Preliminary version

Can foreign aid dampen external political shocks ?

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Abstract

In this paper, an extended econometric model of aid effectiveness is proposed. In growth regressions – estimated by the application of the generalized method of moments developed by Arellano and Bond (1991) – foreign aid and aid interacted with various variables are introduced in order to capture the *conditions* of aid effectiveness. Results suggest that aid effectiveness depends : (i) negatively on internal political instability ; (ii) positively on vulnerability to trade shocks ; (iii) positively on external political shocks, implying that aid can dampen the negative impact of these shocks on economic growth. This latter result suggests an extended notion of vulnerability, which would affect positively aid effectiveness, and would be composed of both economic and political shocks faced by developing countries.

Key words

Foreign aid, economic growth, dynamic panel econometrics, economic policy, regional socio-political instability, spillovers and contagion effects.

JEL codes

C33, F35, H4, O11, O19, O4

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Introduction

The debate on aid effectiveness entered a new phase with the publication of the *Assessing Aid* report by the World Bank in 1998. The report was based on the work of Burnside and Dollar (1997, 2000) which launched the analysis of the conditions of aid effectiveness by the introduction, in growth regressions, of an interaction term between aid and economic policies. A positive impact of this crossed-term was interpreted as the fact that aid is more effective in developing countries pursuing good economic policies.

The idea that aid effectiveness depends on the quality of economic policies had important implications for aid agencies. For example, the *Millennium Challenge Account* (MCA) initiative, launched by the US administration in 2002, is directly inspired from the debate on the selectivity criteria, and advocates that increases in US aid should in priority be directed towards countries with sound economic policies.

Yet, the Burnside-Dollar analysis has been largely debated, on different grounds : the robustness of the econometric results, the concept of economic policy, alternative factors affecting aid effectiveness. In this paper, an extended analysis of the factors likely to influence aid effectiveness is proposed. The conceptual framework is presented in section 1. The standard model captures some factors of aid effectiveness already identified in the literature : (1) the quality of economic policies (Burnside and Dollar 2000) ; (2) the marginal decreasing returns of aid (Hansen and Tarp 2001) ; (3) economic vulnerability (Guillaumont and Chauvet 2001) ; (4) internal socio-political instability of recipients (Chauvet and Guillaumont 2004). But the core of the analysis relies on a fifth hypothesis : the ability of aid to dampen the negative impact on growth of external political instability.

Section 2 presents the econometric methodology, data and variables. In section 3 econometric tests of the standard model are proposed. The fifth hypothesis – focused on the impact of regional political shocks on growth and aid effectiveness – is tested in section 4. The last section concludes.

1. Conceptual framework : five hypotheses tested

Standard model

The role of economic policies

The introduction in growth regressions of an interaction term between aid and economic policies is the core of the debate on aid effectiveness since the mid-nineties. In the analysis performed by Burnside and Dollar (1997, 2000), good economic policies include low inflation rate, budget balance and trade openness policy. A policy indicator is constructed as the weighted sum of the three variables, the weights being their respective impact on growth:

POL = 1.28 + 6.85 x *budget surplus* – 1.40 x *inflation* + 2.16 x *openness policy*.

In the growth regressions, structural, institutional and political variables are also introduced (ethnolinguistic fragmentation, quality of institutions, financial depth, political assassinations). The estimations are performed both by OLS and TSLS (to take into account the endogeneity of aid), on four-year sub-periods going from 1970-73 to 1990-93, for 56 developing countries.

Foreign aid and the aid-policy interaction term are introduced in the growth regressions. After deleting five outliers from their sample, Burnside and Dollar show that the interaction term is significantly positive, suggesting that aid is effective in countries with sound economic policies.[1]

Hypothesis 1 : aid effectiveness depends positively on the quality of economic policies.

Marginal decreasing returns to aid ?

The hypothesis of marginal diminishing returns to aid has mainly two foundations. The first one is the limits to the absorptive capacity of receiving countries (Rosenstein-Rodan 1961, Adler 1965, Chenery and Strout 1966, Guillaumont 1971). The impact of aid on growth depends on the absorptive capacity of recipients, and high amounts of aid are therefore relatively less productive. The second relates to the issue of Dutch disease (van Wijnbergen 1984, 1986) : massive aid may entail a real exchange rate appreciation inauspicious for economic growth.

Diminishing returns to aid have traditionally been captured by an aid squared variable in econometric growth analysis. However, Hansen and Tarp (2000, 2001) stress that the introduction of non-linearities in the aid-growth relationship – either aid squared or aid interacted with policies – has no theoretical foundations, and comes from a simple second-order approximation of the standard Solow model.[2] The different non-linearities are thus only reflecting a greater precision in the approximation of the functional form of the model.

[1] They first introduce a quadratic interaction term (Aid^2 x *POL*), which is significant on the sample of 56 countries. Once they delete the five outliers from the sample, this term is no longer significant. This analysis has been harshly debated by Dalgaard and Hansen (2001), who argue that other outliers could have been identified, and that the five outliers retained by Burnside and Dollar may be discussed.

[2] Following Mankiw *et al.* (1992) : $g_{yt} = \alpha_0 + \alpha_1 \log(i_t) - \rho \log(y_0)$. If $i_t = \gamma_1 s_t + \gamma_2 a_t$, the second-order Taylor approximation is given by (Hansen et Tarp 2000 : 390):

Because there is no real theoretical foundation as to whether the non-linearities in the aid-growth relationship should be captured by aid squared or by aid interacted by policies, this question is mainly empirical. According to Hansen and Tarp (2000, 2001), aid squared and aid interacted with policy constitute a subset of quadratic and interaction terms, being potentially proxies for each others. They introduce simultaneously in a Burnside-Dollar type regression an aid squared variable and aid interacted with policy. Aid and aid squared are significant – consistently with the hypothesis of diminishing returns to aid – whereas aid interacted with policy is no longer significant. From this result, Hansen and Tarp conclude that aid interacted with policy (significant in the Burnside-Dollar analysis) captures actually the influence of the omitted aid squared.

Hypothesis 2 : aid has marginal diminishing returns.

Aid effectiveness depends on economic vulnerability

Guillaumont and Chauvet (1999, 2001) stress that other factors than the quality of economic policies may affect aid effectiveness. They add into the picture the issue of structural economic vulnerability of developing countries. They introduce an interaction term between aid and structural vulnerability to test whether foreign aid is more effective in countries vulnerable to external shocks. If so, aid could play an insurance role, protecting the growth process of developing countries from the negative impact of external shocks.

Following the definition of structural economic vulnerability given by Guillaumont (2001), the indicator of vulnerability used by Guillaumont and Chauvet (2001) captures climatic instability (instability of agricultural added value, weighted by the share of this value added in the GDP), long term trade shocks (trend of terms of trade) and short term trade shocks (instability of exports, weighted by the share of exports in GDP), and the size of population (which captures structural exposure to shocks). The composite indicator of structural vulnerability is constructed as the weighted sum of these variables, the weight being their impact on growth.

