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Aid and Dutch Disease in Sub-Saharan Africa

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Abstract

International aid has an ambiguous effect on the macro-economy of the recipient country. To the extent that aid raises consumer expenditure, there will be some real exchange rate appreciation and a shift of resources away from traded goods production and into non-traded goods production. However, aid for investment in the traded goods sector can mitigate this effect. Also, a relatively high level of productivity in the non-traded goods sector combined with a high level of investment will tend to depreciate the real exchange rate. We examine aid inflows in 26 Sub-Saharan African countries, and find a variety of macro-economic responses. Some of the variation in the responses can be explained by variation in observable country characteristics; this has implications for donor policy.

JEL classification: F41, O56

Key words: aid, Dutch Disease, Africa

1. Introduction

The effect of aid inflows on the recipient economy depends partly on the response of relative prices and the corresponding adjustment in the sectoral composition of output. Any increase in foreign exchange income is likely to affect relative prices. The theoretical analysis of these effects is simplest in a small open economy with a fixed nominal exchange rate. Higher domestic expenditure will raise only non-traded goods prices, because the price of internationally traded goods is exogenous. To the extent that the price change induces a reallocation of resources between production sectors, output of traded goods will fall and output of non-traded goods will rise. This does not necessarily entail lower social welfare. However, income distribution could worsen, if the poor own resources used exclusively in traded goods production. Moreover, the existence of positive externalities in traded goods production could mean that the resource reallocation reduces aggregate productivity. In this case, the traditional name for the relative price effect – 'Dutch Disease' – is appropriate.[1]

In a simple macroeconomic model, these effects are invariant to the exchange rate regime. This is easiest to see in a model with a single input (labour) and two goods, only one of which is internationally traded. There are two market clearing conditions (one for the labour market and one for the nontraded goods market), and a Balance of Payments equilibrium condition. However, there are only two endogenous relative prices: the ratios of the wage and of the nontraded goods price to the traded goods price. The three equilibrium conditions can be satisfied simultaneously only with an adjustment of real money balances. This can occur either

[1] See Corden (1984), van Wijnbergen (1984), Salehi-Esfahani (1988), Sachs and Warner (1995), Gylafson et al. (1997), Elbadawi (1999) and Adam and O'Connell (2004) for further elaboration of these ideas.

through a change in the nominal exchange rate or, under a fixed exchange rate regime, through a change in foreign exchange reserves.

The effects of a resource inflow are less straightforward when some of the increased expenditure is in the form of capital investment (Adam and Bevan, 2006). This can raise labour productivity in the nontraded goods sector, and the corresponding increase in supply can offset the usual relative price effect, at least in the steady state. Moreover, any contraction of traded goods production due to a relative price change can be mitigated by higher investment in this sector. The overall effect of the resource inflow on welfare will depend on the speed of transition to the steady state, the magnitude of the real exchange rate appreciation during the transition, and magnitude of the productivity loss during transition. If there is some domestic price stickiness, then the exchange rate regime can affect this transition process. Exchange rate flexibility (in the form of a float or an adjustable peg) will allow quicker relative price adjustment and a shorter transition period. If productivity is lower during the transition, then a fixed exchange rate is likely to be associated with larger welfare losses.

In this paper, we quantify the macroeconomic responses to aid inflows in 26 Sub-Saharan African countries. There is a great deal of variation in these responses, and a large part of this variation turns out to be correlated with observable country characteristics associated with capital productivity. These correlations have implications for aid effectiveness. The next section reviews the existing empirical literature on Dutch Disease effects in order to provide a context for our own econometric model.

2. The Evidence on Aid and Dutch Disease

Most existing econometric studies point to a significant correlation between the real exchange rate and aid inflows. However, there is substantial variation in the estimated elasticity of the real exchange rate with respect to aid. Using data from francophone West Africa, Adenauer and Vagassky (1998) find that an increase aid inflows leads to a large real exchange rate appreciation, as predicted by the standard Dutch Disease model. This is also the conclusion of White and Wignaraja (1992), using Sri Lankan data, and of Prati and Tressel (2006), using a cross-country panel dataset. These studies suggest that the elasticity of the real exchange rate with respect to aid inflows can be as high as 30%. Bourdet and Falck (2006), using data from the Cape Verde Islands, also report a positive elasticity, but the magnitude of the effect is much smaller. Moreover, Nyomi (1998) and Sackey (2001), using data from Tanzania and Ghana, find a *negative* elasticity, even within the first year following an increase in aid. This implies either that the offsetting productivity effects come into play almost immediately, or that the standard Dutch Disease model is not applicable.

CGE models of the macroeconomic impact of aid inflows also produce a wide variety of results. Papers by Bandara (1995), Jemio and Jansen (1993), Jemio and Vos (1993) and Vos (1998) indicate that in countries such as Mexico, Sri Lanka and Thailand, traded goods sector investment is likely to be high enough to guarantee an expansion of this sector following an increase in aid inflows. By contrast, in countries such as Pakistan and the Philippines, there is a standard Dutch Disease effect: an increase in aid inflows leads to a real exchange rate appreciation and a fall in traded goods production. Such heterogeneity is consistent with Adam and Bevan's (2004) model, calibrated to Ugandan data, in which the composition of aid expenditure makes a large difference to the response of sectoral output and relative prices. This dynamic CGE model also suggests that there will often be some real exchange rate overshooting, with a larger appreciation in the short run than in the steady state. Overshooting is a feature of other dynamic CGE models, for example that of Laplange (2001).

Taken together, the existing evidence suggests that there is substantial heterogeneity in the macroeconomic effects of aid inflows across developing countries. However, there is little econometric evidence concerning the factors underlying this heterogeneity. In the next section, we present a time-series econometric model designed to quantify the effect of variations in aid inflows in an individual country. Applying this model to a range of Sub-Saharan African countries allows us to characterize the cross-country variation in aid effects. Section 4 then presents evidence on the factors that explain this variation.

3. The Time-Series Model

3.1 Model structure

Many Sub-Saharan African countries are lacking in detailed macroeconomic data. For this reason, we will fit a simple time-series model in which the effect of aid on relative prices and output is estimated in reduced form. Interpretation of these effects is left to the next section.

