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June 2010

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Abstract: We construct an endogenous growth model and we employ empirical analysis to investigate the link between foreign aid and production inefficiency in the presence of different political orientations in the recipient country. Using a panel of 124 countries from 1971 to 2007 and the production frontier toolbox, controlling for unobserved heterogeneity, time horizons, the sources of aid, and the timing of aid impact, we document that foreign aid is associated with higher production inefficiency and that this inefficiency is reduced considerably if countries switch to democratic governance. Our study contributes to the aid literature by pointing to the institutional enhancement of the recipient countries through the adoption of democratic ruling practices.

JEL Classification: C01, D24, F35, O43.

Keywords: Democratic reforms, foreign aid, production inefficiency.

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1. Introduction

Much of the recent literature on foreign aid has focused on its effectiveness in facilitating economic growth for recipient countries.[1] Yet, this literature is far from conclusive with recent studies arguing in favour of no effect at all.[2] None, however, has examined the indirect effects of aid that −although do not appear in per capita economic growth− are important elements of its effectiveness. Instead of looking at the direct impact of foreign aid on growth we look at the production inefficiency reduction in the presence of foreign aid. Since foreign aid is managed by the ruling class within a certain political environment, it is interesting to see if, in addition, there are differential effects conditional on this environment.[3]

This paper uses a theoretical model and employs panel data techniques to answer a simple question: what is the impact of foreign aid on the production inefficiency of the recipient country conditional on its political governance. We define inefficiency as the distance between the actual production and its potential level given the available input resources and technology. If foreign aid is asymmetrically beneficial to any production input and total factor productivity conditional on political governance, we should observe a reduction in production inefficiency during democratic years. Seeking to reveal the interactive effects of foreign aid and democracy on production inefficiency, we test the following proposition which is derived from the aid-growth and the democracy-growth literature: foreign aid will foster production efficiency in democracies but not in autocracies; in other words, aid will be used inefficiently and consequently reduce productivity in autocracies.

To empirically investigate whether foreign aid is associated with reductions in production inefficiency we initially examine a sample of 124 bilateral and/or multilateral aid recipients for the period 1971-2007. We then assess if this inefficiency effect differs before and after incidents of permanent democratization during the *Third Wave* of democratization and the 1990s. The panel results reveal some novel evidence. First, controlling for time-invariant, country-specific characteristics and global shocks, an increase of foreign aid by 1% increases production inefficiency by 0.7%. This effect, however, cancels out by an opposite positive efficiency effect of

[1] For detailed reviews and evidence see Kanbur (2006), Doucouliagos and Paldam (2008), and the papers cited therein.
[2] See, for example, Boone (1996) and Rajan and Subramanian (2008).
[3] To this end, we separate countries into two broad categories: democracies and autocracies.

foreign aid during democratic years when aid shows to reduce inefficiency by approximately the same magnitude. Second, although the direct effect of aid on inefficiency is positive, there is evidence of an inverted U-shaped negative inefficiency effect when aid interacts with democracy; early before countries switch to democratic rule aid has a strong effect on inefficiency reduction which diminishes significantly by the 4^{th}, 5^{th} and 6^{th} year after democratization to pick up again afterwards. Third, we find that moderate but stable political changes towards democracy bolster production inefficiency reductions more than abrupt political transitions.

We are not aware of any other paper that studies directly the link between foreign aid and production inefficiency. The closest study to ours is that of Rajan and Subramanian (2010) which show that aid inflows have systematic adverse effects on a country's competitiveness, as reflected in a decline in the share of labour intensive and tradable industries in the manufacturing sector. They also show that these effects stem from the real exchange rate overvaluation caused by aid inflows. By contrast, private-to-private flows like remittances do not seem to create these adverse effects. Our analysis departs from this study in three distinctive ways: (i) we associate directly foreign aid with production inefficiency, (ii) we provide a theoretical framework to explain how foreign aid affects total production inefficiency abstracting from factor specific shares and prices, and (iii) we link foreign aid and production inefficiency to the political orientation of recipients.

The rest of the paper is organized as follows. Section 2 provides an extended review of the related literature and outlines the theoretical arguments of the key relationships. Section 3 presents the theoretical framework of aid effectiveness and section 4 provides the empirical methodology. Section 5 describes the dataset at hand and reports the benchmark empirical results. Section 6 presents and discusses the main empirical findings and finally section 7 concludes the paper.

2. Related Literature

Ample empirical literature on the cross-country aid-growth nexus using different time horizons, channels and methodologies has reported very poor results so far, most of them conditional on various but specific aspects of aid. Burnside and Dollar (2000), for example, show that the growth impact of aid is conditional on the quality of economic policy. Hansen and Tarp (2001) examine the relationship in a panel

framework and Dalgaar et al. (2004) focus on the geography of aid allocations. Clemens et al. (2004) argue that disaggregating aid is important and find evidence of a positive, causal relationship between "short-impact" aid and economic growth regardless of the recipient's financial or institutional environment.[4] Finally, Rajan and Subramanian (2008) show that a comprehensive examination of the aid-growth nexus, controlling for unobserved heterogeneity, endogeneity, different empirical model specifications, time horizons, the sources of aid and the timing of aid impact, leaves no room for a robust statistical relationship between aid and growth.

Recent theoretical and empirical literature has emphasized the role of institutions in the economic performance of countries.[5] Several empirical studies have shown that the most important institutional change of a country, that of democratization, asserts a positive effect in long-run growth under certain conditions.[6] Yet, there is little, if any, attention on the link between this major institutional change and the way foreign aid is distributed, monitored and used in the recipient countries. Although there is evidence that democratization leads to more foreign aid (see, for example, Alesina and Dollar, 2000), no one has so far investigated comprehensively the effect of aid on production efficiency under different political regimes. A joint look at both fields is the innovation of the present study.

As a theoretical argument of the aforementioned differential effect of aid one can assert that political contestation and institutional constraints inherent in a democracy not only prevent its leaders from predating on the society but also force them to allocate resources –like aid– efficiently on an egalitarian basis. Angeles and Neanidis (2009) show that the type of the local elite matters for the use of foreign aid but the authors don't associate this type with the political regime of the country. We do this in the present study by matching the behavior of the local elites with the political orientation of the state alongside foreign aid usage.

More specifically, autocratic rulers tend to misuse state resources for political reasons at the expense of investment and long-run growth and they are more inclined to provide private benefits to political opponents rather than public goods to citizens,

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[4] In their analysis "short-impact" aid includes budget and balance of payments support, investments in infrastructure, and aid for productive sectors such as agriculture and industry.
[5] For a review see Acemoglu et al. (2005).
[6] See for example Papaioannou and Siourounis (2008a) and Giavazzi and Tabellini (2005).

as such an allocation better serves their desire to stay in office (Bueno de Mesquita et al., 2001). This incentive of "rational self-interested dictators" is even stronger when their time horizon is relatively short (Olson, 1993; Wright, 2008). On the other hand, in democracies where the winning coalition becomes large relative to the electorate and political contestation is more intense, political leaders have to provide sufficient public goods as a means of securing popular support and political survival. In this sense, democratic leaders are more pressured to distribute state resources, like foreign aid, effectively and equally for the public rather than use it to favour a small minority of the population. In turn, more equal distribution of foreign aid helps citizens accrue precious capital and motivate them to invest for growth. Following this rationale, one would expect increased aid effectiveness in more democratic recipients.

However, from the extant literature one can also derive the opposite hypothesis: foreign aid may depress growth in democracies rather than in autocracies. The main reason is that democracies of established participatory rights and civil liberties face enormous public pressure for immediate state expenditure and equal resource distribution, voiced easily by strong interest groups via formal channels (Huntington, 1968; Sirowy and Inkeles, 1990; Przeworski and Limongi, 1993; Przeworski et al., 2000). Yet, economic theory teaches us that sustained growth requires increased accumulation of capital for future investment along with decreased current consumption. In essence, while democratic governments tend to satisfy voters' demands for current consumption at the expense of long-term growth, autocratic leaders of long time horizons and less political contestation have the nearly absolute state autonomy to use aid resources in order to pursue rapid economic development (Olson, 1982; Przeworski and Limongi, 1993). Taken these arguments together, it becomes clear that whether foreign aid will stall or promote growth in the recipient country depends crucially on the political environment of the recipient and the time horizon of the ruling regime. In the following sections we develop a simple theoretical model to describe the channels of aid effectiveness and we employ econometric analysis to empirically test the model predictions.

