UNIVERSITY OF JOHANNESBURG

ECONOMIC DEVELOPMENT AND WELL-BEING RESEARCH GROUP

The effect of corruption on economic growth in the BRICS countries. A panel data analysis

Siphiwo Bitterhout and Beatrice D. Simo-Kengne

The effect of corruption on economic growth in the BRICS countries. A panel data analysis

SIPHIWO BITTERHOUT

School of Economics and Econometrics, University of Johannesburg.
Email: siphiwo.bitterhout@gmail.com

BEATRICE D. SIMO-KENGNE

School of Economics and Econometrics, University of Johannesburg.
Email: bdsimo-kengne@uj.ac.za

Abstract

This paper examines the effect of corruption on economic growth in the BRICS countries using panel dataset spanning the period 1996 to 2014. Empirical results indicate that controlling for only heterogeneity (fixed effect) leads to a negative association between output growth and corruption index. However, when heterogeneity and endogeneity are accounted for (GMM specifications), the corruption index exhibits a positive and significant effect on economic growth. While this result is contrary to a large body of empirical evidence, bar a few, which has found corruption to have a detrimental impact on economic growth, the growth impact of corruption does indeed decreases with the level of corruption. This suggests a possible corruption level from which, the relation might lead to opposite effects.

1. Introduction

The acronym 'BRICS' represents a grouping of emerging economies comprising Brazil, Russia, India, China and South Africa. The term was coined by the banking group Goldman Sachs in a 2001 paper that motivated the inclusion of Brazil, Russia, China and India into the Group of 7 (G-7 Forum of Finance Ministers) on account of these countries rising, and expected to continue to rise, in global economic significance (Goldman Sachs, 2001). Basing this finding on various measures of GDP between 2001/02 and 2011/12, Goldman Sachs (2001) predicted that the combined weight of BRICs, excluding South Africa, would rise to between 9% and 27% of global GDP. Furthermore, Goldman Sachs predicted that the BRICs' combined output would surpass that of the G-7 countries.

In recent years, the BRICS government has been confronted with concerns over corruption in their respective countries. In Brazil, investigations by the Brazilian Federal Police uncovered an alleged fraud and corruption scheme aimed at embezzling funds from Petrobas, an energy and petroleum company controlled by the Brazilian federal government. In China, President Xi Jinping made corruption crackdown a priority on the government agenda. Reports from China's ruling Communist Party indicate that it had punished nearly 300 000 officials in 2015 for corruption[1]. Similar concerns around corruption have emerged in India and South Africa as well[2].

---

[1] Accessed from http://www.bbc.com. 'China corruption crackdown netted 300, 000 in 2015'. Accessed on 20 April 2016.

[2] Accessed from http://www.cfr.org/corruption-and-bribery/Governance in India: Corruption. Accessed 4 September 2014. See also http://www.economist.com/news/middle-east-and-africa/21600729-why-string-corruption-scandals-top-so-disquieting-nkandla. Accessed on 2 May 2016.

Historically, the trend on corruption perceptions (see Figure 1 in appendix) points to a dissimilar but consistent picture across these countries.[3] Russia faces the highest levels of corruption perceptions relative to other BRICS member countries. Brazil, India and China also started off with relatively high corruption perceptions, but these have progressively been on a downward trend over the period in Figure 1, namely 1996-2014. Nonetheless, corruption perceptions remain relatively high. Lastly, South Africa, which, at the beginning of the sample period, had low corruption perceptions, has progressively experienced an upward trend in perceived corruption.

In light of the BRICS countries' experience with corruption, this study is interested in examining the impact of corruption on economic growth. Specifically, the study wishes to determine: whether (i) corruption is a significant determinant of economic growth; (ii) the quantity of the magnitude of such an impact, if it exists; and (iii) whether the impact of corruption on economic growth changes with the incidence of corruption, that is, the level of corruption.

This study first notes that no single definition of corruption exists in literature. Instead, the definition of corruption is acknowledged to be dependent on that which is to be modelled and measured (Bardhan, 1997 & Jain, 2001). That said, a broad consensus in the literature is that corruption entails the abuse of public office for personal gain (Bardhan, 1997; Jain, 2001; Svensson, 2005). Adhering to the convention in the literature, this study also defines corruption as the abuse or misuse of public office for private gain.

The above definition gives rise to three types of corruption associated with public office, based on the type of decision-maker; the source of misused power by a decision-maker; and the models used to explain corruption. The first type is 'grand corruption', which is corruption by political elites in economic policy-making. The second type is 'bureaucratic corruption', which is corruption by bureaucrats in their dealings with superiors, that is, political elites or the public. The third type is 'legislative corruption' which is the extent to which voting behaviour by legislators can be influenced by interest groups (Jain, 2001).

The literature on the effects of corruption on economic growth is ambiguous. Leff (1964) and Huntington (1968) have argued that corruption removes government-imposed inefficiencies and rigidities, which, in turn, constrains firms' abilities to invest in the economy and entrepreneurs' skills to innovate (Jain, 2001; Mo, 2001; Tanzi, 1998). Lui (1985) maintains that bribery can be used to speed up queues and service among customers, resulting in the efficient allocation of time among them. Beck and Maher (1986) argue that outcomes from bribery may mirror those from a competitive bidding market, without differences inefficiencies in both outcomes. Building on the work of Beck and Maher (1986), Lien (1986) has argued that, in bidding competitions, efficient firms are likely to afford higher bribes and thus projects will be awarded to these firms, without the loss of allocative efficiency in comparison to competitive bidding procedures.

The view that corruption has a positive impact on growth has, however, been subjected to criticism. Tanzi (1998) argues that corruption does not ease bureaucratic inefficiencies and rigidities since such rigidities are created by bureaucrats to extort bribes. Myrdal (1968) has argued that rather than speed up processes resulting in the efficient allocation of time;

---

[3] Low corruption index points are consistent with low levels of corruption perceptions in those countries and vice versa.

corruption may, in fact, cause bureaucrats to deliberately slow down the pace of processes with the intention of extorting bribes from customers, leading to the inefficient allocation of time (Leite & Weidemann (1999). Boycko, Shleifer and Vishny (1995) note that a further criticism of this argument is related to the uncertainty and lack of enforceability associated with corruption contracts. Lastly, it has been argued that the ability of firms to pay high bribes, and thus be awarded projects in bidding competitions, is not necessarily a reflection on the efficiency of such firms, but rather their ability to engage in rent-seeking, which has a negative impact on economic growth (Baumol, 1990; Shleifer & Vishny, 1993).

Some scholars have argued that corruption has a negative impact on growth. Romer (1994) argues that corruption is a form of tax on profits, which may deter investment in physical capital. Pellegrini and Gerlagh (2004) have argued that corruption increases uncertainty of investment returns, and, consequently, reduces investment spending. Mauro (1995) maintains that by changing the relative prices of goods and services, corruption changes the private investor's assessment of the relative merits of investment projects, leading to a misallocation of resources among sectors of the economy. Tanzi and Davoodi (1997) contend that corruption results in an increase in the number of government projects undertaken, changes the design; enlarges the size of such projects; as well as increases their complexity; resulting in a productivity fall in public investments. Some authors have noted that corruption causes individuals to invest in political capital instead of human capital, reducing the returns from the accumulation of human capital, skills and knowledge (Krueger, 1974; Erlich & Lui, 1999; Tanzi, 1998; Mo, 2001). In relation to this, Mauro (1995), as well as Tanzi and Davoodi (1997), maintain that corruption lowers governments' ability to raise revenues, which can be used to fund education.

