^d) < \lambda U_c(\hat{c}_2^r), \text{ for } t_2 > 0 \ \& \tag{3.5}$$

$$U_c(\hat{c}_1^d) < \lambda U_c(\hat{c}_2^r) f_k(\hat{k}^r), \text{ for } k^d > 0. \tag{3.6}$$

Given that $\hat{k}^r < k^*$, $\hat{c}_1^r \leq \hat{c}_2^r$ and $\hat{c}_1^d = \hat{c}_2^d$, these conditions show that if (3.5) is satisfied then (3.4) and (3.6) are satisfied as well. If the initial conditions are such that it is optimal for the donor to make the second period budgetary transfer to the recipient, it is also optimal for her to make the capital transfer and the first period budget transfer. Thus, when the degree of altruism and/or the relative difference in consumption between the donor and the recipient in the second period are high the donor is more likely to give aid using all the instruments.

Depending on the initial condition, the donor may also choose to only give first period budgetary transfer or the capital transfer or both. In particular, if the marginal productivity of capital is relatively high then the donor is likely to use the capital transfer. On the other hand, if the relative difference in consumption between the donor and the recipient in the first period is high then it is likely to use the first period budgetary transfer.

Next, we analyze the optimal choices of budgetary transfers and the pattern of consumption of the recipient. Results are summarized below:

Lemma 1:

(i) If t_1 & $t_2 > 0$, then $c_1^r = c_2^r$.

(ii) If $t_1 > 0$ & $t_2 = 0$, then $c_1^r \leq c_2^r$ and if $t_1 = 0$ & $t_2 > 0$, then $c_1^r \geq c_2^r$.

These results follow from the first order conditions of the donor. Intuitively, if the donor gives budgetary transfers in both periods, then it chooses them to equalize its perceived marginal utility from these two transfers and thus $c_1^r = c_2^r$. On the other hand, if the donor makes budgetary transfer only in the first period, the marginal utility to the donor from the first period budgetary transfer must be higher than its marginal utility to the donor from the second period budgetary transfer and thus $c_1^r \leq c_2^r$. Opposite happens if it makes budgetary transfers only in the second period. Note that these choices of budgetary transfers hold regardless of whether there is capital transfer.

Now we examine the donor's optimal choice of capital transfer for a given k^r. We distinguish between two cases: (i) the capital investment by the recipient is less than the efficient level, $0 \leq k^r < k^*$ and (ii) the capital investment by the recipient is equal or more than the efficient level, $k^r \geq k^*$.

Case I: $0 \leq k^r < k^*$

Proposition 1:

(i) If the donor makes budgetary transfer in the second period, $t_2 > 0$, then it also makes the capital transfer, $k^d > 0$. In addition, it chooses the capital transfer, $k^d > 0$, such that the total capital investment in the recipient country is at the efficient level for any $0 \leq k^r < k^*$, $k \equiv k^d + k^r = k^*$.

(ii) If the donor does not make budgetary transfer in the second period, $t_2 = 0$, then it chooses the capital transfer, $k^d > 0$, such that the total capital investment in the recipient country is inefficiently low for any $0 \leq k^r < k^*$, $k \equiv k^d + k^r < k^*$.

Proposition 1 shows that if there is capital transfer, then for any $k^r < k^*$, the budgetary transfer in the second period is crucial for achieving the efficient level of capital investment. If $t_2 = 0$, then the capital investment is inefficiently low regardless of whether $t_1 = 0$ or $t_1 > 0$.

These results follow from the first order conditions of the donor. Intuitively, if the donor values the utility of the recipient high enough to make budgetary transfer in the second period, it also values it high enough to make capital transfer when the capital investment by the recipient is inefficiently low.

Additionally, the size of capital transfer by the donor depends on the second period budget transfer due to following reason. The donor has two alternatives: (i) it can save in which case the return to the donor in utility terms is $V_c(c_2^d)$ or (ii) it can make capital transfer in which case the return in the utility terms is $\lambda V_c(c_2^r) f_k(k)$. At margin, it is going to be indifferent between the two.

If the donor is rich or altruistic enough such that $t_2 > 0$, then the marginal utility of consumption in the second period for the donor is equal to its perceived marginal utility of consumption for the recipient and thus $V_c(c_2^d) = \lambda V_c(c_2^r)$ and $f_k(k) = 1$. But when $t_2 = 0$, the donor values its second period consumption relatively more, $V_c(c_2^d) > \lambda V_c(c_2^r)$ and thus $f_k(k) > 1$.

Note that when $t_1,\ t_2,\ \&\ k^d > 0$,

$$\frac{U_c(c_1^r)}{U_c(c_2^r)} = f_k(k) = 1 \tag{3.7}$$

i.e. the donor is able to equalize both the marginal rate of substitution between consumption of the recipient (MRS^r) and the marginal product of

capital (MPK) to the rate of return on financial savings. However, in the case of $t_1 = 0$ & $t_2, k^d > 0$, $MRS^r \leq MPK = 1$. On the other hand, in the case of $t_1,\ k^d > 0$ & $t_2 = 0$, $MRS^r = MPK \geq 1$.

Case II: $k^r \geq k^*$

When $k^r \geq k^*$, it is straightforward to show that the donor will never choose to make both the second period budgetary transfer and the capital transfer i.e. either $t_2 > 0$ & $k^d = 0$ or $t_2 = 0$ & $k^d > 0$. Intuitively, when k^r is at efficient level or higher, then return to the donor from making second period budgetary transfer is higher than the capital transfer. Thus, if it can choose between these two alternatives, then it will not use the capital transfer.

3.2.2 Optimal strategies of the recipient

We analyze the optimal strategies of the recipient under two cases: (i) it receives capital transfer, $k^d > 0$ and (ii) it does not receive capital transfer, $k^d = 0$.

Case I: $k^d > 0$

Results are summarized below.

Proposition 2:

(i) If the capital transfer $0 < k^d < k^*$, then it is always optimal for the recipient to choose $k^r \geq 0$ such that the total capital investment $k \equiv k^r + k^d < k^*$. When the capital transfer $k^d \geq k^*$, then it is optimal for the recipient to choose $k^r = 0$.

(ii) If the recipient receives the capital transfer and the budgetary transfer in both periods, $t_1,\ t_2,$ & $k^d > 0$, then it is optimal for the recipient to choose $s^r = 0$.

(iii) If the recipient does not receive budgetary transfer in the second period, $t_2 = 0$, it is possible to have $s^r > 0$.