There are two versions of the time-series model, depending on the nature of the country's exchange rate regime. Some Sub-Saharan African countries have a long history of a hard exchange rate peg that is not subject to discretionary adjustment. This group of countries includes the CFA Franc Zone, with a peg against the Euro (and formerly the French Franc) that has been adjusted only once since the Second World War, and some of South Africa's smaller neighbours, with a peg against the Rand. For each of these countries, the model is as follows.

$$B(L)\begin{bmatrix} y_t \\ r_t \end{bmatrix} = \delta + \gamma_t + c(L)a_t + \begin{bmatrix} u_t^1 \\ u_t^2 \end{bmatrix} \qquad (1)$$

Here, a_t is the ratio of the value of foreign aid in year t to GDP in year t-1, y_t is the logarithm of real GDP in year t, r_t is the logarithm of the real exchange rate in year t, and γ_t is a dummy variable for the devaluation year (1994) in the CFA Franc Zone countries. u_t^i is a reduced form regression residual for the i^{th} dependent variable. $B(L)$ is a 2×2 matrix of lag polynominals quantifying the interaction between the two dependent variables (GDP and the real exchange rate), and $c(L)$ is a 1×2 vector of lag polynomials quantifying the impact on the system of changes in our aid variable, a_t. The number of lags in the model is to be decided empirically. Equation (1) can be thought of as a reduced-form version of a structural model that contains contemporaneous interactions of y_t, and r_t. Aid itself may respond to past changes of y_t, and r_t, but we assume that it is weakly exogenous to (in other words, independent of the contemporaneous values of) these variables. For our purposes, it is not necessary to fit an aid equation. The assumption of weak exogeneity is based on the premise that international donors' foreign aid budgets are determined by a fiscal process that responds to changing conditions in the recipient countries only with a lag of at least one year.

Given the relatively small sample that we will be using (40 years of annual observations), a test for the presence of a unit root in the three time series will have very low power. Therefore, we will take a conservative approach and assume that there is a unit root in the process driving foreign aid. Standard errors on the model parameters will be computed using a bootstrap under the assumption that the evolution of aid can be approximated by the following unit root process.

$$\Delta a_t = \kappa + v_t, \qquad v_t \sim N(0,\sigma^2) \tag{2}$$

If aid to some countries is in fact stationary, then this will understate the precision of our estimates somewhat. In other words, our results will be presented with a lower-bound estimate of their precision.[2]

[2] Note that with the weak exogeneity of a_t, cointegration between the three series would not entail any restriction on the parameters in equation (1). Therefore, it is not necessary to test for cointegration.

The real exchange rate r_t is defined as the ratio of the domestic GDP deflator to the United States GDP deflator times the price of US Dollars in domestic currency.[3] Ideally, the model would incorporate a real exchange rate based on the relative prices of traded and nontraded goods. However, accurate and consistent time-series measures of such prices are not available for many African countries.[4]

Some of the countries in our sample have some type of flexible exchange rate system – usually an adjustable (sometimes undeclared) peg to a basket of foreign currencies, or else a dirty float. There is no commitment to a hard peg, and the nominal exchange rate can adjust in response to external shocks. For a given real exchange rate, some domestic inflation is possible, through proportional growth in both the domestic price index and the domestic currency price of the US Dollar. For these countries, we fit a three-variable model.

$$B(L)\begin{bmatrix} y_t \\ r_t \\ \pi_t \end{bmatrix} = \delta + c(L)a_t + \begin{bmatrix} u_t^1 \\ u_t^2 \\ u_t^3 \end{bmatrix} \tag{3}$$

Here, π_t is the rate of growth of the domestic GDP deflator; $B(L)$ is now a 3×3 matrix of lag polynominals and $c(L)$ a 1×3 vector of lag polynomials.

[3] The US Dollar exchange rate is not constant – it moves with the value of the Dollar against the Euro (for the CFA Franc Zone countries) or against the Rand (for the satellites of South Africa) – but it is strictly exogenous to events in the domestic economy.

[4] One caveat to our results is that the use of a Purchasing Power Parity proxy for the real exchange rate does introduce some measurement error in one of our dependent variables, with a corresponding efficiency loss in our estimator. If traded and nontraded goods price data were available, then our estimates of the macroeconomic responses to aid inflows could be more precise.

3.2 The fitted model

The time-series model is fitted to data for 26 Sub-Saharan African countries listed in Table 1. These are all the countries with available data that did not experience a large civil war between 1970 and 2009.[5] The variables are constructed using real and nominal GDP and nominal exchange rate data taken from the United Nations Statistical Yearbook for 1970-2009, and using data on total overseas development assistance from the OECD Development Assistance Committee database. Asterisks indicate the countries with a hard exchange rate peg. The table also reports descriptive statistics for the four key time-series variables. These statistics reveal substantial heterogeneity among the countries. The most marked differences include higher inflation rates in most of the flexible exchange rate countries, higher real growth in the Indian Ocean countries (Mauritius, Seychelles) and in Southern Africa (Botswana, Lesotho, Swaziland), and higher real exchange rate growth in mineral exporters with a hard peg (Congo Republic, Gabon, Niger). Given this heterogeneity, it is not surprising to find that the parameters of the fitted model will vary substantially from one country to another.

[Table 1 about here]

The estimated parameters for each country are reported in Tables A1-A2 of the Appendix. These estimates are produced by fitting equation (1) or equation (2) to the data using OLS, with the order of the lag polynomials determined using the Akaike Criterion. There is no significant autocorrelation in the residual series u_t^i. However, the null that u_t^i is normally distributed can be rejected in some cases; this is the result of a number of large outliers, listed in

[5] Classification is based on battle deaths reported in the Correlates of War Project Intra-State War Database 4.1.

Table 2. For this reason, we estimate a further set of parameters using regression equations that include dummy variables for the outlier years. In the next section, these estimates will be used to check the sensitivity of our results to the treatment of atypically large reduced-form shocks.[6]

Using the parameters of the fitted model, it is possible to plot the response of each dependent variable in the system (y_t, r_t and, with a flexible peg, π_t) to a percentage point increase in our aid variable, a_t. These 64 plots are not included in the paper, but are available on request. Instead, Table 3 summarizes our results by reporting the estimated response of y_t and r_t to a percentage point increase in a_t in the year of the increase (the immediate impact) and sixteen years after the increase (the long-run impact). The hypothetical increase in a_t is temporary, lasting for a single year. The estimated responses are based on the original model without outlier adjustments. The responses are measured as percentage changes; those significantly different from zero at the 5% level (using the bootstrapped standard errors) appear in bold type.

[Tables 2-3 about here]

It can be seen that in most countries there is a significant immediate real exchange rate appreciation, but that this appreciation persists into the long run in relatively few countries. There is substantial variation in the magnitude of the appreciation; the largest immediate effects are in Mauritius and Swaziland, where the real exchange rate appreciates by about 5%. However, there are also three countries – Comoros, Gambia and Madagascar – in which there is a significant real exchange rate *depreciation*. Overall, the results are broadly consistent with a standard Dutch Disease model, but with some exceptions. There are fewer significant responses in real GDP, and the magnitude of the responses is smaller. Nevertheless, there is still some

[6] We have also addressed this issue by fitting the model using a LAD estimator; the results of this exercise, which do not change any of the conclusions discussed below, are available on request.

cross-country variation in the GDP responses, and this is negatively correlated with the real exchange rate responses in both the short run (ρ = –0.3) and the long run (ρ = –0.2). These results do suggest that a large real exchange rate appreciation following an increase in aid is associated with a Dutch Disease effect. However, there are not enough countries to establish the statistical significance of the correlations (p = 0.13 and p = 0.30 respectively). In the next section, we explore the country-specific characteristics that are associated with a large appreciation.