Their growth regressions suggest that vulnerability to external shocks significantly reduces growth. Moreover, the higher vulnerability, the greater aid effectiveness : foreign aid seems to compensate for the negative impact of vulnerability on growth. Finally, the interaction term of aid with policies looses its significance when vulnerability is taken into the play.

Similarly, Collier and Dehn (2001) test the link between export price shocks, growth and aid effectiveness. They identify extreme negative and positive price shocks using the price index of Deaton and Miller (1995). Collier and Dehn (2001) show that negative price shocks have a negative impact on growth (positive shocks not being significant). Their results tend to reinforce that of Burnside and Dollar since aid interacted with policies is significant in their regressions. Collier and Dehn (2001) also test the capacity of aid to compensate for price shocks and show that changes in aid interacted with negative price shocks has a significant and positive impact on growth. Thus, the studies of Guillaumont and Chauvet (1999, 2001) and Collier and Dehn (2001) lead to the following hypothesis :

Hypothesis 3 : aid is more effective in countries which are vulnerable to external shocks.

$$g_{yt} = \beta_0 + 2\left(\frac{\alpha_1\gamma_1}{\bar{\tau}}\right)s_t + 2\left(\frac{\alpha_1\gamma_2}{\bar{\tau}}\right)a_t - \frac{1}{2}\left(\frac{\alpha_1\gamma_1^2}{\bar{\tau}}\right)s_t^2 - \frac{1}{2}\left(\frac{\alpha_1\gamma_2^2}{\bar{\tau}}\right)a_t^2 - \left(\frac{\alpha_1\gamma_1\gamma_2}{\bar{\tau}}\right)s_t a_t - \rho\log(y_0)\text{, with } \bar{\tau} = \gamma_1\bar{s} + \gamma_2\bar{a}\,.$$

Hansen and Tarp (2000) underline that savings, s_t, can be captured through institutional and economic policy variables. In this case, aid squared and policy squared, and aid interacted with policy appear in the equation.

Aid effectiveness depends on internal socio-political instability

There is a relatively large consensus about the fact that socio-political instability has a negative impact on economic growth. Different kinds of socio-political instability have been considered in the literature. Some authors examined very specific kinds of political instability, mainly elite instability (Fosu 1992, de Haan and Siermann 1996, Alesina *et al*. 1996) which has a negative impact on growth. Some others have considered an extended notion of socio-political instability. Vieneris and Gupta (1986) as well as Alesina and Perotti (1996) used factor analysis to construct composite indicators capturing different forms of social and political violence. They show that their socio-political indicators have a negative impact respectively on savings and investment. Similarly, Guillaumont, Guillaumont Jeanneney and Brun (1999) measure socio-political instability as the sum of coups d'*état*, civil wars and other violent political events. This variable has a significantly negative impact on growth. Finally, Azam, Berthélemy and Calipel (1996) examine the notion of political risk. They estimate the probability of socio-political troubles (strikes, riots, demonstrations, coups d'*état*) as a function of health and military expenditures, schooling rates, and regional variables. Then, this estimated probability has a negative impact when it is introduced in a growth regression.

If the impact of socio-political instability on growth seems well established, little is said about its influence on aid effectiveness. Recently, Collier and Hoeffler (2002) studied the impact of aid on growth in post-war periods and concluded that aid is more effective in post-conflict situations, especially after a few years of peace. Let aside post-conflict periods, Chauvet and Guillaumont (2004) explore the impact of socio-political instability in a broader meaning (coups d'*état*, demonstrations and civil wars) and show a negative influence of this kind of instability on aid effectiveness.

Hypothesis 4 : aid effectiveness depends negatively on socio-political instability.

Can foreign aid dampen regional political shocks ?

A "good neighbourhood" is essential to the process of development (Easterly and Levine 1998). These authors have shown the contagion effects of economic performance between neighbouring countries. Imitation of policy choices, trade exchanges, foreign investments contribute to the contagion of performance. Ades and Chua (1997) have explored the consequences of regional political instability for growth. They show that regional political instability has strong negative externalities for developing countries – of a similar extent to that of internal political instability. They define regional political instability as the average of revolutions and coups d'*état* in the neighbourhood. They also study the transmission mechanisms. Ades and Chua (1997) show that regional political instability has a significantly negative impact on trade between neighbouring countries and that it increases government military expenditures and decreases education expenditures.

In the framework of an arm race model, Collier and Hoeffler (2001) confirm this result. They study the respective impact on military expenditures of internal and external threats of conflict. Their estimations suggest that the influence of external threat predominates. They also examine the negative externalities of civil wars for neighbouring countries and identify two transmission mechanisms : the increase in military expenditures and the contagion of rebel movements.

More recently, Murdoch and Sandler (2002), as well as Collier *et al.* (2003), study both national and cross-border consequences of civil wars. Murdoch and Sandler (2002) estimate

the impact of civil wars on the growth of developing countries, taking into account the negative externalities of conflicts for neighbouring countries. These countries can suffer from collateral damages, infrastructures and physical capital destructions, as well as refugees' flows – sources of instability and poverty. Moreover, the closeness of a conflict and the risk of contagion create a feeling of uncertainty, disastrous for investment, especially foreign investment. They can also induce breaks in trade exchanges, and shortages in inputs. Murdoch and Sandler (2002) introduce different variables to capture civil war (number of months of war, number of deaths) and show that civil war and its externalities for neighbours have a significantly negative impact on growth of developing countries.

However, the influence of regional political instability on aid effectiveness has never been studied. External political shocks are likely to induce two opposite effects on aid effectiveness : (i) if foreign aid dampens the negative impact political instability on the growth of neighbouring countries, then aid should be more effective in countries undergoing such external political shocks ; (ii) on the contrary, if aid is more effective in a stable political environment – whether national or regional – then external political shocks should have a negative impact on aid effectiveness.

Thus, the way regional political instability influences aid effectiveness is not *a priori* determined. However, this question is crucial, and has never been addressed before. Indeed, if foreign aid can dampen external political shocks, its contribution to the provision of regional public goods like peace and regional political stability (Cook and Sachs 1999, Mendez 1999, Hamburg and Holl 1999, Kanbur 2001, Ferroni 2001, Arce and Sandler 2002) will be reinforced.

Hypothesis 5 : aid effectiveness depends on the political instability of neighbouring countries i.e. external political shocks. The sign is a priori unknown.