3. A theoretical model of production efficiency and aid

Production efficiency and technological progress are the two components of total factor productivity (Grosskopf, 1993). Production efficiency is of great importance for aid-recipient countries as, in the majority of them, technological progress is very slow.

While by technological progress we mean the expansion of the set of production possibilities, an increase in production efficiency is synonymous to a more efficient use of the existing production inputs and corresponds to a convergence towards the production frontier. The production frontier thus refers to the maximum technically feasible output attainable from a given set of production factors.

Following Drine and Nabi (2010) we construct an endogenous growth model of a closed aid-recipient economy to describe how foreign aid affects domestic production efficiency. A key feature of the model is the realistic hypothesis that a part of the economy's output is produced in the informal sector.[7] This sector is widely accepted to be less efficient than the formal one (Loayza, 1997; Johnson et al., 1997; Schneider and Enste, 2000) due to non-exploitation of economies of scale (Ferreira-Tiryaki, 2008) and due to no access to financial markets (Lubell, 1991). The relative size of the informal sector determines the production efficiency of the economy. Investors of the economy have two choices: invest in the formal sector or the less efficient informal one.

Foreign aid is provided by donors directly to the local government of the recipient country and is subject to misuse the extent of which depends on the government's policy; the government provides a part of it to co-finance the formal investment projects of the economy and keeps the rest for own purposes. Foreign aid for investment co-financing poses an incentive for investors to engage in the efficient formal sector as it increases profits. The resulting shrinkage of the share of informal sector is actually the mechanism through which foreign aid affects production efficiency in the recipient economy. However, we assume that the profits of the formal sector are subject to expropriation. By expropriation we mean any event that abridges an investment, for instance acts of the government, such as actual expropriation, capital levies, unexpected export or excise taxes, ownership risk due to low protection of property rights, theft by private parties and actions by capricious or ineffective courts. Investors of the informal sector do not suffer such losses, but have to pay some cost of informality. Intuitively, investors' decisions determine the relative

[7] For the majority of developing countries, the informal sector produces between 20% and 40% of GDP (Chickering and Salahdine, 1991), with its size being approximately 68% in Egypt, 39% in Malaysia, 76% in Nigeria, 71% in Thailand and 45% in Tunisia (Friedman et al., 2000).

size of the informal sector and, eventually, the production efficiency of the economy. Finally, to the extent that both aid misuse and investment expropriation risks −that affect investors' decisions− are associated with the political environment and the institutional framework of the recipient country, we expect foreign aid to affect production efficiency differently in each country, depending on the existing domestic conditions.

We consider an economy of overlapping generations with an infinite, discrete time horizon, $t = 0,1,2...$ The economy produces a consumption good using capital and labour and an investment (or capital) good using the consumption good. At each date a new generation of two-period living agents of mass 1 is born. The old of the first generation are endowed with a stock k_0 of capital good. Agents are endowed with one unit of labour which they supply inelastically and at no disutility cost to the consumption good sector during their first period of life and receive a wage which they invest during their second period of life in order to maximize final consumption.[8] Thus, labour supply is L=1 in each period. Old agents face a tradeoff when choosing between a formal and an informal project: On the one hand, a formal project is eligible for a complementary subsidy financed by aid, but generated profits are subject to expropriation. The informal project, on the other hand, cannot be expropriated but is self-financed and involves some informality cost.

3.1. Consumption good sector

The consumption good is produced out of capital K and labour L and is tradable. We assume a Cobb–Douglas production function of constant returns of the form

$$Y_t = A_t K_t^{\alpha} L_t^{1-a} . \tag{1}$$

If we set, for simplicity, the aggregate level of "knowledge" A_t equal to the aggregate stock of capital $A_t = Ak_t^{1-a} = A\left(K_t / L_t\right)^{1-a}$, then the production of the consumption good corresponds to the capital stock $Y_t = AK_t$ and per capita output is given by

$$y_t = Ak_t . \tag{2}$$

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[8] For simplicity, we assume that consumption occurs only at the end of the second period.

Generated output is entirely distributed to workers and to investment good producers. The factors' prices are equal to their marginal productivity and capital depreciates fully after production. Assuming further that A=1, we can write the price of capital and labour respectively:

$$\rho_t = a \tag{3}$$

$$w_t = (1-\alpha)k_t . \tag{4}$$

3.2. Capital good sector

Old agents make their investment decision on a profit-maximization basis taking into account the following: Any capital good, regardless of its type, is produced using a linear technology of the form bq_t, where b>1 and q_t denotes the quantity of the consumption good used in production. A formal project is eligible to a complementary subsidy d_t^f in terms of the consumption good. This subsidy is financed by aid and increases the amount of the consumption good invested in the formal project (q_t) to $w_t + d_t^f$ and the quantity of the capital good produced to

$$k_{t+1}^f = b\left(w_t + d_t^f\right). \tag{5}$$

Undertaking a formal project provides the agent an income ak_{t+1}^f in terms of the consumption good where a is the unit price of the capital produced. Assuming, for simplicity, zero production cost, the generated income stands for the agent's profits and since the latter are subject to expropriation $0 \le \tau_t \le 1$, then the agent's *net profit* from the formal project is

$$\pi_{t+1}^f = (1-\tau_t)ab\left(w_t + d_t^f\right). \tag{6}$$

The alternative choice of the agent is to undertake an informal project. This investment is self-financed but profits are not subject to expropriation. Thus, the technology here is

$$k_{t+1}^j = bw_t . \tag{7}$$

Moreover, informal projects involve some cost of informality c_{t+1}^j which reduces the agent's *net profit* to $\pi_{t+1}^j = a\left(k_{t+1}^j - c_{t+1}^j\right)$, assuming again zero production cost. This

informality cost includes, for instance, bribes that enable the masking of the activity or high transport costs due to distant firm localization and is assumed to vary across agents and production level, $c_{t+1}^{j} = \left(1-\theta_j\right)k_{t+1}^{j}$, where the parameter θ_j is agent-specific and is distributed uniformly on [0, 1]. Therefore, we can write the agent's *net profit* from the informal project as

$$\pi_{t+1}^{j} = a\left(k_{t+1}^{j} - c_{t+1}^{j}\right) = a\theta_j b w_t . \tag{8}$$

Each agent chooses the project that maximizes his *net profit*. Hence, at date *t* the condition for choosing the informal project is $\pi_{t+1}^{j} \geq \pi_{t+1}^{f}$ and the set of informal entrepreneurs is Θ=$\{j$ such that $\theta_j \in [\theta_t, 1]\}$, where θ_t is defined by

$$\theta_t = \frac{\pi_{t+1}^{f}}{abw_t} = \left(1-\tau_t\right)\left(1+\frac{d_t^{f}}{w_t}\right). \tag{9}$$

The set $\overline{\Theta}$ of formal entrepreneurs includes agents who support sufficiently high cost of informality and for whom it is more interesting to undertake formal projects $\overline{\Theta} = \{j$ such that $\theta_j[0, \theta_t]\}$. Notice that θ_t and $1-\theta_t$ correspond to the share of the formal and the informal sector respectively ($0 \leq \theta_j \leq 1$). As expected, the share of the formal sector increases as the ratio of the investment subsidy to wage increases and as the expropriation risk decreases. The intuition is simple; agents will be encouraged to invest in the efficient formal sector as the projects co-financing increases and as the profits of the sector become more secured.

3.3. Government

In each period *t* the country receives an amount d_t of foreign aid per capita through the local government. The government is responsible for the management of aid and controls its allocation in the economy. Depending on the nature of the government, foreign aid is subject to misuse. The government allocates a proportion $0 \leq \lambda_t \leq 1$ to self-interest purposes and a proportion $1-\lambda_t$ to co-finance the formal investment projects. Thus, foreign aid per capita to the efficient formal sector equals

$$d_t^{f} = \left(1-\lambda_t\right)d_t . \tag{10}$$

The extent of aid misuse λ_t depends on the institutional framework of the recipient country and the political environment.

3.4. The size of the formal sector and the role of aid

In this section we relate the relative size of the efficient formal sector with foreign aid. This relationship is the mechanism through which aid affects production efficiency because, as we will see below, production efficiency is a positive function of the share of the formal sector. Using (9) and (10) the share of the formal sector can be written:

$$\theta_t = (1-\tau_t)\left[1+\frac{(1-\lambda_t)d_t}{w_t}\right]. \tag{11}$$

Differentiating (11) with respect to aid per capita we easily obtain

$$\frac{\partial\theta}{\partial d_t} = (1-\tau_t)(1-\lambda_t)\frac{1}{w_t} \geq 0. \tag{12}$$

Interestingly, an increase in aid per capita increases the share of the efficient formal sector in the economy. However, the magnitude of this effect depends negatively on two closely related factors; the first one is the expropriation risk, implying that in a hostile economic and institutional environment foreign aid will result in an enlarging of the formal sector, the magnitude of which will be nevertheless small compared to what would be the case in a more favorable environment. The second factor is the extent of aid misuse; the greater the mismanagement of aid, the smaller the increase of the formal sector as a result of aid receipts. The economic implications of these relationships are recovered in the next section where we model production efficiency.

