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Asymmetric Information, Rent Extraction and Aid Efficiency

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Abstract

Official Development Aid flows are volatile, non-predictable and not delivered in a transparent way. All these features reinforce asymmetric information between the citizens and the recipient government about the amount of aid flows received by developing countries. This article uses a political economy model of rent extraction to show how this asymmetry (i) encourages rent extraction by kleptocratic regimes, thus reducing aid efficiency, and (ii) increases the negative impact of aid volatility. It identifies a new channel – the "asymmetric information" channel – through which aid volatility is costly for recipient countries. The empirical relevance of the model is confirmed on a panel data of developing countries. Using various specifications and econometric methods, and developing new yearly estimates of aid volatility, I show that (i) introducing more information increases aid efficiency, that (ii) the negative impact of aid volatility on aid efficiency vanishes once one controls for information, and that (iii) this positive impact of information does not come from the fact that more transparent countries tend to have better institutions.

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1 INTRODUCTION

This article uses a political economy model of rent extraction to study the incentives that make a government in a recipient country willing to favor its private interest rather than the public interest when it receives official development aid flows. It is shown that the recipient government takes advantage of both uncertainty and non-transparency that characterize aid flows in order to increase the amounts of rents it extracts at the expense of public goods provision, thus reducing the efficiency of aid, i.e. its effectiveness in generating development per dollar transferred.

Rents can be extracted from two sources: (i) *power* – when a government takes office, citizens temporarily delegate to it the exclusive decision-making authority and so the use of aid flows; and (ii) *asymmetric information* – the government has access to better information on the amount of aid flows received than the rest of the population (Persson, Roland, and Tabellini, 1997). This asymmetry comes from the combination of aid uncertainty and non transparency.

Aid uncertainty may stem from the lack of predictability of aid flows. It is then defined as the difference between what the donors commit to give and what they really disburse (Celasun and Walliser, 2008; Borensztein, Cagé, Cohen, and Valadier, 2008). It may also result from the volatility of aid flows. Quite strikingly, recent studies have found that aid is even more volatile than tax revenues (Fielding and Mavrotas, 2005; Bulir and Hamann, 2006). The problem is that this volatility cannot always be regarded as resulting from the fact that "aid is coming at the right time", since aid appears to be mildly procyclical (Gemmel and McGillivray, 1998; Pallage and Robe, 2001).

Moreover, besides being uncertain, aid is not delivered according to some recipient economic characteristics or efficient allocation criteria. Empirical studies on the determinants of aid flows have emphasized that the main determinants are political and strategic considerations, rather than economic needs of the recipient countries (Alesina and Dollar, 2000; Alesina and Weder, 2002). This pattern of allocation reinforces the non transparency that characterizes the use of aid flows and gives the recipient government an informational advantage over its citizens (Brautigam, 2000)[1]. Having discretion in the use of aid flows, which are fungible resources, the recipient government can extract rents rather than providing public goods[2].

[1] For example, in Tanzania, 70 percent of donor financing was not included in the 1996/97 budget (Moon, 1998).

[2] In this paper, mainly for data availability reasons, I focus on capture and rent extraction at the national level. However, capture may occur subnationally or by regional leaders, as shown for example by Reinikka and Svensson (2004) for Uganda.

Encouraging rent extraction by kleptocratic regimes, asymmetric information about aid thus reduces aid efficiency. I identify a new channel – the "asymmetric information" channel – through which "bad" aid volatility is costly for recipient countries. This channel is the combination of volatility (*ex ante asymmetric information* between donors and recipients) with the lack of transparency (*ex post asymmetric information* between citizens and their government in the recipient country) that characterizes aid flows and reduces aid efficiency. Indeed, there are two different sources of information failures in aid contracting mechanisms. The first information failure is aid uncertainty that weakens the contract between donors and recipients and comes from donors erratic behavior. The second one comes from the fact that citizens lack information about the amount of aid received by the government. Citizens thus cannot monitor the government's behavior well. It is the case in "kleptocratic" regimes, where the government provides its citizens with some public goods, rather than to take all the wealth of the state for its own use, only if it is in its self-interest.

To figure out the government's trade-off between rent extraction and public goods provision, I model electoral competition as "post-election politics" (Persson and Tabellini, 1999). Following Barro (1973) and Ferejohn (1986), I assume that citizens do not compare political platforms proposed by different candidates and then elect the candidate with the best platform, but base their choice on the present skills of the incumbent. They hold the incumbent accountable for past performance and there is no commitment to policies before elections take place. The only way citizens can punish the incumbent is by not reelecting her: elections serve the purpose of holding the politicians accountable to backward-looking citizens. The incumbent runs against a single opponent, who is drawn at random from a large set of candidates. Candidates are not inherently different in their competence or in any other attributes, so the importance of challengers lies entirely in their availability. Each period, the policymaker observes the amount of aid she receives; however, this information is not necessarily available to the citizens (asymmetric information). When it is allocated in a transparent way, the amount of aid is common knowledge. When such is not the case, the citizens only know the distribution of the random variable aid.

Because of the voting rule, the incumbent faces an intertemporal trade-off: if she extracts too much rents today, she cannot satisfy the citizens' expectations and must forego re-election and rents tomorrow. So the reason for which the incumbent refrains from excessive diversion of resources today is that she wants to be able to continue holding office and diverting some resources tomorrow. However**,** since all aid recipient countries are not countries with democratic elections, the model is written in such a way that it

can be reinterpreted as a model of nondemocratic regimes, the government providing public goods or making concessions to the military in order to avoid a revolution rather than in order to be reelected[3].

More precisely, the model is a two-agent – an incumbent and a representative citizen – political economy model of rent extraction. The utility of the citizen is a function of the amount of public goods she receives. The utility of the incumbent is a function of the amount of rents she extracts and of the utility she gains from taking office. The incumbent extracts rents and provides public goods using the aid flows she receives. Aid is modeled as a non-zero mean stationary positive autoregressive process of order one. At the end of each period, the incumbent stays in power if and only if she provided the citizen with the minimum amount of public goods the latter wants.

I show that the combination of aid volatility and non transparency sharply reduces aid efficiency. Both smoothing and transparency would reduce the amount of rents the recipient government can extract.This may help explain why historically very few developing countries have attempted to insure themselves against aid shocks. Moreover, this helps explain why the incumbent does not have interest in the allocation of aid flows being more transparent.

In order to test the relevance of the main results of the model, I assess empirically the impact of asymmetric information on aid efficiency and aid volatility, using panel data of developing countries. While the model is mainly focused on public goods provision, the empirical findings are related to economic growth. Indeed, for data availability reasons, this allows me to use a larger panel. Moreover, it has been shown in the literature that the provision of public goods – e.g. education or infrastructures – by a government promotes economic efficiency and growth (Barro and Sala-i Martin, 2003).

Using various specifications and econometric methods, and developing new yearly estimates of aid volatility, I show that (i) more transparency increases aid efficiency, and that (ii) aid volatility reduces aid efficiency but that this effect vanishes once I control for information. These results are robust to controlling for other country characteristics and for decreasing returns of aid efficiency, and to the inclusion of period and country fixed effects. I also provide evidence of the fact that, through my information proxies, I capture effectively the effect of information and not measure indirectly the effect of institutions. Hence, making different robustness checks, I conclude that data support the results of the model.

The rest of the article is organized as follows. Section 2 discusses the related literature. Section 3 sets up a political economy model of rent extraction. Section 4 studies

[3]See e.g. Acemoglu, Ticchi, and Vindigni (2008).

the equilibrium to investigate the effects of aid asymmetric information on aid efficiency. Section 5 provides empirical evidence confirming the model's prediction that asymmetric information reduces aid efficiency and increases the negative impact of aid volatility. Section 6 concludes.

2 RELATED LITERATURE

This article is related to models of bargaining over resources in the context of political decision-making and in the tradition of principal-agent approaches to politics. I assume that citizens hold the incumbent accountable for past performance and that there is no commitment to policies before elections take place as in Barro (1973) and Ferejohn (1986). After the election, the incumbent has an incentive to follow its most preferred policy (Osborne and Slivinski, 1996; Besley and Coate, 1997; Acemoglu, Ticchi, and Vindigni, 2006; Acemoglu, Egorov, and Sonin, 2006). This lack of commitment and this no enforcement of electoral promises imply an agency problem between citizens and their representatives, with contractual incompleteness (Persson, Roland, and Tabellini, 1997, 2000; Persson and Tabellini, 1999). This approach is widely used in the political budget/business cycle literature (Alesina, 1988; Rogoff and Sibert, 1988; Rogoff, 1990; Alesina and Tabellini, 1990).

One of the contributions of this article is to apply this framework to developing countries, and more precisely to the question of development aid efficiency and aid volatility. There is a growing literature on aid efficiency that tries to determine how foreign aid affects economic growth. Some authors argue that aid raises growth in countries with good policies (Burnside and Dollar, 2000; Collier and Dehn, 2001; Collier and Dollar, 2002, 2004; Collier and Hoeffler, 2004), others that is does so in countries with difficult environment (Guillaumont and Chauvet, 2001), or mainly outside the tropics (Dalgaard, Hansen, and Tarp, 2004), or in average with diminishing returns (Hansen and Tarp, 2001). However, the debate is still opened (Roodman, 2007). This article is related to this literature and gives some tools in order to reinterpret its sometimes contradictory findings. In particular, it underlines the importance of taking into account information, both in the relationship between donors and recipients (aid volatility and predictability), and inside the recipient country (accountability of the recipient government).

As to aid volatility, a first strand of the literature underlines that this volatility is costly for recipient countries (Ramey and Ramey, 1995) and reduces aid efficiency (Kharas, 2008). A second strand examines the channels through which this cost of aid volatility operates (Cassen, 1994). At the macroeconomic level, aid volatility would cause

volatility in some aggregate variables such as inflation (Fielding and Mavrotas, 2005), real exchange rates (Schnabel, 2007), or fiscal policy (Fatas and Mihov, 2005). Volatility in these variables, in turn, would reduce aggregate growth. While this literature is only empirical and focused on the macroeconomic transmission channels of aid volatility, this article provides a theoretical model that takes into account the incentives of the agents inside the recipient country. This is an important contribution since this theoretical approach allows me to present a channel that, as far as I know, has not been examined in the past literature. It consists in studying the joint effect of aid volatility and lack of transparency on aid efficiency. Moreover, it gives some intuition on how aid can be made more efficient even in cases when it cannot be smoothed.

The literature that studies the link between transparency and accountability is also related to my work. Stromberg (2004) illustrates how between 1933 and 1935 the United States federal assistance to low-income households was greater in counties where more households had radios and thus were better informed about government policies and programs (see also Florini (1999)). Kaufmann and Bellver (2005) emphasizes that transparency is important not only because it increases the efficiency in the allocation of resources, but also because it may help in ensuring that the benefits of growth are redistributed and not captured by the elite. Similarly, in this article, I underline the fact that giving more information about the aid flows to the citizens can increase aid efficiency..

3 THE MODEL

The model is a multi-period political economy model of rent extraction. There are two agents: the incumbent and the representative citizen of the recipient country. Each period, the incumbent has to choose whether to use the aid she receives to provide public goods to the citizen or to extract rents. At the end of each period, the citizen decides whether or not she wants the incumbent to stay in power.

3.1 Timing of the Model and Informational Framework

The timing of the model is summarized in Figure 1.

1. In the first step, nature chooses the value taken by the random variable "aid". The government receives θ dollars as resources, which can be used to provide public goods to the representative citizen (θ^g) and/or taken as rents by the incumbent (θ^r). The distribution of θ is common knowledge. The realization of θ is always observed by the incumbent, but can be unknown to the citizen.

2. In the second step, the citizen chooses the minimum amount of public goods she wants $\left(\widetilde{\theta}^{g}\right)$ in order to re-elect (or not to takeover if it is a nondemocratic regime) the incumbent.

3. In the third step, the incumbent chooses her political platform $l = (\theta^{g}, \theta^{r})$, with $\theta^{g} + \theta^{r} \leq \theta$.

4. Then elections take place.

5. Finally, nature plays by choosing θ' and the game starts again.

The random variable θ is modeled as a non-zero mean stationary positive autoregressive process of order one:

$$\theta_t = (1-\rho)\,\overline{\theta} + \rho\theta_{t-1} + \varepsilon_t \tag{1}$$

with $0 < \rho < 1$. ε is a normally distributed white noise with a constant variance σ_{ε}^{2} and is not subject to autocorrelation ($cov\,(\varepsilon_t, \varepsilon_s) = 0,\ t \neq s$): $\varepsilon \sim N\left(0, \sigma_{\varepsilon}^{2}\right)$.