Hypotheses 1-5 suggest that the impact of aid on growth is likely to depend :

1. positively on the quality of economic policies – Burnside-Dollar effect,
2. negatively on the amount of aid – marginal decreasing returns to aid,
3. positively on structural economic vulnerability – dampening effect of aid,
4. negatively on national socio-political instability
5. on external political shocks

Equation (1) summarizes the different factors influencing the impact of foreign aid on growth:

(1) $$\frac{\partial g}{\partial A} = f\left(\underset{+}{EP_{i,t}}, \ \underset{-}{A_{i,t}}, \ \underset{+}{EV_{i,t}}, \ \underset{-}{SPI_{i,t}}, \ \underset{?}{CW_{j,t}} \right),$$

where g denotes income *per capita* growth, $A_{i,t}$ aid as a percentage of national income, $EP_{i,t}$ economic policy, $EV_{i,t}$ vulnerability to trade shocks, $SPI_{i,t}$ socio-political instability in country i, $CW_{j,t}$ civil war in country j – neighbour of country i.

2. Variables, data and econometric methodology

The econometric analysis of aid effectiveness proposed in this paper is based on growth estimations, in the tradition of conditional convergence growth regressions, which generally take the form :

(2) $$\ln Y_{i,t} - \ln Y_{i,t-1} = \alpha \ln Y_{i,t-1} + X_{i,t}\delta + \eta_i + \varepsilon_{i,t},$$

where $Y_{i,t}$ denotes income *per capita* of country i (i = 1…N) in period t (t = 1…T), η_i country specific effects, and $\varepsilon_{i,t}$ the error term.[3] $X_{i,t}$ is a set of economic growth determinants, which in this study is constituted of economic policy, economic vulnerability, internal and external socio-political instability, foreign aid, and a set of variables interacted with aid.

Data and variables

The source of the data and definition of variables are presented in detail in appendix (table A). Economic growth is measured as the log-difference of income *per capita* ($\ln Y_t - \ln Y_{t-5}$), which is measured in purchasing power parity (Summers and Heston 1991). For the nineties, it has been updated by the Global Development Network (GDN 1999). Foreign aid is measured by the net disbursements of official development assistance as percentage of gross national income (OECD-DAC).

Following Burnside and Dollar (2000), the policy indicator is constructed as the sum of inflation and openness policy, both being weighted by their respective impact on growth. The policy indicator slightly differs from that of Burnside and Dollar, for two reasons : (i) they take into account budget surplus, which is not the case in the present analysis due to measurement issues (a budget surplus *excluding* grants artificially increases the deficit in countries receiving large amounts of grants, and a budget surplus *including* grants means that grants are being introduced twice in the regressions with aid) ; (ii) Burnside and Dollar use the Sachs and Warner (1995) openness dummy variable which has largely been discussed, notably by Rodriguez and Rodrik (1999) ; in the present study, openness *policy* is measured as the part of *observed* openness that is not explained by *structural factors* (see Combes *et al.* 2000), namely the size of the population, the extent of mining and oil resources, the level of development, terms of trade improvements and transportation costs.[4]

Following Guillaumont (2001), as well as Guillaumont and Chauvet (1999, 2001), economic vulnerability has two dimensions : (i) short term trade shocks, captured by export instability[5,6] ; (ii) long term trade shocks, measured by the trend of terms of trade. The economic vulnerability indicator is constructed as the sum of these two variables, weighted by their respective impact on growth.[7]

Following Taylor and Hudson (1972) and Gupta (1991) two categories of socio-political instability are distinguished : (i) elite instability, and (ii) mass instability. Elite instability is measured by the number of successful coups d'*état* (Banks 1996). Data on coups d'*état* is only available up to 1988, so it is updated for 1988-1999 with the database of CERDI. Mass instability can further be subdivided into two different categories. The first is social conflicts,

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[3] The introduction of specific time effects does not change the discussion of this section.

[4] Openness *policy* is the residual of the regression of *observed* openness on the structural factors, estimated with GLS, with random effects and time dummies.

[5] Exports (constant dollars) instability is measured as :

$$\text{Exports instability} = 100\sqrt{\frac{1}{n}\left(\frac{e-\hat{e}}{\hat{e}}\right)^2},$$

where $\hat{e}$ is the predicted value from the following regression : $exports_t = \beta_1\, time + \varepsilon_t$. It is estimated for each country on sub-periods of 10 years (*i.e.* on two sub-periods, present and past).

[6] Export instability is weighted by the natural export rate (the export rate purged from openness policy). The natural export rate is measured as the predicted value of the regression from which the openness policy variable has been constructed.

[7] Guillaumont and Chauvet (2001) consider a broader notion of vulnerability and introduce two other variables in their indicator : climatic shocks and population. Because they were no longer significant in the growth estimations presented in the next section, both variables were dropped from the analysis.

which is captured by the number of demonstrations (Banks 1996).[8] The second is internal violent wars, which is captured by the number of months of civil war. Months of war are measured on the basis of a civil war database constructed by Chauvet (2001).

Regional political instability is introduced to capture the negative externalities of political troubles for neighbouring countries. It has already been shown that civil wars have strong negative externalities – economic, social and political damages – for neighbouring countries (Collier and Hoeffler 2001, Murdoch and Sandler 2002, Collier *et al.* 2003). Thus, external political shocks are captured by the number of months of civil war in neighbouring countries.

Each indicator – economic policy, economic vulnerability and socio-political instability – is constructed as a weighted sum of the different variables composing them. The variables are weighted by their impact on growth. In order to be able to compare the coefficients of these variables, they are all transformed to fit on a scale from 0 to 100 :

$$\tilde{X} = 100\left(\frac{X - X_{\min}}{X_{\max} - X_{\min}}\right),$$

where $\tilde{X}$ is the transformed value of X, $X_{\min}$ and $X_{\max}$ being respectively the minimum and maximum values of X. Interpretation of the results will be easier if each transformed variable has an impact on growth going in the same way as the other variables introduced in the same composite indicator. Thus, for some variables (inflation and terms of trade), the scale has been reversed.[9]

Econometric methodology

Whenever country specific effects are correlated with the other variables of the model – which is always the case when $\ln Y_{it-1}$ is on the right-hand side of the equation – OLS estimation of equation (2) is biased. Moreover, when the time dimension, T, is small the *within* estimator is also asymptotically biased (Nickell 1981, Sevestre and Trognon 1985).[10] An alternative way to cope with the correlation of country specific effects with the lagged dependent variable is to get rid of the specific effects by first-differencing the model. Equation (2) can then be re-written :

$$(3) \qquad y_{i,t} - y_{i,t-1} = \beta\left(y_{i,t-1} - y_{i,t-2}\right) + \left(X_{i,t} - X_{i,t-1}\right)\delta + \left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right),$$

where $\beta = \alpha + 1$ and $y_{i,t} = \ln Y_{i,t}$. However, OLS and *within* estimators remain biased, since the endogenous lagged dependent variable is correlated with the error term. Anderson and Hsiao (1981, 1982) proposed to instrument the first-differenced variable, $\Delta y_{i,t-1}$, by its lag in level, y_{it-2}, or in difference, Δy_{it-2}. These two instruments are highly correlated with $y_{i,t-1} - y_{it-2}$, but are not correlated with $\varepsilon_{i,t} - \varepsilon_{i,t-1}$, if the residuals are not auto-correlated (Sevestre and Trognon 1996).

