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A Panel Data Analysis of Developing Countries**

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# Foreign Aid and Export Performance: A Panel Data Analysis of Developing Countries

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## Abstract

The effect of foreign aid on economic activity of a country can be dampened due to potentially adverse effects on exports through a real exchange rate appreciation. In this study we examine the long-term relationship between export performance and foreign aid in developing countries while accounting for other factors. The estimates of direct effect of foreign aid on exports are imprecise. However, the effect of the quadratic term of foreign aid on exports is negative and precise. This implies large amount of foreign aid does adversely affect export performance. The results are robust to the use of two different export performance measures and different sub-samples.

**JEL Codes:** F35, O24.

**Keywords:** Foreign aid, export performance, developing countries.

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## **1. Introduction**

The relationship between export performance and foreign aid of a country depends upon several factors. The traditional justification for foreign aid is that it eases the resource constraint of the developing economies, especially on the supply side. These supply factors include investment, infrastructure, geography, and quality of institutions. Investment and improvements in trade facilitating infrastructure such as roads, ports, and telecommunications are important for enhancing the supply response of exports (World Bank, (2005)). Geographical factors such as distance to the coast or access to sea-navigable rivers directly affect transport costs, and trade is very sensitive to transport costs (Gallup, Sachs and Mellinger, (1999)). The quality of institutions too affects the investment climate, which in turn affects the supply response of the economy (World Bank, (2005)).

However, foreign aid can also harm export performance of an economy through real exchange rate appreciation. A number of studies have shown that aid inflows indirectly eroded the export competitiveness of developing countries by causing real exchange rate appreciation (Van Wijnbergen (1986), Younger (1992), White and Wignaraja (1992), and Elbadawi (1999)). Because foreign aid raises the domestic demand for goods and services, it drives up prices in the non-traded sector and causes the real exchange rate to appreciate - a “Dutch disease” effect which causes aid to have an anti-export bias. Recently, Rajan and Subramanian (2005a, 2005b) also pointed out this channel as a potential reason for quantitatively small effect of foreign aid on economic performance of a country.

This paper seeks to examine the above hypothesis of negative effect of foreign aid on export performance of a country. We use a panel of 84 developing countries to estimate the effect of foreign aid on export performance measures after controlling for the additional factors that may affect exports. The results do show a negative effect of a quadratic term of foreign aid on long term performance of exports when we account for possible endogeneity. The results are also robust to two different export measures and different sub-samples. We interpret these estimates as evidence favoring the importance of the real exchange rate channel effect of foreign aid on export performance in the long run.

The rest of the paper proceeds as follows: section 2 describes the specification of the model to be estimated, the data used in the analysis and estimation issues. Basic results of the estimation are presented in section 3, results from sub-sample estimations in section 4 and conclusions in section 5.

## **2. Model Specification, Data, and Estimation**

### *2.1 Model specification*

We use a simple linear model for estimating the effect of foreign aid on exports but do allow for a quadratic foreign aid term in it. The other potentially important factors are proxies for supply constraints, country size, economic well being of the country and institutional risks. The following equation specifies our empirical model:

$$\begin{aligned} \log(\text{Export Performance})_{it} = & \beta_0 + \beta_1 + \beta_2 + \beta_1 * \log(\text{Aid})_{it} + \beta_2 * (\log(\text{Aid})_{it})^2 \\ & + \beta_3 * \log(\text{Imported Capital})_{it} + \beta_4 * \log(\text{Teledensity})_{it} \\ & + \beta_5 * \log(\text{Population})_{it} + \beta_6 * \log(\text{Lagged per Capita Income})_{it} \\ & + \beta_7 * \log(\text{Financial Risk})_{it} + \beta_8 * \log(\text{Political Risk})_{it} + \varepsilon_{it} \end{aligned}$$

In the above equation, we allow for country (indexed by  $i$ ) fixed effects and time (indexed by  $t$ ) fixed effects<sup>1</sup>. The country fixed effects should capture the potential country heterogeneity biases like geographical location, distance to coast etc. The time fixed effects should capture the global biases like implementation of global trade agreements etc. The imported capital (initial) and teledensity are our proxies for supply and infrastructural constraints. Population captures the country size issue and initial per capita income should capture the countries well being at the beginning of the period. It also serves as a proxy for infrastructural constraints as relatively richer countries are less likely to have poor infrastructure. Finally, the financial risk and the political risk variables serve as proxies for institutional risks.