By **(1)**,

$$\theta_t \sim N\left(\overline{\theta}, \frac{1-\rho^{2t}}{1-\rho^{2}}\sigma_{\varepsilon}^{2}\right). \tag{2}$$

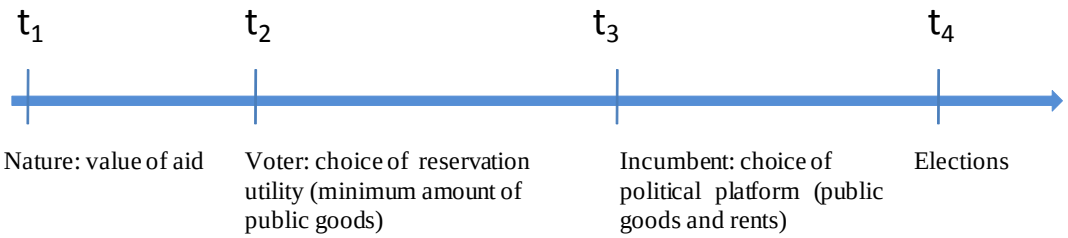

Figure 1: Timing of Events

The solution concept is a subgame perfect equilibrium.

3.2 Citizen

To gain further insights into the results, I concentrate on the two-period case which captures the basic intuitions. The main results are unaltered when the analysis is extended to the infinitely repeated case (Appendix A).

The citizen maximizes her expected utility:

$$U = \theta_1^g + \delta \mathbb{E} \theta_2^g,$$

with δ the discount rate and θ_t^g the amount of public goods provided by the incumbent at time t ($t = 1, 2$). The utility of the citizen is thus an increasing function of the amount of public goods she receives.

3.3 Incumbent

$R > 0$ denotes the welfare – i.e., the exogenous rents – the incumbent gains from being in power. It corresponds to the "ego rents" in Rogoff (1990)'s terminology or to the "spoils of office" in Osborne and Slivinski (1996)'s one. θ_t^r stands for the endogenous rent extracted by the incumbent at time t. As discussed in Persson, Roland, and Tabellini (1997), we can think of θ^r as an outright diversion of resources, such as corruption or party financing, or more generally as an allocation of resources beneficial to the incumbent's private agenda and completely inefficient from the citizen's viewpoint. Let p be the probability of winning the elections. The incumbent chooses $(\theta_1^r, \theta_1^g, \theta_2^r, \theta_2^g)$ to maximize

$$\begin{cases} V = v\left(\theta_1^r, R\right) + p\left(\theta_1^g; \widetilde{\theta}_1^g\right) \delta \mathbb{E}\left[v\left(\theta_2^r, R\right)\right] \\ s.t.\ \theta_t^r + \theta_t^g \leq \theta_t,\ t \in \{1, 2\} \end{cases},$$

where

$$p\left(\theta_1^g; \widetilde{\theta}_1^g\right) = \begin{cases} 1 \text{ if } \theta_1^g \geq \widetilde{\theta}_1^g \\ 0 \text{ otherwise} \end{cases}$$

and

$$v\left(\theta_1^r, R\right) = \begin{cases} \theta_1^r + R \text{ if } p = 1, \\ \gamma\theta_1 + R \text{ otherwise.} \end{cases}$$

The constant $0 \leq \gamma \leq 1$ stands for the fact that running away with all the aid flows is costly for the incumbent: she has to sacrifice a part $(1 - \gamma)$ of the flows she embezzles.

Because there are only two periods, the incumbent will embezzle all the aid received in the second period ("lame-duck effect" *à la* Barro (1973)) so that $\theta_2^g = 0$ and $\mathbb{E}\left[v\left(\theta_2^r, R\right)\right] = \gamma \mathbb{E}\left(\theta_2\right) + R$. According to (1),

$$\mathbb{E}\left(\theta_2\right) = (1 - \rho)\,\overline{\theta} + \rho\theta_1$$

from which

$$\mathbb{E}\left[v\left(\theta_2^r, R\right)\right] = \gamma\left[\overline{\theta} + \rho\left(\theta_1 - \overline{\theta}\right)\right] + R.$$

An important point is that the model is written in such a way that it can also fit the case of some developing countries where there are not democratic elections. Indeed, it can be reinterpreted as a model of nondemocratic regimes. In this case, the incumbent provides public goods to the citizens or makes concessions to the military in order to avoid a revolution rather than to be reelected,and $(1-p)$ can be interpreted as the probability of a revolution.

4 THE EQUILIBRIUM

4.1 Complete information

4.1.1 The Policymaker's Choice

The policymaker faces a trade-off: she can (i) either satisfy the expectations of the citizen so as to be re-elected, or (ii) extract the maximum rent without seeking re-election. In order to solve this trade-off, I compute the policymaker's welfare in (i) and (ii) and compare them.

(i) The policymaker satisfies the expectations of the citizen. The policymaker's optimization programme is

$$\max_{\theta_1^g} (\theta_1 - \theta_1^g) + R + \delta \{\gamma \mathbb{E}\theta_2 + R\} \text{ s.t. } \theta_1^g \geqslant \widetilde{\theta}_1^g,$$

where $\mathbb{E}\theta_2 = \overline{\theta} - \rho\left(\overline{\theta} - \theta_1\right)$. Since the policymaker's objective is decreasing in θ_1^g, the "re-election" constraint $\theta_1^g \geqslant \widetilde{\theta}_1^g$ is active. Consequently, in the optimum,

$$\begin{cases} \theta_1^g = \widetilde{\theta}_1^g, \\ \theta_1^r = \theta_1 - \widetilde{\theta}_1^g, \end{cases}$$

so that

$$V = \left(\theta_1 - \widetilde{\theta}_1^g\right) + R + \delta \left[\gamma \mathbb{E}\theta_2 + R\right].$$

(ii) The policymaker does not satisfy the expectations of the citizen, in which case the incumbent is not reelected. So,

$$\begin{cases} \theta_1^g = 0 \\ \theta_1^r = \theta_1 \end{cases},$$

and

$$V = \gamma\theta_1 + R.$$

The following Proposition is obtained.

Proposition 1 *In the optimum, the policymaker satisfies the expectations of the citizen so as to be re-elected iff*

$$\begin{aligned} &(1-\gamma)\,\theta_1 + \delta\left[\gamma\mathbb{E}\theta_2 + R\right] \geq \widetilde{\theta}_1^g \\ &\Leftrightarrow \left[1-\gamma\,(1-\delta\rho)\right]\theta_1 + \delta\gamma\,(1-\rho)\,\overline{\theta} + \delta R \;\; \geq \widetilde{\theta}_1^g. \end{aligned} \tag{3}$$

Hence, there is a reservation utility threshold under which the policymaker decides to satisfy the expectations of the citizen so as to be re-elected. This threshold depends on three parameters: (i) it is a decreasing function of θ_1, the amount of aid received in period 1; (ii) an increasing function of $\overline{\theta}$, the average level of the aid flows; and (iii) an increasing function of R, the ego rents. The basic intuition is as follows: all the parameters that increase the utility of the incumbent in the second period decreases her reservation threshold since they increase her willingness to stay in power. On the contrary, the higher the amount of aid she receives today, i.e. the more rents she can potentially extract today, the higher her reservation threshold since she can obtain a higher utility level by choosing not to be reelected today.

4.1.2 The Citizen's Choice

The representative citizen would like to receive as much public goods as possible. To this aim, she chooses the maximum reservation utility $\widetilde{\theta}_1^g$ compatible with (3), i.e.,

$$\widetilde{\theta}_1^g = (1-\gamma)\,\theta_1 + \delta\left[\gamma\mathbb{E}\theta_2 + R\right]. \tag{4}$$

Hence, the citizen must be particularly careful when setting her reservation utility: she must endeavour not to set a reservation utility which would be so high that the policymaker would choose not to satisfy her expectations. This is why she must leave some "discretion rent" to the policymaker in order to prevent her from embezzling all public resources.

Notice that here, the rents just come from the fact the incumbent has discretion over the use of aid flows, since there are no informational rents in the complete information case.

4.1.3 Characterization of the Equilibrium

In the equilibrium,

$$\begin{aligned}\frac{\theta_1^g}{\theta_1} &= \min\left\{(1-\gamma)+\delta\frac{\gamma\mathbb{E}\theta_2+R}{\theta_1},1\right\}\\ &= \min\left\{(1-\gamma)+\delta\frac{\gamma\left[\overline{\theta}-\rho\left(\overline{\theta}-\theta_1\right)\right]+R}{\theta_1},1\right\}.\end{aligned} \tag{5}$$

There is a threshold value of θ_1 under which the officeholder devotes all the aid received to the provision of public goods. This threshold can be characterized as follows

$$(1-\gamma)+\delta\frac{\gamma\left[\overline{\theta}-\rho\left(\overline{\theta}-\theta_1\right)\right]+R}{\theta_1}\geq 1 \Leftrightarrow \theta_1 \leq \frac{\delta}{\gamma}\frac{R+\gamma\left(1-\rho\right)\overline{\theta}}{1-\delta\rho}.$$

This threshold increases with the average amount of aid received by the incumbent and with the non monetary benefit R the incumbent gains from being in power.

Above this threshold, the fraction of the aid flows devoted to the provision of public goods is equal to

$$1-\gamma+\delta\frac{\gamma\left[\overline{\theta}-\rho\left(\overline{\theta}-\theta_1\right)\right]+R}{\theta_1}. \tag{6}$$

This fraction is a function of the current amount of aid flows received θ_1 and of the average amount of aid flows $\overline{\theta}$. It decreases with θ_1: when the amount of aid is sufficiently high, the share of the resources used for the public goods decreases with the amount of aid received. In Figure 2, I plot a simple simulation to illustrate this result. The x-axis represents the amount of aid flows received by the incumbent (θ), normalized between 0 and 1. The y-axis indicates the share of the aid flows devoted to public goods (θ^g/θ). If one considers the blue line, it appears that below a certain value of θ (0.3 in the Figure), aid flows are entirely devoted to the provision of public goods, and that above this value, the higher the aid flows, the lower the share devoted to public goods. This result is in the spirit of Acemoglu, Robinson, and Verdier (2003) who underline that greater foreign aid relaxes the budget constraint of the ruler.

However, this result does not mean that the higher the aid flows, the less efficient aid. Indeed, the fraction devoted to public goods increases with $\overline{\theta}$. Moreover, as we underlined, the threshold value also increases in $\overline{\theta}$. As shown in Figure 2, the higher the average amount of aid, the more efficient aid: when the average amount of aid flows increases, the curve moves to the right (from the blue curve to the dashed purple curve). Hence, aid inefficiency does not come from the fact that a country receives a high amount of aid in absolute terms (which is the current view of decreasing returns of aid) but from the fact that it receives a high amount compared to the amount it is used to receive.

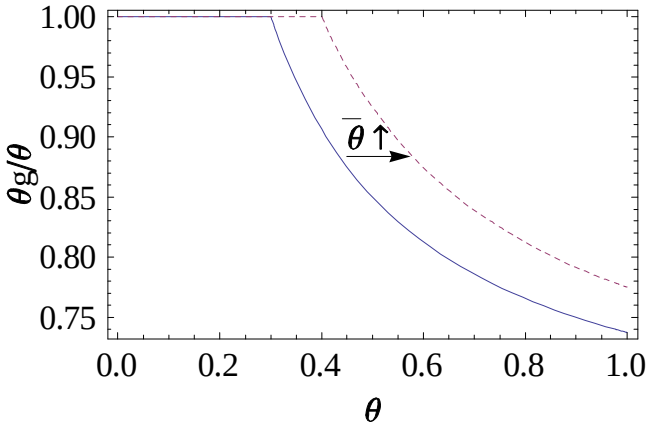

Figure 2: Aid Efficiency and Average Amount of Aid Flows under Complete Information

4.2 Asymmetric Information

With asymmetric information, the citizen is unable to distinguish the actions of the policymaker from exogenous events. Hence, if the policymaker offers few public goods, she cannot determine whether this is due to a high level of rent extraction by the policymaker (a high θ^r) or to a low level of aid (a low θ). This alters the citizen's reservation utility and thus, the choice of the policymaker.

4.2.1 The Policymaker's Choice

Given $\widetilde{\theta}^g$, the choice of the policymaker is the same as under symmetric information:

$$\theta_1^g = \begin{cases} \widetilde{\theta}_1^g & \text{if } \theta_1 \geq \theta_1^*, \\ 0 & \text{otherwise,} \end{cases}$$

with

$$\theta_1^* = \frac{\widetilde{\theta}_1^g - \delta\left[\gamma \mathbb{E}\left(\theta_2\right) + R\right]}{1-\gamma}. \tag{7}$$

4.2.2 The Citizen's Choice

The citizen wants to maximize the amount of public goods she will receive ($\widetilde{\theta}_1^g$), but she knows that the higher her reservation utility, the higher the probability that the

incumbent chooses to embezzle all aid (which is the case if $\theta_1 < \mathbb{E}_1(\theta_1^*)$). She maximizes:

$$\max_{\widetilde{\theta}_1^g} \widetilde{\theta}_1^g \Pr\{\theta_1 \geq \mathbb{E}_1(\theta_1^*)\} = \widetilde{\theta}_1^g \cdot (1 - F[\mathbb{E}_1(\theta_1^*)]).$$

Since the citizen does not observe the realization of θ_1, she assumes that $\mathbb{E}(\theta_2) = \overline{\theta}$ and so $\mathbb{E}_1(\theta_1^*) = \frac{\widetilde{\theta}_1^g - \delta[\gamma\overline{\theta} + R]}{1-\gamma}$.