Holtz-Eakin, Newey and Rosen (1988) and Arellano and Bond (1991) generalized the Anderson-Hsiao approach. They proposed an application of the generalized method of moments (GMM) exploiting all the orthogonality conditions existing between the lagged

[8] Data on demonstrations are only available up to 1995, so 1995 data is considered as a proxy for the last sub-period of our analysis (1995-1999).

[9] The transformed inflation variable will thus have the same (positive) sign as the openness policy variable, and the transformed terms of trade variable will have the same (negative) sign as exports instability.

[10] For a bias-corrected within estimator, see Kiviet (1995). However, this estimator is very difficult to compute in the case of unbalanced panel (Judson and Owen 1999).

endogenous variable and the error term. Besides $y_{i,t-2}$, all the endogenous lagged variables of order greater than two are valid instruments for the equation in first-difference.

Equation (3) can be re-written, for each country i : $\Delta y_i = \Delta W_i \theta + \Delta \varepsilon_i$, where W_i includes the lagged dependent variable and the set of X variables, and $\theta = (\beta, \delta)$. The GMM estimator of θ takes the general form :

$$(4) \qquad \hat{\theta} = \left[\left(\sum_i \Delta X_i' Z_i \right) A_N \left(\sum_i Z_i' \Delta X_i \right) \right]^{-1} \left(\sum_i \Delta X_i' Z_i \right) A_N \left(\sum_i Z_i' \Delta y_i \right),$$

where Z_i denotes the matrix of instruments and $A_N = \left(\frac{1}{N} \sum_i Z_i' H_i Z_i \right)^{-1}$.

Arellano and Bond (1991) propose a two-step approach. In a first step, they assume homoscedasticity of the residuals, and use the following H_i matrix :

$$(5) \qquad H_{1i} = \begin{pmatrix} 2 & -1 & \dots & 0 & 0 \\ -1 & 2 & \dots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & -1 \\ 0 & 0 & \dots & -1 & 2 \end{pmatrix}.$$

If the homoscedasticity hypothesis is correct, the first-step estimator is consistent. In a second step, Arellano and Bond (1991) suppose that the $\varepsilon_{i,t}$ are heteroscedastic. In this case, H_i takes the form $H_{2i} = \Delta\hat{\varepsilon}_i \Delta\hat{\varepsilon}_i'$ where $\Delta\hat{\varepsilon}_i$ are the residuals from the first-step estimation.

While the coefficients from first and second-step estimations are very close, Arellano and Bond (1991 : 289-290) show that the standard errors are likely to be smaller in the second-step estimation, because of a small-sample bias. Thus, when the sample is small, first-step standard errors must be used rather than that second-step standard errors.[11]

This methodology allows both a correct treatment of correlated specific effects and the possibility to take into account the potential endogeneity of explanatory variables $X_{i,t}$. Suppose that $X_{i,t}$ is endogenous in the sense that :

$$(6) \qquad E\left[X_{i,t} \varepsilon_{i,s} \right] \neq 0 \text{ for all } i = 1, ..., N \text{ and } s \leq t.$$

This expression suggests that there is both a contemporaneous correlation between $\varepsilon_{i,t}$ and $X_{i,t}$, and the repercussion of past shocks, $\varepsilon_{i,t-s}$, on the present value of $X_{i,t}$. Then, the first-difference transformation allows adding the following set of orthogonality conditions :

$$(7) \qquad E\left[X_{i,t-s} \Delta\varepsilon_{i,t} \right] = 0 \text{ for } t = 3, ..., T \text{ and } s > 2.$$

Equation (7) implies that lagged values (from $t-2$) of the endogenous explanatory variables $X_{i,t}$ are valid instruments for the first-differenced equation. A drawback of this

[11] Standard errors from first step estimation can be *corrected for heteroscedasticity* :

$$\hat{V}_{1R} = \left[\left(\sum_i \Delta X_i' Z_i \right) A_{1N} \left(\sum_i Z_i' \Delta X_i \right) \right]^{-1} \left(\sum_i \Delta X_i' Z_i \right) A_{1N} A_{2N}^{-1} A_{1N} \left(\sum_i Z_i' \Delta X_i \right) \left[\left(\sum_i \Delta X_i' Z_i \right) A_{1N} \left(\sum_i Z_i' \Delta X_i \right) \right]^{-1},$$

where A_{1N} and A_{2N} correspond to A_N calculated respectively for H_{1i} and H_{2i}.

methodology is that the number of instruments increases rapidly with the number of periods and instrumented explanatory variables.

The assumption of no residual autocorrelation is essential to use the lagged variables as instruments for the endogenous variables. If the error term of the equation in level, $\varepsilon_{i,t}$, are not auto-correlated, the first-order autocorrelation of first-differenced residuals, $\Delta\varepsilon_{i,t}$, should be significant, whereas their second-order autocorrelation should not be significant (Arellano and Bond 1991 : 281-282). The validity of instruments is also tested with a Sargan test of over-identification (Sargan 1958, 1988, Hansen 1982).[12]

However, when the first-differenced variables are weakly correlated with their lagged values in level, the available instruments for equations in first-difference are weak (Alonso-Borrego and Arellano 1996, Blundell and Bond 1998, Bond, Hoeffler and Temple 2001).[13] Blundell and Bond (1998) find evidence that if the variables are highly persistent, then the first-difference GMM estimator suffers from a large bias – an under-estimation – on small-samples (notably when T is small). Following Arellano and Bover (1995), Blundell and Bond (1998) propose a GMM estimator instrumenting level equations with the lagged value of variables in difference. Using these additional orthogonality conditions suppose however that the mean of $y_{i,t}$, although different across countries, is constant for each country across time (Bond, Hoeffler and Temple 2001 : 8). Then, Blundell and Bond (1998) propose to estimate a system of level and first-difference equations, where first-difference equations are instrumented with lagged variables in level and level equations are instrumented with lagged variables in difference.

The choice of the best estimator for equation (2) depends on the trade-off between the three following points :

- Sample size : when T is greater than 30 periods, the *within* estimator is not biased, and is the best alternative (Judson and Owen 1999). In our case, $N = 58$ and $T = 7$ suggesting that the *within* estimator is biased.[14]

- Endogeneity : in presence of endogenous explanatory variables instrumental variable methodology, such as the first-difference GMM estimator (GMM1 and GMM2, Arellano and Bond 1991) or the system-GMM estimator (Blundell and Bond 1998) must be used.