The proof of proposition 2 is in the appendix. The first result follows from the fact that the capital transfer distorts the relative rate of return between recipient's financial savings and capital investment. As discussed earlier,

the recipient's capital investment has a larger negative effect on the capital transfer compared to its financial savings. This makes financial savings more attractive and induces the recipient to under-invest in capital relative to the efficient level.

Note that this under-investment relative to the efficient level is not due to the standard strategic reason as analyzed in Pedersen (1996), where the recipient under-invests in order to elicit more capital transfer. Rather it is due to the distortion in the relative rate of return between financial savings and capital investment. Also, this distortion remains regardless of whether the recipient receives budgetary transfers.

The second result follows from the fact that the disincentive effect of capital transfer on financial savings lowers the rate of return from financial savings. At the same time, the positive incentive effect of the first period budgetary transfers on the recipient's financial savings is counter-balanced by the negative incentive effect of the second period budgetary transfer. Thus, the recipient does not save at all.

Finally, when $t_2 = 0$, its negative incentive effect on the financial savings is no longer operational. In this case, it is possible to have, $s^r > 0$.

Case II: $k^d = 0$

As discussed earlier, when $k^d = 0$ only possibility is that the recipient receives first period budgetary transfer. Then using (2.18), it straightforward to show that the first period budgetary transfer increases k^r relative to $\hat{k}$. This happens due to two reasons: (i) the recipient's first period resources increases and (ii) the positive incentive effect on the capital investment, $\frac{dt_1}{dk^r} > 0$.

4 Equilibrium

So far, we have characterized the best-reply correspondences of the donor and the recipient. Equilibria will occur at the intersections of these correspondences. Let V^r_{ijl} be the value function of the recipient under different aid regimes, where first two subscripts i & j indicate whether the recipient receives first and second period budgetary transfers respectively, and subscript l indicates whether it receives the capital transfer. For example, V^r_{111} indicates the value function of the recipient, when t_1, t_2, & $k^d > 0$. Any equilibrium aid regime(s) will satisfy following two conditions:

$$V^r = max\{V^r_{111},\ V^r_{011},\ V^r_{001},\ V^r_{100},\ V^r_{101}\} \geq V^r_{000} \tag{4.1}$$

and

$$V^d \geq V^d_{000} \tag{4.2}$$

where V^d is the value function of the donor corresponding to the aid-regime(s) satisfying (4.1) and V^d_{000} is the value function of the donor when no aid is given. Now we characterize possible types of equilibria.

4.1 Equilibrium with capital transfer

The results are summarized below.

Proposition 3:

(i) If there is an equilibrium such that the total capital investment is at the efficient level, $k = k^*$, then in equilibrium, it must be the case that the recipient receives the second period budgetary transfer from the donor, $t_2 > 0$. In addition, $k^d = k^*$ and $k^r,\ s^r = 0$.

(ii) If there is an equilibrium such that the total capital investment is inefficiently low, $k < k^*$, then in equilibrium, it must be the case that the recipient does not receive the second period budgetary transfer, $t_2 = 0$. In such an equilibrium, it is possible to have k^r & $s^r > 0$.

These results follow from propositions 1 and 2. As discussed earlier, the capital transfer makes financial savings more attractive to the recipient relative to the capital investment. Further, the free rider problem is exacerbated when the recipient receives the second period budgetary transfer. While making its choices, the recipient takes into account that for any $k^r < k^*$, the donor will make large enough capital transfer such that the capital investment is at the efficient level. In order to elicit larger capital transfer, it reduces its own capital investment to zero. Finally, when the capital investment is at the efficient level, the disincentive effect of s^r on the the capital transfer makes the return from financial savings too low and thus $s^r = 0$.

Even in the case where the recipient receives only the first period budgetary transfer and the capital transfer, since $MRS^r = MPK$, (2.18) implies that for $k^r > 0$, it must be the case that $\frac{dt_1}{dk^r} = |\frac{dk^d}{dk^r}|$ in equilibrium, i.e. the

positive incentive effect of t_1 on k^r exactly balances out the negative incentive effects of k^d on k^r. Similarly, for $s^r > 0$, the necessary condition is that the positive incentive effect of t_1 on financial savings must be strictly larger than the negative incentive effects of k^d on financial savings.

In the case, the recipient receives only capital transfer, the equilibrium k^r can be strictly positive. However, it will be less than $\hat{k}^r$ due to the negative incentive effect of k^r on k^d and the fall in the marginal product of capital which reduces the rate of return on capital investment for any $k^d > 0$. If the fall in k^r is large enough, it may lead to $s^r > 0$. Note that (2.17) imply that equilibrium $c_1^r > c_2^r$ even though $s^r > 0$. The negative incentive effect of k^d on s^r prevents the recipient to save enough to equalize c_1^r and c_2^r.

These results imply that when the recipient receives both the second period budgetary transfer and the capital transfer, then in equilibrium the recipient's capital investment will be zero regardless of whether the recipient receives budgetary transfer in the first period or not. The capital transfer completely crowds out the recipient's own capital investment. The analysis suggests that whenever the capital investment is at efficient level, it is fully financed by the capital transfer and the budgetary transfers are entirely used for consumption. The recipient's contribution to the capital investment is strictly positive only when the total capital investment is inefficiently low.

4.2 Equilibrium without capital transfer

As discussed earlier, we only need to consider the case in which $t_1 > 0$. In this case, equilibrium depends on the size of the positive incentive effect of the first period budgetary transfer on the recipient's capital investment and financial savings. If the positive incentive effect on the financial savings is large enough then $s^r > 0$. In this case, since, $\frac{dt_1}{ds^r} = \frac{dt_1}{dk^r}$, (2.17) and (2.18) imply that the capital investment is at the efficient level and $k^r = k^*$.

However, if the positive incentive effect on the financial savings is not large enough then $s^r = 0$ (2.17a holds) and the capital investment is inefficiently low,

$$f_k(k^r) > 1 \tag{4.3}$$

and $\hat{k}^r < k^r < k^*$.

So far we have characterized various types of aid regimes, which may emerge in equilibrium. Now, we ask the question which aid regime would

yield the highest utility to the recipient.

Proposition 4: $V^r_{111} > V^r_{011} > V^r_{001}$. In addition, $V^r_{111} > V^r_{100}$ or V^r_{101} if it is optimal for the recipient to choose $s^r = 0$ in these two aid regimes.