Using first-order condition,

$$\widetilde{\theta}_1^g = (1-\gamma)\frac{1 - F[\mathbb{E}_1(\theta_1^*)]}{f[\mathbb{E}_1(\theta_1^*)]}, \tag{8}$$

which implicitly defines the citizen's reservation utility.

The hazard rate – which corresponds to the inverse of the second factor in (8) – is monotonically increasing in θ for a normal law. Hence, the reservation utility of the citizen is increasing in R, δ and $\overline{\theta}$. In other words, the reservation utility of the citizen increases with all the parameters whose rise increases the utility of the incumbent in the case she wins the elections.

4.2.3 Characterization of the Equilibrium

Proposition 2 *In the subgame perfect equilibrium,*

$$\frac{\theta_1^g}{\theta_1} = \begin{cases} 0 \text{ if } \theta_1 < \frac{1}{1-\gamma+\delta\gamma\rho}\left[(1-\gamma)\frac{1-F[\mathbb{E}_1(\theta_1^*)]}{f[\mathbb{E}_1(\theta_1^*)]} - \delta\left[\gamma(1-\rho)\overline{\theta} + R\right]\right] \\ \min\left\{\frac{(1-\gamma)}{\theta_1}\frac{1-F[\mathbb{E}_1(\theta_1^*)]}{f[\mathbb{E}_1(\theta_1^*)]}, 1\right\} \text{ otherwise} \end{cases}, \tag{9}$$

with

$$\frac{1 - F[\mathbb{E}_1(\theta_1^*)]}{f[\mathbb{E}_1(\theta_1^*)]} = \frac{1 - \frac{1}{\sigma_\varepsilon\sqrt{2\pi}}\int_{-\infty}^{\mathbb{E}_1(\theta_1^*)} e^{-\frac{(x-\overline{\theta})}{2\sigma_\varepsilon^2}} dx}{\frac{1}{\sigma_\varepsilon\sqrt{2\pi}} e^{-\left[\frac{\widetilde{\theta}_1^g - [1+(1-\delta)\gamma]\overline{\theta} - \delta R}{(1-\gamma)^2}\right]/2\sigma_\varepsilon^2}}.$$

4.2.4 Interpretation: A Simple Case

Figure 3 shows our results for the simple economy considered before. It combines the results obtained under complete information (Dashed Red Curve) with those obtained under asymmetric information (Plain Blue Curve). In the complete information case, under a certain threshold, aid is very efficient, all the aid flows being used in order to provide public goods. But above this threshold, aid becomes less efficient: when its amount is increased, a bigger share of aid is extracted by the incumbent as rents. These

rents only come from the fact that the incumbent is in power: "power rents".

Under asymmetric information, aid has an important multiplicative effect: below a certain threshold, all the aid received by the incumbent is extracted as rents while no public good is provided. This is due to the fact that, under asymmetric information, the citizen can involuntarily choose a reservation utility that is too high for the incumbent to be willing to satisfy it. Above this threshold, aid efficiency decreases with the amount of aid as in the complete information case, but much more rapidly. Indeed, it clearly appears that asymmetric information reduces aid efficiency, the incumbent taking advantage of it to extract more rent. In this case, she does not only extract "power rents" but also "asymmetric information" rents.

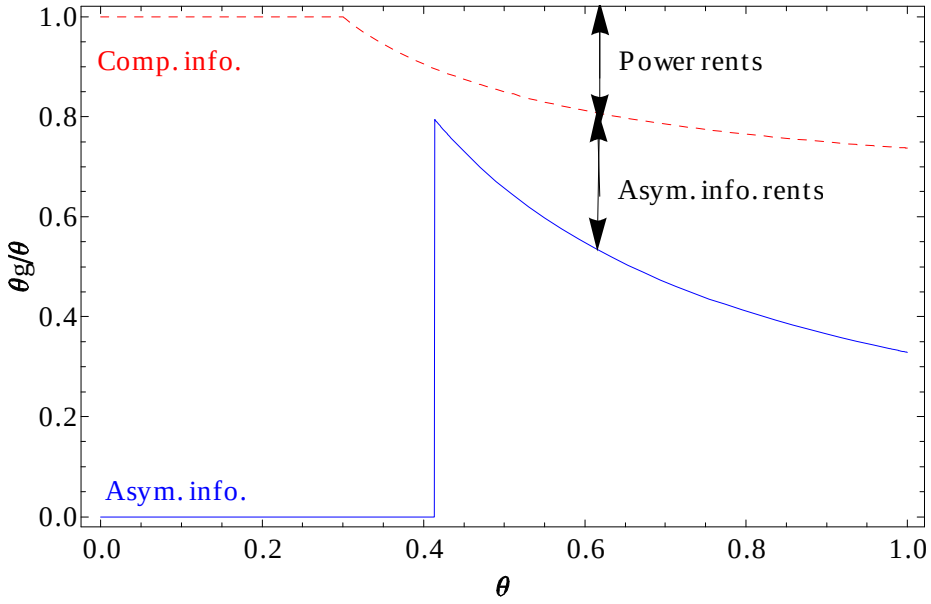

Figure 3: Aid Efficiency under Complete and Asymmetric Information

5 EMPIRICAL ANALYSIS

In this section, I test the main predictions of the model in a panel of developing countries over the 1970-2002 period. I first examine the relationship among development aid, "information", and GDP growth. Using a release of information indicator, I find that aid has a positive impact on growth in developing countries where asymmetric information is less important. I then construct a time-varying measure of volatility that I compute

using a rolling window. I ask whether this volatility reduces aid efficiency and whether this is due to asymmetric information using different specifications. A main finding is that aid volatility sharply reduces aid efficiency, but that this negative impact vanishes once one introduces information. This confirms the fact that the "asymmetric information" channel is an important channel through which aid volatility is costly for recipient countries.

5.1 Data[4]

Panel data on development aid flows are taken from the OECD Development Assistance Committee (DAC) annual series. Following Roodman (2006b), I use the Net Aid Transfers (NAT) variable for measuring aid flows. NAT is a net transfers concept, net of both principle payments received on ODA loans and of interests received on such loans. Moreover, NAT excludes cancellation of old non-ODA loans since such cancellation generates little or no additional net transfers.

As a dependent variable in order to evaluate aid efficiency, I use the growth rate of per capita GDP. I then add usual controls in cross-country growth equations: the log level of per capita GDP, the growth rate of the population, and M2 as a share of GDP lagged one period. Depending on the specifications, I also control for a measure of institutions: the augmented Freedom House political rights index[5].

The extent of asymmetric information is proxied by the release of information indicator of Williams (2006, 2009). This indicator is based on the quantity of reported socio-economic data contained in the two main international databases that are currently used extensively in economic analyses: the World Development Indicators (WDI) produced by the World Bank, and the International Finance Statistics (IFS) database, constructed by the International Monetary Fund[6]. The first advantage of this release of information indicator is its extensive coverage, both across countries (175) and time (1960-2000)[7]. A second advantage is that this indicator is not a weak proxy for income (and the level of development). Indeed, Williams (2009) provides anecdotal evidence that, while incomes are undoutbedly a determinant of the amount of information released by all countries, they are not the only determinant: "*a number of countries with*

[4] For the description and the sources of the data, see Appendix A.

[5] The Freedom House measure is highly correlated with other usual measures of institutions (the Polity IV Index and the Przeworski democracy index), and has the advantage to be better reported.

[6] Although each country has in some form its own statistical agency, and there are also many other regional data collection bodies (for example, the OECD, or the Asian Development Bank), these two databases ensure a commonality in methodology across all countries.

[7] Nearly 6,000 observations are recorded, giving an average of 34 annual observations for each country.

TABLE 1: SUMMARY STATISTICS

	Per capita GDP in 1970	GDP growth (percent per annum)	Aid (percent of GDP)	Aid Volatility	Release of information indicator
Mean	1352.02	3.39	8.88	0.19	0.46
Median	652.76	3.81	6.40	0.08	0.46
Standard deviation	2016.14	5.14	9.16	0.41	0.12

very different levels of per capita incomes produced very different levels of data, which implies that there is something that leads countries to release relatively little information, even though they could easily afford to". Finally, the release of information indicator has been constructed in part to answer questions that are closely related to the aim of this paper, for example to understand the fact that information can help citizens monitor the performance of their government and reduce the problems associated with informational asymmetries between parties.

The aid data cover a large number of countries but the release of information indicator is available only for 134 developing countries. Once I drop from these countries the ones for which there is too many missing data for the control variables, I am left with a sample of 87 countries. Table 1 provides summary statistics for a few key statistics[8].

5.2 Aid Efficiency and Asymmetric Information

5.2.1 Empirical Specifications

The equations are estimated using a panel across six four-years periods from 1974-1977 through 1994-1997[9]. Thus, an observation is a country's performance average over a four-year period. The averaging over four-year, which is usual in the aid-growth literature (Burnside and Dollar, 2000; Clemens, Radelet, and Bhavnani, 2004), allows me to avoid the non stationnarity problem for the growth rate. The panel is unbalanced, with some countries having more observations than others. When I estimate my regressions using two-step system GMM, I thus use the forward orthogonal deviations transform instead of first differencing, because it maximizes the sample size in panel with gaps (Roodman,

[8] The countries covered are listed in Table A1 which provides some country-specific information about the variables that are the main focus of the analysis: per capita GDP, GDP growth, aid (percent of GDP), aid volatility, and the release of information indicator.

[9] The dataset covers the period 1970-2002, but computing aid volatility using an eight-year rolling window, the first and last four years cannot be used for the regressions.

2006a)[10].

My baseline empirical specification is:

$$g_{it} = \alpha_0 + \alpha_1 \left(\frac{aid}{gdp}\right)_{it} + \alpha_2 \left(\frac{aid}{gdp}\right)^2_{it} + \boldsymbol{\alpha}_3 \mathbf{X}_{it} + \eta_i + \gamma_t + \varepsilon_{it}, \tag{10}$$

where $i = 1, ..., 87$ index the recipients and $t = 1, ..., 6$ stand for the six four-year periods (from 1974-1977 to 1994-1997). g is the growth rate of per capita GDP between two periods t and $t+1$[11]; (aid/gdp) are the aid flows normalized by the GDP; and $(aid/gdp)^2$ are the square aid flows normalized by the GDP that I introduce in order to control for decreasing returns of aid. $\mathbf{X}_{it}$ is a vector of control variables including the level of GDP per capita, the growth rate of the population and M2 as a share of GDP lagged one period in my baseline specification. Moreover, depending on the specifications, I also add a measure of institutions. η_i is a country fixed effect that I only introduce when I estimate my regressions using OLS[12]; γ_t is a period fixed effect[13]; and ε_{it} is the error term.

In section 4, I argue that the effectiveness of aid would likely depend on the extent of asymmetric information. To address this issue, I then introduce an interactive term, (aid/GDP)×information, into my regressions. My empirical specification is:

$$g_{it} = \beta_0 + \beta_1 \left(\frac{aid}{gdp}\right)_{it} + \beta_2 \left(\frac{aid}{gdp}\right)_{it} \times \text{information}_{it} + \beta_3 \text{information}_{it} + \boldsymbol{\beta}_4 \mathbf{X}_{it} + \eta_i + \gamma_t + \varepsilon_{it}, \tag{11}$$

where information is the release of information indicator of Williams (2009). What I am interested in is the marginal effect of aid on growth, i.e. $(\beta_1 + \beta_2 information)$. I

[10] The forward orthogonal deviations transform is an alternative to differencing proposed by Arellano and Bover (1995) that preserves sample size in panel with gaps. Indeed, instead of subtracting the previous observation from the contemporaneous – what does the first-difference transform which thus magnifies gaps in unbalanced panels –, it subtracts the average of all future available observations of a variable. No matter how many gaps, it is computable for all observations except the last for each individual, so it minimizes data loss. And since lagged observations do not enter the formula, they are valid instruments.

[11] However, the results are robust to the use of two alternative measures of the growth rate: (i) the average of the growth rate over the four-year periods; and (ii) the average of the per capita growth rate over the four-year periods.

[12] Indeed, it is a mistake to introduce explicit fixed effects dummies when one uses system GMM, because it might cause bias (Roodman, 2006a).

[13] The inclusion of time dummies is of crucial importance for the use of two-step system GMM. Indeed, the autocorrelation test and the robust estimates of the coefficient standard errors assume no correlation across individuals in the idiosyncratic disturbances. Time dummies make this assumption more likely to hold.

want to determine whether or not the effect of a change in aid on growth depends on the value of the release of information indicator.

I first estimate equations (10) and (11) using both OLS with robust standard errors and cluster countries[14], and two-step system GMM with Windmeijer-corrected cluster-robust errors (Windmeijer, 2005)[15] and forward orthogonal deviations transform. Indeed, as it is underlined below, there are some endogeneity concerns, and the advantage of the system GMM method is that it can be used in the absence of any strictly exogenous explanatory variables or instruments. Aid is treated throughout this article as an endogenous variable, and information as a predetermined and not strictly exogenous variable.