3.5. Production efficiency and foreign aid

Production efficiency is defined, at each period, as the ratio of the actual output per capita to the potential output per capita. Thus, production efficiency of period t+1 can be written

$$\phi_{t+1} = \frac{y_{t+1}}{\overline{y}_{t+1}}. \tag{13}$$

From (2) and (13) it follows that $\phi_{t+1} = k_{t+1} / \overline{k}_{t+1}$, i.e. the production efficiency of the economy corresponds to the efficiency of the capital good production process. The

quantity of the capital good available at t+1 is the sum of the output of the formal sector $\theta_t k_{t+1}^f$ and that of the informal sector $\int_{\theta_t}^{1}\left(\theta_j k_{t+1}^j\right)d\theta_i$. By substitution from (5), (7) and (10) we obtain

$$k_{t+1} = \theta_t\left(b\left(w_t + d_t^f\right)\right) + \int_{\theta_t}^{1}\left(\theta_j b w_t\right)d\theta_i = b w_t h\left(\theta_t, \lambda_t\right), \tag{14}$$

where $h\left(\theta_t, \lambda_t\right) = \theta_t\left[1 + \frac{\left(1-\lambda_t\right)d_t}{w_t}\right] + \frac{1-\theta_t^2}{2}$. (15)

As expected, production efficiency is a positive function of the share of the formal sector and a negative function of the extent of aid misuse. Moreover, from (12), (14) and (15) we can recover the marginal effect of aid on production efficiency

$$\frac{d\phi_{t+1}}{dd_t} = \frac{\partial k_{t+1}}{\partial d_t} + \frac{\partial k_{t+1}}{\partial \theta_t}\frac{\partial \theta_t}{\partial d_t} = b w_t\left(1-\tau_t\right)\left(1+\tau_t\right)z_t\left(1+z_t d_t\right) \geq 0 \tag{16}$$

where $z_t = \frac{\left(1-\lambda_t\right)}{w_t}$.

Evidently, the efficiency effect of aid is not uniform but rather depends negatively on the expropriation risk and the extent of aid misuse. Notice, however that both factors are indicators of political governance and institutional quality in the recipient countries. This means that, to the extent that democratic ruling is linked to better institutions and greater political accountability, we expect aid to encourage formal investment activities and, consequently, production efficiency in democracies and not in autocracies (λ_t=1). We can thus derive the following testable prediction:

The efficiency effect of aid depends on the political environment of the recipient country with democratic countries enjoying production efficiency as a result of aid.

4. Empirical methodology

In this section we describe the empirical methodology we employ to test the theoretical prediction. Let the production function be written as a Translog form as follows:

$$\ln(Y_{it}) = \alpha_i + \beta_K \ln(K_{it}) + \beta_L \ln(L_{it}) + \frac{1}{2}\gamma_{KK} \ln(K_{it})^2 + \frac{1}{2}\gamma_{LL} \ln(L_{it})^2$$
$$+\gamma_{KL} \ln(K_{it}) \ln(L_{it}) + \gamma_{KT} \ln(K_{it})T + \gamma_{LT} \ln(L_{it})T \quad (17)$$
$$+\delta_T T + \frac{1}{2}\delta_{TT} T^2 + V_{it} - U_{it}$$

$$i = 1, 2, ...N, \quad t = 1, 2, ...T,$$

where Y_{it} is the level of output for the ith country in the tth time period and K_{it} and L_{it} indicate physical capital and labour respectively. T is a proxy for the exogenous technological progress. α_i shows country specific effects and are introduced in the model to distinguish unobserved heterogeneity from the inefficiency component as in Greene (2005). Finally, V_{it} is a two sided error term, i.e. $V_{it} \sim N(0, \sigma_V^2)$ while U_{it} is a non-negative, unobservable variable associated with the technical inefficiency of production, distributed as $U_{it} = g(w_{it})U_i$ where w_{it} is a set of factors explaining technical inefficiency while $U_i \sim |N(\mu_i, \sigma_U^2)|$. Following Battese and Coelli (1995) the inefficiency effects are defined as:

$$E(U_i) = \mu_i = w_{it}\alpha^* + \eta_{it} \quad (18)$$

Where w_{it} is a vector of explanatory variables we define latter on, α^* is a ($1 \times M$) vector of parameters to be estimated while η_{it} is a random variable. η_{it} is assumed to be independently distributed with mean zero and variance σ^2 that is $\eta_{it} \sim ID(0, \sigma^2)$ such that U_{it} is non-negative (i.e. $\eta_{it} \geq -w_{it}\alpha^*$). The vector w_{it} includes aid flows (AID_{it}), the time trend (T) and the interaction product of the existing democracy level (DEM_{it}) and aid flows ($AID_{it}DEM_{it}$), i.e., $w_{it} = [AID_{it}, T, AID_{it}DEM_{it})$.

The production function (17) does not impose any restrictions on returns to scale and bias of technical progress. Differentiating equation (17) with respect to primary inputs of production, that is capital and labour, we get the output elasticity of the jth factor ($j = K, L$).

$$E_K = \frac{\partial \ln(Y_{it})}{\partial \ln(K_{it})} = \beta_K + \gamma_{KK} \ln(K_{it}) + \gamma_{KL} \ln(L_{it}) \quad (19)$$

$$E_L = \frac{\partial \ln(Y_{it})}{\partial \ln(L_{it})} = \beta_L + \gamma_{LL} \ln(L_{it}) + \gamma_{LK} \ln(K_{it}) \quad (20)$$

The rate of technical progress (*TP*) is obtained as:

$$TP = \frac{\partial \ln(Y_{it})}{\partial T} = \delta_T + \delta_{TT} T + \gamma_{KT} \ln(K_{it}) + \gamma_{LT} \ln(L_{it}) \tag{21}$$

A feature of the Battese and Coelli (1995) model is that it assumes independence over time of the inefficiency terms. In other words, a country observed in two periods is treated as two different countries. However, maximum likelihood estimates of model (17) and (18) are still consistent as long as the distribution of each observation is correctly specified; see Alvarez et al. (2006).

Battese and Coelli (1995) using the parameterization that replaces σ_V^2 and σ_U^2 with $\sigma_\varepsilon^2 = \sigma_U^2 + \sigma_V^2$, $\gamma = \sigma_U^2 / \sigma_\varepsilon^2$, estimate equations (17) and (18) jointly by maximum likelihood. Parameter γ must lie between 0 and 1 and it shows the extent of technical inefficiency relative to random effects (two sided error term).

Finally, Jondrow et al. (1982) have shown that measures of efficiency at country level can be obtained from the error terms $\varepsilon_{it} = U_{it} + V_{it}$.

$$E\left[\frac{U_{it}}{\varepsilon_{it}}\right] = \frac{\sigma_\varepsilon \lambda}{1+\lambda^2}\left[\tilde{w}_{it} + \frac{\phi(\tilde{w}_{it})}{\Phi(\tilde{w}_{it})}\right] \tag{22}$$

where $\sigma_\varepsilon^2 = \sigma_{U_i}^2 + \sigma_{V_i}^2$, $\lambda^2 = \frac{\sigma_{U_i}^2}{\sigma_{V_i}^2}$, $\tilde{w}_{it} = w_{it} - \frac{U_{it}}{\sigma_\varepsilon \lambda}$, and $w_{it} = -\frac{\varepsilon_{it}\lambda}{\sigma_\varepsilon}$ while $\phi(\tilde{w}_{it})$ and $\Phi(\tilde{w}_{it})$ are the density and cumulative density function of the standard normal distribution respectively. For space reasons we report estimation results for the inefficiency equation and those for E_K, E_L, *TP* and *TE*.

5. Data description and preliminary results

Our estimations are based on annual observations of an unbalanced panel of 124 aid-recipient countries (listed in the Data Appendix) for the period 1971-2007. Descriptive statistics of the variables at hand are given in Table B of the Data Appendix. We use panel techniques, which address partially the problem of missing unobserved time-invariant, country-specific characteristics.