While the theoretical debate on the impact of corruption on economic growth remains unsettled, the empirical literature on the subject has been emphatic in its support of the view that corruption has a negative impact on growth. Below we discuss some of these findings, as well as those relating to South Africa.

Mauro (1995) was among the earliest scholars to investigate the relationship between corruption and growth, focusing on corruption's effect on investment. The author concluded that corruption has a negative impact on investment and consequently growth. Mo (2001) investigated the channels through which corruption affects economic growth. Specifically, he focuses on how corruption affects human capital, investment and political stability. He concludes that the most important channel through which corruption affects growth is political instability, which accounts for 53% of the overall effect. Pellegrini and Gerlagh (2004) investigate the relationship between corruption and growth; how corruption affects investment, schooling, trade policy and political stability; as well as the various contributions of these channels on the relationship between corruption and growth.

Besides showing that corruption has a negative impact on growth, these authors show that corruption's impact on growth is most significant via the investment and trade policy channels. Meon and Sekkat (2005) investigate, at a macroeconomic level, the relationship between corruption and growth and a number of governance indicators. They conclude that besides the general conclusion that corruption has a negative impact on growth; the impact of corruption on growth is worsened in the presence of weak rule of law, an inefficient government and political violence. Hodge, Shankar, Rao and Duhs (2011) considered the relationship between corruption and growth, however, using a cross-country panel of data within a simultaneous equation framework. They conclude that corruption, via its effect on various transmission

channels, has a totally negative impact on growth. All these studies were cross-sectional in nature.

Among the panel data studies carried out, Gyimah-Brempong (2002) estimated the impact of corruption on growth and income distribution on African countries using a dynamic panel data estimator. Using a panel of 13 countries and a sample period between 1993 and 1999, the author found that corruption reduced GDP growth and per capita income by between 0.75 and 0.9 percentage points and 0.39 and 0.41 percentage points per year, respectively. Using dynamic panel estimators, Swaleheen (2011) investigated the impact of corruption on growth for a panel of 117 countries over the period 1984 to 2007 and concluded that corruption has a directly negative effect on growth. D'agostino, Dunne and Pieroni (2012) evaluated the impact of corruption on government spending and economic growth. Using a sample of African countries and a sample period between 1996 and 2007, these authors estimated a panel data model and concluded that corruption has a negative impact on growth.

In light of the previous studies on the impact of corruption and economic growth, the present paper aims to contribute to the existing literature by considering the impact of corruption on economic growth across BRICS countries using different panel techniques. The next section discusses the measurement issues of corruption.

2. Measuring corruption

Empirical studies on the impact of corruption on economic growth are plagued by disagreement over the correct measure of corruption. The contention is that corruption cannot be measured objectively. Without an objective measure, scholars and researchers have resorted to subjective measures of corruption, such as corruption perception indices. These indices are usually in the form of surveys targeted at individuals, households, firms or experts, and asking them about their experience of corruption, either in the private or public sector or both. The problem, however, is that corruption perception indices are known to be a poor reflection of real corruption experiences (Kauffman, Kraay and Mastruzzi, 2006; Gonzales, Lopez-Cordova & Valladares, 2007; Olken, 2009).

One of the reasons perception indices are a poor reflection of real corruption experience is that perceptions are inherently biased. In this regard, it is helpful to note the observation made by Olken (2009) that perceptions are biased because individuals' beliefs are biased. Similarly, Gonzalez et al. (2007) observe that, because each respondent has his own reference point, which is unlikely to be shared by many, perceptions tend to be plagued by a contextual problem. Another concern that has been raised about perceptions is the perceptions' convergence problem, which relates to the idea that peoples' perceptions of corruption will tend to converge since they receive news from the same mass media and hear their friends' opinion about corruption (Cabelkova & Hanousek, 2004).

Kauffman et al. (2006) argue that while some of the concerns raised about the validity of corruption perception indices remain valid, some have no merit. For instance, one of the arguments is that subjective measures of corruption are too unreliable. These authors argue that no measure of corruption can be 100% reliable in the sense of giving precise measures of corruption owing to the measurement error present in any forms of data, both subjective and objective. Another objection to the use of corruption perceptions is that they are generic and vague rather than a reflection of reality. Once again, Kauffman et al. (2006) note that survey questions on corruption have become specific, focused and quantitative. In this regard, it is also instructive to note the observation made by Olken (2009) in his study of corruption in the

context of a road-building programme in rural Indonesia. In the study, Olken (2009) observes that villagers were sophisticated enough to distinguish between general levels of corruption in the village and corruption in the particular road project examined.

Given the issues around corruption perception indices, two questions need to be answered relating to their relevance. The first one is whether or not to abandon corruption perception indices completely. Kaufman et al. (2006) argue that corruption perception indices remain the closest way to measure corruption. This is because it is difficult to measure the real corruption experience owing to the secretive nature of corruption and the fact that corruption is known not to leave a paper trail.

Following from the first question is whether or not the valid limitations inherent in corruption perception indices can be dealt with adequately enough to give proper insight into the nature and implications of corruption for the economy. We argue that it is possible to deal with these limitations.

The first way to deal with these limitations is by noting the bias inherent in whichever measure of corruption used and dealing with each bias in the interpretation of results. By taking note of these biases and how they shape these experts' perceptions of corruption in different countries, it becomes possible to adjust this bias downward in the interpretation of results. Secondly, based on who is being asked, particular surveys are likely to provide better information on corruption than others. For example, investment analysts, interviewed as experts, will give a better view of how corruption affects their ability to invest in a country relative to an individual who has no resources to invest in the real economy. Similarly, individuals with political connections will likely provide a more informed view of how corruption affects their incentives to accumulate human capital (relative to political capital) than investment analysts.

In essence, based on the respondents of each survey, particular surveys are likely to reflect corruption in particular spheres of society better than others. Thus, using a variety of corruption perception indices may be a useful way of reducing bias inherent in a particular index as well as providing proper insight into corruption. Lastly, a distinction ought to be drawn at all times between what corruption perception indices measure and how they differ from actual corruption experiences in order to make proper inferences and recommendations from studies that make use of them. To address these shortcomings, Kauffman and Kraay (2008) advise that it is important for researchers to rely on a variety of data sources as measures of corruption. However, due to the lack of data, this study employs only one measure of corruption.

3. Methodology

This study seeks to investigate the effect of corruption on economic growth in the BRICS countries using a battery of panel[4] data techniques. The major attraction of panel data techniques stems from the ability of such models to address serious econometric issues such as heterogeneity, endogeneity and the persistence of shocks in dynamic models, which cannot be efficiently addressed in pure time-series and pure cross-sectional models. Accordingly, besides the benchmarks fixed effects model (FEM) and/or random effects model (RAM), the Arellano-Bond first difference and the system generalized method of moments estimators are considered to account for the dynamic nature of the growth model.