Endogeneity Concerns Running OLS to evaluate the impact of aid on growth can lead to biased results since aid can be endogenous. This endogeneity can come from (i) reverse causation: growth causes aid (e.g. the higher its growth rate, the less aid a country receives because it does not need it); or (ii) simultaneous causation: an omitted variable causes both aid and growth.

In order to deal with these endogeneity problems, a first solution would be to estimate equations (10) and (11) using instrumental variables. However, the exogenous instruments that are commonly used in the literature have been criticized for being endogenous. This is an important issue since the 2SLS estimators cannot yield unbiased coefficient estimates if even one of the instruments for current aid has a distinct effect on growth apart from the effect realized by acting through current aid.

Since the aid efficiency literature has not concluded to the existence of any strictly exogenous instruments for aid, rather than using instrumental variables, I choose to use two-step system GMM. Indeed, under cerain assumptions that are presented in the next subsection, this method helps to overcome the endogeneity concerns when there are no perfect instruments waiting in the wings.

Two-step System GMM Estimation The two-step system GMM are designed for situations with: (i) few time periods and many individuals; (ii) a linear functional relationship; (iii) some endogenous regressors; (iv) other regressors that may be predetermined but not strictly exogenous (meaning correlated with past and possibly current realizations of the error); (v) a dynamic simple left-hand side variable (depending on

[14] I do not cluster the countries when using two-step GMM, since in two-step estimations, errors are already robust.

[15] Without this finite sample correction, the standard errors tend to be severely downward biased.

its own past realizations); (vi) arbitrarily distributed countries fixed effects; (vii) heteroskedasticity and autocorrelation within countries but not across them[16]; and (vii) first differences of instrument variables that are uncorrelated with the fixed effects (Roodman, 2006a).

These conditions are verified here. Indeed, I have only 6 time periods but 87 countries. My main regressor, aid, is endogenous, and information is predetermined but not strictly exogenous. My left-hand side variable – the growth rate of GDP – depends on its own past realizations. I introduce countries fixed effects in all the regressions. Finally, I present with the estimation of each regression the result of the Arellano-Bond test for autocorrelation that confirms that there is no autocorrelation aside from the fixed effects.

It thus appears to be relevant to estimate the impact of aid, aid volatility and information on growth using two-step system GMM estimations here. Moreover, it is an improvement over the past literature, since the results I obtain do not suffer from the biases that can come from the use of 2SLS estimators with not strictly exogenous instruments.

5.2.2 Estimation Results

In Tables 2 and 3, I report results of the impact of aid on the growth rate, depending or not on the extent of asymmetric information (estimation of equations (10) and (11)). Using OLS, I find a negative but not statistically significant impact of aid on growth when I do not control for decreasing returns of aid (columns 1 and 2). This impact turns to be positive and statistically significant once I control for decreasing returns (columns 3 and 4). I find similar results when using system GMM (columns 5 to 8).

I then introduce the release of information indicator (Table 3). The prediction is that of a positive β_2 coefficient for the effect of aid on the growth rate in an environment where asymmetric information is reduced (the release of information indicator is high). Using OLS and system GMM and controlling or not for decreasing returns and a measure of institutions, we see that the corresponding coefficient has the anticipated sign and is statistically significant: aid has a positive impact on growth in a low asymmetric information environment. Moreover, the only impact of information on the growth rate is through aid, since the estimated coefficient β_3 for the release of information indicator is not statistically significant.

[16] The idiosyncratic disturbances (those apart from the fixed effects) may have individual-specific patterns of heteroskedasticity and serial correlation, but the idiosyncratic disturbances are uncorrelated across individuals.

Moreover, the system GMM results turn to be robust. Using the Arellano and Bond (1991) test for autocorrelation, I find AR(1) (which was to be expected, since the regressions are run in first difference), but I reject AR(2), so my lags are valid instruments. To test for over-identifying restrictions (of whether the instruments, as a group, appear exogenous), I use the Hansen J-statistic, and find that the validity of the instruments is accepted. However, the Hansen test of over-identifying restrictions can be weakened by many instruments. In section 5.4.3, I show that these results are robust to reducing the instrument count.

Finally, I will turn to this point in more details in section 5.5, but one has to note that all the results are robust to the introduction of an institutional measure, and that this introduction even increases the robustness of the results.

Marginal effect of Aid on Growth However, as underlined by Brambor, Clark, and Golder (2005), what I am directly interested in is not the significance or the sign of the parameter β_2, but, since I use a multiplicative interaction model, the marginal effect of aid on growth, ($\beta_1 + \beta_2$information). In order to convey the marginal effect of aid on growth, I present a simple figure (Figure 4) that graphically illustrates how the marginal effect of aid changes across the observed range of the release of information indicator. The solid line in Figure 4 indicates this change. Any particular point on this line is ($\beta_1 + \beta_2$information), the coefficients being estimated using system GMM. 95% confidence intervals around the line allow me to determine the conditions under which aid has a statistically significant impact on the growth rate of GDP. It is easy to see that aid has a strong positive impact on growth when there is a lot of information, whereas this impact is negative when the release of information indicator is low. Moreover, as predicted, this positive impact increases as the release of information indicator increases.

This preliminary evidence is thus consistent with one of the main result of the model. The other result that has to be tested is whether aid volatility has a negative impact on growth, and whether the introduction of more information reduces this negative impact.

5.3 Aid Volatility and Asymmetric Information

5.3.1 Econometric Method to Compute Aid Volatility

I use a eight-year rolling window in order to compute a time-varying measure of aid volatility. I first normalize the aid flows by the population of each recipient country. I

TABLE 2: AID EFFICIENCY

Estimation method	OLS[a,b]	OLS[a,b]	OLS[a,b]	OLS[a,b]	System GMM[c]	System GMM[c]	System GMM[c]	System GMM[c]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\left(\frac{aid}{gdp}\right)$	-0.375	-0.308	1.191**	1.344**	-0.097	-0.291	0.698*	0.514*
	(0.279)	(0.367)	(0.492)	(0.514)	(0.316)	(0.278)	(0.378)	(0.298)
$\left(\frac{aid}{gdp}\right)^2$			-0.031***	-0.033***			-0.020***	-0.019**
			(0.009)	(0.009)			(0.007)	(0.008)
Population growth	1.131	1.002	1.479	1.446	0.222	-0.794	-0.283	-1.066
	(1.220)	(1.224)	(1.094)	(1.124)	(2.758)	(1.639)	(1.961)	(1.771)
Log GDP pc	1.232	0.928	4.191	4.576	1.109	-1.421	2.550	0.462
	(3.215)	(3.504)	(3.317)	(3.622)	(1.938)	(1.830)	(1.881)	(1.247)
M2/GDP (lag)	-0.004	-0.014	0.139*	0.145*	0.033	0.077**	0.103**	0.123*
	(0.044)	(0.044)	(0.075)	(0.086)	(0.048)	(0.034)	(0.049)	(0.065)
Freedom House		5.739		2.501		4.905		2.814
		(4.506)		(4.170)		(6.204)		(4.255)
Intercept	-3.148	8.722	-34.473	-28.356	-5.237	10.783	-21.011	-5.769
	(29.534)	(17.415)	(31.205)	(20.763)	(16.804)	(11.540)	(17.835)	(10.983)
N	346	321	346	321	275	257	275	257
R^2	0.661	0.665	0.691	0.696				
χ^2					95.48	96.189	112.944	129.621

* significant at 10%; ** significant at 5%; *** significant at 1%

All the regressions include period fixed effects (coefficients not reported).

a: The regressions include country fixed effects (coefficients not reported).

b: Robust standard errors and cluster(countries).

c: Windmeijer-corrected standard errors.

Notes: The variables are described in more detail in the text. The dependent variable is the growth rate of GDP.

TABLE 3: AID EFFICIENCY AND ASYMMETRIC INFORMATION

Estimation method	OLS[a,b]	OLS[a,b]	OLS[a,b]	OLS[a,b]	System GMM[c]	System GMM[c]	System GMM[c]	System GMM[c]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\left(\frac{aid}{gdp}\right)$	-1.639***	-1.701***	-1.655***	-1.708***	-1.003*	-1.147***	-0.829	-0.984**
	(0.385)	(0.457)	(0.420)	(0.452)	(0.593)	(0.403)	(0.656)	(0.415)
$\left(\frac{aid}{gdp}\right)$ ×info	3.689***	4.414***	6.238***	6.492***	2.334*	2.890***	2.898*	3.443***
	(1.088)	(1.255)	(1.739)	(1.858)	(1.414)	(0.962)	(1.695)	(1.032)
$\left(\frac{aid}{gdp}\right)^2$ ×info			-0.139**	-0.129			-0.072	-0.063
			(0.066)	(0.082)			(0.069)	(0.053)
Release info.	-5.254	-15.284	-19.562	-22.971	-1.248	-6.449	8.970	-0.808
	(26.893)	(27.309)	(26.444)	(27.666)	(18.302)	(11.266)	(18.244)	(10.899)
Population	0.782	0.699	1.126	1.039	-0.943	-1.454*	-0.645	-1.193
growth	(0.889)	(0.879)	(0.911)	(0.941)	(2.157)	(0.820)	(2.333)	(1.267)
Log GDP pc	2.157	3.414	4.786	5.323	0.748	0.923	1.167	1.962
	(3.248)	(3.474)	(3.519)	(3.820)	(1.632)	(1.554)	(1.692)	(1.532)
M2/GDP	0.103*	0.102*	0.099*	0.103*	0.087	0.077	0.082	0.063
(lag)	(0.056)	(0.058)	(0.059)	(0.060)	(0.063)	(0.060)	(0.062)	(0.054)
Freedom		1.618		0.957		4.159		4.016
House		(4.276)		(4.231)		(3.605)		(3.304)
Intercept	-10.592	-7.414	-25.421	-20.764	-2.970	-3.947	-12.925	-15.553
	(32.506)	(19.890)	(34.295)	(22.258)	(10.143)	(10.013)	(15.602)	(14.714)
N	346	321	346	321	275	257	275	257
R^2	0.683	0.692	0.695	0.698				
χ^2					182.389	479.477	167.761	431.035

* significant at 10%; ** significant at 5%; *** significant at 1%

All the regressions include period fixed effects (coefficients not reported).

a: The regressions include country fixed effects (coefficients not reported).

b: Robust standard errors and cluster(countries).

c: Windmeijer-corrected standard errors.

Notes: The variables are described in more detail in the text. The dependent variable is the growth rate of GDP.

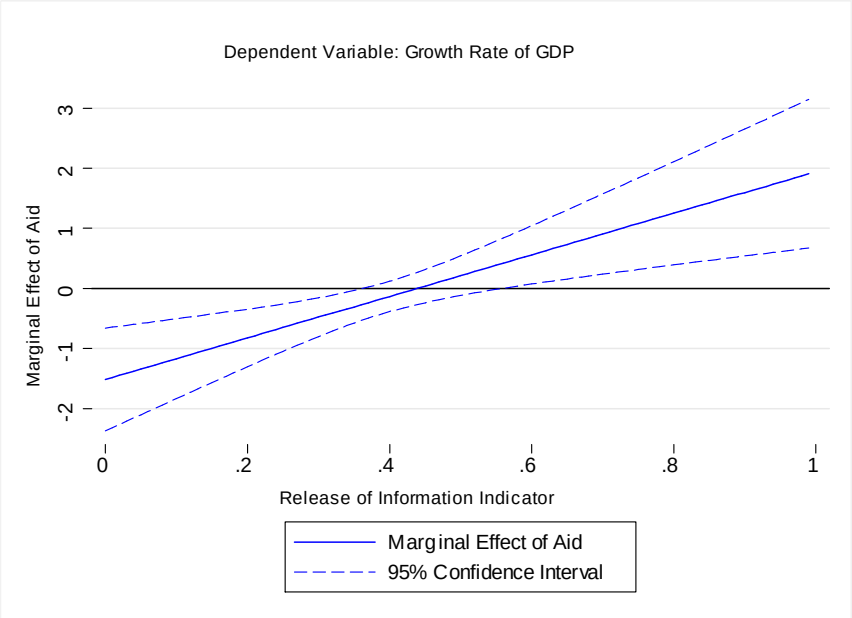

Figure 4: Marginal Effect of Aid on Growth as Information Changes

then take the log of the series and smooth them using the Hodrick-Prescott technique (with a smoothing parameter of 100[17]). I compute the volatility of the aid flows for each country i and for each year t (with $t = 1974,..., 1997$) by taking the variance of the detrended aid series between $t-4$ and $t+3$.