Our dataset includes levels of aid, real output, stock of physical capital, and employment. With the exception of aid, data come from the Heston, Summers and

Aten (2009) Penn World Table 6.3. The output series is GDP in constant 2005 I$ (chain series). The aggregate physical capital stock series was constructed using the perpetual inventory method. To avoid the problem of initial conditions, initial capital stocks were constructed for the year 1960 following Nehru and Dhareshwar (1993): we used the investment share of Real GDP per capita and population data available in PWT6.3 and we assumed a depreciation rate of 0.095 (see the Data Appendix for a detailed description of the methodology). The labour force series was constructed using real GDP (chain series) per worker, in 2005 I$.

Regarding aid data, we use the standard measure provided by the OECD. These data correspond to Net Official Development Assistance from all donor countries (listed in the Data Appendix), and denote the net disbursement amount, i.e., disbursements minus amortisation, of those flows classified as Official Development Assistance. Official Development Assistance includes Grants or Loans to countries and territories on developing countries provided by official agencies, including state and local governments, or by their executive agencies, each transaction of which meets the following three tests: (a) it is undertaken by the official sector; (b) it is administered with the promotion of economic development and welfare of developing countries as the main objective; and (c) it is given at concessional financial terms (if a loan, having a grant element of at least 25 per cent).[9] We employ disbursements (i.e. actual expenditures), instead of commitments and, following common practice, we scale aid data with the recipient's GDP (denoted by *AIDGDP*), both measured in current US dollars. Data for GDP are drawn from the World Bank's World Development Indicators (WDI) 2009.

Estimates of the production function and the underlying inefficiency equation are obtained by estimating jointly equations (17) and (18) via maximum likelihood. Table 1 reports estimation results for the benchmark models that involve foreign aid and time and regional factors of inefficiency. For space reasons we report estimates for the inefficiency equation (17) as well as for output elasticities E_K and E_L, technical progress (*TP*) and technical efficiency (*TE*) evaluated at the sample mean.[10] The

[9] In addition to financial flows, technical co-operation is included in aid. Grants, loans and credits for military purposes are excluded. Transfer payments to private individuals (e.g. pensions, reparations or insurance payouts) are in general not counted.

[10] Estimates for the production function are available upon request.

results suggest that the elasticities of capital and labour do not vary significantly across model specifications and that the output elasticity of capital is higher than that of labour. Kumbhakar and Wang (2005) also report similar estimates for a panel sample of 65 countries over 1960-1999. The average worldwide technical progress is found to be positive for models (1) and (3) and negative for model (2) and statistically significant in all cases.[11] Our findings also show that the one sided error term (*U*) dominates the symmetric error term (*V*); the relevant coefficient γ approaches unity and is statistically significant. This means that the discrepancy between the observed output and the frontier output is almost completely due to technical inefficiency. The average level of technical efficiency ranges from almost 0.77 to 0.84. This means that the world output could increase further if inputs were used efficiently. Henry et al. (2009) report a value of technical efficiency close to 0.73.

Column 1 of Table 1 shows that foreign aid is associated with greater production inefficiency. Following Temple (1999) we construct regional dummy variables to capture differences in the initial level of technology, instead of controlling for country-specific fixed effects. We thus segregate the sample and categorize countries into six broad regions: East Asia and Pacific (*EAP*), Europe and Central Asia (*ECA*), Latin America and Caribbean (*LAC*), Middle East and North Africa (*MENA*), South Asia (*SA*), and Sub-Saharan Africa (*SSA*), following the World Bank geographic classification.[12] Column 2 shows that, with the exception of Latin America and Caribbean, foreign aid increases production inefficiency in all regions, and this inefficiency effect is considerably larger for South Asia, Sub-Saharan and North Africa and oil-rich Middle-East countries. This finding is in line with Djankov et al. (2008) who show that foreign aid results in the same curse as that of natural resources where institution quality is severely undermined by rent seeking activities. Next, to capture any time effects that might be associated with these changes we add decade

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[11] Kneller and Stevens (2003) and Kumbhakar and Wang (2005) report counter-intuitive negative rates of technical progress, whereas Christopoulos and León-Ledesma (2009) find evidence of positive technological progress. Henry et al. (2009) also find negative trend effects, but they consider the contribution of foreign R&D, making overall technical progress positive.

[12] From the 124 countries of our sample, 36% belong to Sub-Saharan Africa, 24% to Latin America, 16% to Middle East and North Africa, 6% to South Asia and 2% to Europe. Notice that, since our entire sample comprises only developing countries, the production frontier we measure is not necessarily the global frontier.

time effects as in Rajan and Subramanian (2008). Interestingly, estimation results reported in column 3 of Table 1 show that the positive inefficiency effect of aid is increasing over time with the highest effect observed in the last decade.

Using a Stochastic Frontier Analysis (SFA), Henry et al. (2009) show that international trade, and particularly imports of machinery products, is an important channel through which both technology transfers and production efficiency affect developing countries' output level. To investigate whether the efficiency impact of aid depends on the targeting sectors of the recipient country we discriminate between aid for social infrastructure and services (*SIS*), aid for economic infrastructure and services (*EI*), and aid for production sectors (*PS*), following the disaggregation argument of Clemens et al. (2004). A detailed listing of the sectors and subsectors of each category is provided in the Data Appendix. Data are again drawn from the Creditor Reporting System (CRS) database provided by the OECD.[13] Column 1 of Table 2 reports the estimates and shows that aid for social infrastructure (i.e., aid for education, health, water supply and civil society) and aid for production purposes (targeting, among others, the agricultural, industrial, and construction sector) increases production inefficiency, although the estimated coefficient for the latter category is statistically significant at 10% level. Interestingly, aid related to economic infrastructure sectors (like transport, communications, energy and banking) exerts a statistically insignificant inefficiency effect.

As a next step, we discriminate between *multilateral* aid (aid transferred by alliances of multiple states) and *bilateral* aid (aid transferred from one single state to another) on the basis that the economic effectiveness of aid may be constrained by the strategic motivations of bilateral donors due to failed conditionality or aid misallocation; that is, to the extent that donors are concerned with achieving geopolitical rather than developmental objectives, their incentive to hold the recipient government accountable for the effective use of aid receipts is weakened. On the other

[13] We employ data for aid commitments which are available for the period under investigation and we convert commitments to real disbursements following the methodology suggested by Clemens et al. (2004): we multiply the share of aid commitments in total commitments with total aid disbursements, thereby assuming that the measurable commitments ratio is roughly equal to the unmeasurable disbursements ratio. Clemens et al. (2004) compare these estimates to actual disbursements data for 1990 onwards to find that calculated values are very close to real ones.

hand, since bilateral aid is often used by the donors as a tool of securing their political, military or economic interests, we expect this form of transfers to benefit less, if not impair, growth in the recipient country, as compared with multilateral aid that is presumed to have diluted donor control and neutralized ulterior motives. To reconsider the bilateral-multilateral dichotomy in a production theory context we draw aid data from the OECD database scaled with the recipient's GDP (source: WDI 2009). Column 2 of Table 2 reports these estimates and shows that, as expected, only strategically motivated bilateral aid increases production inefficiency.[14] This finding is in contrast with Ram (2003) who reports that bilateral aid has very strong growth effects when outliers are removed, whereas multilateral aid has either a non-statistically significant effect, or a massive negative effect, but both results can be attributed to reverse causation as the author makes no allowances for the endogeneity of aid. Controlling for this endogeneity, Rajan and Subramanian (2008) find that multilateral aid is just as ineffective as bilateral aid. Overall, we reveal that foreign aid is not only immaterial for local growth, as previous studies have show, but also that it contributes positively in an inefficient use of the production inputs that are available in the local economy. We next consider if this inefficiency contribution depends on the political organization of the recipient government.

6. Main empirical results

In this section we report estimation results that link aid and production inefficiency with political reforms (section 6.1), their timing (section 6.2) and their intensity (section 6.3).

6.1. Political reforms, aid and production efficiency

To capture political reforms we rely on three different datasets and code them as a binary variable: democratic transitions taken from Papaioannou and Siourounis (2008a, PS hereafter), Polity IV democracy measure; and Freedom House ratings of political rights and civil liberties.