---

[4] These includes Fixed effects, Random Effects and GMM estimators

Specifically, the baseline model is given as:

$$PER\ CAP\ GDP_{it} = \alpha_i + \beta\ CORR_{it} + \gamma\ CORRSQ_{it} + \delta'\chi_{it} + \varepsilon_{it} \qquad , \qquad (3.1)$$
$$i = 1,..,\mathrm{N}\ (\text{country});\ t = 1,..,\mathrm{T}\ (\text{time})\ ,$$

where: α_i signifies country-specific fixed effects; $CORR_{it}$ and $CORRSQ_{it}$ are the corruption variable and the square of the corruption variable; χ_{it} is a vector of control variables, which includes investment, literacy rate, population growth, government consumption, openness and political stability $(INV_{it};\ LIT_{it};\ POPGROW_{it};\ GOVCON_{it};\ OPEN_{it};\ POLSTAB_{it})$ respectively; and ε_{it} is the error term.

3.1.1. Heterogeneity

The significance of heterogeneity bias in the literature on corruption and economic growth has been emphasized by Gyimah-Brempong (2002); Swaleheen and Stansel (2007) as well as Ahmad, Ullah and Arfeen (2012), among others. They argued that time-invariant heterogeneity - in terms of religion, culture and institutions - has an important role to play in explaining cross-country differences in the relationship between corruption and economic growth. Hence, failure to omit country and time-specific effects that exist among cross-sectional units and time series units could result in inconsistent parameter estimates (Hsaio, 2003).

In fact, the use of different political systems represents one source of heterogeneity among BRICS countries. China is a one-party state; Russia has a centralized government; while Brazil, India and South Africa are democracies. As North (1991) noted, institutions both formal (constitutions, laws and property rights) and informational (customs, traditions and taboos) have a role to play in the economic performance of nations. Furthermore, differences, in terms of the importance of the various determinants of economic growth of the BRICS countries, are likely to lead to heterogeneity. In this regard, it is worth noting that BRICS countries also have varying levels of economic development, with China outpacing the rest of the other countries in terms of economic size, growth and trade. The member countries are also differently situated in terms of resources, absolute consumption and energy intensity and have different demographic trends. For instance, Brazil has a predominantly urban population, while India is largely rural. Russia has an ageing population while South Africa is still young (Saran, Singh & Sharan, 2012).

A potential solution to such heterogeneity bias is the use of fixed effects or random effects models, which adequately control for unobserved time-invariant heterogeneity (Hsiao, 2003). A key assumption of the fixed effects model is that the explanatory variables are independent of the error term, ε_{it}. The parameter estimates are obtained by performing the regression in deviations from individual means. In effect, the fixed effects model eliminates country-specific effects, α_i, by transforming the data known as 'demeaned' or 'within transformation'. And the ordinary least squares technique is implemented on the transformed data to obtain the parameter estimates known as the 'within estimator' or 'fixed effects estimator' (Verbeek, 2004). A fundamental assumption of the fixed effects model is that of strict exogeneity, wherein a strictly exogenous variable is not dependent on current, future and past values of the error term (Verbeek, 2004).

A shortcoming of the fixed effects model is its assumption of strict exogeneity, which may not hold in certain instances. In such circumstances, the random effects model is the most appropriate. Contrary to the fixed effects model, the random effects model assumes that the

country-specific effects, α_i, are random factors that are independently and identically distributed over individual countries. The error term consists of two components: an individual specific component, which is time-invariant, and a remainder component, which is assumed to be uncorrelated over time; while α_i and ε_{it} are assumed to be mutually independent and independent of the explanatory variables. In light of these assumptions, the OLS estimator for the country-specific effects and the parameters is unbiased and consistent.

However, the error components structure implies that the composite error term, $\alpha_i + \varepsilon_{it}$, exhibits a particular form of autocorrelation (unless $\sigma_\alpha^2 = 0$). As a result, routinely computed standard errors for the OLS estimator are incorrect and a more efficient generalized least squares (GLS) estimator is obtained by exploiting the structure of the error covariance matrix (Verbeek, 2004).

Verbeek (2004) notes that it may be preferable to use a fixed effects estimator wherein interest lies in the country-specific effects, α_i. Furthermore, the fixed effects may be the appropriate model to use when the country-specific effects, α_i, and the explanatory variables, x_{it}, are correlated, since the fixed effects model eliminates the individual effects of α_i and the problems they cause. The random effects approach, however, because it ignores the correlation between individual effects (α_i) and the explanatory variables (x_{it}), may lead to inconsistent estimators if such an assumption holds. Therefore, a formal testing procedure, namely, the Hausman test has been proposed as the test for choosing between the fixed effects estimator and the random effects estimator.

The Hausman test essentially compares two estimators: one which is consistent under both the null and alternative hypotheses; and one which is consistent and typically efficient under the null hypothesis only. The test compares the random effects model against the fixed effect model under the following hypothesis:

H_0: α_i is independently distributed of χ_i (random effects);
H_1: α_i is correlated with χ_i (fixed effects).

If the p-value is < 0.05, the null hypothesis is rejected and the fixed effects model is chosen; but if the p-value is > 0.05, the null hypothesis is not rejected, meaning the random effects model is more consistent and efficient.

While fixed effects and random effects models are capable of addressing problems of heterogeneity, such models are likely to suffer from a number of shortcomings, notably endogeneity, especially in the context of economic growth.

3.1.2. Endogeneity
Endogeneity refers to the correlation of explanatory variables and the disturbances in a model. This may be caused by the omission of relevant variables, measurement error, sample selectivity, self-selection or other reasons. Endogeneity results in inconsistent ordinary least squares (OLS) estimates (Baltagi, 2005).

One source of endogeneity in the corruption and economic growth literature is simultaneity bias. Simultaneity refers to the dual causality that exists between the dependent and one or more of the explanatory variables, that is, corruption, investment and the rate of economic growth. In other words, random shocks that affect economic growth may simultaneously affect

corruption and investment as well as other explanatory variables. (Gyimah-Brempong, 2002; Swaleheen, 2011; Islam, 1995; Baltagi; 1995: Swaleheen & Stanesel, 2007).

The second source of endogeneity is omitted variable bias. This is because some variables that help explain economic growth might not be included in the model due to the lack of consistent data. For example, human capital is regarded as a determinant of economic growth. This variable is commonly proxied by the use of gross enrolment ratios in primary and secondary education. However, due to the lack of data for the BRICS countries, this study had to rely on adult literacy rates as a proxy for human capital. Other omitted variables include those relating to rule of law or property rights, which were excluded from the present study due to the lack of data but have been considered by other scholars as determinants of economic growth.

Another source of endogeneity is measurement error, which arises from the use of survey data. In this instance, the corruption data used in the present study is based on perceptions of corruption in BRICS countries based on individuals', households' and experts' perceptions of corruption in these countries. In this regard, corruption perceptions data is known to be biased on the basis of economic development, religious beliefs and democratic institutions (Donchev & Ujheyli, 2014). Further, they are known to be a poor reflection of corruption experience (Kauffman, Kraay & Mastruzzi, 2006).

A third source of endogeneity in the corruption and economic growth literature is attributed to the dynamic structure of economic growth models. Economic growth models include, as an additional explanatory variable, a lag of the dependent variable, that is, economic growth in previous periods, to account for the persistence of economic growth (Islam, 1995; Gyimah-Brempong, 2002; Swaleheen, 2011). However, the addition of the lagged dependent variable causes correlation between the lag dependent variable and the error term, resulting in biased estimates of parameters (Hsiao, 2003; Judson & Owen, 1999).