4. Modelling the Cross-Country Variation in Responses to Aid

In this section, we present the results from regression equations designed to explain the variation in the magnitude of the real exchange rate response to an increase in aid. The explanatory variables in these regressions are designed to capture some of the features of an aid recipient that might be associated with the magnitude of the real exchange rate appreciation. Variables (i-iii) are averages constructed from data in the United Nations Statistical Yearbook for the same sample period as that used in the time-series analysis. The values of all variables are listed in Table 4.

[Table 4 about here]

(i) *The average ratio of gross fixed capital formation to GDP*. As noted in the introduction, aid that raises capacity in the non-traded goods sector is likely to cause some real exchange rate depreciation. (Aid that raises capacity in the traded goods sector has no direct effect on relative prices.) The effect of aid on the real exchange rate will depend on the marginal propensity to invest in non-traded goods production. Disaggregated aid figures are not available for long enough to measure the average proportion of aid invested directly in the non-traded goods sector over our sample period; moreover, if some aid is fungible then direct investment figures will not necessarily represent the overall effect of aid on investment. Nevertheless, national accounts statistics do include data on the annual proportion of GDP invested in fixed capital in each country. If the average proportion invested is correlated with the marginal propensity to invest income in capital specific to non-traded goods production, then it should also be associated with a relatively small real exchange rate appreciation following an increase in aid.

(ii) *Average log real per capita GDP*. Any investment following an increase in aid will be less productive, and mitigate the real exchange rate appreciation to a lesser extent, the lower the marginal return to capital. Accurate capital stock figures are not available for very many African countries. However, real *per capita* GDP is likely to be positively correlated with the capital-labour ratio, and therefore negatively correlated with the marginal productivity of capital. For this reason, countries with a higher average level of real *per capita* GDP may experience a larger real exchange rate appreciation following an increase in aid.

(iii) *The average ratio of the value of trade to GDP*. Among African economies with a history of policies that restrict international trade, a high ratio of the value of international trade to GDP is likely to reflect less extensive restrictions, and a smaller gap between the marginal return to traded goods production and the marginal return to non-traded goods production. In such an economy, with a relatively high marginal product in non-traded goods production, investment is more likely to mitigate the real exchange rate appreciation that follows an increase in aid.

(iv) *Whether the country has a hard exchange rate peg*. As noted in the introduction, with some domestic price stickiness, a flexible nominal exchange rate peg may facilitate more rapid transition to the steady state following an increase in aid. If the real exchange rate appreciation is not a characteristic of the steady state, then countries with a hard peg may exhibit a larger and more persistent appreciation in the short run.

(v) *Political stability*. Economic productivity may depend on the quality of domestic political institutions. Countries with weak institutions may therefore exhibit more real exchange rate appreciation following an increase in aid. Kaufman *et al*. (2009) report a variety of indices of institutional quality, including political stability, control of corruption and rule of law. Average values of these measures are highly correlated across countries. The regressions below include one such measure – political stability – as an explanatory variable; including one of the other measures instead makes no substantial difference to the results. One caveat to the inclusion of such a measure is that the data on which the average values are constructed begin only in the mid-1990s, so the averages reflect institutional quality only in the second half of our time series.

(vi) *Whether the country is landlocked*. The range of goods in an economy that are internationally traded will depend on transport costs. In a country with higher transport costs this range will be more restricted; for example, it might exclude some staple foods. If trade is restricted to high-value items (such as cash crop exports or high-quality manufactured imports), then only the richest domestic households will be making decisions about substituting traded good consumption for non-traded good consumption at the margin. The aggregate elasticity of substitution between traded goods and non-traded goods will therefore be lower, and an increase in income will lead to more real exchange rate appreciation. Total transport costs are difficult to measure, but one of the main factors influencing costs is whether a country is landlocked. Countries with direct access to sea ports are likely to face lower transport costs, so an increase in aid should be followed by less real exchange rate appreciation.

Table 5 reports the results from cross-country regression equations for six alternative measure of the real exchange rate response to an increase in aid, each regression incorporating the six explanatory variables. The alternative measures are the percentage changes in r_t in the first, second and third years following a temporary percentage point rise in a_t, estimated either in the unadjusted model (with no outlier correction) or in the adjusted model (with outlier correction). These measures are shown in Figures 1-6 along with the corresponding two-standard-error bars; these bars are based on the bootstrap estimates of the standard errors (σ).[7] The coefficients reported in the table are estimated by OLS, with standard errors corrected for heteroscedasticity using the method of White (1980). Note that the Table 5 results give equal weight to the estimate of the r_t response in each country, regardless of the precision of this estimate. As can be seen in Figures 1-6, there is considerable variation in the level of precision. Table A3 of the Appendix reports results corresponding to those in Table 5, but using Weighted Least squares, the weights being inversely proportional to $\sqrt{\sigma}$. The coefficients produced using this alternative estimator are similar to those in Table 5, but are estimated slightly less precisely. Note also that Table 5 does not include any results from regressions using the estimates of the percentage change in r_t on impact from Table 3; these are available on request, but do not contain any individually significant coefficients.[8]

[Figures 1-6 and Table 5 about here]

[7] The figures use country acronyms that are listed in Table 3 and in Table 4.

[8] In the results for the response of r_t on impact, the parameter values in the cross-country regression equation are similar to those in the regression for the response of r_t after one year, but are estimated less precisely.

The dominant feature of the regressions for the r_t response at one year is the significant positive coefficient on average log real *per capita* GDP. The estimated value of the coefficient is just under two; in other words, raising real *per capita* GDP by 10% is estimated to increase the effect of the percentage increase in aid by nearly 0.2 percentage points. This is consistent with the conjecture that higher *per capita* GDP is associated with a lower marginal productivity of capital, on average. The estimated size of the effect is slightly larger using the r_t responses from the adjusted model, but otherwise the adjustment makes little difference to the results; this is also a feature of the estimated coefficients on the other explanatory variables discussed below. However, the size of the *per capita* GDP effect diminishes rapidly for r_t responses at longer horizons, and is statistically insignificant beyond the first year.

By contrast, the estimated coefficient on the investment-GDP ratio increases in absolute value as the horizon increases. All coefficient values are negative, and most are significant at the 5% level. This is consistent with the conjecture that the investment-GDP ratio is positively correlated with the marginal propensity to invest in non-traded goods production following an increase in aid. Raising the ratio by one percentage point is estimated to reduce the real exchange rate appreciation by 0.1-0.2 percentage points in the first year after the increase in aid. By the third year, this figure has risen to 0.3-0.4 percentage points.

Of the next three explanatory variables in the table, two – the exchange rate peg dummy and the measure of political instability – are statistically insignificant in all cases, and a third – trade openness – is of marginal statistical significance. (Moreover, the trade openness coefficients are positive, which does not support the conjecture that greater openness is associated with higher productivity.) Given the small sample size, it is not possible to conclude that these characteristics have no effect on the response of the real exchange rate to an increase in aid. However, there is little evidence in our data that these factors are of any importance, whatever other consequences they might have for aid effectiveness.