PS dataset: The authors denote a democratic (or autocratic) transition by taking into account sudden changes in the aforementioned measures of democracy, the timing of

[14] Notice that the estimate of technical progress is positive for this regression.

free and fair elections, and whether a five-year stability condition is satisfied.[15] This coding alleviates some of the serious problems often met when measuring democracy, like mismeasurement, exact timing, stability of the reform and acceptance of the new regime. It also covers more countries and more years than any other available democracy measurement. Based on PS dataset we construct a dummy variable that equals zero before the transition year and one during the transition and in the following years (denoted by *PS*1). Table 3, Column 1 reports the estimated coefficients for both aid and the interaction of aid with this reform variable. Surprisingly enough, not only democratization reduces production inefficiency by a statistically significant amount but, more importantly, the size of this reduction offsets almost entirely the inefficiency increase induced by aid. Thus, the model prediction on the differential effect of aid in democracies is empirically validated.

Polity IV measure: The next dataset we employ is the composite Polity index described in Marshall and Jaggers (2004). This index ranges from−10 to +10 , with higher values indicating higher levels of political freedom, and it captures the degree of competitiveness in political participation, the extent of openness in the selection of the legislature, and the checks and balances on executive power. A fully democratic government has three essential elements according to the Polity index: fully competitive political participation, institutionalized constraints on executive power, and guarantee of civil liberties to all citizens in their daily lives and in political participation. A regime change is detected when the 21-range Polity measure jumps from a negative to a positive value and remains there for five years.[16]. We construct a dummy variable that equals zero before the transition year and one during the transition and in the following years (denoted by *Pol*1). This dataset resembles qualitatively that of PS but covers 12 countries less (see Table A in the Appendix).[17] Table 3, Column 2 reports the estimates where again the interaction of aid with permanent democratization episodes is not only negative and statistically significant, but also sizable enough to overturn the positive inefficiency effect of aid. Thus, the

[15] For more details on the index see Papaioannou and Siourounis (2008a).
[16] See also Papaioannou and Siourounis (2008a).
[17] These are: Bahamas, Barbados, Belize, Brunei, Cape Verde, Dominica, Grenada, Malta, Sao Tome and Principe, Seychelles, Suriname and Tonga.

empirical evidence on the differential effect of aid remains intact when we employ alternative measures of democracy thereby validating the model prediction.

Freedom House Indices: Freedom House (FH) democracy measure consists of an evaluation of *civil liberties* protection, such as freedom of speech, association, assembly and demonstration, and *political rights* protection, such as the right for free and fair elections that represent informed citizen preferences. Scores for political rights and civil liberties range from 1 to 7 with lower values indicating more democracy. Countries with an average score of political rights and civil liberties less than 2.5 are assigned "free", while those with a greater than 5.5 score are designated as "not free"; countries with an average score between 2.5 and 5.5 are designated "partly free". Notice that, using this dataset to code transitions is not without problems since these scores move very slowly failing to capture considerable changes in the political organization of countries, whereas the stability criterion is difficult to be implemented. In addition, Muck and Verkuilen (2002) have shown that Freedom House evaluation methods are biased against left-wing governments, socialist regimes and countries not open to international trade. We nevertheless code a regime change when the FH status characterization jumps from Not Free to either Free or Partly Free and from Partly Free to Free provided that the index remains at the new regime status for five years. We then construct a dummy variable that equals zero before the transition year and one during the transition and in the following years (denoted by *FH*1). Table 3, Column 3 reports the results which show that, although with the correct sign, reforms captured by this measure do not affect the positive inefficiency impact of aid.

Table C of the Appendix ranks countries according to technical efficiency estimated using *PS*1 dummy variable to capture political reforms. Given the amount and combination of inputs used, the estimated efficiency values indicate how much GDP a country “produces” as a portion of the GDP that would have been possible to produce had the country in question been on the best practice frontier, i.e. had it been efficient. The top five most efficient countries are Sao Tome and Principe, Namibia, Libya, Vietnam and Tanzania, whereas at the bottom of the efficiency list we find Guinea-Bissau, Singapore, Lebanon, Somalia and Kuwait.

6.2. Timing of reforms, aid and production efficiency

It is important to know if the production inefficiency reduction induced by the interaction of aid with the reform variable is monotonic. Some countries move to democracy without considerable transaction costs, whereas others experience considerable turmoil. In essence, aid distribution might improve immediately in the former case whereas it can delay considerably in the latter. To time the effect of the reform we construct dummy variables for four non-overlapping, three-year spaced periods around the reform date that help capture short to medium-run effects and one dummy variable to isolate the long run effect. In turn, the inefficiency equation (18) for the preferred PS reform dataset becomes:

$$E(U_i) = a + \beta_1 AID_{it} + \beta_2 T_{it} + \beta_3 AID_{it} D_{it}^1 + \beta_4 AID_{it} D_{it}^2 + \beta_5 AID_{it} D_{it}^3 + \beta_6 AID_{it} D_{it}^4 + \beta_7 AID_{it} D_{it}^5 + \eta_{it}$$

where $D_{it}^1 = 1$ in the fifth, fourth and third pre-reform year; $D_{it}^2 = 1$ in the second and first pre-reform year and at the transition year; $D_{it}^3 = 1$ in the first, second and third post-reform year; $D_{it}^4 = 1$ the fourth, fifth and sixth post-reform years; and $D_{it}^5 = 1$ in the seventh and all subsequent post-reform years. So, the base period is the autocratic years before the 5th pre-reform year. Table 4, Columns 1-3, report the estimated coefficients. From those, only the ones that are estimated with the PS and Polity dataset are significant.

Anticipation and transition: The dummy variable *D*1 captures any anticipation effects. It is possible that the ruling elite implements better and wider distribution policies in an attempt to gain legitimacy and remain in power. Using the PS dataset, estimates show that the interaction of *D*1 with aid is considerably large and even outweights the positive inefficiency effect of aid, thereby strengthening our overall argument that political governance is very significant in the way aid is distributed, monitored and used. Evidently, due to anticipation effect foreign aid increases production efficiency in the 5th, 4th and 3rd pre-reform year. Turning to the transition dummy, *D*2, we see that although the interaction effect is negative, it is indistinguishable from zero. The same is true when we use the Polity IV dataset.

Short to medium-term effects: The estimated coefficients for the interaction terms with *D*3 and *D*4 are also negative, but not statistically significant pointing to considerable transition costs that do not allow any positive effects of aid on production efficiency. This result implies that, in several cases it might be better to restrain foreign aid for some time until the local government has established itself, as opposed to recent studies which show that foreign aid exerts a 3-4 years impact in economic performance. Conditional on political reforms, we find that the period when aid seems to start playing a role is beyond 6 years. That period's end seems to coincide with *D*5, whose interaction with aid is significantly negative and sizable.

Long-term effects: The most important result is that of the coefficient of *D*5. Notice that this coefficient is not only significant (using both the PS and the Polity datasets) but its magnitude is large enough to render the overall efficiency effect of aid positive. It shows that as democracy consolidates, representative governance is able to better handle foreign aid, something that reduces considerably production inefficiency present from the former type of governance.

To illustrate the conditional time-varying effectiveness of aid we recover the corresponding inefficiency elasticities, calculated at different time intervals around the *PS*1 reform, and we provide a graphical presentation. Notice that, these elasticities correspond to inefficiency changes incurred as a result of a one-unit increase in average aid. As shown in Graph 1, aid is mostly conductive to production efficiency in the fifth, fourth and third year prior to the reform; for this time interval the inefficiency reduction is the greater in absolute value (−0.08). Yet, this effect vanishes gradually as the reform approaches. At the time of the reform and during the three post-reform years aid produces production inefficiency for the reasons explained above. Finally, after the fourth post-reform year aid fosters production efficiency again; the inefficiency elasticity reached almost−0.06 . This graphical illustration shows that foreign aid induces production efficiency early before the reform and after the reform has established in the recipient country.

6.3. Intensity of reforms, aid and production efficiency

So far we have examined how the incidence and the timing of democratic reforms can offset the positive inefficiency impact of aid. Another potential factor is the intensity of the reforms. The intensity of reforms might have differential effects in the political organization of a country with important implications for the effectiveness of aid.