## 2.2. Data

Data on total net ODA in current US dollars were obtained from the OECD-DAC database and the unit-value of imports price index was obtained from the IMF International Financial Statistics database. Data on non-oil trade and capital imports were obtained from the World Bank's WITS database. Political and financial risk data were obtained from the PRS Group. The remaining data were obtained from the World Bank's WDI and GDF databases.

Two measures of export performance are used in estimating our equation: the share of each country's non-oil exports in total world non-oil imports, and total exports of goods and services as a percent of GDP. We use the standard measure of real per-capita foreign aid which is total net Official Development Assistance (ODA) as our 'aid' variable. As in Burnside and Dollar (2000), data on net ODA was converted into constant

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<sup>1</sup> We also experimented with allowing for lags of foreign aid in the regression. The results were largely similar though imprecise.

2000 dollars using the unit-value of imports price index. We divided the real aid figure for each country by the country's total population to obtain real aid per capita. Another measure of foreign aid used in the regressions is the aid as a percentage of GDP.

Imported capital is measured by imports of machinery and transport equipment as a percent of GDP. Based on Moran (1989), many developing countries are highly dependent on imported capital goods for production and investment. The teledensity variable is mainline teledensity and the population is total population. The real lagged per capita income is PPP based (constant 2000 dollars). The measures of financial risk rating and political risk rating imply, in both cases, the higher the rating, the lower the risk. The political risk rating is derived from governance indicators such as government stability, control of corruption, law and order, ethnic tensions, democratic accountability, bureaucracy quality, and the influence of military in politics. The financial risk rating is based on trade related indicators including exchange rate stability.

### *2.3 Estimation Issues*

There are a few estimation issues that are worth discussing at this point. The first relates to the sample of developing countries in the panel data for the period 1980-2003. The use of panel data makes it possible to account for fixed effects in the model. The data are averaged into five year periods (to account for long term variation) for each country (except for 2000-03, which has 4 periods). The total number of developing countries in our sample is 84. The sample includes both low income and middle income countries, some of which are Least Developed Countries (LDCs), and some of which are non-LDCs (table 1). However, there are three countries<sup>2</sup> that have negative foreign aid per capita numbers in their sample which rules out the use of logarithms for those data points. We

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<sup>2</sup> Chile, Malaysia, Trinidad and Tobago.

decided to treat those datapoints as missing thereby making the full sample an unbalanced panel in our primary estimation. Similarly, there were twelve datapoints missing for aid GDP ratio. The summary statistics for the variables are table 2. Secondly, the data on financial and political risk were available for only 72 countries.

(Table 1 about here)

Finally, we tackle the issue of potential endogeneity in the regressions by using instrumental variables technique. The biggest source of potential endogeneity is probably omitted variables – mostly from inadequate number of supply side constraints. There are two types of instruments that we use in the IV estimation. The first are three dummy variables: Friend of UK (FUK), Friend of France (FF), and Friend of US (FUS). The literature has shown that the key determinants of foreign aid allocation are initial income per capita, population, and political or strategic interests of donors (Boone (1996), Burnside and Dollar (2000), Alesina and Dollar (2000), Bandyopadhyay and Wall (2006)). Following Boone (1996) and Rodrik (1995), these dummies are set to one if a recipient country receives more than one percent of the donor’s total aid budget allocated to developing countries.

(Table 2 about here)

The significance of political and strategic considerations in aid allocation is shown by the fact that more US aid provided to important allies such as Egypt and Israel, while the UK and France allocate most of their aid to former colonies. Following Rajan and Subramanian’s (2005a, 2005b) argument that these types of strategic factors are unrelated to economic performance and can be used as instruments for aid in IV estimation, we use the dummy variables as instruments for aid in our regressions. Our

second type of instruments are the initial aid per capita or initial aid GDP ratio that are predetermined variables at each time period and improve the fit of a linear aid regression considerably. However, our results are not very sensitive to the exclusion of this second type of instruments.

