Donor Policies and Aid Effectiveness

Carl-Johan Dalgaard*
University of Copenhagen and EPRU
April 20, 2006

Abstract
The present paper examines the macroeconomic impact of aid, by introducing endogenous aid allocations into a neoclassical growth framework. On this basis it is shown that donor policies can have important implications for the trajectory of recipients’ GDP per capita. Depending on specific donor policy choices, aid disbursements may lead to faster transitional growth, stagnation or cyclical growth. Moreover, the analysis also suggest that donor policies may be part of the reason why foreign aid is not found to be uniformly effective in raising long run productivity across recipients.

Keywords: Economic growth, Donor policy, aid effectiveness
JEL Classifications: O41, F35

*I wish to thank Thomas Barnebeck Andersen, Lennart Erickson, Henrik Hansen, Theo Larsen, Pascalis Raimondos-Møller, John Rand, Finn Tarp and seminar participants at the University of Birmingham, University of Copenhagen, the 2005 Econometric Society World Congress and the IFPRI/Cornell conference on Threshold Effects and Non-Lineairities in Growth and Development for comments and discussions. Errors are mine. The activities of EPRU (Economic Policy Research Unit) are supported by a grant from the Danish National Research Foundation. Correspondence: Carl-Johan Dalgaard, Institute of Economics, University of Copenhagen, Studiestraede 6, 1455 Copenhagen - K, Denmark. E-mail: Carl.Johan.Dalgaard@econ.ku.dk.
1 Introduction

To many poor nations, foreign aid represents a substantial contribution to their Gross National Income (GNI). As Figure 1 documents, for roughly 20% of the aid recipients aid accounted in 2000 for more than 15% of GNI. To fully appreciate the relative importance of these transfers, it might be useful to observe that the contribution of manufacturing to GNI in the US was 16% in 2000. It is therefore natural to study the consequences of capital transfers on this scale. Specifically, does aid benefit poor countries in the sense of elevating their growth performance?

A large, mainly empirical, literature has pondered this question during the last several decades. Recently there appears to be an emerging consensus that aid does increase growth — on average. By the same token it is also well accepted that aid does not seem to be equally effective in all countries. This conclusion follows from the finding that aid never enters linearly, with a significantly positive sign, in cross country growth regressions. Instead, aid only turns positive and significant once some kind of interaction effect (or non-linearity) is added. Accordingly, some researchers conclude that aid is effective in sufficiently "strong" policy environments (e.g. Burnside and Dollar, 2000), others that aid seems to have worked better outside the geographical tropics (Dalgaard, Hansen and Tarp, 2004), in places with democratic institutions (Svensson, 1999), or in places where the inflows of aid has been sufficiently modest (the "diminishing returns hypothesis", Hansen and Tarp, 2001).¹ This group of contributions, while different in their policy implications, do share a common theme: the reason why aid effectiveness varies across countries is essentially to be found within the aid receiving nations; in the enacted policies, their climate/established institutions, or perhaps in their lack of "absorptive capacity".

The present paper takes another approach and explores theoretically whether the variation in aid effectiveness may be ascribed, at least in part, to donor policies.

The basic framework invoked is a two period overlapping generations model. Transitional growth is fuelled both by capital accumulation and increasing spe-

¹This is a non-exhaustive list. See Clemens, Radelet and Bhavnani (2004) for further references.
cialization (in the sense of Romer, 1987). At each point in time, however, the extent of specialization is limited by a fixed cost associated with firm start-up. Furthermore, it is assumed that the government, by providing services such as an adequate infrastructure and a well-functioning system of justice, can reduce the costs associated with the creation of new firms (sectors), and thereby stimulate overall productivity. Beyond this, the theoretical argument rests on three premises or assumptions.

First, foreign aid inflows are used to fund productive government services. Consistent with this assumption a considerable amount of ODA disbursements (around 30%) is in practice used for investments in infrastructure, or is invested in the production sector (Hjertholm and White, 2000, Table 3.4). Second, borrowing to cover revenue loss from shortfalls in aid is ruled out. This is consistent with the cross country findings of Gemmell and McGillivray (1998), which

---

2At least in part. The results of the analysis do not change in any material way if parts of the flows are used on consumption.

3The assumption that aid finances (productive) government services can also be found in Lensink and White (2001) and Chatterjee, Sakoulis and Turnovsky (2003).
shows a fall in aid is often associated with government spending cuts. The third premise is that the inflow of foreign aid per capita is endogenous, and negatively related to the (lagged) level of GDP per capita of the recipient. The assumption that poorer countries receive more aid per capita is strongly supported by the literature on the allocation of foreign aid (e.g. Dudley and Montmarquette, 1976; Trumbull and Wall, 1994; Alesina and Dollar, 2000; Alesina and Weder, 2002; Gates and Hoeffler, 2004). Moreover, the strength of this association varies empirically from one donor to the next (Dudley and Montmarquette, 1976; Alesina and Dollar, 2000; Gates and Hoeffler, 2004).

Taken together these assumptions imply that aid is productive. Increasing aid inflows enable more government investments to take place, which in turn stimulates specialization, labor productivity and capital accumulation. In the long run the economy converges towards a steady state where both aid inflows and income per capita are determined endogenously. The nature of the transitional path, however, is crucially dependent on donor policies.

Specifically, it is shown that depending on the “poverty bias” of donors, i.e. depending on how sensitive donors are to changes in income per capita of the recipient when measuring out the amount of aid to donate, the aid receiving nation may prosper, stagnate or end up following a trajectory characterized by (dampened) oscillations. The latter case arises when donors are sufficiently poverty biased, though not more poverty biased than what is empirically plausible. This mechanism implies, in reduced form, a positive association between volatility in aid per capita growth and GDP per capita growth. As illustrated in Figure 2, this association does seem to be present in the data. The pure correlation is quite high, at 0.34 (0.37 without Liberia). More generally the model predict that countries faced by more poverty biased donors will not only be more volatile, but also poorer in the long run ceteris paribus. The model therefore deliver a novel explanation for the well known fact that poor countries often face a more volatile evolution of GDP per worker (e.g. Ramey and Ramsey, 1995).