These results follow from Lemma 1 and propositions 1 and 2. Proposition 4 shows that aid regime $t_1,\ t_2,\ \&\ k^d > 0$ may not be the most preferred outcome for the recipient. There may be situations where it prefers aid regimes $t_1 > 0\ \&\ k^d,\ t_2 = 0$ or $t_1,\ k^d > 0\ \&\ t_2 = 0$, if the associated optimal financial savings for the recipient is strictly positive, $s^r > 0$.[4]

Note that in these two cases, $c^r_1 \leq c^r_2$ and $s^r > 0$. The recipient chooses strictly positive level of financial savings, though it first period consumption is lower than its second period consumption. In addition, in the case of $t_1 > 0\ \&\ k^d,\ t_2 = 0$, capital investment $k = k^r = k^*$, while in the case of $t_1,\ k^d > 0\ \&\ t_2 = 0$, capital investment $k < k^*$ and k^r may be positive. In contrast to these two aid regimes, when $t_1,\ t_2,\ \&\ k^d > 0$, we have $c^r_1 = c^r_2$, $k = k^d = k^*$, and $s^r,\ k^r = 0$.

The reason that the recipient may choose to tilt its consumption towards second period is the positive incentive effect of the first period budgetary transfer on financial savings and capital transfer. More financial savings and capital investment elicit larger first period budgetary transfer from the donor. If these effects are strong enough, it may be optimal for the recipient to choose $s^r\ \&\ k^r > 0$.

4.3 Examples

Below, we illustrate the existence of various types of equilibria in a model with logarithmic utility function, $\log c$, and a power production function, βk^α, with $0 < \alpha < 1$. For simplicity, suppose that both the donor and the recipient have no endowment income in the second period, $y^d_1 = y^d$, $y^r_1 = y^r$, and $y^d_2 = y^r_2 = 0$.

When there is no aid, the optimal choices of the donor are given by

$$\hat{c}^d_1 = \hat{c}^d_2 = \hat{s}^d = \frac{y^d}{2}. \tag{4.4}$$

[4]For these regimes to emerge in equilibrium, it also must be the case that the associated $V^d \geq V^d_{000}$.

Under the parametric restriction that $y^r < (1+\alpha)(\alpha\beta)^{\frac{\alpha}{1-\alpha}}$, the optimal choices of the recipient are given by

$$\hat{c}_1^r = \frac{y^r}{1+\alpha},\ \hat{c}_2^r = [\frac{\alpha\beta}{1+\alpha}y^r]^\alpha,\ \hat{k}^r = \frac{\alpha y^r}{1+\alpha}\ \&\ \hat{s}^r = 0. \tag{4.5}$$

We only consider the set of parameter values $(y^d,\ y^r\ \lambda,\ \alpha,\ \beta)$ such that

$$\hat{c}_2^r < \lambda\hat{c}_2^d \tag{4.6}$$

i.e. it is optimal for the donor to give aid using all the three instruments for a given $\hat{k}^r$ and $\hat{s}^r$. This condition is more likely to be satisfied higher is the endowmnt income and the degree of altruism of the donor and lower is the endowment income of the recipient and the productivity of capital. For each set of parameter values, we examine which aid regime(s) emerges in equilibrium and calculate the total transfer made by the donor $(t_1 + t_2 + k^d)$ as a proportion of donor's endowment, y^d, and its composition.

With the assumed form of the production function, the efficient level of capital investment is given by

$$k^* = (\alpha\beta)^{\frac{1}{1-\alpha}} \tag{4.7}$$

which is increasing in the productivity parameter β and is independent of y^d, y^r, and λ.

Relative Income Gap

We first consider the effects of changes in the endowment income of the donor. Other things remaining the same, an increase in the endowment income of the donor reduces the marginal cost of aid to the donor. We arbitrarily set $y^r = .5$, $\lambda = .7$, $\alpha = .3$, and $\beta = 1$, and then vary y^d. Note that with these parameter values, the efficient level of capital investment, $k^* = 0.18$. Given other parameter values, (4.6) is satisfied for any $y^d \geq 1.55$. We simulate the model for $y^d \in [1.55,\ 3]$.

Simulation shows that for any $y^d \geq 1.99$, the aid regime $t_1,\ t_2,\ \&\ k^d > 0$ emerges as an equilibrium with $k^d = k^*$, $c_1^r = c_2^r$, and $k^r,\ s^r = 0$. However, for $1.89 \leq y^d < 1.99$, no aid regime emerges as an equilibrium. Finally, for $1.55 \leq y^d < 1.89$, the aid regime $t_1,\ t_2 = 0\ \&\ k^d > 0$ emerges as equilibrium. We find that even in this aid regime, the equilibrium $k^r,\ s^r = 0$ and $c_1^r = y^r < c_2^r$, though $k^d < k^*$. The disincentive effect of capital transfer

is so large that the recipient reduces its capital investment and financial savings to zero.

Note that given the functional forms, when the recipient receives only capital transfer and the optimal $k^r,\ s^r = 0$, the equilibrium capital transfer is given by

$$k^d = \frac{\lambda\alpha}{2+\lambda\alpha} y^d. \tag{4.8}$$

The capital transfer is increasing in the endowment income and the degree of the altruism of the donor, but is independent of the productivity parameter. However, the share of capital transfer to the endowment income of the donor is independent of the the endowment income of the donor, but an increasing function of the degree of altruism of the donor. Given the parameter values, in this aid regime $\frac{k^d}{y^d} = .095$.

Figure 1 plots the share of the total transfer to the donor's endowment ($shttyd$), the share of t_1 to the donor's endowment ($sht1yd$), the share of t_2 to the donor's endowment ($sht2yd$), and the share of k^d to the donor's endowment ($shkdyd$) for $yd \in [1.55, 3]$. It shows that the shares of the total transfer and the first and the second period budgetary transfers to the donor's endowment are increasing functions of the endowment income of the donor in the aid regime $t_1,\ t_2,\ \&\ k^d > 0$. The increasing shares of the total transfer and the first and the second period budgetary transfers to the donor's endowment reflect the falling marginal cost of aid. Given that the efficient level of capital investment is constant, the share of capital transfer to the donor's endowment falls with the endowment income of the donor.

Degree of Altruism

Now, we analyze the effects of the degree of altruism. Other things remaining the same, an increase in the degree of altruism of the donor increases the marginal benefit of aid to the donor. We set $y^d = 2.5$, $y^r = .5$, $\alpha = .3$, and $\beta = 1$, and then vary λ. In this case as well, k^* remains fixed. Given other parameter values, (4.6) is satisfied for any $\lambda \geq .42$. We simulate the model for $\lambda \in [.42,\ .9]$.

The results are similar to that of changes in y^d. For any $\lambda \geq 0.53$, the aid regime $t_1,\ t_2,\ \&\ k^d > 0$ with $c_1^r = c_2^r$, and $k^r,\ s^r = 0$ emerges as an equilibrium. However, for $.515 \leq \lambda < .53$ there is no equilibrium. Finally, for $.42 \leq \lambda < .515$, the aid regime $t_1,\ t_2 = 0\ \&\ k^d > 0$ with $c_1^r < c_2^r$, and $k^r,\ s^r = 0$ emerges as an equilibrium.