### **3. Primary Empirical Results**

#### *3.1 Full Sample Estimation Results*

We start out by documenting the relationship between export performance and foreign aid. The top panels in figure 1 show a negative relation between aid GDP ratio and two export measures. However, the slope of the linear fit varies between the panels. The bottom left panel in figure 1 also shows a negative relationship between log of world export market share and log of foreign aid per capita. When we use log export to GDP ratio instead of export market share in the bottom right panel, it shows a positive relationship. Overall, the linear relation between aid and exports vary depending on the measures of aid and exports.

(Figure 1 about here)

In the first column of table 3 we present the pooled OLS results with additional control variables. The top panel uses aid GDP ratio and the bottom panel uses aid per capita. The result of negative relationship between foreign aid and export performance is imprecise in the top panel and disappear in the bottom panel. The quadratic term also switches sign. The coefficients of imported capital and initial per capita income are positive and significant. We re-estimate the equation after allowing for country and time fixed effects and report the results in the second column. The linear effect of foreign aid is negative for aid GDP ratio and positive for aid per capita.



The last column reports the fixed effects IV estimation. We instrument for both the linear and the quadratic term of foreign aid using the strategic dummies, initial foreign aid and initial foreign aid squared as instruments. The point estimate of linear effect of foreign aid is negative and imprecise. More importantly, the effect of the quadratic foreign aid term is negative and significant for both the regressions. This implies large amount of foreign aid is likely to adversely affect the export performance of a country; confirming the Rajan and Subramanian (2005a, 2005b) reasons for poor economic performance of the aid recipient countries.

(Table 3 about here)

We see a similar picture when we examine the estimates in table 4 using export to GDP ratio. The pooled OLS results in the first column and fixed effects result in the second column report a mostly positive linear effect of foreign aid on export performance. The quadratic effect estimates are mixed and mostly imprecise. Using instrumental variables in the last column, we see mixed results for the linear effect of foreign aid. However, the quadratic term of foreign aid is negative and significant for both regressions and confirms our table 3 results using a different export performance measure.

(Table 4 about here)

### *3.2 Estimation Results from the Sample of 72 Countries*

We now examine the estimation results from a sub-sample of 72 countries and with institutional risks data in an unbalanced panel. We also concentrate on using just aid GDP ratio as our foreign aid variable due to space considerations. The pooled OLS results with additional controls in the first columns of table 5 and table 6 show mixed

results for linear effects of foreign aid but negative and significant effects of the quadratic term. We get a similar picture when we compare the results of second and third columns of table 5 and table 6. Allowing for cross section and time fixed effects in the second columns, the results for the quadratic term are still negative but insignificant. Fixed effects IV regressions in the third columns show mixed and insignificant estimates for the linear foreign aid term. The quadratic aid term shows negative and significant estimates.

(Table 5 about here)

Overall, the results from the full sample unbalanced panel and the panel of 72 countries are largely similar. Both show that the linear effect of foreign aid on export performance is mixed and imprecise. The results also show that the quadratic term of foreign aid is important. Its effect is negative and significant when the endogeneity problem in the regressions is addressed using instrumental variables. The results imply that large amount of foreign aid will negatively affect exports of a country.

(Table 6 about here)

#### **4. Empirical Results from Least Developed Economies and Low Income African Countries**

In this section we subdivide our sample into two sub-samples. The first is the set of 32 least developed countries as listed in table 1. The second is the set of 33 low income African countries also listed in table 1 and asterisked. These two samples have special significance given the very low level of development in those countries. The fixed effects and fixed effects IV estimation results for the least developed countries are presented in table 7 using both measures of export performance. The results show all positive and precise estimates of linear effect of foreign aid on exports. However, the

quadratic term is also always negative and mostly significant. The evidence supports our hypothesis that large volume of aid adversely affects exports.

