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Foreign direct investment and corruption in developing economies: Evidence from linear and non-linear panel Granger causality tests

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Abstract

This paper determines the causal link between FDI and corruption in 42 developing countries using linear and non linear panel Granger causal methods over the period 1998 to 2009. The findings show that the outcome of the causal association depends on the method used. The linear panel methods revealed that the majority of the markets indicate a bidirectional causal link between FDI and corruption while in contrast, for the nonlinear tests, the link from FDI to corruption dominates.

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1. Introduction

The growing literature on the relationship between corruption and foreign direct investment (FDI) inflows suggests that corruption can have either a negative or positive effect on FDI (see the survey of Campos *et al.,* 2010). Treating corruption as a factor that affects the costs of investment operations, Bardhan (1997) argued that foreign investors would have to pay extra costs in the form of bribes to get licenses or government permits to conduct business and such additional costs would decrease the expected profitability of investment. Moreover, corruption increases uncertainty because corruption agreements are not enforceable in the courts of law. Therefore, foreign investors would tend to avoid investing in countries with high levels of corruption. However, a positive impact of corruption on FDI inflows could exist. In the presence of stiff regulations and an inefficient bureaucracy, corruption may augment bureaucratic efficiency by accelerating the process of decision making (Bardhan, 1997). Empirically, the evidence on the effects of corruption on FDI flows has been mixed but most studies have not found the commonly expected conclusion that a high level of corruption deters FDI (Campos *et al.,* 2010). Some empirical papers provide support of a negative link between corruption and FDI, while others fail to find any significant relationship. However, what has been omitted from this literature is research that allows for the possibility that FDI inflows can cause corruption activities rather than the other way around so that corruption may not necessarily be an independent variable. In fact corruption is a consequence of economic and non-economic variables and so should be treated as an endogenous variable. For instance, FDI can create additional resources which permit a country to fight corruption effectively. On the other hand, if more FDI inflows represent a richer economy this can also raise the probability of individuals getting involve in corruptive activities.

It seems therefore that the causal pattern between corruption and FDI cannot be determined theoretically and an empirical analysis is required to resolve this issue. It should be noted that the previous empirical examinations done on this nexus regressed corruption on FDI, which implicitly posits that corruption is exogenous to the model; no analysis allowed for corruption and FDI to be endogenous and simultaneously determined. By undertaking formal causality tests this note hopes to rectify this deficiency in the literature.

Employing a set of 42 countries covering the period 1998 to 2009 this study assesses for the first time the relationship between corruption and FDI utilizing both linear and nonlinear panel granger causality tests. Linear panel causality methods are increasingly becoming quite popular in economic applications (see Hurlin and Venet, 2001; Hurlin, 2004; Craigwell and Moore, 2008; Greenidge *et al*., 2010). However, few examples appear in the economic literature that uses non-linear panel causality tests. The complex nature of FDI and corruption which depend on several economic and non-economic indicators imply that the former two variables could follow a non-linear process and it therefore appears appropriate to conduct non linearity causal tests on such.

The plan for this paper is as follows: the causality methods are discussed in section 2, followed by an outline of the estimated results in section 3 and in the final section conclusions are made.

2. Methodology and Data

2.1 Methodology

This paper uses the concept of statistical causation developed by Granger (1969), where a variable X is said to Granger cause Y, X needs to add value or make a significant marginal contribution to the forecast of Y given past Y and past X. Hurlin and Venet (2001) and Hurlin (2004) applied this notion of causality to panel data by allowing the autoregressive coefficients in the model to be treated as constants which improve degrees of freedom leading to greater efficiency of the estimates. This procedure contrasts with the more popular approaches of Holtz-Eakin *et al.* (1988), Weinhold (1996) and Nair-Reichert and Weinhold (2001) where the autoregressive coefficients can vary and efficiency is only possible with a 'large time dimension'.

2.1.1 Hurlin Panel Causality Linear Tests

The Hurlin (2004) procedure is based on the following equation:

$$CO_{it} = \eta_i + \sum_{k=1}^{p} \delta_k CO_{it-k} + \sum_{k=0}^{p} \beta_{ik} x_{it-k} + \varepsilon_{it} \qquad (1)$$

where CO represents corruption, the individual country specific coefficients are given by η, the autoregressive and regression coefficients on lagged values of corruption and the explanatory variables (x) that include foreign investment as a percentage of GDP (FDI) are denoted by δ and β, respectively, while ε is the error term with classical properties. The individual effects η are presumed fixed along with δ and β and the lag order, k, is identical (balanced) for all cross-section units of the panel (Hurlin, 2004).