- Variability of data : if the variables are not persistent (their variability is not reduced too much by the transformation in first-difference), the first-step difference estimator (GMM1) can be used when T is finite.[15] On the contrary, if the variables are highly persistent, the system-GMM estimator proposed by Blundell and Bond (1998) must be used. The standard errors of the variables of the model, both in level and in first-difference, are presented in table 1. Correspondingly to the results of Bond *et al.* (2001), the variability of income *per capita* is highly reduced by the transformation in first-difference. However, the variability of economic policy, socio-political instability, structural economic vulnerability, and aid, is merely affected by the transformation in first-difference, suggesting that the GMM1 estimator of Arellano and Bond (1991) can be used.

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[12] Based on first-step estimations, this test is not robust to heteroscedasticity. The Sargan statistic is thus calculated from the second-step estimation. It follows a χ^2 with degrees of freedom corresponding to the number of identification restrictions, under the null hypothesis that instruments are valid.

[13] On the bias due to weak instruments, see also Nelson and Startz (1990a, b) and Staiger and Stock (1997). Their results are discussed by Blundell and Bond (1998) in the case of panel data.

[14] The best estimator is the corrected within estimator computed by Kiviet (1995), but which cannot be used on unbalanced sample.

[15] When T is small, standard errors of the second-step estimator (GMM2) are biased (Arellano and Bond 1991).

Table 1– *Variability of data, 278 observations.*

Variables of the model	Standard errors	
	level	First-difference
Ln income *per capita*	17.430	3.961
Aid / GNP	5.517	4.776
Openness policy	16.900	18.444
Inflation	11.460	10.455
Number of months of civil war	32.384	24.146
Coups d'état	13.724	17.835
Demonstrations	8.832	12.905
Export instability	2.298	4.936
Trend of terms of trade	8.416	11.978

All variables are transformed on a scale from 0 to 100. Note that in econometric estimations, income *per capita* is not transformed. When it is not transformed, its standard error in level is equal to 0.697 while in difference it is equal to 0.159, confirming the results of Bond, Hoeffler and Temple (2001). The standard error of aid is 0.054 in level and 0.047 in difference, correspondingly to Hansen and Tarp (2001).

Thus, the GMM methodology is used on variables transformed in first-difference and instrumented by their lagged values (from $t-2$) in level. All the explanatory variables of the model are instrumented, except the trend of terms of trade, which by definition is assumed to be exogenous. Because the standard errors of the second-step estimation suffer from an under-estimation bias on small sample, inference is based on first-step estimations.[16] Second-step estimations (GMM2) have also been estimated to ensure that the coefficients are stable (results are available from the authors on request). The Sargan test and the test for first and second-order autocorrelation of the residuals are presented for the validity of instruments.[17] Finally, the number of instruments is reported in the tables, to make sure that it remains reasonable compared to the sample size. Estimations are on five-year sub-periods going from 1965-1969 to 1995-1999. The sample includes 58 countries, which are presented in table B in appendix. Finally, note that time dummies are included in all regressions.

3. Estimation of the standard model

This section presents the estimations of the standard model. First composite indicators of economic policy, economic vulnerability and internal socio-political instability are constructed. Then, they are introduced in growth estimations along with aid and a set of interaction terms with aid. Here, I remain in the framework of the Burnisde-Dollar analysis, extended to take into account alternative factors of aid effectiveness highlighted in the literature. So along aid interacted with economic policy (*hypothesis 1*), I also introduce aid squared (*hypothesis 2*), aid interacted with economic vulnerability (*hypothesis 3*) and aid interacted with socio-political instability (*hypothesis 4*). The fifth hypothesis – as to whether or not aid can dampen external political shocks – will only be tested in the next section.

Construction of composite indicators

The first step of our econometric analysis is to construct the composite indicators of economic policy, economic vulnerability and socio-political instability. Each variable introduced in these indicators is weighted by its impact on growth. The variables of the three

[16] Standard errors are corrected for heteroscedasticity and the Sargan test is computed from the second-step estimations.

[17] However, these tests do not tell whether instruments are weak.

indicators are introduced simultaneously in the same growth regression. This procedure minimizes the multi-colinearity of the various indicators, since the impact on growth of each variable is purged from the impact of all other variables of the model. It also avoids omitted variables bias, all the variable included in the growth regression being significant.

Table 2 – *Construction of indicators, 1965-1999.*

Ln Income *p.c.* $_t$ (GMM1)	(1)	(2)
Ln Income *p.c.* $_{t-1}$	0.623***	0.480***
	(0.000)	(0.007)
Economic policy		1.987***
		(0.001)
Openness policy	0.0011*	
	(0.087)	
Inflation [(1)]	0.0015*	
	(0.075)	
Socio-political instability		-0.573*
		(0.052)
Months of civil war	-0.0009*	
	(0.075)	
Coups d'*état*	-0.0018*	
	(0.085)	
Demonstrations	-0.0018*	
	(0.098)	
Economic vulnerability		-0.664***
		(0.003)
Export instability	-0.0031***	
	(0.000)	
Trend of TOT [(1)]	-0.0016**	
	(0.027)	
Constant	0.025*	0.040***
	(0.063)	(0.005)
Observations (countries)	278 (58)	278 (58)
Wald test [(2)]	497 (14)	104 (10)
Test aid / PNB [(3)]	0.216	0.749
Test human capital [(3)]	0.392	0.569
Test financial depth [(3)]	0.538	0.293
AR(1) [(3)]	0.006	0.062
AR(2) [(3)]	0.994	0.714
Sargan test [(2)]	47.98 (93)	43.01 (51)
Instruments	108	62

Time dummies are introduced in all regressions. First-step estimations are corrected for heteroscedasticity. *p-values* in parentheses. Economic policy, socio-political instability and vulnerability variables are transformed on a scale from 0 to 100. (1) the scale has been inverted so that all variables of the same indicator have the same sign. (2) : χ^2, degrees of freedom in parentheses. (3) : *p-values*.

Regression (1) of table 2 suggests that all the variables have a significant impact on growth, with the expected sign.[18] However, economic policy and socio-political instability variables are only significant at 10%. Nested tests are also presented in table 2 for aid (*p-value* = 0.216), as well as for human capital[19] (*p-value* = 0.392), and financial depth[20] (*p-value* = 0.538). The absolute value of the coefficients from the first-step regression is used to weight the variables included in each composite indicator.[21] These indicators are presented in table 3.

Table 3 – *Composite indicators, 1960-1999*.

EP = 0.00114 . openness policy + 0.00155 . inflation rate

SPI = 0.00085 . months of civil war + 0.00181 . coup d'état + 0.00182 . demonstration

EV = 0.00309 . instability of exports + 0.00157 . trend of terms of trade

Coefficients from first-step GMM estimation – table 2, regression (1).

Regression (2) of table 2 presents the results when the different variables are replaced by the three composite indicators. The indicators are significant with the expected sign : while socio-political instability and economic vulnerability have a negative impact on growth, the quality of economic policy has a positive impact on growth.