(Table 7 about here)

Similar results for low income African countries are in table 8. Again the estimated effects of the linear aid terms are positive and the quadratic terms are negative. However, the estimates are significant only for export to GDP ratio as the dependant variable. Imported capital is positive and significant in the exports to GDP ratio regressions but not in case of world export market share. The real initial per capita income coefficients are always positive and significant. Overall, the sub-sample results are largely similar to our full sample results and lend support to the hypothesis that large amount of aid has negative effect on the exports of a country.

(Table 8 about here)

## **5. Conclusion**

In this paper, we analyzed whether aid adversely affects the long term export performance of a country due to an appreciation of real exchange rate while taking into account various supply and other factors. Our results show that large amount of foreign aid adversely affects export performance of developing countries but the effect is not clear for smaller amounts.

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**Table 1: Countries Included in the Estimation**

Least Developed Countries	Other Low Income Countries (per capita GNI <\$825 in 2004)	Middle Income Developing Countries (per capita GNI \$826 - \$10,065 in 04)
Angola*	Cameroon*	Algeria
Bangladesh	Congo, Rep.*	Argentina
Benin*	Cote d'Ivoire*	Belize
Burkina Faso*	Ghana*	Bolivia
Burundi*	India	Brazil
Cambodia	Kenya*	Chile
Central African Republic*	Mongolia	China
Chad*	Nicaragua	Colombia
Congo, Dem. Rep.*	Nigeria*	Costa Rica
Djibouti*	Pakistan	Dominican Republic
Equatorial Guinea*	Papua New Guinea	Ecuador
Gambia, The*	Viet Nam	Egypt, Arab Rep.
Guinea*	Zimbabwe*	El Salvador
Guinea-Bissau*		Gabon
Haiti		Guatemala
Laos		Guyana
Madagascar*		Honduras
Malawi*		Indonesia
Mali*		Iran
Mauritania*		Jamaica
Mozambique*		Jordan
Nepal		Lebanon
Niger*		Malaysia
Rwanda*		Mexico
Senegal*		Morocco
Sierra Leone*		Oman
Sudan*		Panama
Tanzania*		Paraguay
Togo*		Peru
Uganda*		Philippines
Yemen		Saudi Arabia
Zambia*		Sri Lanka
		Syrian Arab Republic
		Thailand
		Trinidad and Tobago
		Tunisia
		Turkey
		Uruguay
		Venezuela

Note: Based on DAC list of ODA Recipients, effective from 2006. The asterisked countries are least developed and low income African countries.

**Table 2: Summary Statistics of Variables**

<b>Variable</b>	<b>Mean</b>	<b>Standard Deviation</b>
<i>Based on 84 Countries</i>		
World export market share	0.175	0.578
Exports as a percent of GDP	29.057	18.333
Real aid per capita	0.376	0.425
Aid GDP ratio (in percentages)	7.86	9.50
Mainlines teledensity	38.438	53.760
Population, total	45.921	157.836
Real per capita income, PPP (initial)	3182.627	2795.528
Imported capital (initial)	8.903	10.891
<i>Based on 72 Countries</i>		
Financial risk	27.158	7.791
Political risk	53.606	12.203



**Table 3: Regression Results for the Full Sample Using World Export Market Share**

Explanatory Variables	POLS	FE	FE-IV
Aid GDP ratio	-0.002 (0.04)	-0.012 (0.05)	-0.023 (0.05)
Aid GDP ratio squared	-0.029*** (0.01)	0.004 (0.01)	-0.038** (0.02)
Log of imported capital (initial)	0.436*** (0.07)	0.277*** (0.06)	0.253*** (0.06)
Log of mainlines teledensity	-0.015 (0.06)	0.392*** (0.09)	0.319*** (0.09)
Log of population	0.824*** (0.03)	0.930* (0.51)	0.604 (0.46)
Log of real per capita income (initial)	1.124*** (0.13)	0.542*** (0.15)	0.520** (0.21)
Log of real per-capita aid	0.123 (0.11)	0.129* (0.08)	-0.050 (0.09)
Log of real per-capita aid squared	0.004 (0.03)	0.006 (0.02)	-0.035* (0.02)
Log of imported capital (initial)	0.439*** (0.07)	0.330*** (0.07)	0.343*** (0.08)
Log of mainlines teledensity	0.007 (0.06)	0.400*** (0.08)	0.384*** (0.08)
Log of population	0.901*** (0.03)	1.320*** (0.50)	1.189** (0.49)
Log of real per capita income (initial)	1.191*** (0.09)	0.563*** (0.16)	0.540*** (0.17)