Implementing the Hurlin (2004) panel causality methodology starts with checking for homogenous and instantaneous non-causality (*HINC*) which is based on a Wald coefficient test that all the βs are equal to zero for all individuals *i* and all lags *k*. If the regression coefficients are not significantly different from zero, then the hypothesis is accepted which implies that the variable *x* is not Granger causing *CO* in the sample. Once the result indicates non-causality then there is no need for further testing (Hurlin and Venet, 2001; Hurlin, 2004; Greenidge *et al.*, 2010). If the null hypothesis is rejected there exists the possibility that a causal relationship for the variables is identical across all countries in the series (Greenidge *et al.*, 2010). This is referred to as the homogeneous causality (*HC*) test which indicates that the regression coefficients are not statistically different across the countries for all lags. *HC* is rejected if the Wald statistic is significant. The rejection of the HC test requires that the regression coefficients must be examined for any statistically significant causal relationships across differing countries. This heterogeneous non-causality (*HENC*) test is one in which the coefficients of the lagged variables are checked to see if all of these terms are equal to zero or statistically different. A Wald statistic is also done for this calculation (Hurlin and Venet, 2001; Hurlin, 2004; Greenidge *et al.*, 2010).

2.1.2 Harvey and Leybourne Panel Causality Non Linear Tests

Non linearity causality tests were first introduced by Baek and Brock (1992) using nonparametric methods of spatial probabilities. However, the main problem with these tests is that they failed to provide appropriate statistics that have similar critical values even if the data being considered is a linear I(0) or I(1) process and is likewise consistent against non-linearity of either form (Harvey and Leybourne, 2007). Harvey and Leybourne (2007) rectified this problem by using the following regression model to test that $FDI \rightarrow CO$:

$$CO = \beta_0 + \beta_1 FDI_{it-1} + \beta_2 FDI_{it-2}^2 + \beta_3 FDI_{it-3}^3 + \beta_4 \Delta FDI_{it-1} + \beta_5 (\Delta FDI_{it-1})^2 + \beta_6 (\Delta FDI_{it-1})^3 \quad (2)$$

A similar expression can be derived for $CO \rightarrow FDI$ by interchanging CO and FDI in Equation (2). The same steps that were undertaken with the Hurlin (2004) linear panel causality approach can then be followed.

2.2 Data

The data utilised in this paper cover the period 1998 to 2009 for forty two markets and were sourced from the International Monetary Fund's International Financial Statistics and the World Bank's Statistics Database. Besides corruption (CO) and foreign direct investment as a percentage of GDP (FDI), the data set consists of several control variables which are augmented to the test equations to check the robustness of the relationship between CO and FDI. The control variables utilized are per capita GDP (GR) and domestic investment as a percentage of GDP (Invt_GDP). These variables are self-explanatory as they are often employed as standard macroeconomic variables in explaining the impact of corruption on per capita growth (see Freckleton *et al*, 2010; Campos *et al.*, 2010).

3. Estimated Results

The soundness of the causality results relies on the series being stationary, using appropriate lag lengths and incorporating control variables that rule out the possibility of an omitted variable driving the causal pattern of interest (Feige and Mcgee, 1977). So this section starts by exploring the temporal properties of the series. The results indicate that all 4 variables are stationary in levels. The series are also checked for cross sectional dependence, and nonlinearity using the method developed by Pesaran (2007) which combines the cross averages of lagged levels and first differences of the series. These findings indicate that most of the countries in the sample displayed linear and independence behaviour. Note all of the above mentioned results were not reported due to space considerations but are available on request. Once the variables are stationary and independent, the panel Granger causality tests can be conducted on the statistical significance of the regression coefficients using the above mentioned Wald statistics.

3.1 Linear Panel Causality Results

Two types of panel regression methods are considered; the pooled ordinary least square (OLS) model and the fixed effects model. The pooled OLS model assumes no variation of the coefficients and intercept terms while the fixed effects model allows for variation within each country intercept (Hsiao, 2003; Craigwell and Moore, 2008). The test statistics, based on the two panel regression methods, are given for lags 1 to 3; an F test was used to test restrictions on the coefficients at the chosen lag lengths which were determined by the Schwartz Bayesian Criterion (SBC), given the relatively small sample utilized here.