A second key result of the analysis relates to the empirically detected vari-

4 A recent study by McGillivray (2000) concerning the Philippines also provides support for the two first assumptions. McGillivray find that aid grants have had no impact on tax and nontax revenue, and that grants are positively associated with government investments.
Figure 2: The figure shows the log standard deviation of GDP per capita growth vs. the log standard deviation of growth in aid per capita for 37 low income countries which received aid each year 1975-2002. Note: (a) Aid and GDP is measured in constant 1995 US$. (b) "Low income countries" is defined according to World Bank classifications. Data source: World Development Indicators CD-Rom (2004) and authors calculations.

The present paper is related to the theoretical growth literature on aid effectiveness (e.g. Boone, 1996; Svensson, 1999; Lensink and White, 2001; Chatterjee, Sakoulis and Turnovsky, 2003; Dalgaard et al, 2004). The crucial difference to these contributions is that aid donations are treated as endogenous below, in...
a way that is consistent with the empirical literature on the allocation of aid.\(^5\)

The political-economy literature which explores the interaction between donors and recipients is also related (e.g. Casella and Eichengreen, 1996; Svensson, 2000; Lahiri and Raimondos-Moller, 2004). These contributions demonstrate how policy differences across donors, like the timing of disbursements (Casella and Eichengreen, Lahiri and Raimondos-Moller) or the degree to which aid is directed towards the poorest individuals (Svensson) may matter for outcomes. Accordingly, a common denominator of this literature and the model below is the notion that donor policies are important for aid effectiveness. However, in contrast to the political-economy literature the present paper takes donor policy rules as given, motivated by the empirical literature on aid allocations. This allows for a tractable analysis of the implications of donor policies for long-run productivity, within a fully dynamic general equilibrium model.

Finally, the work of Clemens, Radelet and Bhavnani (2004) is related at the conceptual level. The authors point out that foreign aid is a very heterogeneous animal. For example, parts of observed aid disbursements come in the shape of emergency assistance, other inflows are directed towards investments in infrastructure, irrigation and the like. It therefore seems plausible that not all inflows are equally effective in raising productivity, and the authors go on to find a positive (and sizable) effect of aid inflows on growth, when aid is directed towards e.g. infrastructure investments or budget support. An important implication of this finding is that the composition of total aid transfers conceivably matters for the effectiveness of any given amount of aggregate disbursements. If donors differ with respect to the “aid package” they offer recipients then donor selection may matter for the estimated aid effectiveness. In this paper it is argued that even if the composition of aid disbursements is the same across donors the impact of aid on growth may still vary due to donor selection. Namely, if the policies associated the allocation decision itself differ from one donor to the next.\(^6\)

\(^5\)In Lensink and White (2001) and Chatterjee et al (2003) foreign aid is also endogenous. But it is assumed that aid inflows rise proportionally when the recipient’s GDP expands so that a constant aid to GDP ratio is maintained.

\(^6\)When Clemens et al solely consider aid which should be able to affect growth within a relatively short period of time (i.e. aid directed towards budget support, infrastructure investments and the like) heterogeneity of impact from aid on growth still prevail. The authors find that aid seems to be more effective in countries where citizens can expect to live longer, and where the inflows have been relatively modest.
2 Analysis

Consider an aid dependant nation in the process of development. The economy is closed, except for the transfer of aid to be described below. The economy in question is inhabited by a constant large number of individuals whose life span is compressed to two periods: youth and old age. The size of the labor force is normalized to one, and remains constant through time. Time is discrete \( t = 0, 1, \ldots \), and extends into the infinite future. For simplicity, exogenous technological change is ignored in the main text.

2.1 Production

The final good, which can be either consumed or invested, is produced using the following production technology

\[
y_t = k_t^\alpha X_t^{1-\alpha},
\]

where \( y_t \) is output per worker, \( k_t \) the capital per worker, and \( X_t \) a composite of \( N_t \) intermediate goods. Specifically

\[
X_t = \left( \sum_{i=0}^{N_t} x_{it}^{1-\alpha} \right)^{\frac{1}{1-\alpha}}.
\]

The market for final goods is competitive, and the price of \( y_t \) is used as numeraire. The inverse factor demands for \( \{x_i\}_{i=0}^{N_t} \) and capital are

\[
(1 - \alpha) k_t^\alpha x_{it}^{-\alpha} = p_{it}
\]

\[
\alpha k_t^{\alpha-1} X_t^{1-\alpha} = R_t.
\]

where \( p_{it} \) is the price of intermediate good \( i \), whereas \( R_t \) is the rental rate of capital.

