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FOREIGN AID AND ECONOMIC GROWTH: NEW EVIDENCE FROM PANEL COINTEGRATION

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The relationship between foreign aid and economic growth is investigated for a panel of developing countries (Botswana, Ethiopia, India, Kenya, Sri-Lanka, and Tanzania) over the period 1974-1996. The results reveal that the variables contain a panel unit root and they cointegrate in a panel perspective. The long-run elasticities (close to one for most countries) show that foreign aid has a positive and significant effect on economic activity for each country in the sample. A policy implication which may be drawn from the study is that foreign capital flows can have a favorable effect on real income by supplementing domestic savings.

Keywords: Foreign Aid, Economic Growth, Panel Unit Root Tests, Panel Cointegration, Africa, Asia
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1. INTRODUCTION

Foreign aid is a significant source of income to developing countries, especially in Africa, where it averages 12.5 percent of gross domestic product and establishes by far the important source of foreign capital (Pallage and Robe (2001)). In such an environment, foreign aid has a potential to play a key role in promoting developing countries' economic growth.

There exist two strands of literature on the role of foreign aid on economic growth. The first studies or the proponents of foreign aid assert that overseas capital inflow is necessary and sufficient for economic growth in the less developed countries. They claim that there exist a positive relationship between aid and economic growth because it complements domestic resources and also supplements domestic savings. Furthermore, foreign aid assists to close the foreign exchange gap, provides access to modern

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technology and managerial skills, and allows easier access to foreign market (Chenery and Strout (1966); Papanek (1973); Gulati (1975); Gupta (1975); Over (1975); Levy (1988); Islam (1992)).

The second studies are related to the emergence of the view that external capital exerts significant negative effects on the economic growth of recipient countries. According to this view, foreign aid is fully consumed and substitutes rather than compliments domestic resources. Furthermore, foreign aid assists to import inappropriate technology, distorts domestic income distribution, and encourages a bigger, inefficient and corrupt government in developing countries (Griffin (1970); Griffin and Enos (1970); Weisskoff (1972a, b); Boone (1994); (1996); Easterly (1999)).

On the other hand, a series of studies argue that the negative relation that might exist between foreign aid flows and economic growth is outcome of factors such as economic policies, state intervention, business cycles, and stability of foreign aid flows in the recipient countries. Singh (1985) considers government regulatory activities into consideration. He concludes that state intervention in the economy has a negative impact on economic growth and renders the aid-growth relationship statistically non- significant. Burnside and Dollar (2000) find that the relationship between foreign aid and economic growth may depend on whether the recipients are pursuing sound economic policies. Lensink and Morrissey (2000) analyze the impact of aid uncertainty on economic growth in developing countries. They find that the effect of foreign aid on economic growth is a function of aid levels and the stability of aid flows.

Finally, Pallage and Robe (2001) explain empirical regularities in the foreign aid flows to developing countries. They reveal that for the vast majority of recipients, aid flows are a major source of income that is highly volatile and overwhelmingly pro-cyclical. This means that, even if foreign aid were meant solely to help foster economic growth, serious problems would nonetheless stem from the fact that aid disbursement patterns intensify the volatility of developing countries' disposable income which affects growth negatively.

However, the bulk of the literature has so far produced inconsistent and elusive results concerning the potential relationship between foreign aid and economic growth. The purpose of this study is to examine the relationship between the Swedish foreign aid and the economic growth in developing countries. The sample countries are: Botswana, Ethiopia, India, Kenya, Sri-Lanka, and Tanzania and the sample period is 1974-1996. We have restricted the sample to this period due to the availability of the data. The reason for the choice of these countries is that they are important recipients of aid from Sweden.

The departure from earlier studies of the role of foreign aid flows on economic growth is in the methodology used to examine the interaction between variables. Here we make use of panel unit root tests and tests for panel cointegration suggested by Pedroni (1997, 1999). One of the major advantages of using a panel cointegration test is a significant increase in power when the cross-sectional dimension of the panel is expanded as compared with the well-known low power of standard cointegration test for small samples.[1] This study is probably the first attempt to test the impact of foreign aid on the economic growth in the developing countries using panel cointegration techniques.

The paper proceeds as follows: Section 2 deals with methodological issues and the data used in the empirical analysis, while in Section 3 the empirical evidence is presented. Finally, Section 4 offers conclusions and policy implications.