Figure 2 plots the effects of changes in λ on the share of the total transfer to the donor's endowment and its components. It shows that in the aid regime $t_1,\ t_2,\ \&\ k^d > 0$ the shares of the total transfer and the first and the second period budgetary transfers to the donor's endowment are increasing functions of the degree of altruism of the donor reflecting increasing marginal benefit of aid. Given that the efficient level of capital investment and the endowment income of the donor are constant, the share of capital transfer to the donor's endowment remains constant at 0.076. As discussed earlier, in the aid regime $t_1,\ t_2 = 0\ \&\ k^d > 0$, the share of capital transfer to the donor's endowment increases.

Productivity Parameter

Finally, we examine the effects of productivity parameter, β. An increase in the productivity parameter affects level and type of aid in a number of ways. Firstly, it increases the second period consumption of the recipient for a given capital investment reducing the marginal benefit of second period budgetary transfer to the donor. It's effect on capital transfer is more complicated. On the one hand, it increases the rate of return from capital transfer. But at the same time an increase in the second period consumption reduces the marginal benefit of the capital transfer. For similar reasons, it may increase or reduce the recipient's own capital investment. Finally, the size of k^* also increases.

We set $y^d = 2.5$, $y^r = .5$, $\lambda = .7$, and $\alpha = .3$, and then vary β. Given other parameter values, (4.6) is satisfied for any $\beta \leq 1.67$. We simulate the model for $\beta \in [.1,\ 1.67]$. Similar to previous cases, simulations show that for any $0.1 \leq \beta \leq 1.14$, the aid regime $t_1,\ t_2,\ \&\ k^d > 0$ with $c_1^r = c_2^r$, and $k^r,\ s^r = 0$ emerges as an equilibrium. However, for $1.14 < \beta \leq 1.215$, no aid regime emerges as an equilibrium. Finally, between $1.215 < \beta \leq 1.67$ the aid regime $t_1,\ t_2 = 0\ \&\ k^d > 0$ with $c_1^r < c_2^r$, and $k^r,\ s^r = 0$ emerges as an equilibrium. In this equilibrium, the recipient receives a constant proportion of the donor's endowment income as capital transfer, $\frac{k^d}{y^d} = .095$.

Figure 3 plots the effects of changes in β on the share of the total transfer to the donor's endowment and its components. It shows that in the aid regime $t_1,\ t_2,\ \&\ k^d > 0$ the shares of the total transfer and the second period budgetary transfers to the donor's endowment are decreasing functions of the productivity parameter of the donor. However, the shares of the first period budgetary transfer and the capital transfer to the donor's endowment

are increasing functions of the productivity parameter of the donor.

The reasons for these results are as follows. As β rises, the recipient becomes better-off for a given capital investment resulting in lower second period budgetary transfer and total transfer. At the time, the efficient level of capital investment increases, resulting in larger capital transfer. Finally, as the second period output in the recipient country rises, the donor increases the first period budgetary transfer to equalize the consumption of the recipient in both periods.

Overall, these examples suggest that higher is the relative income gap and the degree of altruism of the donor and lower is the productivity of the recipient, more likely the recipient will receive the budgetary transfers in both periods and the capital transfer. Even in cases, where the recipient does not receive the second period budgetary transfer, the disincentive effect of capital transfer on the capital investment may induce the recipient to reduce its own contribution to the minimum level.

These examples also suggest that due to strategic interactions among the donor and the recipient, there need not be a linear relationship between the level and the type of aid and the relative incomes of the donor and the recipient, the degree of altruism of the donor, and the productivity level of the recipient. Among poor and low productivity countries, relatively very poor and low productivity countries or relatively less poor and high productivity countries may receive aid, but countries falling in the middle range may not receive any aid. Similarly, the donors in the middle range of the degree of altruism may not provide aid.

5 Policy Implications

The disincentive effect of aid is well-recognized and has spawned a large literature to devise methods to mitigate this problem and increase the effectiveness of aid in achieving its goals. One strand of literature has adopted a contract-theoretic approach and focussed on the issue of conditionality, where aid is made conditional on the performance of the recipient (e.g. Azam and Laffont 2003, Cordella and Ariccia 2007; see Temple 2010 for a thorough review). The other strand, which assumes that the donor is a Stackelberg follower, has focused on issues such as co-operation among donors (Torsvik 2005), delegation (Svennson 2000, Hagen 2006), and generating competition among the recipients (Svennson 2003).

This paper suggests that the form and the timing of aid have a differential effects on the incentives of the recipient. The first period budgetary transfer increases the incentive of the recipient to make capital investment. On the other hand, the second period budgetary transfer and the capital transfer have a disincentive effect on the capital investment. In particular, the capital transfer is highly distortionary as it creates a wedge between the rates of return from capital investment and financial savings for the recipient. This raises the question whether restricting the use of capital transfer can mitigate the effects of the strategic behavior by the recipient and what would be the resulting allocations.

Now, we show that in *the absence of capital transfer*, the multi-period budgetary transfers can achieve not only the efficient level of capital investment, but also the allocations achieved under commitment. By using the multi-period budgetary transfers, the donor can balance the incentive and the disincentive effects of budgetary transfers. The analysis suggests that in this environment by forgoing the use of capital transfer, the donor can mitigate the adverse effects of the strategic behavior by the recipient.

5.1 Allocations under discretion and commitment in the absence of capital transfer

Suppose that the initial conditions are such that, it is optimal for the donor to use all the three instruments of aid. However, there is a rule which forbids the use of capital transfer as an instrument of aid. Thus, the donor can only make budgetary transfers in both periods. Let us first look at the allocations when the donor is the Stackelberg follower (under discretion).

In this case, Lemma 1 implies that $c_1^r = c_2^r$ and the marginal utilities of consumption for both periods for the recipient are equalized. Also from (2.14) and (2.16) it follows that $\frac{dt_1}{ds^r} = |\frac{dt_2}{ds^r}|$. The donor chooses t_1 and t_2 in such a way that the positive incentive effect of t_1 on the recipient's financial savings exactly offsets the negative incentive effect of t_2. Similarly, given that $c_1^d = c_2^d$, (2.14) and (2.15) imply that $\frac{dt_1}{dk^r} = |\frac{dt_2}{dk^r}|$ for $f_k(k) = 1$. Similar to the financial savings, the positive incentive effect of t_1 on the recipient's capital investment exactly offsets the negative incentive effect of t_2.