5.3.2 Empirical Specifications

In order to test the volatility channel, I estimate the impact of the time-varying measure of volatility I compute using the eight-year rolling window method. Since I have data for the volatility series between 1974 and 1997, the equations are estimated using the same panel as before across six four-year periods from 1974-1977 through 1994-1997. My empirical specifications are:

$$g_{it} = \psi_0 + \psi_1 \left(\frac{aid}{gdp}\right)_{it} + \psi_2 \left(\frac{aid}{gdp}\right)^2_{it} + \psi_3 aidvolatility_{it} + \boldsymbol{\psi}_4 \mathbf{X}_{it} + \gamma_t + \eta_i + \varepsilon_{it}, \quad (12)$$

[17]However, the results I obtain are robust to the use of other values of the smoothing parameter. Regression results for these other values are available upon request from the author.

$$g_{it} = \delta_0 + \delta_1 \left(\frac{aid}{gdp}\right)_{it} + \delta_2 \left(\frac{aid}{gdp}\right)^2_{it} + \delta_3 aidvolatility_{it} + \delta_4 \left[aidvolatility_{it} \times \text{information}_{it}\right] + \delta_5 \text{information}_{it} + \boldsymbol{\delta}_6 \mathbf{X}_{it} + \gamma_t + \eta_i + \varepsilon_{it}, \quad (13)$$

where *aidvolatility* is the variance of the detrended aid series. I estimate equations (12) and (13) using both OLS and two-step system GMM.

5.3.3 Estimation Results

I first estimate the impact of aid volatility on the growth rate (equation (12)). The prediction is that of a negative ψ_3 coefficient for the effect on the growth rate of aid volatility. In Table 4, for all the specifications, we see that the coefficient has the anticipated sign and is statistically significant: the higher aid volatility, the lower the growth rate (columns 1 to 4). Moreover, the results are robust to the use of system GMM (columns 5 to 8).

When I introduce the release of information indicator and the interaction term between this indicator and aid volatility (estimation of equation (13)) (Table 5), I find that while the δ_3 coefficient for the effect of aid volatility is still negative and statistically significant, the δ_4 coefficient for the interaction term is positive and statistically significant. In other words, the negative impact of aid volatility disappears in the environments with low asymmetric information. It confirms the prediction of the model that aid volatility only increases rent extraction when there is asymmetric information.

Moreover, as before, there is no autocorrelation of order 2, and the validity of the instruments is accepted by the Hansen J-test of over-identifying restrictions.

To estimate the marginal effect of aid volatility on growth, I present as above a simple figure (Figure 5) that graphically illustrates how the marginal effect of aid volatility changes across the observed range of the release of information indicator. It is easy to see that aid volatility has a strong reductive effect on the growth rate when there is asymmetric information. As predicted, this reductive effect declines as the degree of information increases. Once the release of information indicator is above 0.6, aid volatility no longer has a significant reductive impact on economic growth.

This preliminary evidence thus confirms the main finding of the model: a channel through which aid volatility has a negative impact is the asymmetric information channel.

TABLE 4: AID VOLATILITY

Estim. method	OLS[a,b]	OLS[a,b]	OLS[a,b]	OLS[a,b]	System GMM[c]	System GMM[c]	System GMM[c]	System GMM[c]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\left(\frac{aid}{gdp}\right)$	-0.328	-0.278	1.073**	1.248**	-0.122	-0.277	0.504	0.444
	(0.260)	(0.349)	(0.491)	(0.513)	(0.379)	(0.303)	(0.389)	(0.300)
$\left(\frac{aid}{gdp}\right)^2$			-0.028***	-0.030***			-0.016**	-0.017**
			(0.009)	(0.009)			(0.007)	(0.008)
Aid vol.	-13.141***	-12.211***	-10.385***	-10.042**	-11.222***	-11.540***	-10.320***	-10.096***
	(4.200)	(4.250)	(3.728)	(3.815)	(4.414)	(3.372)	(3.843)	(3.802)
Pop.	0.847	0.797	1.220	1.245	-0.783	-1.305	-1.366	-1.366
growth	(1.156)	(1.171)	(1.068)	(1.112)	(2.717)	(1.330)	(1.887)	(1.355)
Log	1.734	1.406	4.295	4.703	1.476	-0.661	2.275	0.625
GDP pc	(3.094)	(3.391)	(3.259)	(3.551)	(2.165)	(1.970)	(1.954)	(1.164)
M2/GDP	-0.011	-0.020	0.119	0.129	0.045	0.079**	0.094**	0.129**
(lag)	(0.039)	(0.041)	(0.072)	(0.083)	(0.059)	(0.035)	(0.048)	(0.064)
Freed.		3.199		0.648		4.154		3.318
House		(4.552)		(4.321)		(6.942)		(3.524)
Interc.	-2.295	8.413	-30.699	-25.909	-4.087	8.492	-13.697	-5.457
	(28.404)	(17.014)	(30.764)	(20.519)	(19.301)	(12.393)	(18.725)	(10.832)
N	346	321	346	321	275	257	275	257
R^2	0.677	0.679	0.701	0.705				
χ^2					91.554	123.864	138.585	200.973

* significant at 10%; ** significant at 5%; *** significant at 1%

All the regressions include period fixed effects (coefficients not reported).

a: The regressions include country fixed effects (coefficients not reported).

b: Robust standard errors and cluster(countries).

c: Windmeijer-corrected standard errors.

Notes: The variables are described in more detail in the text. The dependent variable is the grow th rate of GDP.

TABLE 5: AID VOLATILITY AND ASYMMETRIC INFORMATION

Estimat. method	OLS[a,b]	OLS[a,b]	OLS[a,b]	OLS[a,b]	System GMM[c]	System GMM[c]	System GMM[c]	System GMM[c]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\left(\frac{aid}{gdp}\right)$	-0.219	-0.162	0.827	0.990*	-0.135	-0.198	0.259	0.401
	(0.206)	(0.273)	(0.518)	(0.549)	(0.252)	(0.226)	(0.388)	(0.341)
$\left(\frac{aid}{gdp}\right)^2$			-0.021**	-0.023**			-0.008	-0.013**
			(0.009)	(0.009)			(0.007)	(0.006)
Aid vol.	-98.421**	-100.694**	-75.728*	-76.957*	-106.175**	-101.052**	-89.957***	-81.403***
	(37.714)	(41.171)	(39.704)	(43.041)	(53.586)	(43.667)	(31.222)	(29.627)
Aid vol.×	162.914**	167.873**	123.353*	125.798*	175.910*	171.379**	150.862***	135.285***
info.	(64.893)	(71.073)	(68.094)	(74.055)	(92.777)	(74.365)	(54.020)	(51.062)
Relea info.	-12.585	-21.125	-14.048	-20.489	-12.764	-28.204*	-11.128	-7.319
	(24.506)	(27.018)	(23.858)	(26.207)	(21.738)	(15.476)	(13.144)	(12.683)
Population	0.174	0.130	0.634	0.657	-2.701	-1.096	-2.356*	-2.316*
growth	(0.941)	(0.958)	(1.017)	(1.077)	(1.887)	(1.381)	(1.427)	(1.351)
Log GDP	1.425	1.450	3.577	4.098	0.157	0.020	1.210	0.786
pc	(2.915)	(3.425)	(3.208)	(3.681)	(2.076)	(1.336)	(1.321)	(1.372)
M2/GDP	-0.031	-0.040	0.073	0.079	0.076*	0.068**	0.086**	0.100**
(lag)	(0.038)	(0.041)	(0.066)	(0.074)	(0.042)	(0.029)	(0.039)	(0.046)
Freed.		2.510		0.751		5.173		0.526
House		(4.620)		(4.426)		(5.054)		(4.912)
Intercept	-2.591	20.778	-22.086	-7.033	13.148	16.565	2.302	1.731
	(30.329)	(21.825)	(33.501)	(25.901)	(14.604)	(12.207)	(14.529)	(14.941)
N	346	321	346	321	275	257	275	257
R^2	0.700	0.703	0.713	0.717				
χ^2					206.393	170.328	268.43	208.937

* significant at 10%; ** significant at 5%; *** significant at 1%

All the regressions include period fixed effects (coefficients not reported).

a: The regressions include country fixed effects (coefficients not reported).

b: Robust standard errors and cluster(countries).

c: Windmeijer-corrected standard errors.

Notes: The variables are described in more detail in the text. The dependent variable is the grow th rate of GDP.

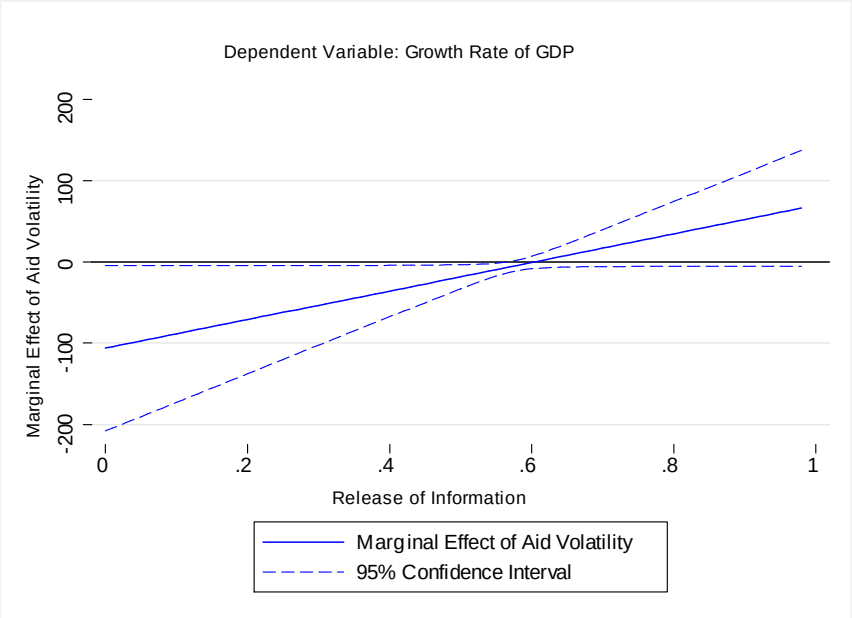

Figure 5: Marginal Effect of Aid Volatility on Growth As Information Changes

5.4 Aid Efficiency, Aid Volatility and Asymmetric Information

In this section, I finally test the impact of aid volatility on aid efficiency, since the model predicts that aid volatility reduces aid efficiency when there is asymmetric information.

5.4.1 Empirical Specifications

My empirical specifications are:

$$g_{it} = \varphi_0 + \varphi_1 \left(\frac{aid}{gdp}\right)_{it} + \varphi_2 \left[\left(\frac{aid}{gdp}\right)_{it} * aidvolatility_{it}\right] + \varphi_3 aidvolatility_{it} + \varphi_4 \mathbf{X}_{it} + \gamma_t + \eta_i + \varepsilon_{it}. \tag{14}$$

$$\begin{aligned} g_{it} = {} & \kappa_0 + \kappa_1 \left(\frac{aid}{gdp}\right)_{it} + \kappa_2 \text{information}_{it} + \kappa_3 aidvolatility_{it} + \kappa_4 \left[\left(\frac{aid}{gdp}\right)_{it} * \text{information}_{it}\right] \\ & + \kappa_5 \left[\left(\frac{aid}{gdp}\right)_{it} * aidvolatility_{it}\right] + \kappa_6 \left[aidvolatility_{it} * \text{information}_{it}\right] \\ & + \kappa_7 \left[\left(\frac{aid}{gdp}\right)_{it} * aidvolatility_{it} * \text{information}_{it}\right] + \kappa_8 \mathbf{X}_{it} + \gamma_t + \eta_i + \varepsilon_{it}. \end{aligned} \tag{15}$$

The estimation of equation (14) allows me to determine (i) to what extent the negative impact of aid volatility on growth comes from the fact that it reduces aid efficiency, and (ii) how aid volatility affects aid efficiency. In equation (15) I introduce the release of information indicator in order to test one of the main predictions of the model: the negative impact of aid volatility on aid efficiency comes from the asymmetry of information.

5.4.2 Estimation Results

The prediction is that of a negative φ_2 coefficient for the effect on the growth rate of the interaction term between aid normalized by GDP and aid volatility. In columns 1 and 2 and 5 and 6 of Table 6, we see that the coefficient has the anticipated sign: aid has a negative impact on growth when aid flows are very volatile. However, as predicted by the model, the negative impact of aid volatility on aid efficiency vanishes when information is introduced (columns 7 and 8). Indeed, when I estimate equation (15) with two-step system GMM, the interaction term between aid and aid volatility is negative and statistically significant, while the triple interaction term between aid, aid volatility and information is positive and statistically significant. Moreover, there is no autocorrelation of order 2, and the validity of the instruments is accepted by the Hansen J-test.

Finally, I turn to the marginal effect of aid on growth which is : $\kappa_1 + \kappa_4 \text{information} + \kappa_5 aidvolatility + \kappa_7 \text{information} \cdot aidvolatility$[18] in equation (15). In Figure 6, I present the marginal effect of aid on growth for all the values of the release of information indicator and three different values of aid volatility: a low value (0.4 – blue line), an intermediate value (0.6 – green line) and a high value (0.8 – red line)[19]. It appears clearly that (i) the higher aid volatility, the higher the negative impact of aid on growth for low levels of information; (ii) the negative impact of aid volatility on aid efficiency disappears from a certain level of the release of information indicator. In other words, as predicted by the model, the negative impact of aid volatility on aid efficiency comes from the asymmetric information channel.