2. MODEL, DATA, AND METHODOLOGY

The model that we utilize in the empirical investigation is a panel system and it is defined as follows:

$$\ln YC_{it} = \alpha_{\mathrm{i}} + \beta_i \ln AID_{it} + \varepsilon_{it}, \quad \text{for } \mathrm{i} = 1, \cdots, \mathrm{N} \text{ and } \mathrm{t} = 1, \cdots, \mathrm{T}, \tag{1}$$

where $\ln YC_{it}$ denotes the log of real GNP per capita for country i at time t, $\ln AID_{it}$ is the log of the Swedish aid to country i at time t, and ε is the stochastic error term.

GNP per capita series consists of annual data and it is expressed in real US dollars. We deflate GNP and aid series using each country's consumer price index and by using population series in each country we calculate GNP per capita. Data for aid series was collected from SIDA (Sweden) and data for GNP series and consumer price index were obtained from International Financial Statistics, various issues. The sample period for each country is 1974-1996. The countries included in the sample are Botswana, Ethiopia, India, Kenya, Seri Lanka, and Tanzania.

It is an accepted fact in the literature that the data generating process for many economic variables is characterized by unit roots, which can result in spurious inference if the time series properties of the data are not carefully taken into account. One of the well-known test statistics for unit roots is the augmented Dickey-Fuller test statistics. This test in its simplest form can be described as follows:

$$\Delta x_t = \gamma x_{t-1} + e_t . \tag{2}$$

The null hypothesis is one unit root, i.e., $\gamma = 0$. However, Shiller and Perron (1985) reported that the Dickey-Fuller unit-root test has very low power in small sample sizes. To enhance the power of the test, Levin and Lin (1993) and Im, Pesaran, and Shin (2003) (IPS hereafter) recommended panel versions of the test. A panel version of the Dickey-Fuller unit-root test is the following:

[1] For another application of non-stationary panel data analysis see Hatemi-J and Irandoust (2004).

$$\begin{bmatrix} \Delta x_{1t} \\ \Delta x_{2t} \\ \vdots \\ \Delta x_{Nt} \end{bmatrix} = \begin{bmatrix} \gamma_1 x_{1t-1} \\ \gamma_2 x_{2t-1} \\ \vdots \\ \gamma_N x_{Nt-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ \vdots \\ e_{Nt} \end{bmatrix}. \tag{3}$$

N denotes the number of cross-sections. The error terms are assumed to be white noise processes. The null hypothesis of one panel unit root is $\gamma_1 = \gamma_2 = \cdots = \gamma_N = 0$. The panel unit root test that was developed by Levin and Lin (1993) (LL) is based on the following regression:[2]

$$\Delta x_{it} = \gamma_i x_{it-1} + e_{it}\ , \quad \text{for } \mathrm{i} = 1,\cdots,\mathrm{N} \text{ and } \mathrm{t} = 1,\cdots,\mathrm{T}. \tag{4}$$

The panel estimator can be defined as the following according to the authors:

$$\sqrt{NT}(\hat{\gamma} - 1) = \frac{\frac{1}{\sqrt{N}}\sum_{i=1}^{N}\frac{1}{T}\sum_{t=1}^{T} x_{it-1}e_{it}}{\frac{1}{N}\sum_{i=1}^{N}\frac{1}{T^2}\sum_{t=1}^{T} x_{it-1}^2}. \tag{5}$$

The following *t*-statistics can be used to test for the null hypothesis of panel unit root:

$$t_\gamma = \frac{(\hat{\gamma} - 1)\sqrt{\sum_{i=1}^{N}\sum_{t=1}^{T} x_{it-1}}}{\sqrt{\frac{1}{NT}\sum_{i=1}^{N}\sum_{t=1}^{T} e_{1t}^2}}. \tag{6}$$

The Monte Carlo experiments conducted by Levin, Lin and Chu (2002) indicate that the power of the panel-based unit root test is much higher compared to individual unit root tests.

The IPS test allows for a diverse coefficient of unit root and this advocates an average of the individual Dickey-Fuller tests. The test, which has better size properties, is defined below:

$$\bar{t} = \frac{1}{N}\sum_{i=1}^{N} t_i\ , \tag{7}$$

here t_i is the individual *t*-statistic for testing $H_0 : \gamma_i = 0 \,\forall\, i, i = 1, ..., N.$ The alternative

[2] It should be pointed out that it is possible to add individual constant and trend terms in Equation (6).

hypothesis in the IPS test is $\gamma_i < 0$ for $i = N_1 + 1, N_1 + 2, \cdots, \mathrm{N}$ such that: $\lim_{N\to\infty} = \frac{N_1}{N} = c$, $0 < c \le 1$. Therefore, this test allows for heterogeneity in the panel. Monte Carlo experiments implemented by Karlsson and Löthgren (2000) also demonstrate that the IPS test has better power properties.