Since $\lim_{k\to 0} f_k(k) = \infty$, (2.17) and (2.18) imply that there is an equilibrium such that the financial savings by the recipient is strictly positive, $s^r > 0$, and the capital investment is at the efficient level

$$f_k(k^r) = 1. \tag{5.1}$$

From (2.4-2.8), Lemma 1, (2.18) and (5.1), it follows that

$$c_1^r = c_2^r = \frac{1}{2}[y_1^r + y_2^r + t_1 + t_2 + f(k^*) - k^*]; \tag{5.2}$$

$$k^r = k^* \ \& \tag{5.3}$$

$$c_1^d = c_2^d = \frac{1}{2}[y_1^d + y_2^d - t_1 - t_2]; \tag{5.4}$$

where the optimal choices of t_1 and t_2 satisfy (2.10) and (2.11) respectively.

Now suppose that the donor only makes budgetary transfers and it can commit to its optimal transfer policy. Fully aware of the donor's policy, the recipient makes its financial savings and capital investment decisions. The recipient's problem is to maximize its utility subject to its budget constraints (2.6) and (2.7) for a given t_1 and t_2. The first order conditions are

$$s^r : U_c(c_1^r) = U_c(c_2^r) \ \& \tag{5.5}$$

$$k^r : U_c(c_1^r) = U_c(c_2^r) f_k(k^r). \tag{5.6}$$

From (2.6), (2.7), (5.5) and (5.6), it follows that

$$c_1^r = c_2^r = \frac{1}{2}[y_1^r + y_2^r + t_1 + t_2 + f(k^*) - k^*]; \tag{5.7}$$

$$f_k(k^r) = 1 \ \& \ k^r = k^* \tag{5.8}$$

which coincide with (5.2) and (5.3) respectively.

The donor maximizes its utility subject to its budget constraints (2.4 & 2.5) and the strategies of the recipient given in (5.7) and (5.8). The first order conditions are

$$s^d : U_c(c_1^d) = U_c(c_2^d); \tag{5.9}$$

$$t_1 : U_c(c_1^d) = \lambda U_c(c_1^r) \ \& \tag{5.10}$$

$$t_2 : U_c(c_2^d) = \lambda U_c(c_2^r). \tag{5.11}$$

(5.10) and (5.11) are identical in form to (2.10) and (2.11) respectively. Using (2.4), (2.5), and (5.9), we have

$$c_1^d = c_2^d = \frac{1}{2}[y_1^d + y_2^d - t_1 - t_2] \tag{5.12}$$

which coincides with (5.4). Thus the allocations under commitment are identical to the allocations under discretion, if the donor can make budgetary transfers in both periods.[5]

Proposition 5: In the absence of capital transfer, if the donor makes budgetary transfers in both periods the allocations under *discretion* and *commitment* coincide.

5.2 Budgetary transfers vrs. capital transfers

As discussed earlier, policy makers are increasingly advocating the use of the budgetary transfers rather than the capital transfer as budgetary transfers lead to better alignment of goals of the donors and the recipients and better co-ordination among various projects (World Bank 1998, 2005, OECD 2007). Cordella and Ariccia (2007) examine the issue of the relative effectiveness of the (conditional) budgetary transfer and the capital transfer in the principal-agent framework, where the donor is the principle. They find that the conditional budgetary transfer leads to a higher level of development expenditure than the capital transfer, when the goals of the donor and the recipient are relatively close. Jelovac and Vandeninden (2008) generalize the Cordella and Ariccia model by allowing for a more general form of the production function and the simultaneous choice of both the budgetary transfers (unconditional or conditional) and the capital transfer by the donor. They find that the budgetary transfers are relatively more effective than the capital transfer.

[5]Under commitment when the donor also makes capital transfer, it is easy to show that the recipient chooses k^r such that $f_k(k) = 1$ for any $0 < k^d < k^*$, if $s^r > 0$. However, as discussed earlier, under discretion the recipient always chooses k^r such that $f_k(k) > 1$. Thus, the allocations under commitment do not coincide with allocations under discretion.

Our analysis provides further insight on the relative effectiveness of different types of instruments of aid. This question can be posed in (at least) two ways. Firstly, how do different instruments and their combination affect the incentives of the recipient to make capital investment? Secondly, which instruments and their combinations lead to the efficient level of capital investment?

Regarding the first question, our analysis shows that if the goal of the donor is to increase the contribution of the recipient to the capital investment, then the first period budgetary transfer is preferable to the other kinds of transfers. Also from (2.8), (2.12) and (2.15), it follows that between the second period budgetary transfer and the capital transfer, the capital transfer has a larger disincentive effect on the capital investment by the recipient, since $|\frac{dk^d}{dk^r}| > |\frac{dt_2}{dk^r}|$ for any $f_k(k) \geq 1$. The reason is that an increase in k^r reduces t_2 by increasing the second period consumption of the recipient, but it reduces k^d both because the marginal product of capital falls as well as increasing the second period consumption of the recipient.

The analysis shows that the interaction among instruments have significant implications with regard to the effectiveness of aid and the nature of equilibrium. As discussed earlier, by using multi-period budgetary transfers the donor can balance their incentive and disincentive effects. However, the combination of capital and second period budgetary transfer magnifies the disincentive effect. It completely crowds out of the recipient's own contribution to the capital investment, even if the recipient receives budgetary transfer in the first period.

Regarding the second question, our analysis shows that if the donor is using only one instrument it cannot achieve the efficient level of capital investment through the capital transfer. The first period budgetary transfer can lead to the efficient level of capital investment in the absence of capital transfer. However, in the case of capital transfer, the total capital investment is at the efficient level only when the recipient also receives budgetary transfer in the second period. As discussed earlier, in this case it completely crowds out the recipient's own contribution to the capital investment.

The analysis also suggests that the disincentive effects of the capital transfer and the second period budgetary transfer are magnified when the recipients have access to different instruments of savings and investment (financial and physical). In particular, the capital transfer distorts the rate of return on financial savings and the capital investment and make the financial savings more attractive.

It is possible that the recipient chooses to invest in financial instruments abroad with lower rate of return than to invest in capital domestically. This can happen particularly when the recipient receives capital transfer but no second period budgetary transfer. As shown earlier, in these cases it is possible to have $s^r > 0$ despite the fact that $f_k(k) > 1$. In this sense, aid can lead to "capital flight".[6]

5.3 Human capital investment

While the analysis is done in the context of foreign aid to a country, it is applicable more generally to all situations where an individual or agency is not able to make efficient level of investment in productive opportunities due to imperfections in the financial markets. One important situation arises where poor individuals may under-invest in their human capital (schooling, health) due to imperfect financial markets. An altruistic aid agency may have to decide the level of aid as well whether to provide income support (budgetary transfer) and its timing or subsidize the cost of human capital (capital transfer) or both. The analysis suggests that income support may be a more efficient instrument of aid.