The market for intermediate goods is monopolistically competitive. Accordingly, given demand for good \( i \), equation (3), the problem in sector \( i \) is to find

\[
\{p_{it}, x_{it}\} = \arg \max \{p_{it} x_{it} - w_{it} l_{it}\},
\]

where \( l_{it} \) is labor input in production of intermediate good \( i \). It is assumed that producers have access to a technology whereby 1 unit of labor input produces
1 unit of \( x_t \), contingent on the initial payments of a fixed cost \( \psi_t \), measured in units of labor. Given this set-up it is straightforward to show that

\[
p_{it} = \frac{w_t}{1-\alpha} = p_t \ \forall i. \tag{4}
\]

Since the price is the same across sectors, it follows that the quantity produced of each variety is constant across sectors as well. Profits in each sector is

\[
\pi = w_t x_t \left[ \frac{\alpha}{1-\alpha} \frac{\psi_t}{x_t} \right].
\]

Assuming free entry, pure profits are competed away. Therefore, in equilibrium each operating firm produces the quantity

\[
x_t = \frac{1-\psi_t}{\alpha}.
\tag{5}
\]

Since total demand for labor in the economy is \( N_t x_t + N_t \psi_t \), and the total labor force is normalized to one, it follows that

\[
x_t = \frac{1-\psi_t}{N_t}.
\]

The number of firms operating in equilibrium can be deduced by inserting this expression into equation (5):

\[
N_t = \alpha \psi_t^{-1}. \tag{6}
\]

Hence, the fixed labor cost associated with entry determines the degree of specialization in the economy. The labor requirement for setting up a firm will be linked to public services and foreign aid inflows below.

We are now in a position to derive a reduced form expression for total production of final goods. Given symmetrical equilibrium, it follows from equation (1) and (2) that

\[
y_t = k_t^{\alpha} x_t^{1-\alpha} N_t,
\]

which implies that productivity rises, for \((k_t, x_t)\) given, when the number of intermediate goods (sectors) increases. Next, using equations (5) and (6) in the above expression for \( y_t \), yields

\[
y_t = (1-\alpha)^{1-\alpha} \alpha^\alpha k_t^{\alpha} \psi_t^{-\alpha}. \tag{7}
\]

Finally, we may derive equilibrium wages. Equations (3) and (4) imply that

\[
w_t = (1-\alpha)^2 k_t^\alpha \left( \frac{1-\alpha}{\alpha} \psi_t \right)^{-\alpha} = (1-\alpha) (1-\alpha)^{1-\alpha} \alpha^\alpha k_t^{\alpha} \psi_t^{-\alpha}.
\]
Further, in light of equation (7), it follows that

$$w_t = (1 - \alpha) y_t.$$  \hspace{1cm} (8)

2.2 Foreign Aid Inflows and the Role of Government

Aid inflows are endogenously determined, linked to the level of economic activity. Specifically, it is assumed that aid per capita donations, $i_{a,t}$, at time $t$ depends negatively on the recipients’ income per worker at $t - 1$.

$$i_{a,t} = \phi \cdot y_{t-1}^\lambda, \ \phi > 0.$$  \hspace{1cm} (9)

Throughout we maintain the following assumption

A1 $\lambda < 0$.

In the remaining the following terminology will be adopted:

Definition 1 A donor policy rule is defined by the pair $(\phi, \lambda)$.

Definition 2 A donor policy rule $(\phi_i, \lambda_i)$ is more poverty biased than the policy rule $(\phi_j, \lambda_j)$ if $\lambda_i < \lambda_j$.

The policy rule (9) mimic the baseline empirical specification from the literature on the allocation of aid. The negative association between income per capita and inflows per capita, as stipulated in A1, is well documented (e.g. Trumbull and Wall, 1994; Alesina and Weder, 2002). In addition, once a separate equation is fitted to each donor’s disbursements nuances emerge. While $\lambda < 0$ hold for all donors, the numerical size of $\lambda$ varies considerably (Gates and Hoeffler, 2004; Alesina and Dollar, 2000; Dudley and Montmarquette, 1976). This observed variation across donors indicate that $\lambda$ may very well differ from one recipient to the next, since the composition of associated donors varies. Consequently, in the remaining we may think of $\lambda$ as a country specific characteristic.

While GDP per capita of the recipient is a robust determinant of per capita aid inflows, it is also clear that other factors matter for disbursements. Political determinants – like former colonial status, voting behavior in the UN and so

---

7 If GDP per worker grows perpetually, due to exogenous technical change, a slightly different version of this equation would be required for the results to carry over. See Appendix B for details.
on – appears to matter a great deal as well (e.g. Alesina and Dollar, 2000). For present purposes such influences are (crudely) captured by the parameter \( \phi \). Since \( \phi \) is independent of the per capita income of the recipient, it will be referred to as capturing “exogenous” determinants of \( i_{a,t} \).

All aid inflows accrue to the government. The only role of the government is to use these inflows to finance public services, \( g_t \). Accordingly, imposing a balanced budget implies

\[
g_t = i_{a,t},
\]

where \( i_{a,t} \) is the inflow of aid in period \( t \). Public services, which can be thought of as investments in infrastructure (roads, telecommunication, ports, electricity generators and so forth) or law and order, are assumed to lower the (labor) costs associated with the creation of a new firm (/sector) \( \psi_t \):

\[
\psi_t = \frac{\psi}{g_t}, \quad \psi > 0.
\]

Note that government services are assumed to be non-rival in the sense that \( g_t \) lower costs in all sectors simultaneously. This set of assumptions imply that government services (and thereby aid inflows) are productive since they allow for increasing specialization (cf. equation (6)).

A potentially important objection to specification (10) is that the economy itself does not contribute to government investments which might be seen as unrealistic. However, as demonstrated in Appendix A, this specification can be viewed as a reduced form in the following set-up. Imagine, as is typically done in the literature on the fungibility of aid, that the government derives utility from various kinds of expenditures (e.g. Feyzioglu, Swaroop and Zhu, 1998). In the present case, government consumption and government investments. Foreign aid enters the revenue side of the budget, along with receipts from taxation of labor income. The tax rate on labor income is exogenous and constant through