Sudden changes in the political leadership may foster aid effectiveness if, for instance, the replacement of a corrupt or expropriate leadership by a democratic one is followed by a distinctly different and more effective distribution policy of aid. On the other hand, local autocratic leaders may allow some resources to be distributed in a more egalitarian way if they are subject to internal or international pressure and the marginal effect of the reform is large. To investigate if the effectiveness of aid depends on the intensity of the political reforms we code countries into two categories: fully democratized and partially democratized. For Papaioannou and Siourounis (2008a) dataset we use the authors' classification. For Polity IV, fully democratized countries are those that scored at least +7 after democratization, whereas partially democratized countries are those that scored 0 to +6 after democratization. For Freedom House, we use the existing characterizations after democratization episodes. Estimation results are reported in Table 5, Columns 1-3. As can be readily seen, all coefficients for the interaction terms of aid with the reform variables are negative, but only the interactions of aid with partial reforms are statistically significant across estimations. This finding provides strong evidence that the inefficiency effect of aid is moderated in recipients that have experienced partial democratization episodes. Interestingly, estimation results of columns 1 and 2 show that a partial move to democratic ruling has a significantly negative effect on production inefficiency that is moreover sizeable enough to overturn the positive effect of aid. Using the preferred PS reform dataset, we find evidence that recipient countries that have moved to partial democratic ruling enjoy an inefficiency reduction due to the reform that is not experienced by countries that have moved to full democratic governance. This result is in accordance with Papaioannou and Siourounis (2008a) who find that partial democratizations assert a higher impact in long run growth and Barro (1996, 1997) who shows that growth accelerates when a country moves from total autocracy to intermediate levels of political freedom.

7. Conclusions

This study contributes to the aid literature by investigating the impact of aid on the production inefficiency of the recipient countries. This relationship has received considerably little attention by theorists and empirical researchers who have mainly focused on the growth implications of aid, giving rise to a huge literature of inconclusive results. As opposed to economic growth, production efficiency

corresponds to the efficient use of the existing production inputs and is of great importance for aid-recipient countries as, in the majority of them, technological progress –that could alternatively foster productivity– is very slow.

We document that foreign is associated with greater production inefficiency, controlling for unobserved heterogeneity, the time horizon, and the sources of aid. Moreover, our analysis goes further by exploring whether the political orientation of the recipient country alters the positive relationship between the aid flows received and the production inefficiency estimated. To this end, we present a theoretical framework to describe the channels of aid effectiveness which lies in the realistic assumption that a part of a recipient economy's output is produced in the inefficient informal sector. Foreign aid acts on the production efficiency of the economy by increasing the relative size of the efficient formal sector. Yet, foreign aid is managed by the ruling class within a certain political environment and, therefore, any mismanagement of these resources has important implications for their economic effectiveness. In line with the model prediction, we provide strong empirical evidence that the quality of institutions, captured by the political orientation of the recipient country, matter. Production inefficiency caused by the misuse of aid reduces significantly if the political regime of the recipient switches to democratic ruling as the latter is often associated with increased political accountability and moderate corruption levels. In practice, democratic ruling enables the ruling elite to adopt long-term policies that are less extractive and result in a better allocation of foreign aid thereby increasing production efficiency.

Moreover, we find empirical evidence that the differential effect of aid is not monotonic with respect to the time of the democratic reform; in the 5^{th}, 4^{th} and 3^{rd} pre-reform year aid has a strong effect in inefficiency reduction which diminishes significantly by the 4^{th}, 5^{th} and 6^{th} year after democratization to pick up again afterwards. This result pinpoints the importance of anticipation and long-run effects in determining the effectiveness of aid flows. Finally, we investigate the intensity of democratic reforms and we recover that moderate but stable political changes towards democracy bolster production inefficiency reductions in the presence of aid more than abrupt political transitions.

We see this work as a contribution to the ongoing research on the prerequisites that aid recipient countries need to have in order to benefit themselves from long-term improvement in production efficiency, output growth and standards of living.

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Table 1: Foreign Aid (% of GDP) and Production Efficiency

	Inefficiency Equation		
	(1)	(2)	(3)
$Constant$	-1.407**	0.745***	-1.610*
	[0.035]	[0.001]	[0.069]
AID	0.229***		
	[0.003]		
$Time$	-0.129***	-0.041****	-0.121***
	[0.001]	[0.001]	[0.001]
$AID * Time$	0.002*		
	[0.056]		
$AID * EAP$		0.007***	
		[0.001]	
$AID * ECA$		0.006***	
		[0.001]	
$AID * LAC$		-0.003	
		[0.462]	
$AID * MENA$		0.010***	
		[0.001]	
$AID * SA$		0.018***	
		[0.001]	
$AID * SSA$		0.014***	
		[0.001]	
$AID * (1971-1979)$			0.052***
			[0.008]
$AID * (1980-1989)$			0.034***
			[0.007]
$AID * (1990-1999)$			0.064***
			[0.001]
$AID * (2000-2007)$			0.085***
			[0.001]
$\gamma = \frac{\sigma_U^2}{\sigma_U^2 + \sigma_v^2}$	0.991***	0.957***	0.991***
	[0.001]	[0.001]	[0.001]
$\sigma^2 = \sigma_U^2 + \sigma_V^2$	0.648***	0.079***	0.658***
	[0.003]	[0.001]	[0.001]
E_K	0.376***	0.416***	0.376***
	[0.001]	[0.001]	[0.001]
E_L	0.238***	0.297***	0.235***
	[0.001]	[0.001]	[0.001]
TE	0.843	0.766	0.843
TP	0.006***	-0.009***	0.006***
	[0.001]	[0.001]	[0.001]
No of countries	124	124	124

Notes: Estimation method is Maximum Likelihood. Production Function estimates are not reported foe space reasons but are available from the authors upon request. *, **, *** correspond to statistical significance at 10%, 5%, and 1%, respectively. For each independent variable the first row provides the estimates of regression coefficients whereas figures in brackets are *p*-values. E_K and E_L denote the elasticity of capital and labour with respect to output respectively while *TP* and *TE* denote Technical Progress and Technical Efficiency respectively. E_K, E_L, *TP* and *TE* are evaluated at the sample mean.

Table 2: Disaggregated Foreign Aid (% of GDP) and Production Efficiency

	Inefficiency Equation	
	(1)	(2)
Constant	-1.658	-140.886
	[0.109]	[0.100]
Time	-0.104**	-2.578**
	[0.015]	[0.012]
SIS	0.087***	
	[0.008]	
EI	0.026	
	[0.137]	
PS	0.026*	
	[0.078]	
Multilateral Aid		0.100
		[0.152]
Bilateral Aid		0.046***
		[0.006]
$\gamma = \frac{\sigma_U^2}{\sigma_U^2 + \sigma_v^2}$	0.993***	0.991***
	[0.001]	[0.001]
$\sigma^2 = \sigma_U^2 + \sigma_V^2$	0.522**	39.85**
	[0.025]	[0.025]
E_K	0.482***	0.400***
	[0.001]	[0.001]
E_L	0.439***	0.264***
	[0.001]	[0.001]
TE	0.869	0.820
TP	-0.0003	0.006***
	[0.784]	[0.001]
No of countries	118	118

Notes: See Table 1.

Table 3: Aid, Production Efficiency and Permanent Political Reforms

	Inefficiency Equation		
	(1)	(2)	(3)
$Constant$	0.644***	0.021	-4.800
	[0.001]	[0.651]	[0.264]
AID	0.012***	0.013***	0.108***
	[0.001]	[0.001]	[0.001]
$Time$	-0.045***	-0.018***	-0.189
	[0.001]	[0.001]	[0.235]
$AID * EV\_PS1$	-0.011**		
	[0.013]		
$AID * EV\_POL1$		-0.013***	
		[0.001]	
$AID * EV\_FH1$			-0.797
			[0.264]
$\gamma = \frac{\sigma_U^2}{\sigma_U^2 + \sigma_v^2}$	0.999***	0.999***	0.995***
	[0.001]	[0.001]	[0.001]
$\sigma^2 = \sigma_U^2 + \sigma_V^2$	0.113***	0.151***	0.249***
	[0.001]	[0.001]	[0.001]
E_K	0.421***	0.389***	0.411***
	[0.001]	[0.001]	[0.001]
E_L	0.103**	0.199**	0.133***
	[0.040]	[0.050]	[0.010]
TE	0.768	0.801	0.860
TP	-0.004	0.010***	0.010***
	[0.795]	[0.001]	[0.001]
No of countries	114	102	102

Notes: See Table 1.