[18] The variance of this quantity is $var(\widehat{\kappa}_1) + \text{information}^2 \cdot var(\widehat{\kappa}_4) + aidvolatility^2 \cdot var(\widehat{\kappa}_5) + \text{information}^2 \cdot aidvolatility^2 \cdot var(\widehat{\kappa}_7) + 2 \cdot \text{information} \cdot cov(\widehat{\kappa}_1 \widehat{\kappa}_4) + 2 \cdot aidvolatility \cdot cov(\widehat{\kappa}_1 \widehat{\kappa}_5) + 2 \cdot \text{information} \cdot aidvolatility \cdot cov(\widehat{\kappa}_1 \widehat{\kappa}_7) + 2 \cdot \text{information} \cdot aidvolatility \cdot cov(\widehat{\kappa}_4 \widehat{\kappa}_5) + 2 \cdot aidvolatility \cdot \text{information}^2 \cdot cov(\widehat{\kappa}_4 \widehat{\kappa}_7) + 2 \cdot \text{information} \cdot aidvolatility^2 \cdot cov(\widehat{\kappa}_5 \widehat{\kappa}_7)$.

[19] The plot indicates statistical significance through the use of stars rather than confidence intervals in order for the plot not to become cluttered.

TABLE 6: AID EFFICIENCY, AID VOLATILITY AND ASYMMETRIC INFORMATION

Estimation method	OLS[a]	OLS[a]	OLS[a]	OLS[a]	System GMM[b]	System GMM[b]	System GMM[b]	System GMM[b]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\left(\frac{aid}{gdp}\right)$	0.285	0.349	-0.453	-0.307	0.599**	0.269	0.572	0.946
	(0.235)	(0.274)	(0.847)	(0.888)	(0.282)	(0.204)	(0.732)	(0.632)
Release of info.			-21.114	-27.076			8.918	1.580
			(30.227)	(31.778)			(19.058)	(12.840)
Aid volatility	-7.603***	-6.351**	-58.585*	-62.302	-1.255	-4.400	-45.007*	-46.049**
	(2.704)	(2.733)	(34.681)	(37.576)	(3.516)	(3.045)	(23.016)	(21.346)
$\left(\frac{aid}{gdp}\right)$ ×info.			1.614	1.359			-1.002	-2.063
			(2.267)	(2.357)			(1.718)	(1.387)
$\left(\frac{aid}{gdp}\right)$ ×aid vol.	-2.020***	-2.356***	-1.958	-2.386	-2.590***	-2.270**	-4.410**	-5.424***
	(0.616)	(0.802)	(1.867)	(1.963)	(0.865)	(1.014)	(1.736)	(1.453)
Information× aid volatility			93.603	99.528			68.742*	72.144*
			(59.982)	(65.349)			(40.675)	(38.187)
Aid vol.× $\left(\frac{aid}{gdp}\right)$ ×info.			2.270	4.152			8.012*	11.027***
			(5.136)	(5.815)			(4.553)	(3.453)
Population growth	-0.346	-0.639	-0.416	-0.358	-0.724	-2.206**	-2.541	-2.200**
	(0.804)	(0.855)	(0.798)	(0.850)	(1.711)	(0.960)	(1.680)	(1.022)
Log GDP pc	2.629	2.011	2.673	2.940	3.382**	0.776	0.343	0.102
	(3.015)	(3.403)	(3.155)	(3.627)	(1.425)	(1.323)	(1.485)	(1.130)
M2/GDP (lag)	-0.011	-0.007	0.036	0.025	0.037	0.081*	0.098**	0.084***
	(0.037)	(0.040)	(0.058)	(0.061)	(0.032)	(0.047)	(0.039)	(0.029)
Freedom House		4.593		1.198		-0.420		0.551
		(4.509)		(4.379)		(4.059)		(4.760)
Intercept	-12.763	2.715	-11.032	9.720	-21.225	0.067	-2.057	3.468
	(27.618)	(16.671)	(25.477)	(22.092)	(12.922)	(9.047)	(9.408)	(10.128)
N	346	321	346	321	275	257	275	257
R^2	0.697	0.700	0.714	0.719				
χ^2					152.655	172.757	5575.509	15805.709

* significant at 10%; ** significant at 5%; *** significant at 1%

All the regressions include period fixed effects (coefficients not reported).

a: The regressions include country fixed effects (coefficients not reported).

b: Robust standard errors and cluster(countries).

c: Windmeijer-corrected standard errors.

Notes: The variables are described in more detail in the text. The dependent variable is the growth rate of GDP.

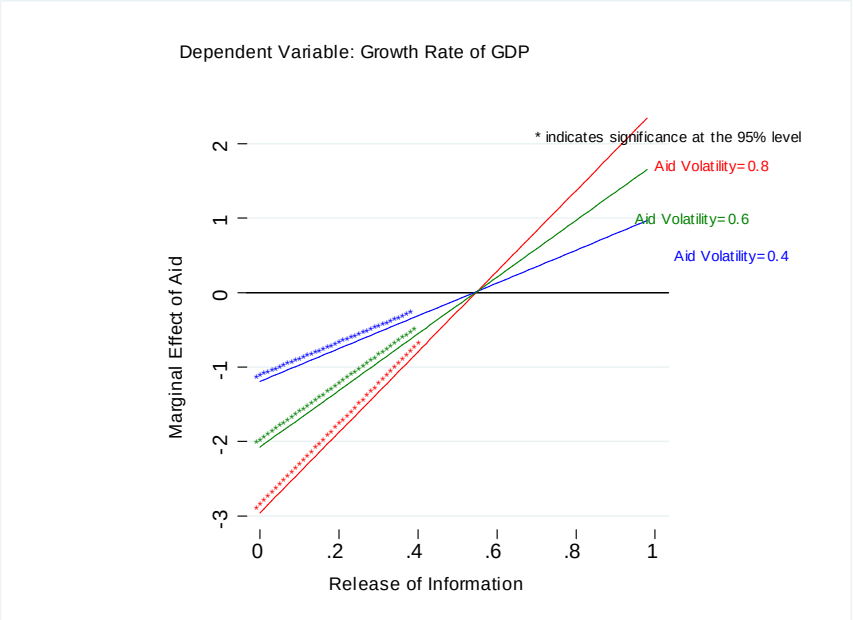

Figure 6: Marginal Effect of Aid on Growth As Information and Aid Volatility Change

5.4.3 Robustness Check

One of the main weaknesses of system GMM estimators is that they can generate moment conditions prolifically, with the instrument count quadratic in the time dimension of the panel. This can cause several problems in finite samples (Roodman, 2006a): (i) it can weaken the Hansen test to the point where it generates implausibly good p values of 1.000 (Anderson and Sorenson, 1996; Bowsher, 2002); and (ii) it can overfit endogenous variables.

So one has to test the robustness of the results to reducing the instrument count. I do so by limiting the lags used in GMM-style instruments[20]. In Table 7, I present the results of the main estimations of the paper after limiting the lags. It appears that (i) the results are still robust, and that (ii) the validity of the instruments is still accepted by the Hasen J-test of over-identifying restrictions.

5.5 A Possible Concern: Information Endogeneity

Both the theoretical and the empirical parts of this paper underline the importance of information and of transparency for aid efficiency. However, the level of transparency

[20] I obtain similar results when I collapse the instrument count.

TABLE 7: ROBUSTNESS CHECK
(LIMITING THE LAGS)

Estimation method	System GMM[a] (1)	System GMM[a] (2)	System GMM[a] (3)	System GMM[a] (4)	System GMM[a] (5)	System GMM[a] (6)	System GMM[a] (7)	System GMM[a] (8)
$\left(\frac{aid}{gdp}\right)$	-1.049*	-0.840*	0.432	-0.175	0.628*	0.340*	0.633	1.008
	(0.547)	(0.459)	(0.312)	(0.183)	(0.321)	(0.204)	(0.840)	(0.727)
$\left(\frac{aid}{gdp}\right)^2$			-0.017**					
			(0.008)					
Relea. info.	-6.970	0.035		-35.527*			8.121	-0.812
	(9.519)	(9.375)		(19.830)			(18.277)	(15.344)
Aid vol.			-10.333***	-112.552**	-0.953	-3.295	-44.923**	-51.278**
			(3.648)	(50.555)	(3.842)	(2.902)	(21.325)	(24.474)
$\left(\frac{aid}{gdp}\right)$ ×info.	2.655*	3.145**					-1.202	-2.244
	(1.355)	(1.284)					(1.998)	(1.639)
$\left(\frac{aid}{gdp}\right)^2$ ×info		-0.067						
		(0.055)						
$\left(\frac{aid}{gdp}\right)$ ×aid vol					-2.617***	-2.461***	-4.477**	-5.620***
					(0.898)	(0.903)	(2.015)	(1.739)
Information×				192.451**			68.820*	82.302*
aid volatility				(87.619)			(37.906)	(43.441)
Aid vol.×$\left(\frac{aid}{gdp}\right)$							8.397	11.547***
×info							(5.516)	(4.092)
Population	-1.385*	-1.061	-1.706	-1.489	-0.798	-2.306**	-2.124	-2.427**
growth	(0.797)	(1.233)	(1.111)	(1.418)	(1.731)	(0.989)	(1.680)	(1.137)
Log GDP pc	0.759	1.868	0.366	0.180	3.500**	0.857	0.465	-0.053
	(1.203)	(1.663)	(1.226)	(1.109)	(1.549)	(1.367)	(1.478)	(1.010)
M2/GDP	0.073	0.060	0.126**	0.065***	0.034	0.080**	0.091*	0.088***
(lag)	(0.051)	(0.055)	(0.055)	(0.025)	(0.034)	(0.040)	(0.038)	(0.031)
Freedom	5.160*	3.439	2.867	3.184		0.125		-0.320
House	(3.066)	(4.540)	(4.632)	(4.204)		(3.996)		(4.727)
Intercept	-3.209	-15.253	-2.676	20.972*	-22.093	-0.997	-2.695	6.703
	(9.439)	(15.473)	(10.985)	(10.844)	(13.906)	(9.458)	(10.477)	(9.535)
N	257	257	257	257	275	257	275	257
χ^2	535.186	493.231	208.168	188.432	147.106	166.492	5668.74	6270.46

* significant at 10%; ** significant at 5%; *** significant at 1%

All the regressions include period fixed effects (coefficients not reported).

a: Windmeijer-corrected standard errors.

Notes: The variables are described in more detail in the text. The dependent variable is the grow th rate of GDP.

across countries is highly correlated with other institutional characteristics that are, in the long run, likely to be codetermined. I thus need to check whether my results do not suffer from an omitted variables bias, being just capturing the fact that aid efficiency is higher in countries with better institutions, since more transparent countries tend to have more favorable institutional features in general. In a recent paper, Glennerster and Shin (2008), who define transparency as the accuracy and frequency of economic information released to the public, successfully overcome this difficulty by studying the data generated during 1999-2002 when the IMF introduced a series of reforms to promote transparency[21].

Here, due to the fact that my dataset covers a much longer time period and a higher number of countries, I cannot use this instrument. However, even if I do not have a good instrumental strategy for release of information and I cannot use a natural experiment, I run different checks that give supporting results according to which I am not capturing the positive effect of institutions.

First, it is important to underline that the measure of information I use – the release of information indicator of Williams (2009) – is very weakly correlated with usual measures of institutions (the augmented Freedom House political rights index, the Polity IV index, and the dichotomous democracy index developed by Przeworski, Alvarez, Cheibub, and Limongi (2000a) and augmented by Boix and Rosato (2001)), as shown in Table 8.

TABLE 8: CORRELATION BETWEEN RELEASE OF INFORMATION INDICATOR AND USUAL MEASURES OF INSTITUTIONS

	Polity IV	Freedom House	Przeworski Democracy	Release Info
Polity IV	1			
Freedom House	0.8025	1		
Przeworski Democracy	0.5826	0.6146	1	
Release Info	0.2475	0.3652	0.1330	1

Moreover, in all the different specifications I use, I find no positive and statistically significant direct impact of release of information on growth. If what I was capturing using the release of information indicator was the impact of good institutions, I should have found a positive impact of information on growth.

[21] Indeed, the IMF's preexisting internal timetable for country reports introduced exogenous variation when countries were faced with the option to become more transparent.

Finally, when I introduce an institutional measure (Freedom House) as a control in my regressions, it does not modify the results. On the contrary, it even increases both the positive impact and the statistical significance of the release of information indicator.

Thus, it seems that what I am capturing is actually the positive impact of information and transparency and not the one of institutions.

6 CONCLUSION

Using a political economy model of rent extraction, I have shown that asymmetric information sharply reduces aid efficiency. In particular, aid flows received by the policymaker can have substantial multiplicative effects under asymmetric information. Moreover, aid volatility has different effects depending on whether or not the amount of aid flows is observed by the citizens. All other things being equal, more aid volatility results in an increase in the probability that the officeholder embezzles aid completely, thus providing no public good. Consequently, I identify a new channel – the "asymmetric information" channel – through which aid volatility is costly for recipient countries. Using various empirical methods on a cross-country panel of developing countries and computing new yearly estimates of aid volatility, I have confirmed the empirical relevance of the model. On the one hand, I have found that more "news" increases aid efficiency, using a release of information indicator. On the other hand, the negative impact of aid volatility on aid efficiency vanishes when private information is revealed such that it is no longer asymmetric.