To address the problems of endogeneity in the model, the study proposes the use of the generalized method of moments estimators (Caselli, Esquivel & Lefort, 1996). More specifically, the model is presented as follows:

$$LOG\ PERCAP\ GDP_{it} = \alpha_i + \beta\ CORR_{it} + \gamma CORRSQ_{it} + \delta'\chi_{it} + \lambda LOG\ PERCAP\ GDP_{i(t-1)} + \varepsilon_{it}$$
(3.2)

$i = 1, .., N(country); t = 1, .., T\ (time),$

where: α_i is country-specific fixed effects; $CORR_{it}$ and $CORRSQ_{it}$ are proxies for corruption and the square of corruption; χ_{it} is a vector of control variables, which includes $INV_{it}, LIT_{it}, POPGROW_{it}, GOVCON_{it}, POLSTAB_{it}$ and $OPEN_{it}$.

The variable $LOGPERCAP\ GDP_{i(t-1)}$ is the lag of the logged dependent variable; and ε_{it} is the error term.

This study employs the Arellano-Bond first difference estimator as proposed by Arellano and Bond (1991). To obtain the Arellano-Bond estimator, the growth regression is first rewritten as a dynamic model, as in equation (3.2). Secondly, the dynamic model is differenced in order to eliminate individual effects. Thirdly, the right-hand side variables are instrumented using all lagged values of endogenous and predetermined variables as well as the current and lagged values of exogenous regressors as instruments in the differenced equation. The last step eliminates the inconsistency arising from the endogeneity of the explanatory variables, while the differencing removes the omitted variable bias. The model thus appears as follows:

$$\Delta LOG\ PERCAP\ GDP_{it} = \alpha + \beta\Delta CORR_{it} + \gamma\Delta CORRSQ_{it} + \delta\Delta'^{\chi_{it}} + \lambda\Delta LOG\ PERCAP\ GDP_{i(t-1)} + \Delta\varepsilon_{it}$$
(3.3)
$i = 1,..,N\ (country); t = 1,..,T\ (time).$

However, in circumstances where the lagged dependent variable and explanatory variables are persistent, the lagged instruments of the Arellano-Bond first difference estimator are weak, thus compromising the asymptotic precision of the estimator. Furthermore, the first differences used in the Arellano-Bond estimator worsen the bias due to measurement errors in variables (Blundell & Bond, 1998; Felbermayr, 2005; Swaleheen, 2011).

3.1.3. Persistence of economic growth

A solution to problems caused by the persistence of the lag of the dependent variable and explanatory variables is the use of system generalized method of moments estimators as proposed by Blundell and Bond (1998). The Blundell and Bond GMM system estimator jointly estimates the Arellano-Bond GMM first difference estimator in first differences and levels, using different sets of instruments for each part. The instruments for the equations in first differences are lagged level values of the endogenous variables and first differences of the exogenous variables. The instruments for the equations in levels are lagged differences of the endogenous variables under the weak assumption that the country effects are time-invariant. Further, additional instruments, either in levels or differences, can be added for the equation in levels or differences or both (Swaleheen, 2011).

In order to test for the validity of the instruments in both the Arellano-Bond first difference estimator and the system GMM estimator, the Sargan test for over-identifying restrictions is employed. The Sargen test tests whether the instruments, as a group, appear to be exogenous (Felbermayr, 2005). The null and alternate hypotheses of the Sargan test are given by the following:

H_0: Over-identifying restrictions are valid;
H_1: Over-identifying restrictions are not valid.
The Sargan test has an asymptotic chi-squared distribution. A failure to reject the null hypothesis is an indication that the instruments are valid.

An additional test carried out under the Arellano-Bond first difference estimator and the system GMM estimator is the test for second-order autocorrelation in the differenced error term as suggested by Arellano and Bond (1991) as well as Blundell and Bond (1998). In both cases, a failure to reject the null hypothesis suggests the lack of serial autocorrelation in the second-order differenced error term and hence supports the results of the model.

4. Empirical Analysis

4.1. Preliminary Data Analysis
4.1.1. Data

This study compiles annual data for the five BRICS countries for the period 1996 to 2014 (that is, T=19 and N=5). Based on the available data, we follow Swaleheen (2011) and Gyimah-Gyimah-Brempong (2002) and make use of the following annual time series: real per capita

GDP; investment; population growth; government consumption expenditure; adult literacy rates; trade openness; political stability and corruption perception indices[5].

Investment is expected to have a positive effect on economic growth since investment adds to the productive capacity of the economy by increasing existing fixed capital stock. Population growth is expected to have a negative impact on economic growth, since a rising population reduces the economic resources available to inhabitants, decreases investment and diverts resources, using them to maintain rather than increase the capital stock per worker. Government consumption expenditure is expected to have a negative impact on economic growth since it lowers savings and growth through the distorting effects from taxation or government expenditure programmes. Adult literacy is a proxy for human capital and is expected to have a positive impact on economic growth since an educated labour force is better at creating, implementing and adopting new technologies. Trade openness is expected to have a positive impact on economic growth, since relatively more open countries face more competition from imports, thus forcing local firms to become efficient in their allocation of resources. Political stability is expected to have a positive impact on economic growth since politically stable countries protect property rights, which are essential for investment and economic growth. Except for the data on corruption, which was sourced from Transparency International, as well as the data on political stability, which was sourced from the Polity IV database; all the other data was sourced from the World Bank's World Development Indicators.

TABLE 1: SUMMARY STATISTICS: ANNUAL DATA

| Variable		Mean	Std. Dev.	Min	Max	Observations	
LOG PERCAP GDP	Overall	7.95	0.83	6.2	8.84	N	95
	Between		0.87	6.62	8.6	n	5
	Within		0.29	7.20	8.71	T	19
PERCAP GDP GROW	Overall	0.18	1.14	-3.46	8.78	N	95
	Between		0.27	-0.14	0.55	n	5
	Within		1.11	-3.14	8.42	T	19
LLOG PERCAP GDP	Overall	7.93	0.84	6.20	8.84	T	90
	Between		0.88	6.6	8.59	N	5
	Within		0.28	7.22	8.67	T	18
CORR	Overall	6.50	0.83	4.32	7.9	N	95
	Between		0.85	5.28	7.55	n	5
	Within		0.34	5.54	7.49	T	19
CORRSQ	Overall	42.95	10.62	18.66	62.41	T	95
	Between		10.8	27.99	57.06	N	5
	Within		4.3	33.62	56.8	T	19
INV	Overall	24.73	8.74	14.39	45.76	N	95
	Between		9.1	18.25	39.33	n	5
	Within		3.08	18.09	31.16	T	18.6
LIT	Overall	86.86	11.61	61.01	99.7	N	90

---

[5] Corruption perceptions are measured on a scale of 0 to 100, wherein a score of 0 means the highest level of perceived corruption and a score of 100 means the lowest level of perceived corruption. Following Swaleheen (2011), we transformed this data such that as corruption perceptions increase, the score of the index also rises. Hence, our Corruption Perceptions Index score is given by CORR=100-CPI.

	Between		8.09	73.5	95.53	n	5
	Within		9.05	67.28	111.86	T	18
POPGROW	Overall	1.00	0.74	-0.46	2.48	N	95
	Between		0.77	-0.16	1.7	n	5
	Within		0.28	0.57	1.78	T	19
POLSTAB	Overall	29.74	22.21	0	65	N	95
	Between		24.01	6.68	56	n	5
	Within		5.23	20.74	38.74	T	19
GOVCON	Overall	16.39	3.26	10.29	21.07	N	95
	Between		3.46	11.45	19.17	n	5
	Within		0.99	12.91	19.4	T	19
OPEN	Overall	20.98	6.66	8.87	37.24	N	95
	Between		5.64	12.21	27.82	n	5
	Within		4.32	11.71	31.48	T	19

Source: STATA 12 estimations.