Table 4. Aid, Production Efficiency and Political Timing of Political Reforms

	Inefficiency Equation		
	(1)	(2)	(3)
$Cons\tan t$	0.610***	0.586***	-3.296
	[0.001]	[0.001]	[0.150]
AID	0.012***	0.013***	0.075**
	[0.001]	[0.001]	[0.014]
$Time$	-0.039***	-0.038***	-0.078*
	[0.001]	[0.001]	[0.070]
$AID*D1$	-0.024***		
	[0.008]		
$AID*D2$	-0.012*		
	[0.062]		
$AID*D3$	-0.007		
	[0.260]		
$AID*D4$	-0.016		
	[0.104]		
$AID*D5$	-0.023**		
	[0.044]		
$AID*D1\_POL$		-0.011***	
		[0.001]	
$AID*D2\_POL$		-0.010**	
		[0.038]	
$AID*D3\_POL$		-0.013***	
		[0.001]	
$AID*D4\_POL$		-0.012*	
		[0.053]	
$AID*D5\_POL$		-0.015***	
		[0.001]	
$AID*D1\_FH$			-0.098*
			[0.082]
$AID*D2\_FH$			-0.0173
			[0.154]
$AID*D3\_FH$			-0.234
			[0.203]
$AID*D4\_FH$			-0.560
			[0.217]
$AID*D5\_FH$			-0.192
			[0.240]
$\gamma = \frac{\sigma_U^2}{\sigma_U^2 + \sigma_v^2}$	0.997***	0.996***	0.996***
	[0.001]	[0.001]	[0.001]
$\sigma^2 = \sigma_U^2 + \sigma_V^2$	0.102***	0.097***	0.703***
	[0.001]	[0.001]	[0.001]
E_K	0.427***	0.403***	0.436***
	[0.001]	[0.001]	[0.001]
E_L	0.204	0.187***	0.302***
	[0.100]	[0.001]	[0.001]
TE	0.767	0.771	0.864
TP	-0.003***	-0.009	0.006***
	[0.004]	[0.860]	[0.001]
No of countries	90	85	85

Notes: See Table 1.

Table 5: Aid, Production Efficiency and Political Intensity of Political Reforms

	Inefficiency Equation		
	(1)	(2)	(3)
$Constant$	0.632***	0.633***	0.305***
	[0.001]	[0.001]	[0.001]
AID	0.014***	0.016***	0.018***
	[0.001]	[0.001]	[0.001]
$Time$	-0.046***	-0.044***	-0.041***
	[0.001]	[0.001]	[0.001]
$AID*D\_FUL$	-0.049		
	[0.240]		
$AID*D\_PARTIAL$	-0.015***		
	[0.001]		
$AID*D\_FUL\_POL$		-0.019***	
		[0.001]	
$AID*D\_PARTIAL\_POL$		-0.099***	
		[0.001]	
$AID*D\_FUL\_FH$			-0.046
			[0.551]
$AID*D\_PARTIAL\_FH$			-0.010***
			[0.001]
$\gamma = \frac{\sigma_U^2}{\sigma_U^2 + \sigma_v^2}$	0.997***	0.997***	0.998***
	[0.001]	[0.001]	[0.001]
$\sigma^2 = \sigma_U^2 + \sigma_V^2$	0.120***	0.112***	0.162***
	[0.001]	[0.001]	[0.001]
E_K	0.407***	0.392***	0.393***
	[0.001]	[0.001]	[0.001]
E_L	0.112***	0.049	0.049
	[0.029]	[0.501]	[0.564]
TE	0.764	0.766	0.794
TP	0.004	0.029	0.007***
	[0.850]	[0.218]	[0.002]
No of countries	114	102	102

Notes: See Table 1.

Data Appendix

Country coverage – Aid Recipients

Sample (124 countries):

Algeria, Angola, Argentina, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia, Botswana, Brazil, Brunei, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China, Congo, Dem. Rep., Congo, Rep., Colombia, Comoros, Costa Rica, Cote d' Ivoire, Cyprus, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Ethiopia, Fiji, Gabon, Gambia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hong Kong, India, Indonesia, Iran, Iraq, Israel, Jamaica, Jordan, Kenya, Korea, Kuwait, Laos, Lebanon, Lesotho, Liberia, Libya, Macao, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Namibia, Nepal, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Rwanda, Samoa, Sao Tome & Principe, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Solomon Islands, Somalia, Sri Lanka, St. Lucia, St.Vincent & Gredines, Sudan, Suriname, Swaziland, Syria, Tanzania, Thailand, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Arab Emirates, Uruguay, Vanuatu, Venezuela, Vietnam, Zambia, Zimbabwe, Yemen.

Disaggregated data of aid

A. Bilateral vs. Multilateral Aid:

Bilateral aid includes aid from the 22 Development Assistance Committee member countries defined in the OECD's Development Assistance Committee (DAC) database. These are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and the United States.

Multilateral aid is identified in the OECD's DAC database and includes assistance from the World Bank, and the regional development banks. These are: African Development Bank (AfDB), African Development Fund (AfDF), Asian Development Fund (AsDF), Asian Development Bank (AsDB), Caribbean Development Bank (CarDB), European Bank for Reconstruction and Development (EBRD), European Commission (EC), Global Environment Facility (GEF), Global Fund for AIDS, TB and Malaria (GFATM), Montreal Protocol, Nordic Development Fund, International Bank for Reconstruction and Development (IBRD), International Development Association (IDA), Inter-American Development Bank (IDB), IDB Spec. Fund, IMF Trust Fund, IMF, International Fund for Agricultural Development (IFAD), United Nations Development Programme (UNDP), United Nations Population Fund (UNFPA), United Nations High Commissioner for Refugees (UNHCR), United Nations Children's Fund (UNICEF), United Nations Relief and Works Agency (UNRWA), United Nations Transitional Authority (UNTA), World Food Programme (WFP), Council of Europe, Arab Agencies, Czech Republic, Hungary, Iceland, Korea, Poland, Slovak Republic, Turkey, and Arab Countries.

B. Sectoral coverage of aid flows:

Aid for *social infrastructure and services* (as % of GDP) includes assistance for the following sub-sectors:

I.1. Education
I.1.a. Education, Level Unspecified
I.1.b. Basic Education
I.1.c. Secondary Education
I.1.d. Post-Secondary Education
I.2. Health
I.2.a. Health, General
I.2.b. Basic Health
I.3. Population Pol./Progr. & Reproductive Health
I.4. Water Supply & Sanitation
I.5. Government & Civil Society
I.5.a. Government & Civil Society-general
I.5.b. Conflict, Peace & Security
I.6. Other Social Infrastructure & Services

Aid for *economic infrastructure and services* (as % of GDP) includes assistance for the following sub-sectors:

II.1. Transport & Storage
II.2. Communications
II.3. Energy
II.4. Banking & Financial Services
II.5. Business & Other Services

Aid for *production sectors* (as % of GDP) includes assistance for the following sub-sectors:

III.1. Agriculture, Forestry, Fishing
III.1.a. Agriculture
III.1.b. Forestry
III.1.c. Fishing
III.2. Industry, Mining, Construction
III.2.a. Industry
III.2.b. Mineral Resources & Mining
III.2.c. Construction
III.3.a. Trade Policies & Regulations
III.3.b. Tourism

Data on each category of aid are in terms of commitments. Conversion to disbursements was made by taking the ratio of commitments in each sector to overall commitments and then multiplying this amount by aggregate aid disbursements.

Physical capital data construction: Estimates of the physical capital stock are generated using the perpetual inventory method and the pair of equations:

$$K_{it} = (1-\Delta)K_{it-1} + I_{it-1}, \quad K_{i0} = \frac{I_0}{(g^K + \Delta)},$$

where K refers to the physical capital stock, Δ is the depreciation rate, I stands for investment and g^K denotes the average annual growth rate of investment over the sample period. To overcome the problems regarding the assumptions about initial capital stocks, this value was estimated for the first available observation. The depreciation rate was set equal to 9.50 percent.