Finally, the estimated real exchange rate response is larger in landlocked countries than in those with a coastline, as anticipated above. The effect is more pronounced at longer horizons, and for the response three years after the aid increase it is significant at the 5% level. In this case, the estimated coefficient is close to three: in other words, the real exchange rate appreciation following a percentage point increase in aid is expected to be three percentage points higher in landlocked countries. Physical geography does have a significant impact on the Dutch Disease effect.

5. Summary and Conclusion

Time-series estimates of the impact of aid inflows on the real exchange rate and output reveal a considerable degree of heterogeneity across Sub-Saharan Africa. An aid inflow causes a real exchange rate appreciation in most countries, but the size of the effect varies substantially, and in some countries there is a real exchange rate depreciation. The responses of output are equally varied. This heterogeneity reflects the variation in previous single-country studies using both econometric and calibrated general equilibrium models. Analysis of the cross-country variation in the response to aid inflows indicates the importance of country characteristics associated with the propensity to invest in fixed capital and capital productivity. This result is also consistent with recent general equilibrium studies discussed in the literature review.

Conditional on these effects, we do not find that the variation is significantly correlated with standard measures of institutional quality or ‘good’ government policy, such as trade openness, or with the nature of the nominal exchange rate regime. Subject to caveats about sample size, our results indicate that policy choice modifies the macroeconomic response to aid inflows if it impacts on investment and capital productivity, but not otherwise. However, physical geography also matters: landlocked countries are more likely to experience a large real exchange rate appreciation as a result of increased aid.

In the light of this evidence, there is a case for including measures to mitigate real exchange rate appreciation as part of an aid package. Whatever the wider benefits of general reforms to improve institutional quality and macroeconomic policy, such reforms will not reduce the magnitude of the appreciation unless they have an effect on investment and capital productivity in the non-traded goods sector. Without this component of development assistance, aid inflows are likely to generate macroeconomic imbalances in the short run, except in the least developed countries where the marginal return to capital investment is very high.

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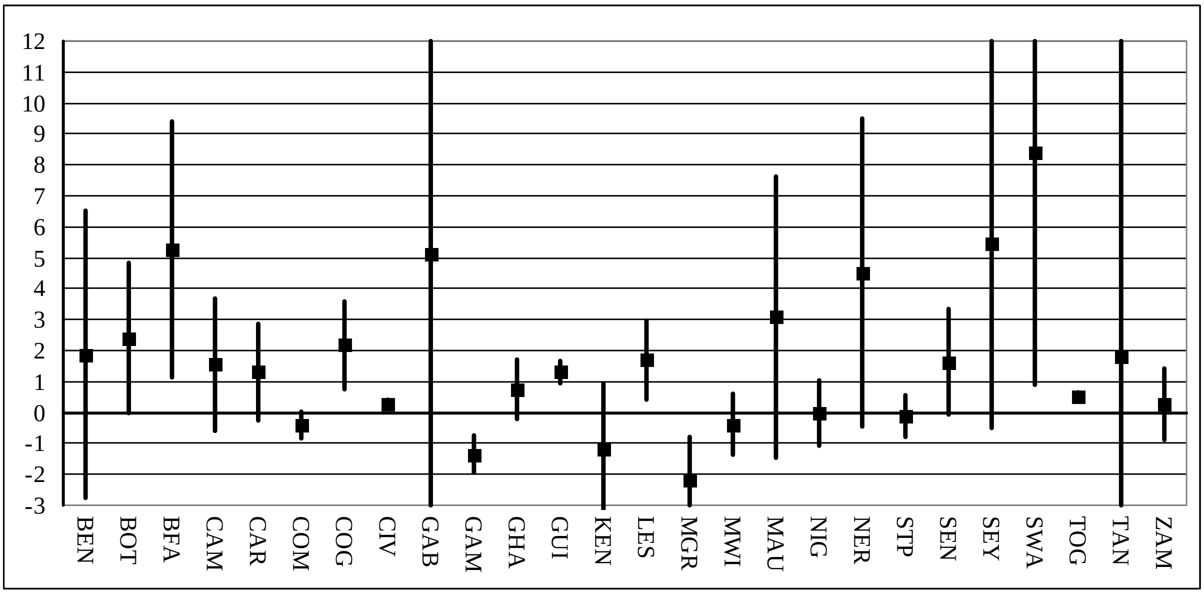