This preliminary evidence is along the lines of recent micro studies on private servants incentives. These studies emphasize that the need for more accountability comes hand-in-hand with a need for more transparency (Olken, 2007; Duflo, Kremer, and Glennerster, 2006). Recent case studies have thus shown that more transparency can reduce corruption and make the use of resources more effective. The example of the Ugandan newspapers campaign is the most striking. Reinikka and Svensson (2004) found that only 13% of central government transfers to local primary schools in Uganda arrived at destination. To deal with this problem, the Ugandan central government took the bold measure of publishing intended transfers by school in local newspapers where they could be monitored by parents and local officials. Reinikka and Svensson (2005) then found that this newspapers campaign successfully increased the proportion of transfers that arrived at schools from 13 percent to over 80 percent. Similarly, Besley and Burgess (2002) provide evidence for the role of local newspapers in increasing the responsiveness of Indian state governments to natural disaster. In the same way, since the incentives

facing incumbents in recipient countries seem too weak for them to have an interest in providing public goods rather than extracting rents, the introduction of more information can appear as a good way to increase aid efficiency at low cost. This is in the spirit of the DFID "Extractive Industries Transparency Initiative", the idea being to "publish what you pay".

A Appendix A: Infinitely Repeated Case

I distinguish two strategies for the incumbent:

1. I first consider all histories without defection: in this case, the strategy of the incumbent is stationary: she chooses to be reelected (and so to satisfy the citizen's reservation utility) at each stage of the entire game.
2. At a time T, there is a one-shot deviation: the incumbent chooses not to be reelected and to embezzle all the aid flows.

1. In the non defection case, the incumbent payoff can be written as follows:

$$\sum_{t=0}^{\infty} \delta^t \mathbb{E}\left(\theta_t - \widetilde{\theta}_t^g + R\right)$$

2. In the one-shot deviation case, it can be written as follows:

$$\begin{array}{l} \sum_{t=0}^{T-1} \delta^t \mathbb{E}\left(\theta_t - \widetilde{\theta}_t^g + R\right) + \delta^T (\gamma\theta_T + R) + \sum_{t=T+1}^{\infty} 0 \\ = \sum_{t=0}^{T-1} \delta^t \mathbb{E}\left(\theta_t - \widetilde{\theta}_t^g + R\right) + \delta^T (\gamma\theta_T + R) \end{array}.$$

The incumbent chooses the non-defection rather than the one-shot deviation strategy iff

$$\begin{array}{l} \sum_{t=0}^{\infty} \delta^t \mathbb{E}\left(\theta_t - \widetilde{\theta}_t^g + R\right) \geq \sum_{t=0}^{T-1} \delta^t \mathbb{E}\left(\theta_t - \widetilde{\theta}_t^g + R\right) + \delta^T (\gamma\theta_T + R) \\ \Leftrightarrow \sum_{t=T}^{\infty} \delta^t \mathbb{E}\left(\theta_t - \widetilde{\theta}_t^g + R\right) \geq \delta^T (\gamma\theta_T + R) \\ \Leftrightarrow \sum_{t=T}^{\infty} \delta^t \mathbb{E}\widetilde{\theta}_t^g \leq \frac{\delta^T}{1-\delta}\left(\overline{\theta} + R\right) - \delta^T (\gamma\theta_T + R). \end{array}$$

At time T, the citizen has to determine her reservation utility $\widetilde{\theta}_T^g$. She chooses $\widetilde{\theta}_T^g$ such that

$$\delta^T \widetilde{\theta}_T^g \leq \frac{\delta^T}{1-\delta}\left(\overline{\theta} + R\right) - \delta^T (\gamma\theta_T + R) - \sum_{t=T+1}^{\infty} \delta^t \mathbb{E}\left(\widetilde{\theta}_t^g\right). \tag{16}$$

Moreover, since she wants to maximize her utility, (16) is binding:

$$\delta^T \widetilde{\theta}_T^g = \frac{\delta^T}{1-\delta}\left(\overline{\theta} + R\right) - \delta^T (\gamma\theta_T + R) - \sum_{t=T+1}^{\infty} \delta^t \mathbb{E}\left(\widetilde{\theta}_t^g\right). \tag{17}$$

Each period t, the citizen will follow the same strategy (the one which consists in giving the incumbent just enough for her not to choose to embezzle all aid flows[22]). The reservation utility of the citizen $\widetilde{\theta}_t^g$ will then be a function of θ_t: $\widetilde{\theta}_t^g = \widetilde{\theta}_t^g(\theta_t)$. As a consequence, the expectation of $\widetilde{\theta}_t^g$ depends on that of θ_t. However, $\mathbf{E}(\theta_t) = \overline{\theta}$ (it is independent of t) and so $\widetilde{\theta}_t^g$ is also independent of t: $\mathbf{E}\left(\widetilde{\theta}_t^g\right) = \widetilde{\theta}^g$.

Thus (17) can be rewritten as follows:

$$\widetilde{\theta}_T^g = \frac{\overline{\theta} + R}{1-\delta} - (\gamma\theta_T + R) - \frac{\delta}{1-\delta}\widetilde{\theta}^g = \frac{\overline{\theta} + R - \delta\widetilde{\theta}^g}{1-\delta} - (\gamma\theta_T + R). \tag{18}$$

In this case, the incumbent will always prefer the non defection rather than the one-shot deviation strategy and so will satisfy the reservation utility of the citizen.

We can now generalize this result.

Proposition 3 *Each period t the incumbent will provide the citizen with an amount of public good*

$$\theta_t^g = \widetilde{\theta}_t^g = \frac{\overline{\theta} + R - \delta\widetilde{\theta}^g}{1-\delta} - (\gamma\theta_t + R). \tag{19}$$

We need now to determine the value of $\widetilde{\theta}^g$ in the RHS of equation (19). We know that each period t equation (19) is satisfied, but that the players can only anticipate the value of θ and so consider its average. So we have

$$\begin{array}{l} \widetilde{\theta}^g = \frac{\overline{\theta}+R-\delta\widetilde{\theta}^g}{1-\delta} - \left(\gamma\overline{\theta} + R\right) \\ \Leftrightarrow \widetilde{\theta}^g = \overline{\theta} + R - (1-\delta)\left(\gamma\overline{\theta} + R\right) \end{array}. \tag{20}$$

Plugging $\widetilde{\theta}^g$ into equation (19),

$$\begin{array}{l} \widetilde{\theta}_t^g = \frac{\overline{\theta}+R-\delta\left[\overline{\theta}+R-(1-\delta)\left(\gamma\overline{\theta}+R\right)\right]}{1-\delta} - (\gamma\theta_t + R) \\ \Leftrightarrow \widetilde{\theta}_t^g = (1+\delta\gamma)\,\overline{\theta} + \delta R - \gamma\theta_t \end{array}. \tag{21}$$

Proposition 4 *The incumbent always chooses to be reelected and each period t, she provides the citizen with an amount of public good*

$$\theta_t^g = (1+\delta\gamma)\,\overline{\theta} + \delta R - \gamma\theta_t. \tag{22}$$

If we now turn to aid efficiency (proxied by the share of the aid flows used to provide public goods rather than extracted as rents), we obtain that:

$$\frac{\theta_t^g}{\theta_t} = \min\left\{\frac{(1+\delta\gamma)\,\overline{\theta} + \delta R}{\theta_t} - \gamma; 1\right\}. \tag{23}$$

So aid efficiency is increasing in the average amount of aid flows and decreasing in the current amount of aid flows. This has important political implications. On the one

[22] It is never in her interest to deviate since her alternative payoff is equal to 0.

hand, this means that when one increases the average amount of aid flows provided to a recipient country, it increases aid efficiency (and so that there are increasing rather than decreasing returns to aid flows). On the other hand, this means that a one-shot positive shock on aid flows has a negative impact on aid efficiency since it increases the share of aid rents extracted by the incumbent. Thus donor countries do not have to compensate low average amounts of aid shocks by time to time (inefficient) increase in aid flows, but should rather prefer a smooth increase in the providing amounts of aid.

Moreover

$$\begin{array}{l} \frac{(1+\delta\gamma)\overline{\theta}+\delta R}{\theta_t} - \gamma \geq 1 \\ \Leftrightarrow \theta_t \leq \frac{(1+\delta\gamma)\overline{\theta}+\delta R}{1+\gamma}. \end{array}$$

Proposition 5 *Each period t, aid efficiency is such that*

$$\left\{ \begin{array}{l} \frac{\theta_t^g}{\theta_t} = 1 \text{ if } \theta_t \leq \frac{(1+\delta\gamma)\overline{\theta}+\delta R}{1+\gamma} \\ \frac{\theta_t^g}{\theta_t} = \frac{(1+\delta\gamma)\overline{\theta}+\delta R}{\theta_t} - \gamma \text{ otherwise} \end{array} \right. . \tag{24}$$

Appendix B: Data Sources and Description

Aid: Net Aid Transfers (NAT). Source: DAC.

Concentration: measure of the geographic dispersion of the population. Based on population data for 400 km2 cells, this is a dispersion index, or Gini coefficient of population dispersion for each country. The minimum value of 0 indicates that the population is evenly distributed across the country while a maximum value of 1 indicates that the total population is concentrated in one area. Source: Democracy and Development Extended Data Set.

Democracy: dichotomous democracy index developed by Przeworski, Alvarez, Cheibub, and Limongi (2000b) and augmented by Boix and Rosato (2001).

Freedom House Political Rights Index: index normalized between 0 and 1, with 0 corresponding to the least democratic set of institutions and 1 to the most. Source: Freedom House.

GDP growth rate: Annual percentage growth rate of GDP at market prices based on constant local currency. Source: WDI (2006).

GDP per capita: GDP at market prices based on constant local currency, normalized by the country population. Source: WDI (2006).

M2 (% GDP): Money and quasi money comprise the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government. Source: WDI (2006).

Polity 4 index (0 to1): aggregate score obtained as the difference between democracy and autocracy. Source: Polity 4 Project, UMD.

Population growth: Annual percentage growth rate of the population. Source: WDI (2006).

Release of information: indicator based on the quantity of reported socio-economic data contained in the World Development Indicators and the International Finance Statistics databases. Source: Williams (2009).

TABLE A1: COUNTRY-SPECIFIC SUMMARY STATISTICS

Country	Per capita GDP in 1970	GDP growth (percent per annum)	Aid over GDP	Aid Volatility	Release of information indicator
Algeria	1719.21	3.26	0.45	0.07	0.45
Argentina	4168.62	2.23	0.06	0.19	0.61
Armenia	492.55	-7.70	8.40	1.83	0.40
Azerbaijan	653.68	-10.78	1.86	3.40	0.38
Bangladesh	176.78	3.99	5.45	0.10	0.51
Belize	2167.58	5.86	7.13	0.08	0.41
Benin	305.36	3.31	9.73	0.02	0.46
Bhutan	427.58	7.40	14.73	0.02	0.22
Bolivia	628.61	2.17	6.60	0.11	0.60
Botswana	1697.70	9.21	7.14	0.03	0.46
Burkina Faso	223.01	3.95	12.64	0.03	0.37
Burundi	164.51	1.97	15.77	0.06	0.40
Cameroon	669.25	3.87	3.61	0.08	0.42
Cape Verde	1080.18	5.47	29.52	0.03	0.31
Central African Republic	297.32	1.19	13.17	0.04	0.34
Chad	212.18	2.72	12.64	0.07	0.34
China		9.10	0.36	0.34	0.47
Colombia	1252.63	4.04	0.20	0.25	0.67
Comoros	433.71	2.43	27.09	0.02	0.21
Congo. Dem. Rep.	290.52	-1.75	3.57	0.11	0.36
Cote d'Ivoire	768.25	2.65	3.97	0.06	0.49
Cyprus	6641.79	7.77	2.03	0.14	0.59
Dominica	2128.79	3.66	13.93	0.12	0.41
Ecuador	1147.02	3.50	1.08	0.11	0.57
Egypt. Arab. Rep.	701.62	5.96	7.27	0.18	0.56
Ethiopia	136.18	2.78	9.29	0.05	0.38
Fiji	1670.81	2.26	2.98	0.02	0.50
Gambia. The	280.11	3.94	22.67	0.07	0.39
Ghana	341.91	2.19	6.03	0.10	0.53
Grenada	2066.76	4.00	8.02	0.16	0.36
Guatemala	1067.42	3.12	1.43	0.10	0.51
Guyana	647.60	1.25	9.27	0.24	0.43

TABLE A1: COUNTRY-SPECIFIC SUMMARY STATISTICS
(CONTINUED)