Appendix Table A: Country sample

Panel A: Preferred Sample: Papaioannou and Siourounis (2008) 114 Countries						Panel B: Polity IV 102 countries		Panel C: Freedom House 113 countries	
Full Democratization	**Partial Democratization**	**Always Authoritarian**		**Borderline and Reversals**	**Always Democratic**	**Full and Partial Democratization**	**Always Authoritarian**	**Full and Partial Democratization**	**Always Authoritarian**
Argentina (1983)	Bangladesh (1991)	Algeria	Jordan	**Borderline**		**Panel A minus:**		**Panel A minus:**	
Benin (1991)	Djibouti (1999)	Angola	Kenya		Israel				
Bolivia (1982)	Ethiopia (1995)	U. Arab Emirates	Kuwait	Central African Republic (1993)	Bahamas	Bahamas		Sao Tome and Principe	
Brazil (1985)	Guatemala (1996)	Bahrain	Laos		Jamaica	Barbados			
Cape Verde (1991)	Indonesia (1999)	Barbados	Liberia	Comoros (1990)					
Chile (1990)	Lesotho (1993)	Bhutan	Libya			Belize			
Dom. Rep. (1978)	Madagascar (1993)	Brunei	Mauritania	Iran (1997)	Belize				
Ecuador (1979)	Malawi (1994)	Burkina Faso	Morocco	Nepal (1991)	Botswana	Malta		Brunei	
El Salvador (1994)	Mozambique (1994)	Burundi	Oman	Niger (1999)		Mauritius			
Ghana (1996)	Nicaragua (1990)	Cambodia	Qatar	Pakistan (1988)	Colombia	Namibia		Cape Verde	
Grenada (1984)	Nigeria (1999)	Cameroon	Rwanda		Costa Rica				
Guyana (1992)	Paraguay (1993)	Chad	Saudi Arabia		Cyprus			Dominica	
Honduras (1982)	Suriname (1991)	China	Sierra Leone						
Korea, Rep. (1988)	Tanzania (1995)	Congo, Dem.	Singapore	**Reversals**	Dominica	Papua New Guinea		Grenada	
Mali (1992)	Turkey (1983)	Congo, Rep.	Somalia	Gambia (1994)	Fiji			Malta	
Mexico (1997)	Zambia (1991)	Egypt	Syria	Lebanon (1975)		Sri Lanka			
Mongolia (1993)		Equatorial Guinea	Sudan	Zimbabwe (1987)				Sao Tome and Principe	
Panama (1994)		Gabon	Swaziland			Trinidad & Tobago			
Peru (1980)		Guinea	Togo	**Intermediate**				Seychelles	
Philippines (1987)		Guinea-Bissau	Tunisia		India			Suriname	
Sao Tome and Principe (1991)		Haiti	Uganda	Malaysia		Venezuela			
Senegal (2000)		Iraq	Vietnam	Tonga				Tonga	
Thailand (1992)		Seychelles							
Uruguay (1985)									

Panel A gives the base sample countries. Panels B and C report the differences in countries according to PolityIV and Freedom House respectively from our preferred sample. According to Papaioannou and Siourounis (2008a), there are seven categories. (1) "Always authoritarian" are those countries that are autocratic throughout the sample period. (2) The "full" democratization group includes countries that abandoned autocratic ruling in the period 1960-2005 and in addition get an almost perfect score in civil rights and political liberties protection. (3) The "partial" democratization group includes countries that abandoned autocracy in the period 1960-2005, but the level of civil rights protection is not perfect. (4) "Borderline democratization" countries implemented political reforms towards democratic rule, but civil liberties and freedoms are still at a very low level. (5) "Always democratic" countries are throughout the sample period democratically ruled. (6) "Intermediate" countries get a far from perfect democratic score but have not experienced a regime change. (7) "Reversals" indicate countries that experienced a political set-back, moving from a relatively stable democracy to autocratic status. The year of transition is given in parenthesis. Section 2 of the authors' paper provides details on their algorithm in grouping countries and identifying political transitions.

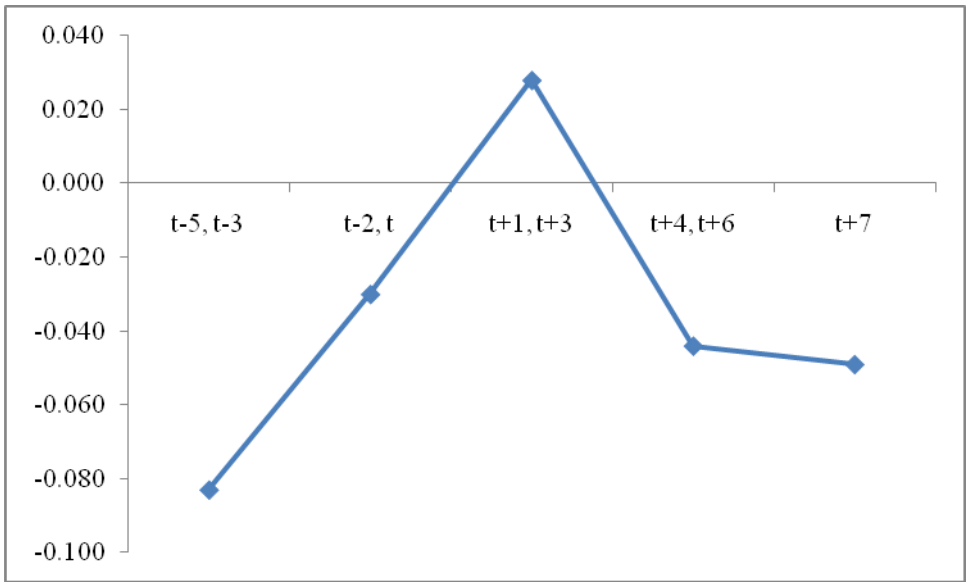
Appendix Table B. Descriptive statistics on inputs and outputs

	Sample: 124 countries, 1971-2007			
Variables	Mean	St. Dev.	Min	Max
AIDGDP (%)	7.40	10.16	-2.76	108.3
Aid for Social Infrastructure	3.67	6.31	0.00	91.59
Aid for Economic Infrastructure	2.66	4.21	0.00	60.19
Aid for Production Sectors	2.31	3.94	0.00	56.82
Multilateral Aid	26.14	40.76	-36.80	491.87
Bilateral Aid	69.44	126.47	-175.76	1837.23
Capital per worker	0.04	0.11	0.00	1.31
GDP per worker	18,689.09	27,978.74	413.20	317,528.50
Labour (thousands)	13,882.33	64,441.14	24.087	785,714.50

Appendix Table C. Countries ranked by technical efficiency (TE)
(Average values for the entire 1971-2007 sample period, 114 countries – 3,283 observations)

Country	TE	Country	TE	Country	TE
Sao Tome & Principe	0.965	Honduras	0.808	Seychelles	0.726
Namibia	0.925	Iran	0.807	Congo, Dem. Rep.	0.724
Libya	0.909	Bolivia	0.807	Trinidad and Tobago	0.723
Vietnam	0.899	Comoros	0.805	Sierra Leone	0.723
Tanzania	0.899	Burundi	0.804	Swaziland	0.722
Tonga	0.898	Togo	0.803	Cyprus	0.719
Argentina	0.887	Fiji	0.799	Congo, Rep.	0.716
Laos	0.878	Paraguay	0.799	Indonesia	0.714
Algeria	0.873	Uruguay	0.798	Benin	0.714
Guinea	0.868	Peru	0.797	Uganda	0.707
Lesotho	0.861	Saudi Arabia	0.794	Panama	0.704
Philippines	0.860	Jamaica	0.793	Qatar	0.702
Cambodia	0.858	Niger	0.793	Syria	0.699
Haiti	0.857	Morocco	0.791	Tunisia	0.699
Djibouti	0.856	Brunei	0.789	Bhutan	0.697
Nepal	0.856	Jordan	0.787	Egypt	0.696
Central African Rep.	0.853	Angola	0.786	Mali	0.693
Guatemala	0.850	Chad	0.782	Malaysia	0.683
Senegal	0.848	Guyana	0.779	Liberia	0.683
Barbados	0.847	Nicaragua	0.777	Korea	0.683
Mauritius	0.840	Cape Verde	0.776	Mauritania	0.682
Ethiopia	0.838	Bahrain	0.775	Thailand	0.680
Bangladesh	0.837	Mongolia	0.774	Sudan	0.675
Zambia	0.837	Cameroon	0.773	Oman	0.667
Ecuador	0.836	Madagascar	0.772	Botswana	0.661
Bahamas	0.835	Pakistan	0.769	Malawi	0.645
Mexico	0.835	China	0.769	Nigeria	0.630
Belize	0.833	Grenada	0.766	Equatorial Guinea	0.630
El Salvador	0.833	Burkina Faso	0.766	Iraq	0.627
Rwanda	0.832	Ghana	0.759	Guinea-Bissau	0.615
Mozambique	0.828	Malta	0.756	Singapore	0.577
Brazil	0.822	Sri Lanka	0.754	Lebanon	0.574
Venezuela	0.817	United Arab Emirates	0.753	Somalia	0.535
Dominica	0.817	Zimbabwe	0.752	Kuwait	0.497
Surime	0.816	Papua New Guinea	0.746		
Colombia	0.814	Gabon	0.745		
Turkey	0.812	Kenya	0.744		
India	0.811	Dominican Republic	0.739		
Costa Rica	0.811	Israel	0.731		
Gambia	0.810	Chile	0.729		

Graph 1:
Production Inefficiency Change due to Aid and Timing of Reform



Years around the democratic reform (t)