Figure 1: Percentage change in the real exchange rate (r_t) ± 2 standard errors

in the first year after a percentage point shock to aid (a_t), unadjusted model

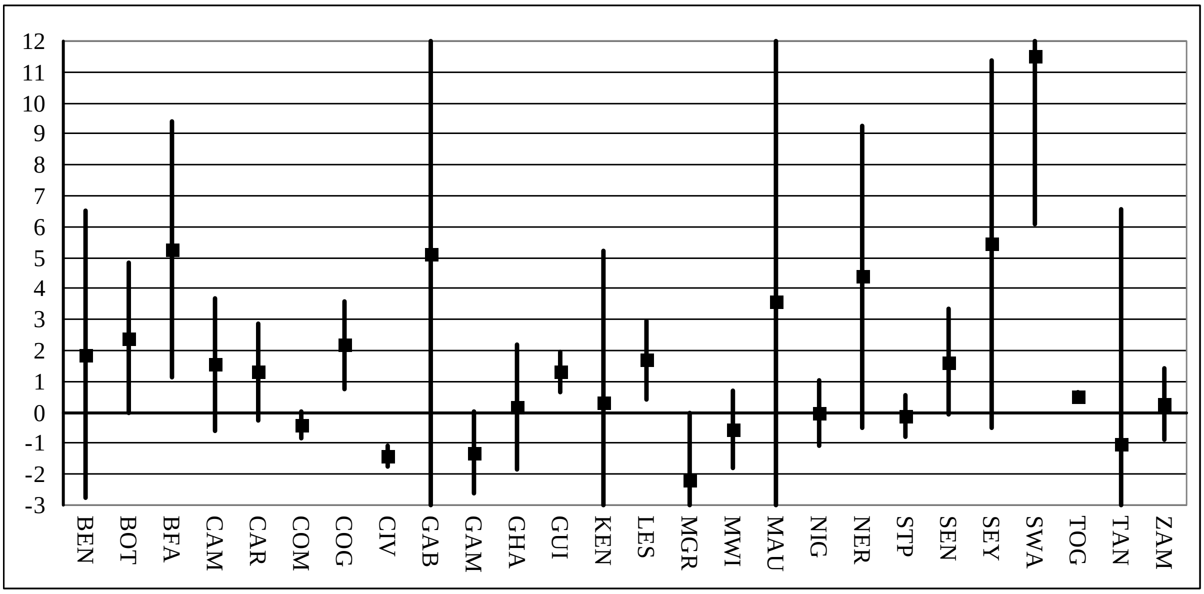

Figure 2: Percentage change in the real exchange rate (r_t) ± 2 standard errors

in the first year after a percentage point shock to aid (a_t), adjusted model

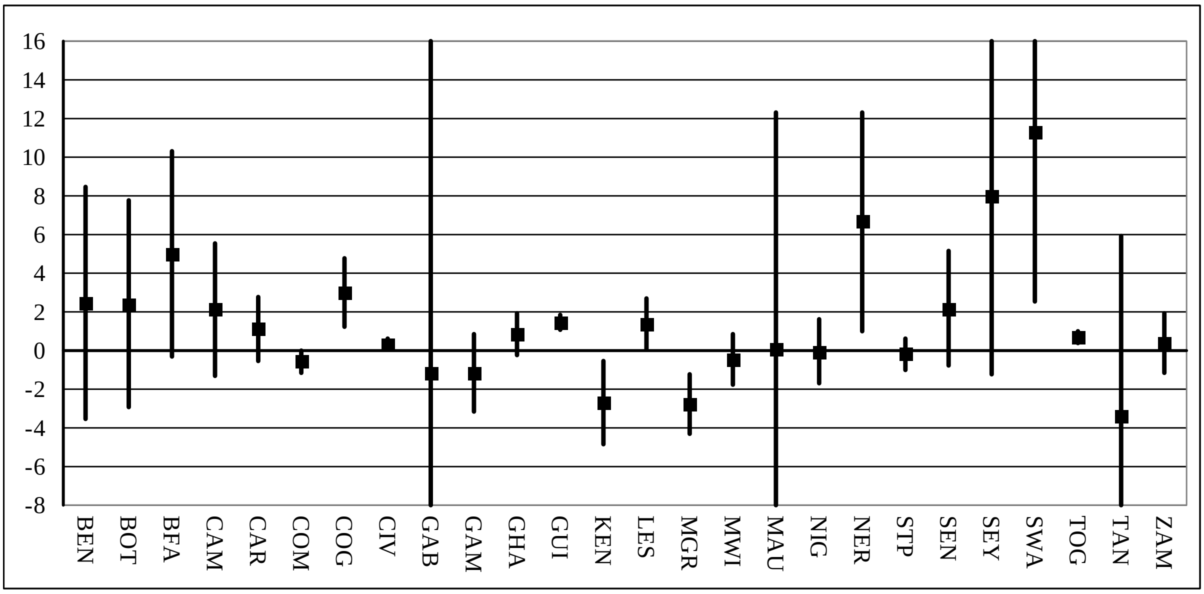

Figure 3: Percentage change in the real exchange rate (r_t) ± 2 standard errors

in the second year after a percentage point shock to aid (a_t), unadjusted model

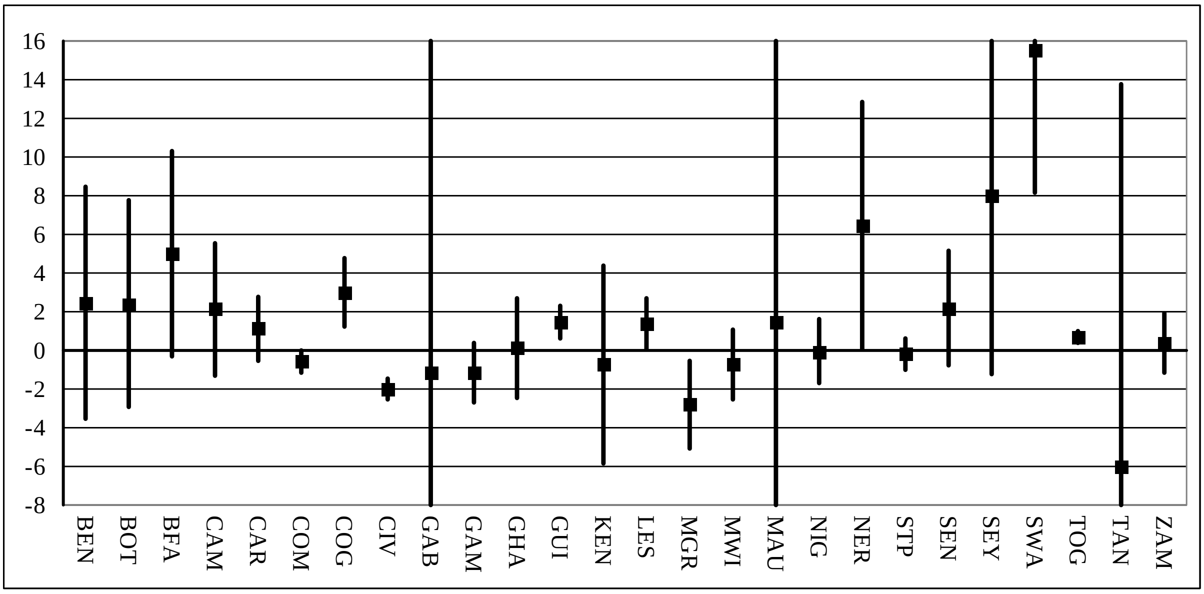

Figure 4: Percentage change in the real exchange rate (r_t) ± 2 standard errors

in the second year after a percentage point shock to aid (a_t), adjusted model

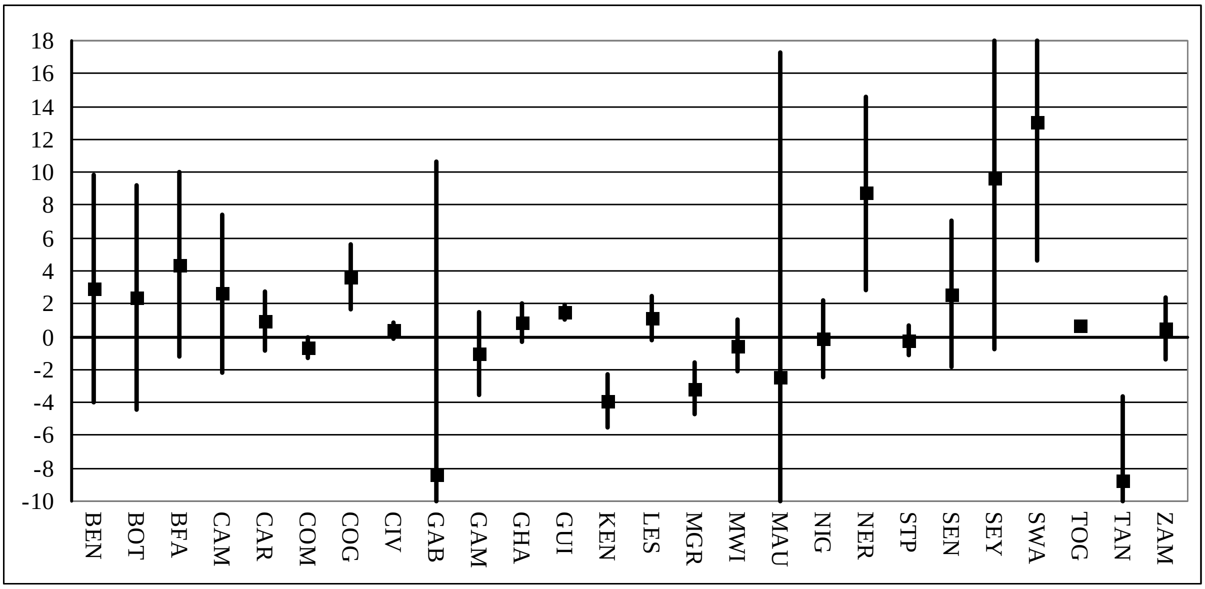

Figure 5: Percentage change in the real exchange rate (r_t) ± 2 standard errors

in the third year after a percentage point shock to aid (a_t), unadjusted model

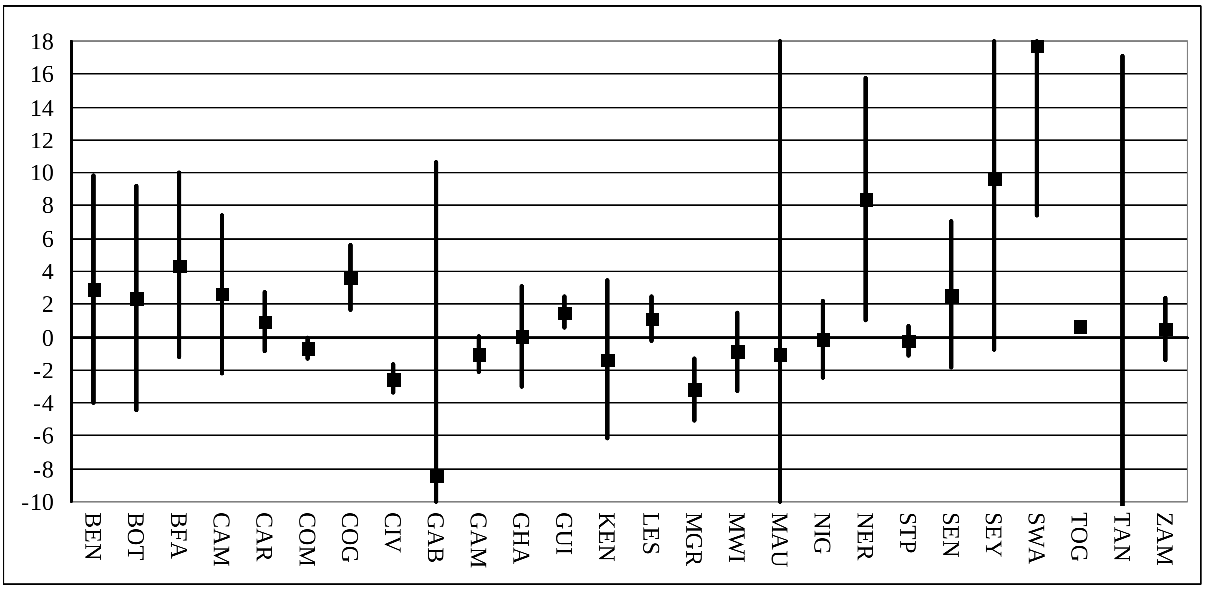

Figure 6: Percentage change in the real exchange rate (r_t) ± 2 standard errors

in the third year after a percentage point shock to aid (a_t), adjusted model

Table 1: Descriptive Statistics (1971-2009)

Figures are in percentage points.

	GDP growth (Δy_t)		inflation (π_t)		real exchange rate growth (Δr_t)		aid/GDP growth (Δa_t)	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Benin*	3.92	3.67	5.39	6.31	0.17	13.00	0.29	1.42