Table 1 above presents a summary of the data used in this study. Cursory evidence on the relationship is depicted in Figure 1.3 above, which shows a scatter plot of real per capita GDP and corruption perceptions among BRICS countries. The figure shows that, at the intermediate levels of real per capita GDP, which is between $3000 and $6000, there is a negative relationship between corruption and economic growth. Such a pattern is, however, not clearly discernible at real per capita GDP levels above $6000 and at levels between $1000 and $3000. Lastly, the figure also shows a slightly negative relationship between corruption and real per capita GDP at real per capita GDP levels below $1000.

FIGURE 2: REAL PER CAPITA GDP AND CORRUPTION PERCEPTIONS
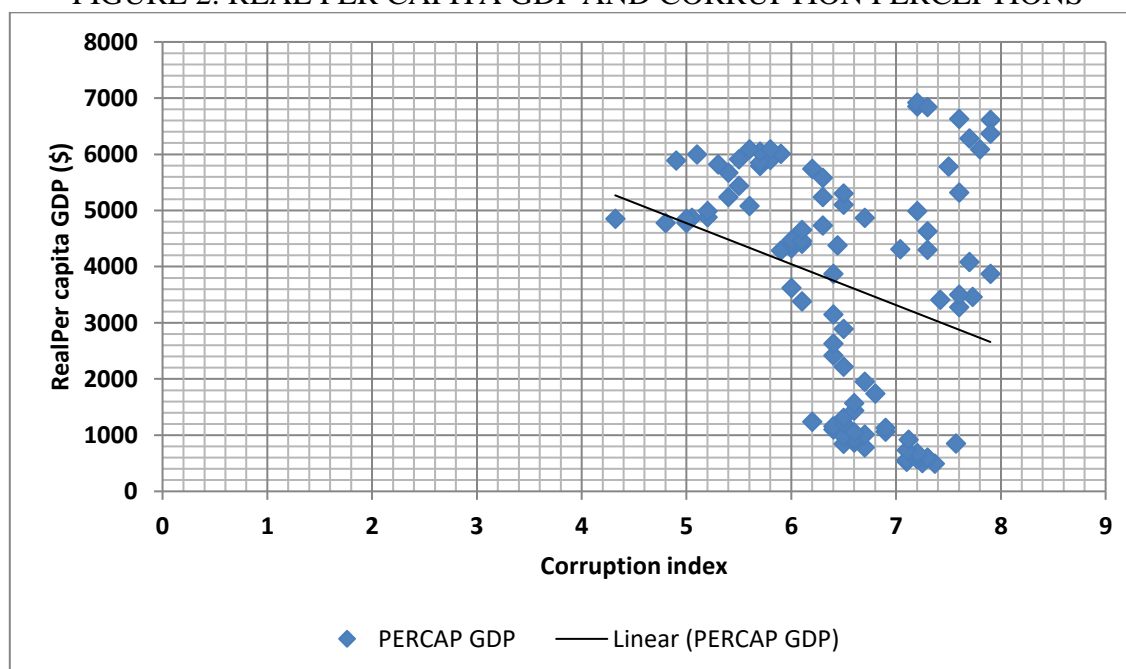
Source: World Bank Development Indicators, Transparency International and author's own calculations.

The above inference, however, may be misleading given that they are not based on any statistical methods or inferences that are best suited to the study of this relationship. In this

regard, it is the purpose of this study to conduct the assessment of the impact of corruption on economic growth using statistically robust methods of inference.

4.1.2. Stationarity

Following the standard approach of analysing panel time series, the first step consists of assessing the stationarity property of the variables upon which the choice of the appropriate estimation technique will be based. To test for the stationarity property of the variables, we conducted panel unit root testing, which determines whether the relationship between the dependent variable and the explanatory variables can be regarded as having a sound economic basis, that is, that the relationship is not spurious in nature. The stationarity properties of the variables were examined using the Levin-Lin-Chu panel unit root test. The null and alternate hypotheses of the LLC test are given by:

H_0: $Panels\ contain\ unit\ roots$;
H_1: $Panels\ are\ stationary$;

The test statistic is the bias-adjusted t-statistic (adjusted t*). The decision criterion is that, if the probability of the adjusted t* is less than 0.005, the null hypothesis that the panels contain unit roots is rejected; otherwise, we fail to reject the null hypothesis that the panels contain unit root tests. In Table 3, the probabilities are all less than 0.05, indicating that we can reject the null hypothesis and conclude that the panels are stationary, and integrated to order 0, that is, they are all [I,(0)].

TABLE 2: LEVIN-LIN-CHU TEST RESULTS

	Adjusted t* statistic	p-value
LOG PERCAP GDP	-4.0290	0.0000
PERCAP GDP GROW	-3.4002	0.0003
CORR	-2.0132	0.0220
CORRSQ	-1.9970	0.0229
INV	-3.3014	0.0005
LIT	-2.3223	0.0101
POPGROW	-2.3150	0.0103
GOVCON	-2.1918	0.0142
POLSTAB	-3.7081	0.0001
OPEN	-1.7515	0.0399

Source: Author's calculations.

4.2. Empirical results

This section presents the findings of this study on the effects of corruption on economic growth in BRICS countries. The section first considers the results from a basic model, the fixed effects results, and proceeds to consider the results from the Arellano-Bond first differenced estimator model; and finally compares these results with those of the benchmark model, the system GMM model.

Before reporting on the regression results of the basic model, we choose between two candidate models, namely, the fixed effects and the random effects models. This is done by considering the results of the Hausman test. The null and alternate hypothesis of the Hausman test is given by the following:

$H_0 = u_i$ uncorrelated with explanatory variables (random effects model);
$H_1 = u_i$ correlated with the explanatory variables (fixed effects model).

Where: u_i refers to the country-specific effect. The results of the Hausman test are presented in Table 4 below.

TABLE 3: HAUSMAN TEST STATISTIC

	chi2	Prob > chi2
Corruption	11.81	0.0188

Source: Author's calculations, STATA.

The probability of the chi-squared statistic is 0.0188, which is less than 0.05. Therefore we reject the null hypothesis and conclude that country-specific effects are correlated with the explanatory variables. As a result, we choose the fixed effects model.

The fixed effects model was thereafter tested for the presence of heteroscedasticity, a common problem with cross-sectional data. The heteroscedasticity test checks whether the variances of the five BRICS countries are equal or not.

$H_0: \sigma^2 = \sigma^2$ for all countries;
$H_1: \sigma^2 \neq \sigma^2$ for at least one country.

The null hypothesis is that the variances of the BRICS countries are equal, while the alternative hypothesis is that at least one of the variances of the BRICS is not equal to the rest. The null hypothesis is rejected if the probability of the F-statistic is less than 0.05. Table 5 below reports F-statistics and its probability.

TABLE 4: HETEROSKEDASTICITY TEST

	F-Statistic	Prob> F-Statistic
$H_0: \sigma^2 = \sigma^2$	3.29	0.0153

Source: STATA output

The probability of the F-statistic is 0.0153, which is less than 0.05. Therefore we reject the null hypothesis that the BRICS countries have equal variances and conclude that the variances among the BRICS countries are heteroskedastic. To correct the presence of heteroskedasticity, we use the robust standard error estimator for fixed effects modelling.