The HC test results seen in Table 1 reveal a strong causal relationship from corruption to FDI, and a similar link from FDI to corruption. To ensure that the model in Table 1 is well specified, per capita GDP and domestic investments as a percentage of GDP are added as control variables.

These results are displayed in Table 1 and are quite revealed similar to the findings of the models without the controls.

Table 1: Homogenous and Instantaneous Non-Causality Tests (No Controls and Controls)

		HINC (No Controls)		**HINC (With Controls)**		**HC**	
	Lags	OLS – Levels	Fixed effects – Levels	OLS – Levels	Fixed effects – Levels	OLS – Levels	Fixed effects – Levels
$CO \rightarrow FDI$	1	34.85***	4.41***	23.76***	3.81***	8.41***	3.17***
	2	33.24***	4.36***	20.87***	3.52***	7.02***	2.89***
	3	30.71***	2.81***	17.43***	2.17**	5.99***	2.30**
$FDI \rightarrow CO$	1	34.94***	4.44***	22.28***	3.24***	7.12***	2.15**
	2	33.24***	2.62***	19.07***	2.91***	6.29***	2.08**
	3	31.61***	3.09***	17.66***	2.04**	5.27***	1.67*

Note: ***,** and * indicates significance at the 1,5 and 10 percent level, respectively.

With evidence that $CO \rightarrow FDI$, country specific tests of the HINC form can be undertaken (Hood *et al.*, 2008; Craigwell and Moore, 2008). Utilizing the HINC tests, the regression coefficients across countries are statistically different from zero and the null hypothesis is rejected (Table 1). The $HENC$ test is also used to determine if the β_{ik} coefficients are different across countries. Table 2 shows that the majority of the markets (27) suggest a bidirectional causal link between FDI and corruption, 14 indicate causality from corruption to FDI and 1 market revealed that FDI Granger caused corruption.

3.2 Non-linear Panel Causality Results

The non-linear panel causality results observed in Table 3 show that the hypothesis of $CO \rightarrow FDI$ is rejected contrasting with the acceptance findings that $FDI \rightarrow CO$. Since there is evidence of causality, as in the linear panel investigations, country specific non-linear panel causal checks are made utilizing the HC and HINC tests (Table 4). In contrast to the linear tests, the results imply that the majority of the markets (22) indicate that FDI Granger caused corruption, 11 revealed that there was bi directional links between FDI and corruption, 4 had a significant non-linear causal relationship from corruption to FDI while the remaining 5 markets showed no discernible pattern.

Table 2: Heterogeneous Granger Causality Tests

Country	$CO \rightarrow FDI$	$FDI \rightarrow CO$
Argentina	3.63***	4.70***
Belarus	-0.44	8.93***
Belgium	7.99***	6.03***
Bolivia	9.59***	0.97
Botswana	-0.15	12.96***
Brazil	1.26	8.44***
Bulgaria	5.78***	4.10***
Cameroon	2.74***	4.22***
Chile	3.61***	11.75***
China	0.45	8.35***
Colombia	1.94*	7.77***
Costa Rica	0.76	9.95***
Ecuador	4.86***	3.31***
Egypt	3.07***	6.04***
Estonia	4.91***	7.79***
Ghana	2.19**	7.25***
Guatemala	1.70*	5.94***
Hungary	5.14***	6.69***
Indonesia	1.13	4.14***
India	-0.65	8.07***
Jamaica	7.73***	3.51***
Jordan	5.97***	5.62***
Kenya	-0.04	5.40***
Malaysia	3.34***	7.75***
Mexico	2.02**	7.51***
Namibia	3.43***	8.13***
Nicaragua	6.39***	2.94***
Pakistan	0.83	5.35***
Paraguay	2.56**	4.26***
Peru	0.93	8.93***
Philippines	1.66*	6.39***
Poland	2.09**	7.81***
Romania	2.66***	6.00***
South Africa	1.94*	9.99***
El Salvador	1.26	9.00***
Senegal	-0.76	8.42***
Tunisia	6.13***	6.08***
Turkey	0.09	8.47***
Uganda	2.84***	4.84***
Ukraine	2.11**	5.11***
Uruguay	-0.20	14.25***
Venezuela	5.00***	3.12***

Note: ***,** and * indicates significance at the 1,5 and 10 percent level of testing, respectively.