If the data generating process for the variables is characterized by panel unit roots, it is crucial to test for cointegration in a panel perspective. Performing panel unit root tests is important in order to avoid spurious regression when panel data is used. Pedroni (1995, 1997, 1999) proposes among others the following test statistics to test for panel cointegration:

1. Panel *t*-Statistic (Non-Parametric):

$$Z_{tN,T} = \left(\tilde{\sigma}_{N,T}^2 \sum_{i=1}^{N}\sum_{t=1}^{T} \hat{L}_{11}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1/2} \sum_{i=1}^{N}\sum_{t=1}^{T} \hat{L}_{11}^{-2} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right), \tag{8}$$

2. Panel *t*-Statistic (Parametric):

$$Z_{tN,T}^{*} = \left(\tilde{s}_{N,T}^{*2} \sum_{i=1}^{N}\sum_{t=1}^{T} \hat{L}_{11}^{-2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{i=1}^{N}\sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*} \Delta \hat{e}_{i,t}^{*} , \tag{9}$$

3. Group *t*-Statistic (Non-Parametric):

$$N^{-1/2} \tilde{Z}_{tN,T} = N^{-1/2} \sum_{i=1}^{N} \left(\hat{\sigma}_i^2 \sum_{t=1}^{T} \hat{L}_{11}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1/2} \sum_{t=1}^{T} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right), \tag{10}$$

4. Group *t*-Statistic (Parametric):

$$N^{-1/2} \tilde{Z}_{tN,T}^{*} = N^{-1/2} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \tilde{s}_i^{*2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{t=1}^{T} \hat{e}_{i,t-1}^{*} \Delta \hat{e}_{i,t}^{*} , \tag{11}$$

where

$$\hat{\lambda}_i = \frac{1}{T} \sum_{s=1}^{k_i} \left(1 - \frac{s}{k_i + 1} \right) \sum_{t=s+1}^{T} \hat{\mu}_{i,t} \hat{\mu}_{i,t-s} , \tag{12}$$

$$\hat{s}_i^2 = \frac{1}{T} \sum_{t=1}^{T} \hat{\mu}_{i,t}^2 , \quad \hat{\sigma}_i^2 = \hat{s}_i^2 + 2\hat{\lambda}_i , \tag{13}$$

$$\tilde{\sigma}_{NT}^{2}=\frac{1}{T}\sum_{t=1}^{T}\hat{L}_{11i}^{2}\hat{\sigma}_{i}^{2}\ ,\quad \hat{s}_{i}^{*2}=\frac{1}{T}\sum_{t=1}^{T}\hat{\mu}_{i,t}^{*2}\ , \tag{14}$$

and

$$\hat{L}_{11i}^{2}=\frac{1}{T}\sum_{t=1}^{k_i}\hat{\eta}_{i,t}^{2}+\frac{2}{T}\sum_{T=1}^{T}\left(1-\frac{s}{k_i+1}\right)\sum_{t=s+1}^{T}\hat{\eta}_{i,t}\hat{\eta}_{i,t-s}\ . \tag{15}$$

The estimated error terms used to calculate the above expressions are obtained by running the following regressions:

$$\hat{e}_{i,t}=\hat{\gamma}_i\hat{e}_{i,t-1}+\hat{\mu}_{i,t}\ , \tag{16}$$

$$\hat{e}_{i,t}=\hat{\gamma}_i\hat{e}_{i,t-1}+\sum_{k=1}^{K_i}\hat{\gamma}_{i,k}\Delta\hat{e}_{i,t-k}+\hat{\mu}_{i.t}^{*}\ , \tag{17}$$

and

$$\Delta\ln YC_{it}=b\Delta\ln AID_{it}+\hat{\eta}_{i,t}. \tag{18}$$

Δ is the first difference operator. Pedroni suggests some adjustments for each of all test statistics (both for panel unit root tests and panel cointegration tests) described above that produces standard normal distributions. In this study, we report the adjusted values so that in all cases the reported test values can be compared to the standard normal distribution. This is the case for both the cointegration and unit root tests.[3]

3. ESTIMATION RESULTS

The estimation results for three tests of panel unit roots are presented in Table 1. All three tests show that each variable in the panel is integrated of the first order; I(1). Since the variables are found to be integrated (non-stationary), it is important to investigate whether the variables establish any long-run steady state (cointegration). Based on Pedroni's tests for panel cointegration, presented in Table 2, we find strong empirical evidence for panel cointegration between foreign aid and real GNP per capita for all countries in the sample. All the four tests support the view that the variables cointegrate in a panel perspective. Three tests reject the null hypothesis of no cointegration at the 1% significance level while the remaining test rejects the null at the 5% significance

[3] For more details see Pedroni (1999).

level. The adjusted values for the tests are also reported in Table 2. These values can be directly compared to the one sided standard normal distribution.