4.2.1. Fixed effects results

The results of the fixed effects model are summarized in Table 6 below. The 'within' R-square measures the extent to which variations in economic growth are explained by country-specific variations amongst the BRICS countries. The results suggest that 30.8% of the variation in economic growth is explained by country-specific factors. Further, only 0.3 % of the variation in economic growth is explained by factors that exist across the BRICS countries. Lastly, only 9.1% of the explanatory variables explain the variation in economic growth across the total sample.

The probability of the F-Statistic is 0.003, which is less than 0.05. Therefore we reject the null hypothesis at the 5% level of significance and conclude that the explanatory variables are jointly significant in explaining variations in real per capita GDP.

TABLE 5: FIXED EFFECTS RESULTS – ANNUAL DATA

Dependent Variable: PERCAP GDP GROW		
	Coeff.	S.E
CORR	-9.48***	3.21
CORRSQ	0.83***	0.25
INV	-0.05	0.06
LIT	0.03**	0.01
POPGROW	0.39	0.58
GOVCON	-0.21*	0.12
OPEN	0.03	0.06
POLSTAB	0.01	0.04
R-square (within)	0.3088	
R-square (between)	0.003	
R-square (overall)	0.0911	
F-Stats	4.3	
Prob > F-Stats	0.003	
Observations	90	
Cross-sections	5	

Note: (*, **, ***) denotes statistical significance at 10%, 5% and 1%.

Source: Author's calculations - robust standard errors reported.

The coefficient of corruption is negative and significant. A one unit increase in the corruption index, that is, worsening of corruption reduces the growth rate of real per capita GDP by 0.09 percentage points. This result supports the hypothesis that corruption has a negative impact on economic growth, a result first supported by Mauro (1995) as well as Gerlagh and Pellegrini (2004). To measure the partial effect of a change in the incidence of corruption, we consider the corruption squared variable. The coefficient of the corruption squared variable is positive and significant. This supports the hypothesis that the effect of corruption on growth changes with the level of corruption. A one unit increase in the corruption index, at levels above 5.7 index points, reduces the annual growth rate of real per capita GDP by 0.008 percentage points[6]. Hence, at levels below 5.7 index points, the effect of corruption on growth is represented by the coefficient of the corruption variable; while, at corruption values above 5.7 index points, the effect of corruption on growth is represented by the coefficient of the corruption squared variable.

The coefficient of investment has the wrong sign and is insignificant. The coefficient of adult literacy rates has the expected positive sign and is significant. The coefficient of the rate of population growth has the expected positive sign but is insignificant. The coefficient of government consumption expenditure has the expected negative sign and is significant. The coefficient of openness has the expected positive sign but is insignificant. The coefficient of political stability has the expected positive sign but is insignificant.

---

[6] To obtain the value at which the partial effect of corruption changes, i.e. 5.7 index points, we note that the quadratic nature of corruption can be represented as: $ax^2 + bx + c$, where a is the coefficient of corruption squared (0.83) and b is the coefficient of corruption (-9.48). The value at which the impact of corruption is zero, i.e. where the curve of the quadratic equation for corruption turns, is given by: $x = \frac{-b}{2a}$, which is $\frac{-(-9.48)}{(0.83)*(2)} \approx$ 5.7 index points.

These results, however, may be inconsistent due to the factors elaborated upon in Chapter 3 of this study, namely, that: (i) time-invariant heterogeneity - in terms of religion, culture and institution, etc. - may have a role in explaining cross-country differences in the relationship between corruption and economic growth; (ii) corruption, investment and economic growth are simultaneously determined; and (iii) economic growth is characterized by persistence, wherein current growth rates are correlated with their own lagged values.

To correct for the shortcomings of the fixed effects model, we estimated dynamic panel models using the Arellano-Bond first-differenced estimator. The results are discussed in the next section.

4.2.2. Arellano-Bond first differenced estimator results

For the Arellano-Bond first difference estimator, we report results based on models estimated using annual data and averaged data. The estimation of the model based on averaged data is on account of business cycle effects due to the high frequency of the data that does not capture (Swaleheen, 2011; Gyimah-Brempong, 2002; Bond, Hoeffler, Temple, 2001). The averaged data were computed for the periods: 1996 - 1999; 2000 – 2003; 2004 – 2007; 2008 – 2011 and 2012 – 2014. The model was estimated using a one-step estimator.

Annual data results

The dependent variable is the log of real per capita GDP. Further, government consumption expenditure, political stability and openness were assumed to be predetermined. Population growth and adult literacy rates were assumed to be exogenous, while investment and the corruption variables we assumed to be endogenous. Lastly, the lag of the dependent variable, that is, the log of real per capita GDP, was included as an additional explanatory variable. The Arellano-Bond first difference estimator was conducted using the one-step estimator.

The probability of the Wald chi-square statistic of 0.0000 is less than 0.05, suggesting that the model is well specified in that the explanatory variables are jointly significant in explaining variations in real per capita GDP.

The coefficient of corruption has a positive sign and is significant. A one unit increase in the corruption index, that is, a worsening of corruption, increases the growth rate of real per capita GDP by 0.12 percentage points, at corruption levels under 7 index points. The coefficient of corruption squared is negative and significant. A one unit increase in the corruption index at levels beyond 7 index points increases the growth rate of real per capita GDP by 0.01 percentage points. The implication of the result is that at higher levels of corruption, that is, those above 7 index points, the impact of corruption on growth is lower than at lower levels of corruption, that is, at levels below 7 index points, as evidenced by the disparity in the magnitudes of the coefficients of corruption and corruption squared variables.

The coefficient of the lagged dependent variable has a positive sign and is significant. The elasticity of current real per capita GDP (0.98), with respect to its lagged value, reveals a high degree of persistence of economic growth. The coefficient of investment is positive but insignificant. The coefficient of adult literacy rates is positive but insignificant. The coefficient of the population growth rate is negative and significant. The coefficient of government consumption expenditure is negative and significant. The coefficient of political stability is negative and insignificant. The coefficient of openness is a positive sign but insignificant.

The probability of the Sargan test statistic is 0.619, which is greater than 0.05, suggesting that the instruments used in the model are valid. Results from the serial autocorrelation test show a z statistic of 0.066 and 0.139, respectively, which are greater than 0.05, for the first-differenced error term of orders 1 and 2, suggesting the absence of serial correlation in the differenced error term.

Averaged data results
The p-value of the Wald statistic is equal to 0.0000, which is less than 0.05, suggesting that the explanatory variables are jointly significant in explaining variations in real per capita GDP. The probability of the Sargan test statistic is 0.57, which is greater than 0.05, suggesting that the instruments used are valid. The probabilities of the serial correlation z statistics are 0.148 and 0.889, respectively, suggesting a lack of serial correlation in the first differenced error term.

Contrary to the Arellano-Bond first difference model estimated using annual data, the coefficients of corruption and corruption squared are negative and positive, respectively but insignificant when using averaged data; implying the unresponsiveness of output to corruption at all levels.