Note: The dependent variable is log of world export market share. The data is an unbalanced panel of 84 countries. The regressions include a constant. White's standard errors are in the parentheses. The sign \* implies the coefficient significant at the 10 percent level. Similarly, \*\* implies the coefficient is significant at the 5 percent level and \*\*\* implies significance at the 1 percent level.

**Table 4: Regression Results for the Full Sample Using Export to GDP Ratio**

Explanatory Variables	POLS	FE	FE-IV
Aid GDP ratio	-0.022 (0.02)	0.113*** (0.03)	0.105*** (0.03)
Aid GDP ratio squared	-0.022*** (0.01)	0.001 (0.01)	-0.024* (0.01)
Log of imported capital (initial)	0.552*** (0.04)	0.292*** (0.04)	0.270*** (0.04)
Log of mainlines teledensity	-0.011 (0.03)	-0.002 (0.05)	-0.053 (0.05)
Log of population	-0.094*** (0.02)	0.349 (0.26)	0.071 (0.24)
Log of real per capita income (initial)	0.122* (0.07)	0.417*** (0.09)	0.408*** (0.10)
Log of real per-capita aid	0.014 (0.03)	0.075 (0.05)	-0.033 (0.07)
Log of real per-capita aid squared	0.002 (0.01)	-0.004 (0.01)	-0.025* (0.01)
Log of imported capital (initial)	0.526*** (0.04)	0.335*** (0.05)	0.350*** (0.05)
Log of mainlines teledensity	0.004 (0.02)	0.002 (0.05)	-0.011 (0.05)
Log of population	-0.069*** (0.01)	0.463* (0.25)	0.327** (0.16)
Log of real per capita income (initial)	0.164*** (0.01)	0.288*** (0.07)	0.269*** (0.07)

Note: The dependent variable is log of export to GDP ratio. The data is an unbalanced panel of 84 countries. The regressions include a constant. White's standard errors are in the parentheses. The sign \* implies the coefficient significant at the 10 percent level. Similarly, \*\* implies the coefficient is significant at the 5 percent level and \*\*\* implies significance at the 1 percent level.

**Table 5: Regression Results for 72 Countries Using World Export Market Share**

Explanatory Variables	POLS	FE	FE-IV
Aid GDP ratio	0.003 (0.05)	-0.046 (0.03)	-0.017 (0.04)
Aid GDP ratio squared	-0.031*** (0.01)	-0.001 (0.09)	-0.031* (0.02)
Log of imported capital (initial)	0.378*** (0.08)	0.203*** (0.05)	0.220*** (0.06)
Log of mainlines teledensity	-0.079 (0.05)	0.350*** (0.09)	0.304*** (0.09)
Log of population	0.813*** (0.04)	0.576 (0.45)	0.645 (0.44)
Log of real per capita income (initial)	1.179*** (0.13)	0.592*** (0.17)	0.672*** (0.17)
Log of Financial Risk	-0.296 (0.19)	0.353*** (0.11)	0.377*** (0.12)
Log of Political Risk	0.451* (0.25)	-0.285 (0.16)	-0.316* (0.17)

Note: The dependent variable is log of world export market share. The data is an unbalanced panel of 72 countries. The regressions include a constant. White's standard errors are in the parentheses. The sign \* implies the coefficient significant at the 10 percent level. Similarly, \*\* implies the coefficient is significant at the 5 percent level and \*\*\* implies significance at the 1 percent level.