6 Discussion

So far we have assumed that the domestic capital and the capital transfer are equally productive and there is perfect alignment between the goals of the donor and the recipient. However, the donor and the recipient may have differen goals. For example, the donor may just care about the development expenditure rather than the overall welfare of the recipient. Similarly, the projects financed by the donor may be less productive (possibly due to lack of perfect fit with the physical environment of the recipient) or it may be more productive (possibly due to superior technology or expertise). Now, we relax these two assumptions.

Suppose that domestic capital and capital transfer have differential productivity. Specifically, let the production function has following form

[6]The issue of capital flight has been mainly analyzed in the context of political instability, corruption, investment risk etc. (e.g. Alesina and Tabillini 1989, Bhattacharya 1999).

$$f(k) \equiv f(k^r + \delta k^d) \tag{6.1}$$

where the total effective capital, $k = k^r + \delta k^d$ and $\delta > 0$. δ captures the differential productivity of domestic and foreign capital. If $\delta < 1$ the marginal productivity of capital transfer is lower and if $\delta > 1$ the marginal productivity of capital transfer is higher than the domestic capital. Rest of the model remains as before.

The first order condition for the optimal choice of k^d modifies to

$$k^d : U_c(c_1^d) = \delta\lambda U_c(c_2^r) f_k(k) \;\text{ if } k^d > 0 \;\& \tag{6.2}$$

$$k^d : U_c(c_1^d) \geq \delta\lambda U_c(c_2^r) f_k(k) \;\text{ if } k^d = 0. \tag{6.2a}$$

Denote the level of effective capital satisfying the condition that $f_k(k) = \frac{1}{\delta}$ by $\tilde{k}$. For $\delta < 1$, $\tilde{k} < k^*$. Then using (2.8), (2.11), (6.2), and (6.2a), it is straight forward to show that for any $0 \leq k^r < \tilde{k}$ when $t_2 > 0$ the donor will choose k^d such that

$$f_k(k) = \frac{1}{\delta}. \tag{6.3}$$

(6.3) equates the marginal return to the donor from the capital transfer, $\delta f_k(k)$, to the marginal return from the second period budgetary transfer, 1.

For any $k^r \geq \tilde{k}$, the donor will choose $k^d = 0$. Also, if $t_2 = 0$,

$$f_k(k) > \frac{1}{\delta}. \tag{6.4}$$

If $\delta < 1$, (6.3) and (6.4) imply that for any $0 \leq k^r < \tilde{k}$, there will be under-investment of capital relative to the efficient level. On the other hand, if $\delta > 1$ and $t_2 > 0$, there will be over-investment of capital relative to the efficient level for any $0 \leq k^r < \tilde{k}$.[7]

Turning to the recipient's optimal choices, the first order conditions of the recipient are given by:

$$s^r : U_c(c_1^r)(1 - \frac{dt_1}{ds^r}) = U_c(c_2^r)\left[\delta f_k(k)\frac{dk^d}{ds^r} + \frac{dt_2}{ds^r} + 1\right] \;\text{ if } \mathrm{s^r} > 0; \tag{6.5}$$

[7] If $\delta < 1$, (6.2) and (6.2a) also imply that the donor is less likely to use capital transfer. On the other hand, if $\delta > 1$, the donor is more likely to use capital transfer.

$$s^r : U_c(c_1^r)(1 - \frac{dt_1}{ds^r}) \geq U_c(c_2^r)\left[\delta f_k(k)\frac{dk^d}{ds^r} + \frac{dt_2}{ds^r} + 1\right] \text{ if } s^r = 0; \qquad (6.5a)$$

$$k^r : U_c(c_1^r)(1 - \frac{dt_1}{dk^r}) = U_c(c_2^r)\left[f_k(k)(1 + \delta\frac{dk^d}{dk^r}) + \frac{dt_2}{dk^r}\right] \ \& \qquad (6.6)$$

$$k^r : U_c(c_1^r)(1 - \frac{dt_1}{dk^r}) \geq U_c(c_2^r)\left[f_k(k)(1 + \delta\frac{dk^d}{dk^r}) + \frac{dt_2}{dk^r}\right] \text{ if } k^r = 0. \qquad (6.6a)$$

Suppose now that t_2 $\& k^d > 0$. Using (6.5)-(6.6a), it is straightforward to show that $k^r, s^r = 0$ as $\frac{dk^d}{ds^r}$ & $\frac{dk^d}{dk^r} < 0$.[8]

Proposition 6: If the domestic capital and capital transfer have differential productivity, the capital transfer does not lead to efficient level of total capital investment in the recipient country.

Now, suppose that the objectives of the donor and the recipient are misaligned as assumed by most of the literature (e.g. Pedersen 1996, 2001, Hagen 2006, Cordella and Ariccia 2007). In particular, suppose that the donor only cares about the second period consumption (or growth) of the recipient. In this case, the objective function of the donor is

$$U(c_1^d) + U(c_2^d) + \lambda U(c_2^r). \qquad (6.7)$$

It is straightforward to show that in this case $t_1 = 0$ and the donor will only use the second period budgetary transfer and the capital transfer. The rest of the analysis and policy implications remain the same.

7 Conclusion

This paper developed a two-period and two-country model in which an altruistic donor country faces Samaritan's Dilemma to address three important

[8]The expressions for $\frac{dk^d}{dk^r}$ & $\frac{dk^d}{ds^r}$ are slightly different than in (2.12) and (2.13), but the qualitative properties remain the same. In particular, $|\frac{dk^d}{dk^r}| > |\frac{dk^d}{ds^r}|$ and $|\frac{dk^d}{dk^r}| > |\frac{dt_2}{dk^r}|$.

policy questions. Firstly, whether foreign aid can lead to efficient level of capital investment in the recipient country. Secondly, whether the form of aid transfer (e.g. budgetary transfer, direct financing of capital investment) and its timing matter for the efficiency of the capital investment. Thirdly, what instruments can be used to mitigate the problems of dynamic inconsistency?

The paper finds that the capital transfer makes financial savings more attractive relative to the capital investment for the recipient. The result is that when the capital investment is at the efficient level, the capital transfer completely crowds out the recipient's own capital investment. In the case of capital transfer, the recipient contribution to the capital investment is strictly positive, only when the total capital investment is inefficiently low.