TABLE 6: ARELLANO-BOND FIRST DIFFERENCE ESTIMATOR

	Dependent Variable: LOG PERCAP GDP			
	Annual Data		Average Data	
	Coeff.	S.E	Coeff.	S.E
CORR	0.122***	0.035	-0.222	0.19
CORRSQ	-0.009***	0.003	0.02	0.014
LLOG PERCAP GDP	0.98***	0.018	0.791***	0.102
INV	0.001	0.002	0.005	0.003
LIT	0.001	0.000	-0.001	0.002
POPGROW	-0.022***	0.004	-0.05	0.07
GOVCON	-0.017***	0.002	-0.049***	0.017
POLSTAB	-0.001	0.001	0.008	0.008
OPEN	0.001	0.001	0.002	0.002
Wald chi2	6934.11		1569.84	
Prob > chi2	0.0000		0.0000	
Sargan chi2 (Prob > chi2)	72.648 (0.6193)		4.826252 (0.5663)	
AR(1) z Statistic (Prob > z)	-1.8325 (0.0669)		-1.4449 (0.1485)	
AR(2) z Statistic (Prob > z)	-1.4767 (0.1397)		0.13866 (0.8897)	
Observations	80		15	
Number of groups	5		5	

Note: (*, **, ***) denotes statistical significance at 10%, 5% and 1%.
Source: Author's calculations - robust standard errors reported.

The coefficient of the lagged value of the dependent variable is positive and significant. The elasticity of current real per capita GDP of 0.79 percentage points, with respect to its own lagged value, still reveals a high degree of persistence of economic growth. The coefficient of investment is positive but insignificant. The coefficient of adult literacy rates is negative but insignificant. The coefficient of the rate of population growth is negative but insignificant. The coefficient of government consumption expenditure is negative and significant. The coefficient

of political stability is positive but insignificant. The coefficient of openness is positive but insignificant.

Despite these findings Bond, et al. (2001) note that due to the persistence of economic growth, and the fact that economic growth empirical models consider a small number of time periods based on averaged data, the use of the Arellano-Bond first-differenced estimator leads to estimation problems. Bond et al. (2001) note that the Arellano-Bond first-differenced estimator estimates of the coefficient on the lagged dependent variable tends to lie below the corresponding within the group's estimates. This result suggests that the Arellano-Bond first-differenced estimates are biased. One of the reasons for this result is that, given the high degree of persistence in economic output, the instruments are weak. These authors, whose results we discuss below, argue that more plausible results can be achieved by the use of a system GMM estimator.

4.2.3. System GMM Results

The system GMM estimator exploits assumptions about the initial conditions to obtain moment conditions that remain informative even for persistent series, and this estimation method has been shown to perform well in simulations (Bond et al, 2001). It is for these reasons that this study employs the system GMM estimator as its baseline model.

The dependent variable is the log of real per capita GDP. The GMM system estimator was also estimated using both annual data and averaged data. The averaged data were computed for the periods: 1996 – 1999; 2000 – 2003; 2004 – 2007; 2008 – 2011 and 2012 – 2014. The models were estimated using the one-step estimator. Following Swaleheen (2011), the following variables were treated as endogenous: investment, government consumption, political stability, openness, corruption and corruption squared. The population growth rate and adult literacy rates were treated as exogenous.

Annual data results
The probability of the Wald chi-square statistic is equal to 0.0000, which is less than 0.05, suggesting that the explanatory variables are jointly significant in explaining variations in the log of real per capita GDP.

The coefficient of corruption is positive and significant. A one unit increase in the corruption index increases the growth rate of real per capita GDP by 0.10 percentage points, at levels below 5.6 index points. The coefficient of corruption squared is negative and significant. A one unit increase in the corruption index at levels higher than 5.6 index points increases the growth rate of real per capita GDP by 0.03 percentage points. The implication of this result is that, at lower levels, corruption has a significantly higher beneficial impact on growth than at higher levels of corruption, that is, corruption levels above 5.6 index points.

The coefficient of the lagged dependent variable is positive and significant. The elasticity of current real per capita GDP (0.99), with respect to its lagged value, displays a high degree of persistence of economic growth. The coefficient of investment has the expected positive sign but is insignificant. The coefficient of adult literacy rates has the anticipated positive sign and is significant. The coefficient of the population growth rate has the predicted negative sign and is significant. The coefficient of government consumption expenditure has the negative sign and is significant. The coefficient of political stability is negative and significant. The coefficient of openness is negative but insignificant.

TABLE 7: SYSTEM GMM RESULTS

	Annual Data		Average Data	
Dependent Variable: LOG PERCAP GDP				
	Coeff.	S.E	Coeff.	S.E
CORR	0.103***	0.012	0.454***	0.011
CORRSQ	-0.009***	0.001	-0.039***	0.001
LLOG PERCAP GDP	0.993***	0.015	0.884***	0.007
INV	0.000	0.001	0.009***	0.003
LIT	0.001*	0.001	0.002	0.002
POPGROW	-0.025***	0.005	-0.109***	0.014
GOVCON	-0.014***	0.005	-0.017*	0.009
POLSTAB	-0.001**	0.000	-0.005***	0.001
OPEN	0.000	0.001	0.000	0.002
Wald chi2	748566.81		40828.39	
Prob > chi2	0.0000		0.0000	
Sargan chi2 (Prob > chi2)	133.4806 (0.844)		10.61289 (0.9698)	
AR(1) z Statistic (Prob > z)	-1.7591 (0.0786)		-0.14826 (0.8821)	
AR(2) z Statistic (Prob > z)	-1.5584 (0.1191)		-1.6088 (0.1077)	
Observations	85		20	
Groups	5		5	

Note: (*, **, ***) denotes statistical significance at 10%, 5% and 1%.

Source: Author's calculations - robust standard errors are reported.

The probability of the Sargan chi-squared statistic is equal to 0.844, which is greater than 0.05, suggesting that the instruments are valid. The probabilities of the z statistics for the first differenced error term of orders 1 and 2 are 0.078 and 0.119, respectively. It can thus be concluded that there is no autocorrelation in the first differenced error term of orders 1 and 2.

Averaged data results

The probability of the chi-squared statistic is 0.0000, which is less than 0.05, suggesting that the explanatory variables are jointly significant in explaining variations in real per capita GDP.

The coefficient of corruption is positive and significant. A one unit increase in the corruption index increases the growth rate of real per capita GDP by 0.45 percentage points at corruption levels below 5.8 index points. The coefficient of corruption squared is negative and significant. A one unit increase in the corruption index at corruption levels above 5.8 index points increases the growth rate of real per capita GDP by 0.03 percentage points. The implication is that corruption is relatively more beneficial to the growth process at lower levels than at higher levels.

The coefficient of the lagged dependent variable is positive and significant. The elasticity of the current real per capita GDP (0.88), with respect to its lagged value, still displays the high degree of persistence of economic growth. The coefficient of investment is positive and significant. The coefficient of adult literacy rates is positive but insignificant. The coefficient of the population growth rate is negative and significant. The coefficient of government consumption expenditure is negative and significant. The coefficient of political stability is negative and significant. The coefficient of openness is positive but insignificant.

The probability of the Sargan test statistic is 0.96, which is greater than 0.05, suggesting that the instruments used in the model are valid. The probabilities of the serial correlation z statistics are 0.88 and 0.11, respectively, which are both greater than 0.05, suggesting that the model does not suffer from serial correlation.