Botswana	8.69	5.47	9.71	6.34	-0.04	10.05	-0.06	1.37
Burkina Faso*	4.10	4.73	4.73	5.74	-0.50	14.03	0.40	2.11
Cameroon*	3.15	5.35	5.80	6.69	0.58	14.36	0.07	2.09
Cent. Afr. Rep.*	1.79	4.01	4.75	7.65	-0.47	13.13	0.32	3.14
Comoros*	2.66	2.63	6.43	5.34	1.95	13.04	0.17	3.50
Congo Rep.*	3.94	6.17	6.76	14.74	1.54	14.78	0.08	5.79
Côte d'Ivoire*	3.03	4.41	5.35	8.74	0.13	13.01	0.34	2.68
Gabon*	3.12	10.60	6.83	15.29	1.61	15.63	0.00	0.45
Gambia	3.52	3.69	8.79	8.20	-1.57	13.98	0.40	4.22
Ghana	2.95	4.43	26.39	14.76	-1.90	11.02	0.29	2.17
Guinea	3.28	2.14	12.05	11.22	-1.69	9.55	0.15	3.27
Kenya	3.76	2.37	8.99	4.53	-0.96	10.35	0.18	0.95
Lesotho*	4.27	7.43	9.96	4.85	-0.24	12.86	0.06	2.11
Madagascar	1.47	4.58	13.47	8.03	0.53	11.80	0.16	4.34
Malawi	3.05	5.59	7.68	6.92	-0.14	8.16	0.27	5.02
Mauritius	5.06	4.23	9.16	7.39	0.82	10.02	0.03	0.60
Nigeria	3.60	6.64	17.09	16.44	-0.42	16.12	0.02	1.80
Niger*	1.60	6.44	6.21	7.35	0.99	14.73	0.27	2.86
São Tomé*	2.86	5.50	17.79	17.72	-2.26	16.39	0.52	12.83
Senegal*	2.90	4.20	5.13	5.10	-0.10	13.34	0.23	2.60
Seychelles	4.32	5.75	7.08	7.51	0.93	9.05	-0.04	0.96
Swaziland*	5.35	7.99	9.17	9.21	-1.03	16.20	0.04	0.90
Togo*	1.69	5.49	6.05	7.90	0.83	12.89	3.24	12.43
Tanzania	4.15	2.26	15.55	9.88	-1.68	12.07	0.06	0.63
Zambia	1.93	3.93	25.83	24.62	-0.74	16.28	0.37	6.88

* Countries with a hard exchange rate peg.