The analysis has a number of policy implications. It finds that the general budgetary transfers have less distortionary effect on the recipient than the capital transfer. Using multi-period budgetary transfers rather than the capital transfer, the donor can achieve not only the efficient level of capital investment, but the same allocations as under commitment. By tying its hand in the sense of forgoing capital transfer, the donor can give aid more efficiently.

The analysis shows that the effect of aid on capital investment depends on a number of factors such as the type of aid, the timing of aid, and the interaction among different types of aid. In designing aid policy, the donor needs to be congnizent of these factors. While the analysis in this paper is done in the context of foreign aid to a country, it is applicable more generally to all the situations where an individual or agency is not able able to make efficient level of investment in productive opportunities due to imperfections in the financial markets and an altruistic donor can provide aid using multiple instruments.

Appendix

Proof of Proposition 2:

(i) First, suppose that s^r & $k^r > 0$ i.e. (2.17) and (2.18) hold. Then, (2.14), (2.17) and (2.18) imply that

$$\left[f_k(k)\frac{dk^d}{ds^r} + \frac{dt_2}{ds^r} + 1\right] = \left[f_k(k)(1 + \frac{dk^d}{dk^r}) + \frac{dt_2}{dk^r}\right]. \qquad (A1)$$

Since the marginal cost of financial savings and capital investment is same, at the optimum the marginal benefits from both must be the same.

From (A1) it follows that $f_k(k) = 1$ only if $\frac{dk^d}{ds^r} = \frac{dk^d}{dk^r}$ and $\frac{dt_2}{ds^r} = \frac{dt_2}{dk^r}$. (2.15) and (2.16) imply that $|\frac{dt_2}{dk^r}| \geq |\frac{dt_2}{ds^r}|$ if $f_k(k) \geq 1$. However, as discussed earlier, (2.12) and (2.13) imply that $|\frac{dk^d}{ds^r}| < |\frac{dk^d}{dk^r}|$ i.e. one unit increase in the recipient's capital investment has a larger negative effect on the capital transfer from the donor than a unit increase in the recipient's financial savings. Thus, at $f_k(k) = 1$ the marginal benefit from financial savings (the LHS of A1) is greater than the marginal benefit from capital investment (the RHS of A1). Thus, the reallocation of resources towards financial savings away from capital investment makes the recipient better-off. Therefore, the recipient chooses k^r such that $f_k(k) > 1$ for any $0 < k^d < k^*$. This is true regardless of whether the recipient receives budgetary transfers or not.

In the case, $s^r = 0$ and $k^r > 0$, (2.14), (2.17a) and (2.18) imply that

$$\left[f_k(k)(1 + \frac{dk^d}{dk^r}) + \frac{dt_2}{dk^r}\right] > \left[f_k(k)\frac{dk^d}{ds^r} + \frac{dt_2}{ds^r} + 1\right]. \qquad (A2)$$

The marginal benefit from capital investment is higher than the marginal benefit from financial savings. However, (2.12), (2.13), (2.15), and (2.16) imply that in order for (A2) to hold, it must be the case that the recipient chooses k^r such that $f_k(k) > 1$.

The above analysis shows that it is always optimal for the recipient to choose k^r such that $f_k(k) > 1$ for any $0 < k^d < k^*$. Suppose now that $k^d \geq k^*$. In this case, $f_k(k) \leq 1$ for any $k^r \geq 0$. Now if $k^r > 0$, then either (A1) or (A2) must hold. But then it implies that $f_k(k) > 1$, which is a contradiction. The only possibility then is that the recipient sets $k^r = 0$.

(ii) Follows from (2.17) and (2.17a) and the results that $|\frac{dt_1}{ds^r}| = |\frac{dt_2}{ds^r}|$, $\frac{dk^d}{ds^r} < 0$, and $f_k(k) = 1$ when $t_1,\ t_2 > 0$.

(iii) Follows from (2.17) and (2.17a).

References

[1] Alesina, A. and G. Tabellini (1989), "External debt, capital flight and political risk", *Journal of International Economics*, 27, 199-220.

[2] Arellano, C., A. Bulir, and L. Lipschitz (2009), "The dynamic effects of foreign aid and its variability", *Journal of Development Economics*, 88, 87-102.

[3] Assar, L. and J. W. Weibull (1988), "Altruism and time consistency: the economics of fait accompli", *Journal of Political Economy*, 96, 1165-1182.

[4] Azam, J.-P and J.J. Laffont (2003), "Contracting for aid", *Journal of Development Economics*, 70, 25-58.

[5] Bhattacharya, R. (1999), "Capital flight under uncertainty about taxation and trade liberalization", *Journal of Development Economics*, 59, 365-387.

[6] Boone, P. (1996), "Policies and the effectiveness of foreign aid", *European Economic Review*, 40, 289-329.

[7] Buchanan, J. (1975), "The Samaritan's Dilemma", In *Altruism, Morality, and Economic Theory*, Edited by E. Phelps, New York, Sage Foundation.

[8] Burnside, C. and D. Dollar (2000), "Aid, policies, and growth", *American Economic Review*, 40, 289-329.

[9] Collier, P. and D. Dollar (2000), "Aid allocation and poverty reduction", *European Economic Review*, 46, 1475-500.

[10] Cordella, T. and G. D. Ariccia (2007), "Budget suppost versus project aid: a theoretical appraisal", *Economic Journal*, 117, 1260-1279.

[11] Easterly, W. (2003), "Can foreign aid buy growth?", *Journal of Economic Perspective*, 17, 23-48.

[12] Hagen, R. J. (2006), "Samaritan agents? On the strategic delegation of aid policy", *Journal of Development Economics*, 79, 249-261.

[13] Hansen, H. and F. Tarp (2001), "Aid and growth regressions", *Journal of Development Economics*, 64, 547-70.

[14] Jelovac I. and and F. Vandeninden (2008), "How should donors give foreign aid? Project aid versus budget support", *CREPP Working Papers 2008/04*.

[15] Kanbur, R. (2004), "The economics of international aid" in *The economics of giving, reciprocity, and altruism* Editors: S. Christophe-Kolm and J. Mercier-Ythier, North-Holland.

[16] R. Rajan and A. Subramanian (2008), "Aid and growth: what does the cross-country evidence really show?", *Review of Economics and Statistics*, 90, 643-665.

[17] R. Rajan and A. Subramanian (2011), "Aid, Dutch disease, and manufacturing growth", *Journal of Development Economics*, 94, 100-118.

[18] M., Obstfeld (1999), "Foreign resource inflows, saving, and growth", in K. Schmidt-Hebbel and L. Serven (Ed.), *The economics of savings and growth*, Cambridge, CUP.