Aid effectiveness depending on policies, vulnerability and political instability

The three indicators can now be introduced in growth regressions including foreign aid and a set of quadratic (AID^2, *hypothesis 2*) and interaction terms with aid : *AID* x *EP* (*hypothesis 1*), *AID* x *EV* (*hypothesis 3*) and *AID* x *SPI* (*hypothesis 4*). Table 4 presents the results.

Hansen and Tarp (2000, 2001) suggest that aid squared and the different interaction terms with aid are likely to be proxies for each others. Thus, it could be possible that aid squared captures in fact the impact of aid interacted with, for example, economic policy, and inversely. Thus, I proceed in three steps: (i) introduction of aid and aid squared ; (ii) introduction of the different interaction terms ; and (iii) introduction simultaneously of all the quadratic and interaction terms.

Regression (1) suggests that foreign aid is not significant. In regression (2), the aid variable has a positive sign, but is not significant (*p-value* = 0.161), while aid squared is significantly negative, correspondingly to the assumption of diminishing returns to aid (Lensink and White 1999, Hansen and Tarp 2000, 2001, Collier and Dollar 2001, 2002).[22]

[18] The signs of inflation and terms of trade trend are respectively positive and negative because their scale has been inverted.

[19] This variable is not introduced by Burnside and Dollar (2000) and Hansen and Tarp (2001), but it is traditionally introduced in growth regressions (Barro 1991, Mankiw *et al.* 1992, Benhabib and Spiegel 1994, Islam 1995, Caselli *et al.* 1996, Bond *et al.* 2001).

[20] Financial depth is measured by *M2* as a share of GDP (GDN 1999). This variable is introduced by Burnside and Dollar (2000) and Hansen and Tarp (2001), to capture the development of the financial system (King and Levine 1993). It is not significant in our framework.

[21] I use the absolute value of the coefficients in order to avoid reversing the impact of the composite indicators on growth. Indeed, if the coefficients (weights) are negative, then the composite indicators would be pre-multiplied by –1, since all variables lay between 0 and 100.

[22] The turning point calculated from regression (2) is equal to 49.6% of GNP (close to that of Lensink and White 1999). No country of our sample is in the decreasing part of the curve.

Table 4 – *Estimations of the standard model, 1965-1999.*

Ln Income *p.c.* $_t$	(1)	(2)	(3)	(4)
Ln Income *p.c.* $_{t-1}$	0.491***	0.515***	0.637***	0.566***
	(0.000)	(0.000)	(0.000)	(0.000)
Economic policy (EP)	1.729***	1.735***	1.243***	1.949***
	(0.005)	(0.000)	(0.008)	(0.000)
Socio-political instability (SPI)	-0.526**	-0.466**	-0.510**	-0.142
	(0.019)	(0.037)	(0.037)	(0.627)
Economic vulnerability (EV)	-0.561**	-0.676**	-1.893***	-1.552**
	(0.038)	(0.013)	(0.000)	(0.011)
Aid / GNI	-0.097	0.979	-1.866**	-1.246
	(0.749)	(0.161)	(0.031)	(0.325)
Aid / GNI, squared		-0.987**		0.761
		(0.048)		(0.191)
EP x (Aid / GNI)			3.939	-2.719
			(0.203)	(0.611)
SPI x (Aid / GNI)			-4.812*	-11.174***
			(0.082)	(0.006)
EV x (Aid / GNI)			15.426	19.364*
			(0.110)	(0.054)
Constant	0.039***	0.035***	0.025**	0.036***
	(0.000)	(0.000)	(0.032)	(0.000)
Observations (countries)	278 (58)	278 (58)	278 (58)	278 (58)
Wald test (1)	160 (11)	315 (12)	364 (14)	490 (15)
Test human capital (2)	0.564	0.859	0.189	0.222
Test financial depth (2)	0.267	0.162	0.748	0.294
AR(1) (2)	0.019	0.006	0.001	0.001
AR(2) (2)	0.653	0.998	0.801	0.938
Sargan test (1)	43.31 (73)	41.93 (97)	45.21 (122)	40.84 (106)
Instruments	85	110	137	122

Times dummies included in all regressions. First-step GMM estimations corrected for heteroscedasticity. *p-values* in parentheses. (1) : χ^2, degrees of freedom in parentheses. (2) : *p-values*.

In regression (3), the three interaction terms are introduced, but aid squared is omitted. Only the interaction of aid and socio-political instability has a significant impact on growth. It is negative, suggesting that aid is less effective in a politically unstable environment. The interaction term between aid and economic vulnerability is not really significant (*p-value* = 0.110), but still has the positive sign shown by Guillaumont and Chauvet (2001). Contrary to Burnside and Dollar, aid interacted with policy is not significant (*p-value* = 0.203). Finally, foreign aid has a significantly negative impact on growth.

In regression (4), all the quadratic and interaction terms are simultaneously introduced. While aid squared looses its significance, aid interacted with economic vulnerability becomes significant at 10% (*p-value* = 0.054). Aid interacted with socio-political instability remains highly significant.[23] These results question those of Hansen and Tarp (2000, 2001) who

[23] However, the socio-political instability indicator loses its significance in regression (4).

suggested that the interaction of aid and policy introduced by Burnside and Dollar (2000) was in fact capturing the decreasing marginal returns to aid. Here, it seems that a finer specification than that of Hansen and Tarp (also taking into account interaction terms of aid with vulnerability and political instability) does not confirm the decreasing returns hypothesis.

Thus, socio-political instability and economic vulnerability have an opposite influence on aid effectiveness, while both having a negative impact on growth. Aid seems to cushion the negative impact of economic vulnerability on growth, while its effectiveness is reduced in a politically unstable environment. This latter result can be explained by the fact that, contrary to external economic shocks, internal political events are in a way endogenous and depend on the political choices made by governments.

4. Can foreign aid dampen external political shocks ?

Aid effectiveness depending on external political shocks

If aid effectiveness negatively depends on internal socio-political instability of receiving countries (like suggested by the first set of results), can we deduce that an *unstable regional political environment* will be harmful for aid effectiveness (*hypothesis 5*) ? Aid might be less effective in an unstable political environment, the source of the instability being either national or regional. But aid could also play a cushioning role regarding external political shocks, as it does for trade shocks. For example, aid could protect growth from a civil war in a neighbouring country, by helping to cope with refugees, hence avoiding the potential contagion of conflicts. Similarly, aid could help countries to face the financial costs linked to neighbouring countries' wars (stocks of goods blocked at borders, shortages of inputs) or the financial losses that they trigger. If aid dampens the negative impact on growth of external political shocks, then aid effectiveness should be greater in countries facing such shocks.

Hypothesis 5 is tested by the introduction of the number of months of civil wars in neighbouring countries, as well as this variable interacted with aid. Results are presented in table 5. In regressions (1) and (2) I estimate growth regressions with all the interaction terms with aid, respectively *with* and *without* aid squared.