\footnote{Of course, aid could be “wasted”. A simple way to capture waste, would be to assume that \( g_t = \pi i_{a,t} \), where \( \pi \leq 1 \). As long as \( \pi \neq 0 \) the results reported below easily carry over to this case. To my knowledge there is no empirical evidence to suggest that it is reasonable to impose \( \pi = 0 \). On the contrary, aid earmarked for infrastructure investments, like transport and communication, does not seem to be fungible in practice (Feyzioglu, Swaroop and Zhu, 1998). Note also that one could alternatively assume that investments today \( i_{a,t} \), only yield a pay-off “tomorrow”. That is \( g_{t+1} = i_{a,t} \). This would be appropriate if \( g \) where to be thought of explicitly as a form of capital. In this case the equation governing GDP per worker, derived below, would be a second order difference equation, rather than first order. Accordingly, this extension would only add complexity with little value added in terms of insight.}
time. Assuming log preferences, the government will spend a constant fraction of the budget on both kinds of expenditures. However, suppose the recipients are faced with terms of conditionality from donors. That is, donors require the recipient to spend at least \( \kappa i_{a,t} \) on investment, where \( \kappa \leq 1 \). If the recipient is sufficient poor, and/or sufficiently aid dependant, the government simply spends \( g_t = \kappa i_{a,t} \), and the remaining revenue on government consumption. The formulation (10) is the particular case where \( \kappa = 1 \) is imposed. Therefore the present analysis can be seen as relevant for a highly aid dependent poor economy.\(^9\)

2.3 Consumption and Savings

The individual lives for two periods; youth (denoted by subscript \( y \)) and old age (subscript \( o \)). The preferences of an individual born at time \( t \) is

\[
U(c_{y,t}, c_{o,t+1}) = \ln c_{y,t} + \frac{1}{1 + \rho} \ln c_{o,t+1},
\]

where \( \rho \) is the rate of time preference. During youth the individual work, save for old age, and consume. Hence

\[
w_t = c_{y,t} + s_t.
\]

(12)

During old age the individual consumes his accumulated wealth

\[
c_{o,t+1} = R_{t+1} s_t.
\]

(13)

The problem of maximizing life time utility, subject to equations (12) and (13) implies the following closed form solution for optimal savings

\[
s_t = \bar{s} w_t,
\]

(14)

where \( \bar{s} \equiv 1/(2 + \rho) \)

2.4 The Evolution of Income per Worker

As the old consume their total savings the capital stock in period \( t + 1 \) is solely determined by the savings of the young. Combining this with equations (8) and

\(^9\)Of course, suppressing the conditionality parameter \( \kappa \) leaves us with one less policy instrument. But since changes in \( \kappa \) are ultimately isomorphic to changes in \( \phi \), nothing much is lost by this simplification.
leads to the following law of motion for capital:

\[ k_{t+1} = s w_t = s (1 - \alpha) y_t. \]  

Next, using equations (9), (10) and (11) in equation (7) we can express output per worker in period \( t \) as

\[ y_t = \bar{\psi} - \alpha (1 - \alpha) 1 - \alpha k_t^\alpha \phi^\alpha y_{t-1}emble }\]

Substituting for \( k_t \) in equation (16), using the lagged version of equation (15), and taking logs leaves us with the following law of motion for log income per worker:

\[ y_t = \bar{\psi} - \alpha (1 - \alpha) 1 - \alpha k_t^\alpha \phi^\alpha y_{t-1} = \bar{\psi} (1 - \alpha) 1 - \alpha k_t^\alpha \phi^\alpha y_{t-1} \]

\[ \frac{\partial}{\partial \phi} (\bar{\psi} (1 - \alpha) 1 - \alpha k_t^\alpha \phi^\alpha y_{t-1}) > 0. \]

Next, using equations (9), (10) and (11) in equation (7) we can express output per worker in period \( t \) as

\[ y_t = \bar{\psi} - \alpha (1 - \alpha) 1 - \alpha k_t^\alpha \phi^\alpha y_{t-1} = \bar{\psi} (1 - \alpha) 1 - \alpha k_t^\alpha \phi^\alpha y_{t-1} \]

Substituting for \( k_t \) in equation (16), using the lagged version of equation (15), and taking logs leaves us with the following law of motion for log income per worker:

\[ y_t = \bar{\psi} - \alpha (1 - \alpha) 1 - \alpha k_t^\alpha \phi^\alpha y_{t-1} = \bar{\psi} (1 - \alpha) 1 - \alpha k_t^\alpha \phi^\alpha y_{t-1} \]

where \( y_t = \ln y_t, \quad \Omega = \ln \left( \bar{\psi} - \alpha (1 - \alpha) 1 - \alpha \phi^\alpha \right) \) and

\[ \beta = (1 + \lambda) \alpha. \]

In the rest of the analysis we make the following assumption:

**A2** \( \Omega = \ln \left( \bar{\psi} - \alpha (1 - \alpha) 1 - \alpha \phi^\alpha \right) > 0. \)

A2 is a necessary condition for the existence of a (non-trivial) steady state. Since equation (17) is a first order difference equation we can solve for the entire time path of log income per worker \( \{ y_t \}_{t=0}^{\infty} \) in closed form:

\[ y_t = \bar{y}^* - \beta y_0, \quad \text{for } | \beta | < 1 \]

where

\[ \bar{y}^* = \frac{\Omega}{1 - \beta} > 0, \]

is the steady state level of (log) income per worker. Note that A1 ensures that \( \beta < 1 \).

Before examining the impact of donor policies on the transitional dynamics of the economy the following results can be stated:

**Proposition 1** **Donor policies and steady state income per worker.** (i) An exogenous increase in foreign aid increases steady state income per worker, \( \partial \bar{y}^*/\partial \phi > 0. \) (ii) Increased poverty bias reduces long run income per worker \( \partial \bar{y}^*/\partial \lambda > 0. \)
Proof. Follows immediately from equation (20) and the definition of Ω.