Table 2: Years with Atypically Large Reduced-Form Shocks

Côte d’Ivoire	1980	Gambia	1979
Ghana	1975 1982 2000	Guinea	1986
Kenya	1993	Madagascar	1994
Malawi	1993	Mauritius	1974
Nigeria	2004	Swaziland	1973 1974
Tanzania	1983 1988		

Table 3: Immediate and Long-Run Changes in the Real Exchange Rate (r_t) and GDP (y_t)

with a Percentage Point Increase in Aid (a_t), Unadjusted Model

Changes are measured in percent; those significant at the 5% level are in bold type.

	real exchange rate (r_t)		GDP (y_t)	
	immediate (zero years)	long-run (16 years)	immediate (zero years)	long-run (16 years)
Benin (BEN)	1.0	0.0	0.1	0.0
Botswana (BOT)	**2.3**	0.0	0.6	0.0
Burkina Faso (BFA)	**3.0**	0.0	**0.7**	0.1
Cameroon (CAM)	**0.8**	0.0	0.0	0.0
Cent. Afr. Rep. (CAR)	**1.6**	0.0	0.0	0.0
Comoros (COM)	**-0.2**	0.0	0.0	0.0
Congo Republic (COG)	**1.2**	0.0	0.2	0.4
Côte d'Ivoire (CIV)	**0.2**	0.0	**0.3**	0.1
Gabon (GAB)	0.3	-0.8	0.2	1.0
Gambia (GAM)	**-1.4**	0.0	0.0	0.0
Ghana (GHA)	**0.5**	**-0.3**	**0.5**	**0.5**
Guinea (GUI)	**0.9**	**-0.1**	**0.1**	**0.1**
Kenya (KEN)	**0.8**	0.0	**1.0**	0.0
Lesotho (LES)	**2.2**	0.0	**-0.7**	-0.1
Madagascar (MGR)	**-1.3**	0.2	0.3	0.0
Malawi (MWI)	**-0.3**	0.0	-0.1	0.0
Mauritius (MAU)	**4.9**	0.0	0.7	0.0
Niger (NER)	0.0	-0.1	**0.4**	0.4
Nigeria (NIG)	**2.3**	**1.8**	0.0	-1.0
São Tomé (STP)	-0.1	0.0	0.0	0.0
Senegal (SEN)	**0.9**	0.0	**0.2**	0.0
Seychelles (SEY)	**2.4**	0.9	0.0	**1.4**
Swaziland (SWA)	**5.1**	0.0	**-1.6**	**-0.6**
Togo (TOG)	**0.2**	0.0	0.1	0.0
Tanzania (TAN)	**3.5**	**0.8**	**-0.6**	**0.9**
Zambia (ZAM)	0.1	0.1	0.0	0.0

Table 4: Cross-Section Data

country	fixed capital to GDP ratio	trade volume to GDP ratio	log average GDP *per capita*	hard exchange rate peg	landlocked
Benin (BEN)	0.20	0.51	5.79	yes	no
Botswana (BOT)	0.29	1.13	7.37	no	yes
Burkina Faso (BFA)	0.18	0.45	5.47	yes	yes
Cameroon (CAM)	0.18	0.33	6.51	yes	no
Cent. Afr. Rep. (CAR)	0.13	0.55	5.77	yes	yes
Comoros (COM)	0.21	0.55	5.88	yes	no
Congo Republic (COG)	0.28	1.31	6.74	yes	no
Côte d'Ivoire (CIV)	0.14	0.77	6.60	yes	no
Gabon (GAB)	0.25	0.83	8.44	yes	no
Gambia (GAM)	0.29	0.42	6.38	no	no
Ghana (GHA)	0.14	0.88	5.82	no	no
Guinea (GUI)	0.20	0.72	5.86	no	no
Kenya (KEN)	0.19	0.55	6.04	no	no
Lesotho (LES)	0.39	1.49	5.69	yes	yes
Madagascar (MGR)	0.17	0.75	5.59	no	no
Malawi (MWI)	0.26	1.03	6.15	no	no
Mauritius (MAU)	0.22	1.24	7.54	no	no
Niger (NER)	0.22	0.51	5.44	yes	yes
Nigeria (NIG)	0.07	0.61	6.25	no	no
São Tomé (STP)	0.31	0.94	6.65	yes	no
Senegal (SEN)	0.19	0.69	6.29	yes	no
Seychelles (SEY)	0.26	0.99	8.30	no	no
Swaziland (SWA)	0.19	1.40	6.99	yes	yes
Togo (TOG)	0.18	0.81	5.69	yes	no
Tanzania (TAN)	0.25	0.27	5.64	no	no
Zambia (ZAM)	0.14	0.24	6.16	no	yes

Table 5: Determinants of the Cross-Sectional Variation in the Response of the Real Exchange Rate to a Shock to Aid

	one year response			*two year response*			*three year response*		
unadjusted model	*coeff.*	*t ratio*	*p value*	*coeff.*	*t ratio*	*p value*	*coeff.*	*t ratio*	*p value*
log average GDP per capita	1.683	3.783	0.00	1.193	0.923	0.37	0.466	0.192	0.85
fixed capital to GDP ratio (%)	-0.132	-1.653	0.12	-0.241	-2.278	0.03	-0.342	-2.074	0.05
ratio of value of trade to GDP	1.654	1.089	0.29	4.013	1.870	0.08	6.426	1.794	0.09
hard exchange rate peg	0.865	1.092	0.29	1.017	0.890	0.39	0.962	0.515	0.61
political stability	0.146	0.231	0.82	0.274	0.271	0.79	0.375	0.259	0.80
landlocked	1.758	1.770	0.09	2.264	2.034	0.06	2.646	2.062	0.05
R^2		0.52			0.44			0.33	
joint significance (p value)		0.02			0.06			0.20	
adjusted model	*coeff.*	*t ratio*	*p value*	*coeff.*	*t ratio*	*p value*	*coeff.*	*t ratio*	*p value*
log average GDP per capita	1.806	3.710	0.00	1.333	0.989	0.34	0.615	0.248	0.81
fixed capital to GDP ratio (%)	-0.186	-2.132	0.05	-0.309	-2.215	0.04	-0.417	-2.032	0.06
ratio of value of trade to GDP	2.895	1.685	0.11	5.588	1.964	0.06	8.184	1.886	0.08
hard exchange rate peg	1.055	1.248	0.23	1.145	0.880	0.39	1.094	0.536	0.60
political stability	0.364	0.472	0.64	0.618	0.540	0.60	0.764	0.485	0.63
landlocked	2.295	1.947	0.07	2.926	2.018	0.06	3.393	2.069	0.05
R^2		0.59			0.50			0.39	
joint significance (p value)		0.01			0.03			0.11	

APPENDIX

Table A1: Time-Series Regression Coefficients (Flexible Exchange Rate Countries)