Country	Per capita GDP in 1970	GDP growth (percent per annum)	Aid over GDP	Aid Volatility	Release of information indicator
Haiti	299.04	0.49	8.52	0.23	0.44
India		5.11	0.72	0.07	0.59
Indonesia		7.08	0.99	0.15	0.59
Israel	8675.91	4.48	3.57	0.22	0.63
Jordan	1442.40	7.26	15.52	0.20	0.54
Kenya	312.30	3.76	6.77	0.05	0.57
Kuwait	12269.85	6.54	0.02	0.58	0.52
Lao PDR	328.32	5.52	10.77	0.13	0.25
Lebanon	2381.88	-5.92	3.32	0.14	0.26
Lesotho	317.77	5.90	19.95	0.02	0.41
Liberia	293.44	-2.90	24.95	0.22	0.24
Madagascar	274.22	0.88	7.78	0.06	0.46
Malawi	165.92	3.70	17.42	0.05	0.38
Maldives	1141.31	10.17	16.35	0.19	0.27
Mali	205.54	2.82	17.61	0.05	0.44
Mauritania	400.28	2.80	24.71	0.07	0.39
Mauritius	2337.69	5.47	2.46	0.53	0.51
Moldova	439.18	-2.87	1.74	0.35	0.45
Mongolia	401.78	3.71	22.23	0.04	0.28
Morocco	835.77	3.99	2.97	0.14	0.58
Mozambique	214.07	2.77	24.61	0.11	0.36
Nepal	160.48	4.34	8.31	0.03	0.49
Nicaragua	651.84	0.20	11.30	0.27	0.53
Niger	255.33	1.85	13.35	0.06	0.34
Nigeria	418.64	2.46	0.40	0.16	0.54
Pakistan	235.04	5.45	2.77	0.08	0.62
Panama	2211.34	3.12	0.99	0.20	0.56
Papua New Guinea	826.74	2.84	11.64	0.02	0.49
Paraguay	1173.82	4.94	1.39	0.11	0.58
Peru	1283.54	2.36	1.03	0.07	0.59
Philippines	654.10	3.31	1.45	0.06	0.65

TABLE A1: COUNTRY-SPECIFIC SUMMARY STATISTICS
(CONTINUED)

Country	Per capita GDP in 1970	GDP growth (percent per annum)	Aid over GDP	Aid Volatility	Release of information indicator
Rwanda	221.85	3.27	18.49	0.13	0.44
Senegal	486.96	2.75	11.21	0.04	0.54
Seychelles	4311.50	4.63	10.23	0.05	0.43
Sierra Leone	221.01	-0.78	9.85	0.10	0.34
Slovenia	8393.71	0.25	0.17	0.49	0.59
Solomon Islands	678.09	6.99	22.31	0.08	0.35
South Africa	2589.24	2.09	0.16	0.01	0.66
Sri Lanka	451.45	4.81	6.49	0.05	0.58
St. Kitts and Nevis	4356.25	5.60	5.95	0.64	0.36
St. Lucia	2652.71	5.29	5.01	0.64	0.40
St. Vincent and the Grenadines	1745.84	3.56	9.12	0.41	0.40
Sudan	395.55	4.39	5.78	0.11	0.44
Suriname	2062.51	0.79	9.11	0.56	0.42
Tanzania	85.69	3.26	18.69	0.04	0.41
Thailand	1183.79	7.33	0.76	0.06	0.67
Togo	322.19	2.93	10.75	0.05	0.52
Tonga	851.50	2.15	22.48	0.07	0.35
Tunisia	1294.01	4.80	2.39	0.32	0.57
Uganda	221.03	4.85	8.48	0.29	0.39
Uruguay	3140.80	2.66	0.27	0.78	0.58
Vanuatu	1100.30	2.42	25.24	0.05	0.47
Yemen. Rep.	385.56	5.87	4.83	0.05	0.47
Zambia	453.85	0.88	13.34	0.26	0.49
Zimbabwe	698.06	3.25	3.38	0.19	0.45

References

Acemoglu, D., G. Egorov, and K. Sonin (2006): "Coalition Formation in Political Games," NBER Working Paper No. 12749.

Acemoglu, D., J. A. Robinson, and T. Verdier (2003): "Kleptocracy and Divide-and-Rule: A Model of Personal Rule," NBER Working Paper No. 10136.

Acemoglu, D., D. Ticchi, and A. Vindigni (2006): "Emergence and Persistence of Inefficient States," MIT Department of Economics Working Paper No. 06-32.

——— (2008): "A Theory of Military Dictatorships," NBER Working Paper No. 13915.

Alesina, A. (1988): "Credibility and Political Convergence in a Two-Party System with Rational Voters," *The American Economic Review*, 78(4), pp. 796–806.

Alesina, A., and D. Dollar (2000): "Who Gives Foreign Aid to Whom and Why?," *Journal of Economic Growth*, 5(1), pp. 33–63.

Alesina, A., and G. Tabellini (1990): "Voting on the Budget Deficit," *The American Economic Review*, 80(1), pp. 37–49.

Alesina, A., and B. Weder (2002): "Do Corrupt Governments Receive Less Foreign Aid?," *The American Economic Review*, 92(4), pp. 1126–1137.

Anderson, T., and B. Sorenson (1996): "GMM Estimation of a Stochastic Volatility Model: a Monte Carlo Study," *Journal of Business and Economic Statistics*, 14, pp. 328–352.

Arellano, M., and S. Bond (1991): "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *The Review of Economic Studies*, 58, pp. 277–297.

Arellano, M., and O. Bover (1995): "Another Look at the Instrumental Variables Estimation of Error Components Models," *Journal of Econometrics*, 68, pp. 29–51.

Barro, R., and X. Sala-i Martin (2003): *Economic Growth*.

Barro, R. J. (1973): "The Control of Politicians: An Economic Model," *Public Choice*, 14, pp. 19–42.

Besley, T., and R. Burgess (2002): "The Political Economy of Government Responsiveness: Theory and Evidence," *Quarterly Journal of Economics*, 117(4), pp. 1415–1451.

Besley, T., and S. Coate (1997): "An Economic Model of Representative Democracy," *The Quarterly Journal of Economics*, 112(1), pp. 85–114.

Boix, C., and S. Rosato (2001): "A Complete Data Set of Political Regimes, 1800-1999," Unpublished, Department of Political Science, University of Chicago.

Borensztein, E., J. Cagé, D. Cohen, and C. Valadier (2008): "Aid Volatility and Macro Risks in Low-Income Countries," OECD Development Centre Working Papers No. 273.

Bowsher, C. (2002): "On Testing Overidentifying Restrictions in Dynamic Panel Data Models," *Economics Letters*, 77, pp. 211–220.

Brambor, T., W. R. Clark, and M. Golder (2005): "Understanding Interaction Models: Improving Empirical Analyses," *Political Analysis*, 14, pp. 63–82.

Brautigam, D. (2000): *Aid Dependence and Governance*. Stockholm: Almqvist & Wiksell International for the Swedish Ministry of Foreign Affairs.

Bulir, A., and A. J. Hamann (2006): "Volatility of Development Aid : From the Frying Pan into the Fire?," IMF Working Paper, WP/06/65.

Burnside, C., and D. Dollar (2000): "Aid, Policies and Growth," *American Economic Review*, 90(4), pp. 847–868.

Cassen, R. (1994): *Does Aid Work?* Oxford University Press (2nd edn.).

Celasun, O., and J. Walliser (2008): "Predictability of Aid: Do Fickle Donors Undermine Aid Effectiveness?," *Economic Policy*, 23(55), pp. 545–594.

Clemens, M. A., S. Radelet, and R. Bhavnani (2004): "Counting Chickens when they Hatch: The Short-Term Effect of Aid on Growth," Working Paper No. 44, Centre for Global Development.

Collier, P., and J. Dehn (2001): "Aid, Shocks and Growth," World Bank Policy Research Working Paper No. 2688.

Collier, P., and D. Dollar (2002): "Aid Allocation and Poverty Reduction," *European Economic Review*, 45(1), pp. 1–26.

——— (2004): "Development Effectiveness: What Have We Learnt?," *The Economic Journal*, 114(496), pp. 244–271.

Collier, P., and A. Hoeffler (2004): "Aid, Policy and Growth in Post-Conflict Societies," *European Economic Review*, 48(5), pp 1125–1145.

Dalgaard, C.-J., H. Hansen, and F. Tarp (2004): "On the Empirics of Foreign Aid and Growth," *The Economic Journal*, 114(496), F191–F216.

Duflo, E., M. Kremer, and R. Glennerster (2006): "Using Randomization in Development Economics Research: A Toolkit," MIT Department of Economics Working Paper No. 06-36.

Fatas, A., and I. Mihov (2005): "Policy Volatility, Institutions and Economic Growth," CEPR Discussion Paper No. 5388.

Ferejohn, J. (1986): "Incumbent Performance and Electoral Control," *Public Choice*, 50, pp. 5–25.

Fielding, D., and G. Mavrotas (2005): "The Volatility of Aid," Discussion Paper No. 2005/06, United Nations University, WIDER.

Florini, A. (1999): "Does the Invisible Hand Need a Transparent Glove? The Politics of Transparency," An overview paper prepared for the Annual World Bank conference on Development Economics, Washington D.C., Carnegie Endowment for International Peace.

Gemmel, N., and M. McGillivray (1998): "Aid and Tax Instability and the Government Budget Constraints in Developing Countries," CREDIT Working Paper 98/1, University of Nottingham.

Glennerster, R., and Y. Shin (2008): "Does Transparency Pay?," *IMF Staff Papers*, 55(1), pp. 183–209.

Guillaumont, P., and L. Chauvet (2001): "Aid and Performance: A Reassessment," *Journal of Development Studies*, 37(6), pp. 66–92.

Hansen, H., and F. Tarp (2001): "Aid and Growth Regressions," *Journal of Development Economics*, 64, pp. 547–570.

Kaufmann, D., and A. Bellver (2005): "Transparenting Transparency: Initial Empirics and Policy Applications," Working Paper (Washington, World Bank).

Kharas, H. (2008): "Measuring the Cost of Aid Volatility," Wolfensohn Center for Development Working Paper No. 3.

Moon, A. (1998): *Aid, METFs, and Budget Processes*. ECSPE, Washington, D.C., World Bank.

Olken, B. (2007): "Monitoring Corruption: Evidence from a Field Experiment in Indonesia," *Journal of Political Economy*, 115, pp. 200–249.

Osborne, M. J., and A. Slivinski (1996): "A Model of Political Competition with Citizen-Candidates," *The Quarterly Journal of Economics*, 111(1), pp. 65–96.

Pallage, S., and M. A. Robe (2001): "Foreign Aid and the Business Cycle," *Review of International Economics*, 9(4), pp. 641–672.

Persson, T., G. Roland, and G. Tabellini (1997): "Separation of Powers and Political Accountability," *The Quarterly Journal of Economics*, 112(4), pp. 1163–1202.

——— (2000): "Comparative Politics and Public Finance," *The Journal of Political Economy*, 108(6), pp. 1121–1161.

Persson, T., and G. Tabellini (1999): "The Size and Scope of Government: Comparative Politics with Rational Politicians," *European Economic Review*, 43, pp. 669–735.

Przeworski, A., M. Alvarez, J. A. Cheibub, and F. Limongi (2000a): *Democracy and Development: Political Institutions and Material Well-Being in the World, 1950-1990*. Cambridge University Press, New York NY.

Przeworski, A., M. E. Alvarez, J. A. Cheibub, and F. Limongi (2000b): *Democracy and Development: Political Institutions and Well -Being In The World 1950-1990*. New York: Cambridge University Press.

Ramey, G., and V. A. Ramey (1995): "Cross-Country Evidence on the Link Between Volatility and Growth," *The American Economic Review*, 85(5), pp. 1138–1151.

Reinikka, R., and J. Svensson (2004): "Local Capture: Evidence from a Central Government Transfer Program in Uganda," *Quarterly Journal of Economics*, 119, pp. 679–705.

——— (2005): "Fighting Corruption to Improve Schooling: Evidence from a Newspaper Campaign in Uganda," *Journal of the European Economic Association*, 3, pp. 259–267.

Rogoff, K. (1990): "Equilibrium Political Budget Cycles," *The American Economic Review*, 80(1), pp. 21–36.

Rogoff, K., and A. Sibert (1988): "Elections and Macroeconomic Policy Cycles," *The Review of Economics Studies*, 55(1), pp. 1–16.

Roodman, D. (2006a): "How to Do xtabond2: An Introduction to Difference and System GMM in Stata," Center for Global Development Working Paper Number 103.

——— (2006b): "An Index of Donor Performance," Center for Global Development Working Paper No. 67.

——— (2007): "The Anarchy of Numbers: Aid, Development, and Cross-country Empirics," *World Bank Economic Review*, 21(2), pp. 225–277.

Schnabel, G. (2007): "Exchange Rate Volatility and Growth in Small Open Economies at the EMU Periphery," European Central Bank Working Paper No. 773.

Stromberg, D. (2004): "Radio's Impact on Public Spending," *Quarterly Journal of Economics*, 119(1).

Williams, A. (2006): "A New Cross-National Time Series Indicator of Bureaucratic Quality," Economics Discussion / Working Papers 06-31, The University of Western Australia, Department of Economics.

——— (2009): "On the Release of Information by Governments: Causes and Consequences," *Journal of Development Economics*, 89(1), pp. 124–138.

WINDMEIJER, F. (2005): "A
Finite Sample Correction for the Variance of Linear Efficient Two-Step GMM Estimators," *Journal of Econometrics*, 126, pp. 25–51.