Hence exogenous aid inflows increases income per worker in the long run. The intuition for the result is simple. An additional (exogenous) inflow of foreign aid yields more productive government services. This allows for greater specialization, since the costs of setting up firms decline, and thereby higher aggregate labor productivity and equilibrium wages. The latter spurs capital accumulation. Enhanced poverty bias, i.e. a reduction in λ, works so as to decrease the aggregate returns to scale in broad capital. The returns to capital is reduced by λ, since increases in productivity brought forth by capital accumulation is counteracted by donors retracting aid. But aside from these aspects of the model, it otherwise has the steady state properties of a standard Diamond model with Cobb-Douglas production technology and preferences (e.g. Romer, 2001, Ch. 2).

Turning next to the issue of transitional dynamics, it should be clear that the characteristics of the trajectory followed by the economy hinges on the sign and size of β. Under the assumption that that all countries share a common production technology, and thus share the parameter α, the degree of poverty bias in aid donations becomes the key parameter.

Consider first a case which can be labeled weak poverty bias, where the degree of poverty bias is bounded from below:

\[ 0 < \beta < 1 \iff -1 < \lambda < \frac{1 - \alpha}{\alpha}. \tag{21} \]

The transitional dynamics of an economy fulfilling this parameter restriction is illustrated in Panel A of Figure 3. In this case transition to steady state is monotonic, and the steady state is globally stable. Thus, if the tendency to reduce aid as the economy grows is not “too great” the trajectories of income per worker, for an aid recipient and a non-recipient nation, are qualitatively indistinguishable.

Consider next the case we may label strong poverty bias

\[ -1 < \beta < 0 \iff -\frac{1 + \alpha}{\alpha} < \lambda < -1. \tag{22} \]

The associated transitional dynamics are depicted in Panel B of Figure 3. While the stability properties of this economy are identical to the case of weak poverty bias, the trajectory followed by the economy is very different in nature. The
transitional dynamics are characterized by dampened oscillations. The intuition is as follows. Suppose donors reduce aid in the face of an increase in economic activity in the previous period. The consequence of a (sufficiently marked) reduction in aid inflows, and therefore in productive government services, will be a reduction in the degree of specialization, aggregate labor productivity and therefore in the level of wages. This decline will subsequently manifest itself in lower capital accumulation, leading income per worker to fall. In the following period however, donors will tend to react to the contraction in economic activity, and after an infusion of aid, growth will be revitalized. Then the process may begin anew.

The remaining cases, illustrated in Panels C and D, correspond to two different “knife-edge” conditions. Panel C illustrates the case where

$$\beta = 0 \iff -1 = \lambda.$$
Hence the economy immediately reaches $\Omega$, and absent disturbances to the system, stays there. In other words; the economy stagnates, even though it receives foreign aid in every period. In Panel D the elasticity of income per worker with respect to aid disbursements fulfill

$$\beta = -1 \iff \frac{1 + \alpha}{\alpha} = \lambda.$$ 

In this case the economy is characterized by a two-period cycle. Convergence to steady state does not occur; the growth rate fluctuates. Finally, for completeness, we may note that if $-\beta > 1$ (corresponding to $\lambda < -\frac{1+\alpha}{\alpha}$), the economy ventures along a divergent path where, given A2, $\lim_{t \to \infty} |y_t| = \infty$.

The relationship between donor policies and the transitional dynamics of the economy is summarized in Proposition 2

**Proposition 2 Donor Policies and Transitional Dynamics.** Assume $\lambda$ is chosen such that $-1 \leq \beta < 1$. The degree of poverty bias determines the characteristics of the transitional path. Convergence is (A) Monotonic if $-1 < \lambda < -\frac{1+\alpha}{\alpha}$, (B) characterized by dampened oscillations if $-\frac{1+\alpha}{\alpha} < \lambda < -1$, (C) instantaneous (stagnation) if $-1 = \lambda$ or (D) absent (two-period cycle) if $-\frac{1+\alpha}{\alpha} = \lambda$.

From an empirical standpoint it seems that (A) to (C) can be regarded as plausible scenarios. Alesina and Dollar (2000) provide estimates for $\lambda$ across 12 major donors. In their study $\lambda$ is estimated to fall in the interval $[-2.08, -0.25]$, and for half of the donors $\lambda < -1$ is obtained. This group includes major contributors like the US and Canada. Gates and Hoefller (2004) find $\lambda \in [-1.4, -0.29]$ in a sample comprising 11 donors. Donors with a $\lambda$ below $-1$ are USA, Canada, Norway and Denmark. Interestingly, Gates and Hoefller also examine aid disbursed by all multilateral agencies. Here they find an estimate for $\lambda$ of $-1.5$. Finally, in Dudley and Montmarquette (1976) $\lambda \in [-1.02, -0.32]$.

Consequently, these considerations suggest that poverty bias, of empirically reasonable magnitudes, does not dramatically limit the viable set of outcomes from Proposition 2. Plausible values for $\lambda$ may generate monotonic convergence, oscillations as well as stagnation. However, it can be concluded that the case

---

10It is worth noting that allowing for exogenous technological progress does not modify the conditions stated in Proposition 2. See Appendix B.
involving a two-period cycle does not seem to be plausible. This scenario requires \( \lambda = - (1 + 1/3) / (1/3) = -4.0 \), assuming \( \alpha \) of 1/3. Poverty bias of this magnitude can be rejected on empirical grounds.