Confirming previous results, aid effectiveness positively depends on economic vulnerability and negatively depends on socio-political instability.[24] The number of months of civil wars in neighbouring countries has a negative and significant effect on growth, confirming the results of Murdoch and Sandler (2002). Hence, violent political instability in a country has negative externalities for the growth of its neighbours. Moreover, this variable interacted with aid has a significantly positive impact on growth. Thus, aid seems to be more effective in countries with politically unstable neighbours, suggesting that aid can dampen external political shocks.

Note that in this analysis the measure of regional political shocks is limited to civil wars in neighbouring countries. In future research, this concept should be deepened and extended to other types of political instability – as for example elite instability (Ades and Chua 1997). Still, the econometric results regarding external political instability are of particular interest regarding the prospect of the provision of *regional public goods*, like peace and political stability (Mendez 1999, Hamburg and Holl 1999, Kanbur 2001, Arce and Sandler 2002). Indeed, if aid can dampen the impact on growth of external political shocks, it contributes to

[24] However, *AID* x EV_t is not significant in the first regression (*p-value* = 0.115). The socio-political instability variable looses its significance in regression (2).

protect some countries from breaks in the growth process, potentially avoiding the spreading of conflicts and instability. This indirect effect of aid – *via* growth – on regional stability suggests that aid might protect countries that are vulnerable to economic and political shocks.

Table 5 – *Aid effectiveness depending on external political shocks, 1965-1999.*

Ln Income *p.c.* $_t$	(1)	(2)
Ln Income *p.c.* $_{t-1}$	0.703***	0.686***
	(0.000)	(0.000)
Economic Policy (EP)	1.499***	1.424***
	(0.001)	(0.002)
Socio-political instability (SPI)	-0.387*	-0.293
	(0.091)	(0.250)
Economic vulnerability (EV)	-1.992***	-1.857***
	(0.000)	(0.000)
Months of civil war in neighbouring countries	-0.0016*	-0.0017*
	(0.097)	(0.090)
Aid / GNI	-0.974	-0.848
	(0.310)	(0.390)
Aid / GNI, squared		0.516
		(0.159)
EP x (Aid / GNI)	-2.604	-6.184
	(0.415)	(0.110)
SPI x (Aid / GNI)	-4.658*	-6.694*
	(0.065)	(0.061)
EV x (Aid / GNI)	15.438	18.176**
	(0.115)	(0.049)
Months of war in neighbouring countries x (Aid / GNI)	0.022**	0.023***
	(0.015)	(0.009)
Constant	0.065**	0.076**
	(0.024)	(0.012)
Observations (countries)	278 (58)	278 (58)
Wald test (1)	544.23 (16)	1336 (17)
AR(1) (2)	0.000	0.0001
AR(2) (2)	0.969	0.948
Sargan test (1)	42.29 (174)	39.11 (179)
Instruments	191	197

Times dummies included in all regressions. First-step GMM estimations corrected for heteroscedasticity. *p-values* in parentheses. The variable of regional political instability is transformed on a scale from 0 to 100. (1) : χ^2, degrees of freedom in parentheses. (2) : *p-values*

Towards an extended concept of vulnerability ?

Economic vulnerability, socio-political instability and external political shocks have all a negative impact on economic growth of developing countries. However, aid effectiveness depends differently on these three factors : negatively on internal political instability, but positively on economic vulnerability and regional political instability. Thus aid effectiveness

is affected in the same way by economic and political external shocks. From this, a *sixth hypothesis* arises, regarding an extended notion of vulnerability of developing countries, which would take into account both exogenous trade shocks and regional political shocks.

In order to aggregate external trade and political shocks in a composite indicator of extended vulnerability, I re-estimate the first growth equation to identify the weights of each variable. These weights correspond to their respective impact on growth.

Table 6 – *An extended concept of vulnerability, 1965-1999.*

Ln Income *p.c.* $_t$	(1) Indicator 1	(2) Indicator 2
Constant	0.022	0.023**
	(0.136)	(0.032)
Ln Income *p.c.* $_{t-1}$	0.662***	0.660***
	(0.000)	(0.000)
Economic policy		1.359***
		(0.008)
Openness policy	0.0013*	
	(0.064)	
Inflation [(1)]	0.0016*	
	(0.083)	
Socio-political instability		-0.626***
		(0.000)
Months of civil war	-0.0008*	
	(0.054)	
Coups d'*état*	-0.0017*	
	(0.097)	
Demonstrations	-0.0023*	
	(0.084)	
Economic vulnerability		-0.943***
		(0.001)
Export instability	-0.0026**	
	(0.029)	
Trend of TOT [(1)]	-0.0021***	
	(0.006)	
Months of civil war in neighbouring countries	-0.0009	-0.0008
	(0.218)	(0.151)
Observations (countries)	278 (58)	278 (58)
Wald test [(2)]	498.33(15)	190.21(11)
AR(1) [(3)]	0.005	0.001
AR(2) [(3)]	0.959	0.873
Sargan test [(2)]	39.72 (94)	43.16(100)
Instruments	110	112

All regressions contain time dummies. First-step estimations are corrected for heteroscedasticity. *p-values* in parentheses. Economic policy, national and regional socio-political instability and vulnerability variables are transformed on a scale from 0 to 100. (1) the scale has been inverted so that all variables of the same indicator have the same sign. (2) : χ^2, degrees of freedom in parentheses. (3) : *p-values*.

Table 7 – *Construction of composite indicators.*

From regression (1) :

EP = 0.0012686 . openness policy + 0.001642 . inflation
SPI = 0.000822 . civil war months + 0.001652 . coups d'état + 0.002315 . demonstrations
EV = 0.002593 . export instability + 0.0020822 . trend of terms of trade

From regression (2) :

Extended vulnerability = EV + 0.0007822 . months of civil war in neighbouring countries

Coefficients are from table 6, regressions (1) and (2).

Table 8 – *Aid effectiveness and extended vulnerability, 1965-1999*

Ln Income *p.c.* $_t$		(1)	(2)
Ln Income *p.c.* $_{t-1}$		0.726***	0.624***
		(0.000)	(0.000)
Economic policy	(EP)	1.452***	1.522***
		(0.000)	(0.000)
Socio-political instability	(SPI)	-0.404*	-0.421
		(0.095)	(0.141)
Extended vulnerability	(ExtV)	-2.017***	-1.571***
		(0.001)	(0.009)
Aid / GNI		-1.275	-2.269
		(0.169)	(0.102)
Aid / GNI, squared			0.498
			(0.291)
EP x (Aid / GNI)		-1.546	1.508
		(0.515)	(0.693)
SPI x (Aid / GNI)		-4.986*	-7.481**
		(0.093)	(0.020)
ExtV x (Aid / GNI)		14.449*	16.135*
		(0.099)	(0.094)
Constant		0.019**	0.030***
		(0.027)	(0.007)
Observations (countries)		278 (58)	278 (58)
Wald test (1)		327(14)	398(15)
AR(1) (2)		0.000	0.001
AR(2) (2)		0.973	0.725
Sargan test (1)		53.19 (138)	43.58 (119)
Instruments		153	135

Times dummies included in all regressions. First-step GMM estimations corrected for heteroscedasticity. *p-values* in parentheses. (1) : χ^2, degrees of freedom in parentheses. (2) : *p-values*

The results are presented in table 6, and are very close to that of table 2. The regional political variable is negative, but is not significant (*p-value* = 0.218). This result is surprising since this variable was strongly significant in the growth regressions of table 5.[25] In column (2) I re-estimate the same regression but replace the different variables by the composite indicators.[26] If the number of months of civil war in the neighbourhood remains not significant, its *p-value* decreases sensibly (*p-value* = 0.151).