	MGR	MWI	TAN	GAM	GHA	GUI	KEN	MAU	NIG	ZAM	SEY	BOT
***y* equation**												
y_{t-1}	0.941	0.987	1.271	1.007	1.009	1.015	0.992	1.043	1.054	1.047	1.194	0.959
y_{t-2}			-0.255	-0.023				-0.057			-0.232	
π_{t-1}	0.013	0.110	-0.023	-0.064	0.024	-0.021	0.060	-0.187	0.067	-0.059	-0.219	-0.037
π_{t-2}			0.092	-0.069				0.422			-0.112	
r_{t-1}	-0.047	-0.082	-0.049	0.127	-0.014	0.014	0.004	-0.043	-0.020	-0.024	-0.112	-0.088
r_{t-2}			0.038	-0.142				-0.109			0.057	
a_t	0.322	-0.087	-0.622	-0.004	0.500	0.060	1.044	0.730	-0.044	-0.002	0.046	0.563
a_{t-1}			0.868	0.561			-1.155	-1.396				-0.503
a_{t-2}			-1.385	-0.529								
δ	0.928	-0.125	-0.407	0.331	-0.208	-0.182	0.245	-0.155	-1.418	-1.212	0.725	0.847
π equation												
y_{t-1}	-0.060	-0.062	0.066	-0.025	-0.298	-0.062	-0.063	0.014	-0.231	-0.082	0.500	-0.019
y_{t-2}			-0.144	-0.174				-0.113			-0.412	
π_{t-1}	0.426	0.006	0.658	0.811	0.063	0.541	0.406	-0.284	-0.004	0.781	0.432	0.126
π_{t-2}			-0.384	-0.278				0.000			0.349	
r_{t-1}	0.042	-0.045	-0.328	-0.243	-0.210	-0.063	-0.036	0.125	-0.111	-0.061	-0.238	-0.036
r_{t-2}			0.290	0.124				-0.105			0.069	
a_t	0.099	0.349	5.203	0.021	-0.413	0.108	-0.112	1.759	1.412	-0.168	0.021	1.741
a_{t-1}			-3.402	-0.398			0.891	-2.950				-1.822
a_{t-2}			1.755	0.439								
δ	1.704	1.070	1.578	3.663	7.066	0.880	1.342	2.353	5.386	1.416	-2.082	0.442
***r* equation**												
y_{t-1}	0.208	-0.088	-0.205	-1.313	-0.111	-0.467	-0.035	0.451	-0.057	0.124	0.164	-0.009
y_{t-2}			0.018	0.649				-0.508			-0.015	
π_{t-1}	0.059	0.231	-0.185	-0.618	0.147	0.027	0.250	-0.478	-0.023	-0.076	-0.779	0.053
π_{t-2}			-0.034	0.339				0.130			0.123	
r_{t-1}	0.763	0.852	1.151	0.857	0.779	0.470	0.866	1.080	0.965	0.887	1.241	0.717
r_{t-2}			-0.336	-0.329				-0.363			-0.665	
a_t	-1.271	-0.253	3.453	-1.464	0.486	0.907	0.766	4.859	2.316	0.131	2.440	2.278
a_{t-1}			-4.766	1.380			-2.555	-6.502				-1.596
a_{t-2}			-2.238	0.061								
δ	-6.224	1.073	3.096	11.978	2.491	5.833	0.313	0.339	1.236	-3.718	-3.851	-0.292

Table A2: Time-Series Regression Coefficients (Hard Exchange Rate Peg Countries)

	BEN	BFA	CAM	CAR	COG	CIV	GAB	NER	SEN	TOG	COM	LES	SWA	STP
***y* equation**														
y_{t-1}	0.997	0.743	0.944	0.989	0.965	0.921	1.078	0.975	0.981	1.281	0.960	0.921	0.813	0.944
y_{t-2}		0.197					-0.234			-0.504			0.080	
π_{t-1}	-0.005	-0.020	-0.025	-0.049	0.076	-0.022	0.233	-0.031	-0.052	-0.043	0.009	-0.072	0.131	-0.048
π_{t-2}		-0.099					-0.300			-0.042			-0.189	
a_t	0.060	0.747	0.033	-0.015	0.207	0.265	0.221	0.376	0.193	0.120	-0.016	-0.741	-1.550	-0.040
a_{t-1}		-0.147		0.013			6.424					0.513		
a_{t-2}		-0.077					-3.325							
δ	0.074	0.560	1.171	-0.050	1.290	1.721	3.113	0.324	0.109	4.148	0.861	1.543	2.242	0.638
γ	-0.060	-0.013	-0.031	0.062	-0.095	-0.028	0.036	-0.011	0.002	0.193	-0.077			
***r* equation**														
y_{t-1}	-0.111	0.765	-0.094	-0.153	-0.046	-0.092	-0.089	-0.081	-0.128	0.549	0.009	-0.019	0.568	0.086
y_{t-2}		-0.900					-0.123			-1.020			-0.536	
π_{t-1}	0.753	0.826	0.839	0.883	0.833	0.829	0.843	0.881	0.789	0.952	0.827	0.714	0.835	0.859
π_{t-2}		-0.049					-0.125			-0.240			-0.084	
a_t	1.071	3.011	0.843	1.553	1.193	0.161	0.267	0.008	0.927	0.234	-0.220	2.210	5.067	-0.067
a_{t-1}		-0.806		-1.610			4.637					-2.090		
a_{t-2}		-1.552					-9.714							
δ	0.786	1.469	1.176	2.482	-0.091	1.090	3.086	1.045	1.519	8.103	-1.168	-0.171	-1.307	-2.852
γ	-0.434	-0.502	-0.575	-0.442	-0.461	-0.360	-0.359	-0.542	-0.455	-0.240	-0.314			

Table A3: Determinants of the Cross-Sectional Variation in the Response of the Real Exchange Rate to a Shock to Aid

(Weighted Least Squares Estimates)

	one year response			*two year response*			*three year response*		
unadjusted model	*coeff.*	*t ratio*	*p value*	*coeff.*	*t ratio*	*p value*	*coeff.*	*t ratio*	*p value*
log average GDP per capita	1.289	2.218	0.04	1.355	1.676	0.11	1.220	1.066	0.30
fixed capital to GDP ratio (%)	-0.101	-1.480	0.16	-0.155	-1.631	0.12	-0.238	-1.788	0.09
ratio of value of trade to GDP	2.125	1.616	0.12	3.283	1.773	0.09	5.227	1.992	0.06
hard exchange rate peg	0.389	0.570	0.58	0.553	0.588	0.56	0.760	0.572	0.57
political stability	0.138	0.244	0.81	0.066	0.087	0.93	0.099	0.090	0.93
landlocked	1.691	2.083	0.05	1.990	1.780	0.09	2.299	1.439	0.17
R^2		0.42			0.37			0.34	
joint significance (p value)		0.07			0.14			0.20	
adjusted model	*coeff.*	*t ratio*	*p value*	*coeff.*	*t ratio*	*p value*	*coeff.*	*t ratio*	*p value*
log average GDP per capita	1.332	1.861	0.08	1.427	1.435	0.17	1.172	0.907	0.38
fixed capital to GDP ratio (%)	-0.139	-1.600	0.13	-0.205	-1.726	0.10	-0.229	-1.488	0.15
ratio of value of trade to GDP	2.912	1.774	0.09	4.341	1.910	0.07	5.101	1.718	0.10
hard exchange rate peg	0.441	0.514	0.61	0.506	0.425	0.68	0.381	0.244	0.81
political stability	0.499	0.686	0.50	0.624	0.626	0.54	0.522	0.394	0.70
landlocked	2.055	2.149	0.05	2.469	1.855	0.08	2.573	1.460	0.16
R^2		0.42			0.37			0.27	
joint significance (p value)		0.07			0.14			0.36	