Regardless, however, of whether oscillations occur or not, the model suggests a clear relationship between growth volatility, suitably measured, and donor policies. Indeed, it can be shown that the coefficient of variation of the growth rate, \( CV_\gamma \), between \( t = 1 \) and \( t = T \), is given by: \(^{11}\)

\[
CV_\gamma = \frac{T \left( 1 - (\beta^2)^T \right) (1 - \beta)^2}{(1 - \beta^2) \left( 1 - \beta^T \right)^2} - 1,
\]

for \( |\beta| < 1 \). Since the parameter \( \beta \) is determined by the degree of poverty bias in foreign aid donations, it follows that differences in measured growth volatility are determined – solely – by variations in donor policies. The implied relationship between growth volatility and \( \beta \) (thus, implicitly, the policy parameter \( \lambda \)) is depicted in Figure 4. Consequently, we have the following result:

![Figure 4: Poverty bias and growth volatility (\( T = 3 \)).](image)

\(^{11}\)CV_\gamma \equiv \frac{\sigma_\gamma}{\bar{\gamma}_T} \), where \( \sigma_\gamma \) is the standard deviation of growth over the period \( t = 1,..T \), whereas \( \bar{\gamma}_T \) is the average growth rate over the same period.
Proposition 3 **Donor policies and growth volatility.** Let growth volatility be measured by the coefficient of variation, and assume $\lambda$ is such that $|\beta| < 1$. Then the volatility of the growth rate is higher in countries submitted to more poverty biased donor policy rules.

There is an interesting corollary to this results. Proposition 1 says that countries exposed to more poverty biased donations will be poorer in the long run, *ceteris paribus*. Combining this fact with Proposition 3 suggest the following:

**Corollary** Poorer countries will tend to have more volatile growth.

This association, which is documented e.g. by Acemoglu and Zilibotti (1997), is in the present context the result of (variations in) donor policies.12

The key insights from Propositions 1 – 3 is that donor policy choices matter for long-run productivity, the nature of the transitional dynamics and for the amount of growth volatility over the long run. The next section shows that donor policy rules also have bearing on aid effectiveness as measured in the empirical literature on the topic.

### 2.5 Donor Policies and Aid Effectiveness

The empirical literature on aid effectiveness typically focuses on growth, rather than on long run income per worker. In a neoclassical growth framework, however, steady state income per worker and (transitional) growth are two sides of the same coin. Indeed, at any point in time, we may write the growth rate of income per worker, $\gamma_t$, as

$$\tilde{y}_t - \tilde{y}_{t-1} = \gamma_t = \left( \tilde{y}^* - \tilde{y}_0 \right) \left( \frac{1 - \beta}{1 - \beta} \right)^{\beta t-1}.$$  

The discussion which follows focuses on the relationship between aid transfers and $\tilde{y}^*$ for convenience, but it should be clear that any point made relates directly to the way empirical work takes place in this area.

---

12 Aside from documenting that the variability of growth in current-day poor economies is larger than in their richer counterparts, Acemoglu and Zilibotti proceed to develop a theory of how financial development may facilitate the diversification of risk related to high-return investment projects. Such a theory is also, as pointed out by the authors, consistent with historical evidence suggesting that current day rich economies faced more volatile growth around the time of take-off compared with today. The present "aid explanation" will only have bearing on the experiences of current-day poor.
In the steady state the level of GDP per worker and the inflow of aid per capita are jointly determined. Using equations (9) and (20) the system of equations can be written

\[
\tilde{y}^* = \frac{\alpha \ln \tilde{\psi}}{1 - \alpha} + \frac{\alpha \ln \tilde{s}}{1 - \alpha} + \frac{\alpha \ln i_s^*}{1 - \alpha} \equiv \tilde{y}^* (i_a^*)
\]

\[
\ln i_a^* = \ln \phi + \lambda \tilde{y}^* \equiv i_a^* (\tilde{y}^*)
\]

which pins down \(i_a^* \) and \(\tilde{y}^*\). If we so desire, noise terms can be added to both equations thus making it an "empirical" model. The system is depicted in Figure 5.

![Figure 5: Steady state income per worker and aid per capita.](image)

Notice that the "pure" impact of aid on long-run productivity is given by the slope of the \(y^* (i_a^*)\) schedule. As should be clear, the slope is \(\alpha / (1 - \alpha)\), which implies that aid inflows have an impact on long-run productivity comparable to that of "domestically generated" investments \((\bar{s})\).13 Moreover, if the production function is the same in all countries the impact of aid on long-run productivity

---

13This is consistent with the finding in Dalgaard and Hansen (2005) that aid financed investments, and investments financed by other sources are about equally productive.
will also be the same. From the perspective of aid effectiveness the empirical challenge is that of identifying the slope of $y^\ast (i^\ast_a)$.

It is immediately obvious that a standard OLS regression analysis is unlikely to produce this slope, due to the presence of the feedback loop represented by the allocation equation, $i^\ast_a (\tilde{y}^\ast)$. Indeed, seen through the lenses of the model one would expect an OLS regression to produce a slope estimate for $y^\ast (i^\ast_a)$ which is biased towards zero. This basic identification problem is well recognized in the empirical literature on the topic; instrumental variable techniques is therefore typically applied to the issue at hand.\footnote{See e.g. the discussion in Dalgaa\textit{d et al} (2004, Section 2) or Clemens \textit{et al} (2004).}

Unfortunately, the identification problem implied by the model is more complicated than that which can be solved by invoking standard instrumental variables techniques. The problem is that the slope of the $i^\ast_a (\tilde{y}^\ast)$ schedule is most likely country specific. As mentioned above, the degree of poverty bias, $\lambda$, varies from one donor to the next, and the composition of donors differ from one recipient to the next.