Table 3a: Non-Linear Causality Results: Dependent Variable (CO)

Causal Variable	Lags	Coefficient	t-statistic
FDI	1	0.168	28.38***
FDI^2	2	-0.001	-12.42***
FDI^3	3	0.00026	3.70
ln(FDI)	1	-0.13	-5.86***
$\ln(FDI)^2$	1	0.0009	1.15
$\ln(FDI)^3$	1	-0.0004	-1.09*

Table 3b: Non-Linear Causality Results: Dependent Variable (FDI)

Causal Variable	Lags	Coefficient	t-statistic
CO	1	5.84	5.22***
CO^2	2	0.77	2.10**
CO^3	3	-0.03	-0.98
ln(CO)	1	3.95	0.86
$\ln(CO)^2$	1	-0.23	-0.04
$\ln(CO)^3$	1	-1.62	-0.38

Note: ***,** and * indicates significance at the 1,5 and 10 percent level of testing, respectively.

Table 4: Heterogeneous Granger Non-Linear Causality Tests

Country	$CO \rightarrow FDI$	$FDI \rightarrow CO$
Argentina	1.90*	0.04
Belarus	-1.92*	8.08***
Belgium	4.16***	4.79***
Bolivia	6.34***	-2.94***
Botswana	-2.73***	9.69***
Brazil	-0.43	4.81***
Bulgaria	3.64***	1.08
Cameroon	1.30	0.49
Chile	0.26	6.05***
China	-0.99	5.44***
Colombia	-0.04	4.19***
Costa Rica	-0.90	6.35***
Ecuador	2.38**	-2.00**
Egypt	1.27	1.43
Estonia	2.44**	3.86***
Ghana	0.51	3.05***
Guatemala	0.21	1.86*
Hungary	2.51**	2.02**
Indonesia	-0.09	3.22***
India	-1.51	8.45***
Jamaica	5.26***	-0.47
Jordan	3.64***	3.19***
Kenya	-0.79	4.43***
Malaysia	0.37	3.06***
Mexico	0.41	3.29***
Namibia	0.722	2.81***
Nicaragua	4.70***	-1.90
Pakistan	-0.18	3.92***
Paraguay	1.11	0.43
Peru	-0.49	4.87***
Philippines	-0.14	2.11***
Poland	0.51	3.49***
Romania	1.32	2.29***
South Africa	-0.13	5.17***
El Salvador	-0.36	5.46***
Senegal	-1.95*	9.02***
Tunisia	3.05***	1.45
Turkey	-1.07	7.63***
Uganda	1.60	1.05
Ukraine	0.90	2.15**
Uruguay	-2.15**	13.83***
Venezuela	2.85***	-1.95*

Note: ***,** and * indicates significance at the 1,5 and 10 percent level of testing, respectively.

4. Conclusion

This paper determines the causal link between FDI and corruption in 42 developing countries using granger causality linear and non linear panel methods over the period 1998 to 2009. The findings show that the outcome of the causal association depends on the method used. The linear panel methods revealed that the majority of the markets indicate a bidirectional causal link between FDI and corruption while in contrast, for the nonlinear tests, the link from FDI to corruption dominates.

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FOREIGN DIRECT INVESTMENT AND CORRUPTION IN DEVELOPING ECONOMIES: EVIDENCE FROM GRANGER LINEAR AND NON-LINEAR PANEL CAUSALITY TESTS

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FOREIGN DIRECT INVESTMENT AND CORRUPTION IN DEVELOPING ECONOMIES: EVIDENCE FROM GRANGER LINEAR AND NON-LINEAR PANEL CAUSALITY TESTS

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Abstract

This paper aims at determining the Granger causal relationship between FDI and corruption in 42 developing countries using linear and non linear panel methods over the period 1998 to 2009. The findings show a causal association as corruption appears to Granger caused FDI and FDI seems to Granger lead corruption using linear methods, while for weaker results are obtain using non linear methods. The general value of these results is that adequate institutional facilities must be in place in developing economies to reduce losses from corruption especially in an attempt to attract foreign direct investment.

Keywords: Panel Linear and Non-Linear Causality, Corruption and Foreign Direct Investment

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