On the basis of these regressions, a composite indicator of *extended vulnerability* is constructed.[27] Results are in table 7.

The last step of our analysis is to introduce these indicators in the growth regressions. The results are presented in table 8. It leads to similar conclusions than table 5. Foreign aid seems to be more effective in politically stable countries. The extended vulnerability indicator is negatively significant, suggesting that external trade and political shocks faced by developing countries are disastrous for growth. This indicator interacted with aid is significantly positive, confirming the conclusions from table 5 : by dampening economic and political shocks, foreign aid is more effective when allocated to countries facing such shocks.

The econometric results regarding the five hypotheses proposed in section 1 and the sixth hypothesis added in section 4 can be summarized in table 9.

Conclusion – Aid effectiveness and global public goods

This paper suggests that aid effectiveness depends on its ability to dampen the negative impact of external shocks – both *economic* and *political* – on economic growth. It also seems that aid effectiveness depends differently on political instability, whether it is internal or external to developing economies : foreign aid is likely to protect economic growth from political instability in neighbouring countries, but aid is less effective in countries facing internal destabilising political events.

Most civil conflicts have regional stakes because of the risk of contagion and destabilisation of whole regions. Thus, political stability and peace may be regional (or even global) public goods (Mendez 1999, Hamburg and Holl 1999, Arce and Sandler 2002). Aid, by dampening the negative externalities of civil wars for the neighbours, might thus contribute to the provision of regional public goods such as political stability.

Finally, note that the econometric analysis proposed in this paper is subject to weak points which imply that the conclusions should be regarded with caution. First, estimations may be subject to the issue of weak instruments, which is likely to weaken the results. Also, a highly restricted notion of external political shocks is considered, and it would be interesting to extend it to other violent, or less violent, political events. Moreover, the definition of neighbouring countries (common borders) is very simple, and economic closeness, trade exchanges, might be considered as alternative definitions to test the impact of external political shocks. Finally, even if the results suggest a dampening effect of aid regarding external economic and political shocks, this analysis has still to explore the means by which aid might cushion these shocks. Further research is needed on this point to clearly identify the mechanisms at work.

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[25] Moreover, this variable is hardly correlated with the other variables of the model (never higher than 0.10).

[26] *EP*, *EV*, *SPI* are constructed from regression (1) of table 6 (see table 7). The correlations of the number of months of civil wars with the three composite indicators remain weak (inferior to 0.10).

[27] A second indicator has also been constructed using only the first regression : regional political instability (weighted by 0.0009) is added to the indicator of economic vulnerability. All the regressions have also been performed with this indicator and give really similar results (available from the author on request).

Tableau 9 – *Conclusions of econometric tests*.

Hypotheses	Econometric results
Hypothesis 1 Effect of aid on growth depends on economic policies	Contrary to Burnside and Dollar, *AID* x *EP* is never significant in our estimations
Hypothesis 2 Marginal decreasing returns to aid	AID^2 is only significant in estimations omitting the interaction terms with aid, suggesting that when the quadratic relationship, is significant, it captures in fact the non-linearities in the aid-growth relationship (and function of *EV*, *SPI*…).
Hypothesis 3 Effect of aid on growth depends on economic vulnerability	*AID* x *EV* has a significantly positive impact on growth, suggesting that aid is more effective when allocated to countries facing external economic shocks : *dampening effect of aid*.
Hypothesis 4 Effect of aid on growth depends on internal socio-political instability	*AID* x *SPI* is significantly negative in all regressions, suggesting that aid is less effective in politically unstable countries.
Hypothesis 5 Effect of aid on growth depends on external political shocks	Aid interacted with external socio-political instability, *AID* x CW_j, is significantly positive : aid can dampen the negative externalities of regional civil wars for the growth of developing countries.
Hypothesis 6 An extended concept of vulnerability ?	An *extended vulnerability* indicator, aggregating economic and political shocks, positively influences aid effectiveness. Thus it seems that, because aid can dampen both economic and political shocks, it is more effective in countries facing such shocks.

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Appendix

Table A – Definitions and sources of variables.

Variables	Sources	Definitions and remarks
Ln Income *per capita*	Summers and Heston (1991), and GDN (1999)	Calculated in purchasing power parity.
Aid	OECD-DAC. www.oecd.org.	Net disbursements of official development assistance, in percentage of GNI.
Inflation	Global Development Network (GDN 1999)	Average annual growth rate of consumer price index.
Openness policy	WDI (2000) for exports of good and services, population and natural resources. GDN (1999) for income *per capita*. UNCTAD for terms of trade.	Residual of the regression of observed openness on different structural factors.
Export instability, weighted by natural export rate	World Development Indicators (WDI 2000)	Mean quadratic deviation (with respect to a deterministic trend). The natural export rate is the predicted value obtained from the regression of observed openness on structural factors.
Trend of terms of trade	UNCTAD (various years)	Computed on sub-sample of 8, 9 or 10 years.
Successful coups d'état	Banks (1996) and CERDI	
Demonstrations	Banks (1996)	
Number of months of civil war and number of months of civil wars in neighbouring countries	Chauvet (2001)	When many neighbouring countries face a civil war, the number of months is cumulated.
Human capital	Barro and Lee (2000)	Percentage of population (aged 15 years and more) with secondary schooling.
Financial depth	GDN (1999)	M2 / GDP.

Table B –*58 countries of the sample*.

Algeria	Madagascar
Argentina	Malaysia
Bangladesh	Malawi
Bolivia	Mali
Brazil	Morocco
Burundi	Mexico
Cameroon	Mozambique
Chile	Nicaragua
China	Niger
Colombia	Nigeria
Congo	Pakistan
Congo (ex-Zaire)	Panama
South Korea	Papua New Guinea
Costa Rica	Paraguay
Ivory Cost	Peru
Egypt	Philippines
El Salvador	Dominican Rep.
Ecuador	Rwanda
Gabon	Senegal
Gambia	Sierra Leone
Ghana	Sri Lanka
Guatemala	Syria
Honduras	Thailand
Mauritius	Togo
India	Trinidad and Tobago
Indonesia	Tunisia
Jamaica	Uruguay
Jordania	Venezuela
Kenya	Zimbabwe