To assess the consequence of this heterogeneity for the results stemming from cross-country examinations of the aid/growth nexus, it is useful to look at the reduced form solution for income per capita:

$$\tilde{y}^\ast = -\frac{\alpha \ln \tilde{\psi}}{1 - (1 + \lambda)\alpha} + \frac{\ln (1 - \alpha)\alpha^\alpha}{1 - (1 + \lambda)\alpha} + \frac{\alpha \ln \tilde{s}}{1 - (1 + \lambda)\alpha} + \frac{\alpha \ln \phi}{1 - (1 + \lambda)\alpha}.$$  

In theory the elasticity of income per worker with respect to an exogenous increase in aid per capita is $\frac{\alpha}{1 - (1 + \lambda)\alpha}$. This elasticity will be smaller in countries where associated donors follow a highly poverty biased policy rule. Therefore, although the true impact of aid on growth is the same across countries (i.e. $\frac{\alpha}{1 - \alpha}$), the measured impact from an exogenous increase in aid is likely to differ depending on donor policies, and therefore donor selection.\footnote{Actually, the model suggests that the impact of all the right hand side variables in the growth regression could be country specific. Such heterogeneity has been detected in a number of studies, following Durlauf and Johnson (1995). However, whereas the finding of various growth "regimes" in this literature typically is seen as suggestive evidence in favour of differences in the aggregate production technology, the present model demonstrate that the observed heterogeneity could (also) be policy induced, and associated with aid disbursements.}

This heterogeneity can motivate many of the empirically detected interaction effects. Consider, for example, the regularity that aid features diminishing returns (e.g. Hansen and Tarp, 2001). It is possible, as commonly argued,
that the cause of this finding is a lacking ability to absorb aid in highly aid dependent nations. But the same regularity could also be rationalized by donor selection. The argument runs as follows. Aid donors tend to be poverty biased (in the sense that their policy rule is such that $\lambda < 0$). As a result, one would expect that the poorest countries in the world are the ones that receives the most aid, *ceteris paribus*. Moreover, the presence of relatively poverty biased donors (like the US, Canada and Scandinavia) should tend to be greater in the poorest places. As a result, we would expect to find a smaller impact of aid on productivity in highly aid dependent countries (due to the concentration of relatively poverty biased donors), compared to less aid dependent countries.

As another suggestive example, consider Figure 6. The figure shows the correlation between selected coefficients from the aid allocation study by Alesina and Dollar (2000). As can be seen, the coefficient associated with income per capita (i.e. $\lambda$) is highly and negatively correlated with the coefficient attached to whether the recipient is democratic or not. The pure correlation is -0.7! Hence, donors pursuing a poverty biased strategy are apparently also more sensitive to whether recipients are democratic or not. At the intuitive level, this could also motivate an interaction effect between aid and democracy.

Clearly, other interactions could be explained insofar as the variable being interacted with aid plausibly is picking up donor selection, which in turn will determine the "effective" poverty bias faced by individual recipients.

The bottom line is that the observed nonlinearity in the aid/growth relationship may not be caused (solely) by variation in the "true" impact of aid on growth. Instead, it could (in part) be caused by the way aid is given, the policy rule of donors, and therefore be the result of donor selection.

3 Conclusion

The present paper has examined the implications of endogenous aid per capita disbursements for the growth process in aid dependant nations. The analysis provides are reason why GDP per capita growth is more volatile in poor countries, and links this phenomenon to foreign aid disbursements and donor policy rules. More generally it delivers an example of policy-induced bifurcations of the dynamical system. If the donor composition of an aid dependant
nation changes, and the associated policy rule therefore changes, the nature of the dynamical system may change; cyclical adjustment may replace stagnation or smooth convergence, for example. Likewise, when comparing different aid dependent nations the observed trajectory of GDP per capita may look very different, even though time averaged aid flows (and investment rates etc) are fairly similar.

Some of these predictions may be submitted to empirical testing. For example, whereas previous research has argued that growth volatility is determined by e.g. lack of financial development (Acemoglu and Zilibotti, 1997) and terms of trade volatility (Kose, Prasad and Terrones, 2003), the analysis in the present paper suggests that donor composition should be added to the list of explanatory variables.

Figure 6: Source: Alesina and Dollar (2000), Table 6.
The analysis also provides an interpretation of the complexity of empirically inquiring into the aid-growth nexus. Previous research has discovered significant variation across recipients in the effectiveness of aid in raising productivity. The usual interpretation is that domestic structural characteristics are to blame; geography, political institutions, policies or the magnitude of the inflow etc. However, as the analysis shows, the interaction effects underlying this conclusion might proxy for donor composition, and ultimately, for variations in donor policies. Whether variation in aid effectiveness is caused by domestic conditions, or reflect the influence of donors, is obviously critically important to the issue of how to elevate the impact of aid. Hence, future empirical work on aid effectiveness should attempt to control for such composition effects directly when examining the inflows macroeconomic consequences.

Finally, the integration of aid allocation into a growth framework provides some motivation for further theoretical work. It has long been known that some donors are more poverty biased (in the sense of this paper) than others. It is not clear, however, why that is and what (political) mechanism would lead to such heterogeneity. Thus, providing micro foundations for the aid allocation equation, which has been widely estimated in the empirical literature on the topic, would be an interesting topic for future work, especially in light of its potential importance to aid effectiveness and growth in aid dependent nations.