[19] OECD (2007), "Joint evaluation of general budget support: 1994-2004", avilable at http://www.oecd/dataoecd.

[20] Pedersen, K. (1996), "Aid, investment, and incentives", *Scandinavian Journal of Economics*, 98, 423-438.

[21] Pedersen, K. (2001), "The Samaritan's Dilemma and the effectiveneess of foreign aid", *International Tax and Public Finance*, 8, 693-703.

[22] Svensson, J. (2000), "When is foreign aid policy credible? Aid dependence and conditionality", *Journal of Development Economics*, 61, 61-84.

[23] Svensson, J. (2003), "Why conditional aid does not work and what can be done about it?", *Journal of Development Economics*, 70, 381-402.

[24] Temple, J. (2010), "Aid and conditionality", Chapter 67 in the *Handbook of Development Economics, Vol 5* Editors: D. Rodrik and M. Rosenzweig, Elsvier B.V.

[25] Torsvik, G. (2005), "Foreign economic aid; should donors cooperate?", *Journal of Development Economics*, 77, 503-515.

[26] World Bank (1998), "Assessing aid: what works, what doesn't and why", Oxford University Press, New York.

[27] World Bank (2005), "Conditionality Revisited", Edited By S Koeberle, H. Bedoya, P. Siarsky, and G. Verheyen.

Figure 1: Effect of Changes in the Endowment Income of Donor

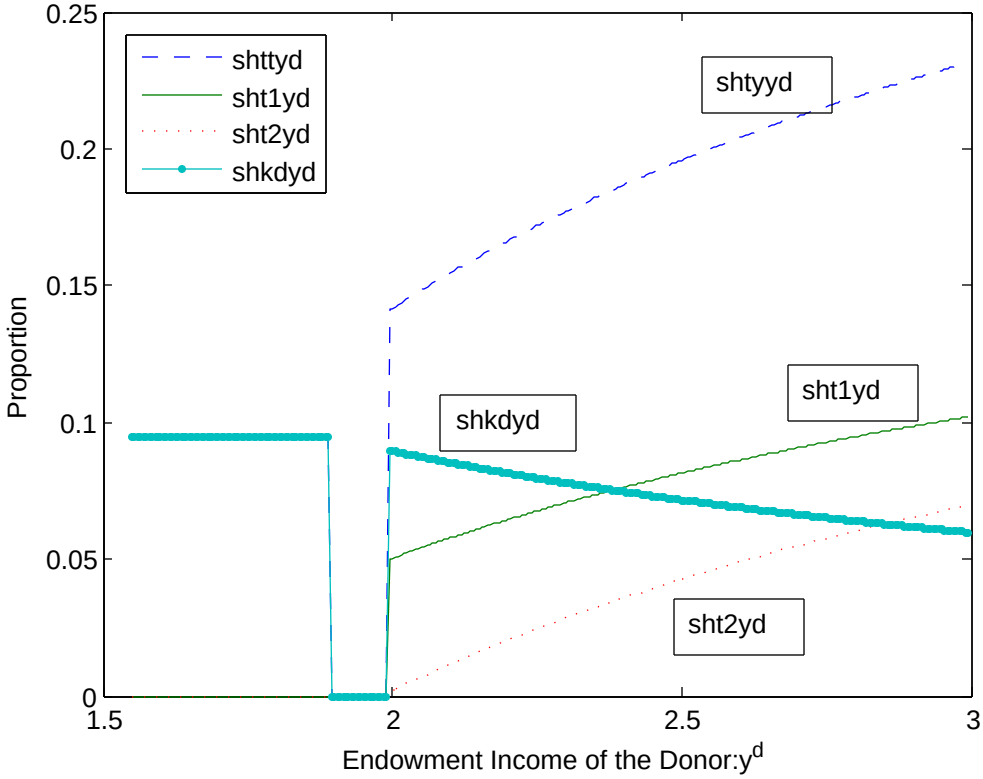

Figure 2: Effect of Changes in the Degree of Altruism of Donor

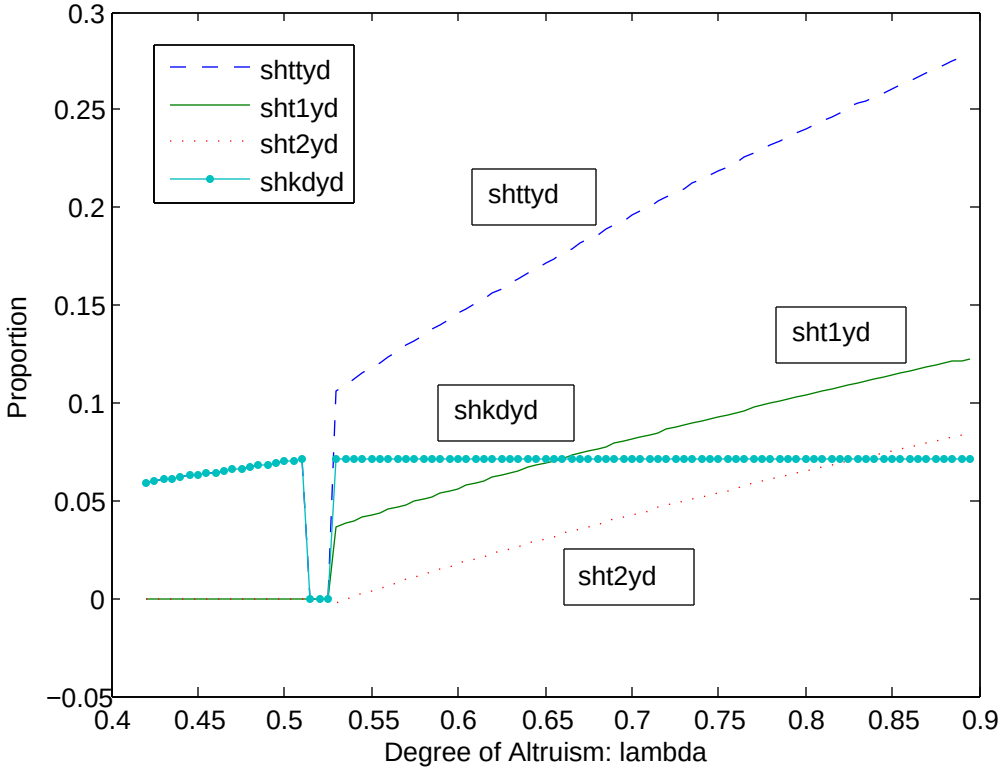

Figure 3: Effect of Changes in the Productivity Parameter