Table 1. Test Results for Panel Unit Roots

H_0: I(1), H_1: I(0)				H_0: I(2), H_1: I(1)			
	LL_1	LL_2	IPS		LL_1	LL_2	IPS
$ln\, YC_i$	-0.94	-0.98	-1.03	$ln\, YC_i$	-7.10^{a}	-7.36^{a}	-9.39^{a}
$ln\, AID_i$	0.27	0.55	0.19	$ln\, AID_i$	-9.48^{a}	-9.82^{a}	-12.42^{a}

Notes: 1. LL_1 and LL_2 are the tests recommended by Levin and Lin (1993). The first test augments the regression until autocorrelation is removed. The second test takes into account the effect of potential autocorrelation when the parameters are estimated.

2. IPS is the test introduced by Im *et al*. (2003). a indicates that the null hypothesis can be rejected at 1% significance level.

3. The adjusted test results are reported here so they can be compared to the N(0,1) distribution. Notice that each test is one sided (to the left side of the distribution).

Table 2. Panel Cointegration Test Results for real GNP per Capita and Foreign Aid Based on Pedroni Tests

Test 1	Test 2	Test 3	Test 4
-2.21	-2.37	-1.67	-2.10

Notes: Notice that Test 1 = Panel *t*-Statistic (Non-Parametric), Test 2 = Panel *t*-Statistic (Parametric), Test 3 = Group *t*-Statistic (Non-Parametric), and Test 4 = Group *t*-Statistic (Parametric) as described in the main text. Once again using Pedroni's procedure, we present the adjusted values hear that can be compared to the N(0,1). Since the tests are one sided the 1% critical value is -1.96, the 5% value is -1.64 and the 10% critical value is -1.28.

Since there is strong indication of long-run equilibrium (cointegration) in the panel, we are in a position to proceed and estimate the parameters of interest. To obtain the country-specific elasticities, we estimated the panel system presented in Equation (1) by making use of the dummy least squares method. The estimated elasticities are presented in Table 3 together with their standard errors, t-statistics and the corresponding p-values. Each elasticity appears to be of positive sign and statistically significant at any significance levels. For most countries in the sample, the country-specific elasticity is close to one. These elasticities indicate that, other things being equal, the foreign aid received from Sweden has a significant positive impact on the real per capita GNP in our sample countries. The last row in Table 3 also presents the group (pooled) elasticity of foreign aid. This elasticity appears to be significant at all conventional significance levels. This estimated elasticity implies that a 10% increase in foreign aid results in a 9%

increase in GNP per capita in our sample countries as a group.[4]

Table 3. The Long-Run Foreign Aid Elasticities

Country	*Elasticity*	S.E	*T-statistics*	P-value
Botswana	1.364	0.095	14.41	<0.000
Ethiopia	0.595	0.090	6.61	<0.000
India	1.053	0.136	7.76	<0.000
Kenya	0.905	0.086	10.54	<0.000
Srilanka	1.006	0.099	10.05	<0.000
Tanzania	0.873	0.052	16.87	<0.000
Pooled Data	0.926	0.037	24.847	<0.000

Notes: 1. The elasticity presented in column 2 is the elasticity of GNP per capita in each country with respect to aid from Sweden, except the last elasticity which shows group elasticity.

2. It should be mentioned that the elasticities (both individual and pooled) are estimated by allowing for individual effects through dummy variables to take into account the scale effect.

5. CONCLUSIONS

This study makes use of the new developments in the filed of panel cointegration analysis to investigate the long-run relationship between foreign aid and real economic growth. The donor country is Sweden and the recipients are Botswana, Ethiopia, India, Kenya, Sri- Lanka, and Tanzania and the sample period is 1974-1996. Several tests for panel unit roots and panel cointegration are conducted. The estimation results show that the variables are characterized by one panel unit root. However, the tests for panel cointegration provide empirical support that the variables can be considered as a cointegrated panel system. The estimated long-run elasticities (both individual and group) indicate that the Swedish foreign aid has a positive and significant impact on economic activity for all countries in the sample. For most countries, the country-specific elasticity of real income with respect to foreign aid is close to one. A policy implication, which may be drawn from the study, is that foreign capital flows can have a favorable effect on real income by supplementing domestic savings.

[4] It should be pointed out that the elasticities (both individual and pooled) are estimated by allowing for individual effects via dummy variables to capture the scale effect. These estimates are not presented but they are available from the authors upon request.

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