References


A Some microfoundations for government behaviour

Consider a government with the following utility function:

\[
\max U(g_I, g_C) = \beta \ln g_I + \ln g_c
\]

\(g_I\) is government investments, \(g_c\) government consumption. Aid enters the budget:

\[
\tau w_t + i_{A,t} = g_{I,t} + g_{c,t}
\]

\(\tau w_t\) is revenue from labor income, \(\tau\) is assumed to be constant over time. The problem then is to select

\[
g_I = \arg \max \left\{ \beta \ln g_I + \ln (\tau w_t + i_{A,t} - g_{I,t}) \right\}
\]

yielding the following foc

\[
g_I = \beta g_c.
\]

So

\[
g_{I,t} = \frac{1}{1+\beta} (\tau w_t + i_{A,t})
\]

\[
g_{c,t} = \frac{\beta}{1+\beta} (\tau w_t + i_{A,t})
\]

**Conditionality.** Suppose the donor requires the government to spend at least \(g_{I,t} = \kappa i_{A,t}\) on investments, then (when \(i_{A,t} > 0\)):

\[
g_{I,t} = \begin{cases} 
\kappa i_{A,t} & \text{if } \kappa \geq \frac{\tau w_t}{\tau w I + i_{A,t}} \quad (\iff \kappa i_{A,t} \geq \frac{\tau w_t}{1+\beta}) \\
\frac{1}{1+\beta} (\tau w_t + i_{A,t}) & \text{otherwise}
\end{cases}
\]

implying

\[
g_{c,t} = \begin{cases} 
\tau w_t - \kappa i_{A,t} & \text{if } \kappa \geq \frac{\tau w_t}{\tau w I + i_{A,t}} \quad (\iff \kappa i_{A,t} \geq \frac{1}{1+\beta} (\tau w_t + i_{A,t})) \\
\frac{\beta}{1+\beta} (\tau w_t + i_{A,t}) & \text{otherwise}
\end{cases}
\]

So the "constrained economy", with sufficiently low income and large aid inflows will be characterized by \(g_{I,t} = \kappa i_{A,t}\).

The consequence for the dynamics of the economy is minor, given this assumption. The evolution of GDP per worker becomes

\[
y_t = \bar{\Omega} + \beta y_{t-1} \equiv \check{D} \left(y_{t-1}, \check{\Omega} \right)
\]
where $\hat{\Omega} = \Omega + \alpha \ln \kappa + \ln (1 - \tau)$. The term $\ln (1 - \tau)$ follows from the fact that the period 1 budget constraint of the household now becomes $c_{y,t} + s_t = (1 - \tau) w_t$. The parameter $\Omega$ is as defined in the text. Accordingly, the only effect from this extension is to modify the constant term $\Omega$, which is not important for Proposition 1-3.

B Steady State Growth

Suppose the production technology in the final goods sector, equation (1), is modified to

$$y_t = k_t^\alpha (E_t X)^{1-\alpha}$$

where $E_t$ represents efficiency gains resulting from exogenous technological progress which are unrelated to the division of labor. Let $E_{t+1} = (1 + \varepsilon) E_t$, $\varepsilon > -1$. Moreover, define GDP per efficiency unit of labor as $\hat{y}_t$, and likewise capital per efficiency unit is $\hat{k}_t$. Then

$$\hat{y}_t = \hat{k}_t^{\alpha} \psi_t^{1-\alpha}.$$  

After solving for the number of sectors in equilibrium we get the following expression for output per worker (in efficiency units):

$$\hat{y}_t = (1 - \alpha)^{1-\alpha} (1 + \varepsilon)^{\alpha} \hat{k}_t \hat{y}_t^{1-\alpha}.$$  

(23)

Finally, we need to add aid allocation. In order to ensure that aid inflows does not asymptote to zero it is assumed that

$$i_{a,t} = \phi \cdot \left( \frac{y_{R,t-1}}{y_{R,t-1}} \right)^\lambda, \quad \phi > 0,$$

where $y_{R,t-1}$ is income per capita of a reference country. In principle, the reference country could be the donor, another less developed country (LDC), or an average of LDCs. In the remaining it will be assumed the reference country is another LDC.

27
Using that $\psi_t = \bar{\psi}/g_t = \bar{\psi}/i_{a,t}$ along with the modified policy rule in equation (23) we get

$$\hat{y}_t = (1 - \alpha) \alpha^\alpha \left( \frac{\bar{s}}{1 + \bar{\varepsilon}} \right)^\alpha \bar{\psi}^{\alpha - \alpha} \phi^{\alpha} \left( \frac{\hat{y}_{t-1}}{y_{R,t-1}} \right)^{\lambda \alpha},$$

where it has been assumed that both the reference country and the one under consideration share the same underlying rate of exogenous technical progress.

The law of motion for income per efficiency unit of labor becomes

$$\hat{y}_t = (1 - \alpha) \alpha^\alpha \left( \frac{\bar{s}}{1 + \bar{\varepsilon}} \right)^\alpha \bar{\psi}^{\alpha - \alpha} \phi^{\alpha} \bar{y}^{(1+\lambda)\alpha},$$

which now obviously depends on the path of $\tilde{y}_R$.

Consider the law of motion for income per efficiency units of labor in the reference nation

$$\bar{y}_{Rt} = (1 - \alpha) \alpha^\alpha \left( \frac{\bar{s}}{1 + \bar{\varepsilon}} \right)^\alpha \bar{\psi}^{\alpha - \alpha} \phi^{\alpha} \bar{y}^{(1+\lambda)\alpha}.$$

Accordingly, this nation will be converging smoothly towards steady state, where

$$\bar{y}^*_{R} = \left[ (1 - \alpha) \alpha^\alpha \left( \frac{\bar{s}}{1 + \bar{\varepsilon}} \right)^\alpha \bar{\psi}^{\alpha - \alpha} \phi^{\alpha} \right]^{\frac{1}{1-\alpha}}.$$

When the reference country is in steady state the law of motion for log income per efficiency units of labor in all other aid receiving nations becomes

$$\ln \hat{y}_t = \bar{\Omega} + \beta \ln \bar{y}_{t-1},$$

where $\bar{\Omega} \equiv \Omega - \lambda \alpha \bar{y}^*_R - \alpha \ln (1 + \varepsilon)$. $\Omega$ and $\beta$ is defined in the text above. Therefore Propositions 1 - 3 hold. Of course, in this version of the model individual countries’ growth rate will be oscillating (if $-\frac{1+\alpha}{\alpha} < \lambda < -1$) around its steady state growth rate, $\varepsilon$. 

28