**Table 6: Regression Results for 72 Countries Using Export to GDP Ratio**

Explanatory Variables	POLS	FE	FE-IV
Aid GDP ratio	-0.022 (0.023)	0.094*** (0.03)	0.106 (0.03)
Aid GDP ratio squared	-0.022*** (0.01)	-0.001 (0.01)	-0.026* (0.01)
Log of imported capital (initial)	0.477*** (0.04)	0.247*** (0.04)	0.266*** (0.05)
Log of mainlines teledensity	-0.055* (0.03)	-0.019 (0.05)	-0.093 (0.06)
Log of population	0.118*** (0.02)	0.249 (0.25)	0.157 (0.25)
Log of real per capita income (initial)	0.098 (0.06)	0.424*** (0.10)	0.512*** (0.10)
Log of Financial Risk	0.331*** (0.10)	0.053 (0.08)	0.029 (0.08)
Log of Political Risk	0.272* (0.11)	-0.047 (0.11)	-0.033 (0.11)

Note: The dependent variable is log of export to GDP ratio. The data is an unbalanced panel of 72 countries. The regressions include a constant. White's standard errors are in the parentheses. The sign \* implies the coefficient significant at the 10 percent level. Similarly, \*\* implies the coefficient is significant at the 5 percent level and \*\*\* implies significance at the 1 percent level.

**Table 7: Regression Results for Least Developed Economies**

Explanatory Variables	FE	FE-IV	FE	FE-IV
	World Export Market Share		Export to GDP ratio	
Aid GDP ratio	1.120*** (0.42)	1.183** (0.53)	0.837*** (0.24)	0.621* (0.36)
Aid GDP ratio squared	-0.220*** (0.07)	-0.302** (0.12)	-0.153*** (0.05)	-0.158 (0.08)
Log of imported capital (initial)	0.306*** (0.10)	0.359*** (0.13)	0.279*** (0.07)	0.300*** (0.08)
Log of mainlines teledensity	0.154 (0.17)	-0.070 (0.18)	-0.075 (0.09)	-0.198** (0.10)
Log of population	1.571 (1.54)	0.153 (1.82)	-0.317 (0.65)	-1.002 (0.77)
Log of real per capita income (initial)	0.966*** (0.20)	0.847*** (0.24)	0.717*** (0.12)	0.542*** (0.16)

Note: The dependent variables are log of world export market share (first two columns) and log of export to GDP ratio (last two columns). The data is an unbalanced panel of 32 countries. The regressions include a constant. White's standard errors are in the parentheses. The sign \* implies that the coefficient significant at the 10 percent level. Similarly, \*\* implies the coefficient is significant at the 5 percent level and \*\*\* implies significance at the 1 percent level.

**Table 8: Regression Results for Low Income African Economies**

Explanatory Variables	FE	FE-IV	FE	FE-IV
	World Export Market Share		Export to GDP ratio	
Aid GDP ratio	0.090 (0.10)	0.140 (0.10)	0.329*** (0.07)	0.337*** (0.10)
Aid GDP ratio squared	-0.033 (0.02)	-0.020 (0.03)	-0.047*** (0.02)	-0.058** (0.02)
Log of imported capital (initial)	0.093 (0.08)	0.068 (0.08)	0.190*** (0.06)	0.196*** (0.07)
Log of mainlines teledensity	-0.053 (0.11)	-0.009 (0.12)	-0.115 (0.09)	-0.143* (0.08)
Log of population	2.044* (1.21)	2.349* (1.31)	0.566 (0.63)	0.398 (0.68)
Log of real per capita income (initial)	0.620*** (0.17)	0.705*** (0.19)	0.568*** (0.13)	0.552*** (0.15)

Note: The dependent variables are log of world export market share (first two columns) and log of export to GDP ratio (last two columns). The data is an unbalanced panel of 33 countries. The regressions include a constant. White's standard errors are in the parentheses. The sign \* implies the coefficient significant at the 10 percent level. Similarly, \*\* implies the coefficient is significant at the 5 percent level and \*\*\* implies significance at the 1 percent level.

**Figure 1: Scatter Diagram of Exports and Aid**