A comparison of the results estimated using the annual and averaged data system GMM estimator shows that the signs of all the coefficients are the same in both models, except for political stability. Further, the averaged data system GMM model had more variables that were significant at the 1% level of significance than the annual data system GMM model. In both models, the signs of the corruption and corruption squared variables were the same and these coefficients were both significant at the 1% level of significance. These results support the hypothesis that corruption is beneficial for economic growth and also that the marginal effect of a partial change in corruption on economic growth changes with the level of corruption.

Bond et al. (2001) note that in autoregressive models of order 1, OLS levels of the estimate of the lagged dependent variable give estimates of the coefficient of the lagged dependent variable which is biased upwards in the presence of individual-specific effects, and that 'within groups' give an estimate of the coefficient of the lagged dependent variable that is biased downward in the short panel. Therefore, a consistent estimate of the coefficient of the lagged dependent variable can be expected to lie between the OLS levels and the 'within group's' estimates. Thus, if it is observed that the first-differenced GMM estimate is close to or below the 'within group's' estimate, it seems likely that the GMM estimate is also biased downwards, perhaps due to weak instruments. In this regard, compared to the averaged data, the Arellano-Bond first-differenced estimator, the averaged data system GMM estimator has a coefficient of the lagged dependent variable (0.88), which is higher than the one obtained from the averaged Arellano-Bond first-difference estimator (0.79). This result serves as evidence that the averaged data system GMM estimator provides consistent estimates compared to the averaged data Arellano-Bond first-difference estimator.

5. Conclusion

This study seeks to determine the impact of corruption on economic growth in the BRICS country bloc over the period 1996 to 2014. Particularly, the level and/or magnitude of such impact is analysed. To this end, panel data techniques are utilized on the basis of the adequacy in addressing problems inherent in dynamic panel economic growth modelling, namely, heterogeneity bias, endogeneity bias and the persistence of economic growth.

Our results confirm the mixed conclusions reported in the empirical literature, depending on the estimation techniques. More specifically, controlling for only heterogeneity (fixed effect) leads to a negative association between output growth and corruption index. However, when heterogeneity and endogeneity are accounted for (GMM specifications), the corruption index exhibits a positive and significant effect on economic growth. Our finding proves support to the hypothesis that corruption is beneficial to economic growth among the BRICS countries.
 While this result is contrary to a large body of empirical evidence, bar a few, which has found corruption to have a detrimental impact on economic growth, the growth impact of corruption does indeed decreases with the level of corruption. This suggests a possible corruption level from which, the relation might lead to opposite effects.

References

Ahmad, E., Ullah, M. A. & Arfeen, M. I. (2012). Does Corruption Affect Economic Growth? *Latin American Journal of Economics,* 49(2): 277-305.

Arellano, M. & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies,* 58: 277-297.

Baltagi, B. H. (2005). Econometric Analysis of Panel Data. *3rd Edition.* John Wiley & Sons Ltd: East Sussex.

Banerjee, A. V. & Duflo, E. (2003). Inequality and Growth: What Can the Data Say? *Journal of Economic Growth,* 8: 267-299.

Bardhan, P. (1997). Corruption and Development: A Review of Issues. *Journal of Economic Literature*, Vol XXXV: 1320-1346.

Baumol, W. (1990). Entrepreneurship: Productive, Unproductive, and Destructive. *Journal of Political Economy,* 98(5): 893-921.

Beck, P. J. & Maher, M. W. (1986). A Comparison of Bribery and Bidding in Thin Markets. *Economic Letters,* 20: 1-5.

Benhabib, J. & Spiegel, M. M. (2000).The Role of Financial Development in Growth and Investment. *Journal of Economic Growth,* 5: 341-360.

Blundell, R. & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics,* 87: 115-143.

Bond, S. R., Hoeffler, A. & Temple, J. 2001. 'GMM Estimation of Empirical Growth Models'. *Centre for Economic Policy Research Discussion,* paper series no.3048.

Cabelkova, I. & Hanousek, J. (2004). The power of negative thinking: Corruption, perception and willingness to bribe in Ukraine. *Applied Economics,* 36: 383-397.

Caselli, F., Esquivel, G. & Lefort, F. (1996). Reopening the Convergence Debate: A New Look at Cross-Country Growth Empirics. *Journal of Economic Growth,* 1: 363-389.

d'Agostino, G., Dunne, P. J. & Pieroni, L. (2012). Government spending, corruption and economic growth. *MPRA paper no.38109.* Accessible at http://mpra.ub.uni-muenchen.de/38109/]

Donchev, D. & Ujhelyi, G. (2014). What Do Corruption Indices Measure? *Economics & Politics,* 26(2): 309-339.

Ehrlich, I. & Lui, F. T. (1999). Bureaucratic Corruption and Endogenous Economic Growth. *Journal of Political Economy,* 107(S6): 270-293.

Felbermayr, G. J. (2005). Dynamic Panel Data Evidence on the Trade-Income Relation. *Review of World Economics,* 141(4): 583-611.

Goldman Sachs. (2001). Building Better Global Economic BRICs. *Goldman Sachs Global Economics, paper no. 66.*

Gonzales, A., Lopez-Cordova, J. E. & Valladares, E. E. (2007). The Incidence of Graft on Developing-Country Firms. *The World Bank Policy Research,* working paper no. 4394.

Gyimah-Brempong, K. (2002). Corruption, economic growth, and income inequality in Africa. *Economics of Governance,* 3: 183-2009.

Hodge, A., Shankar, S., Rao, D. S. & Duhs, A. (2011). Exploring the Links Between Corruption and Growth. *Review of Development Economics*, 15(3):474-490.

Hsiao, C. 2003. *Analysis of Panel Data. 2nd Edition.* Cambridge University Press: Cambridge.

Jain, A. (2001). Corruption: A Review. *Journal of Economic Surveys* 1 5(1): 71-121.

Kaufmann, D. & Kraay, A. (2008). Governance Indicators: Where Are We, Where Should We Be Going? *The World Bank Research Observer,* 23(1): 1-30.

Kaufmann, D., Kraay, A. & Mastruzzi, M. (2006). *Measuring Corruption: Myths and Realities.* The World Bank.

Krueger, A. O. (1974). The Political Economy of the Rent-Seeking Society. *The American Economic Review,* 64(93): 291-303.

Leite, C. & Weidmann, J. (1999). Does Mother Nature Corrupt? *Natural Resources, Corruption, and Economic Growth,* IMF working paper WP/99/85.

Levine, R. & Renelt, D. (1992). A Sensitivity Analysis of Cross-Country Growth Regressions. *The American Economic Review,* 82(4): 942-963.

Lien, D. D. (1986). A Note on Competitive Bribery Games. *Economic Letters,* 22: 337-341.

Lui, F. T. (1985). An Equilibrium Model of Bribery. *Journal of Political Economy,* 95(4): 760-781.

Mankiw, N. G., Romer, D. & Weil, D. N. (1992). A Contribution to the Empirics of Economic Growth. *The Quarterly Journal of Economics,* 107(2): 407-437.

Mauro, P. (1995). Corruption and Growth. *The Quarterly Journal of Economics,* 11(3): 681-712.

Méon, P. & Sekkat, K. (2005). Does Corruption Grease or Sand the Wheels of Growth? *Public Choice,* 122(1/2): 69-97.

Mo, P. H. (2001). Corruption and Economic Growth. *Journal of Comparative Economics,* 29: 66-79.

North, D. (1991). Institutions. *The Journal of Economic Perspectives*, 5(1): 97-112.

Olken, B. A. (2009). Corruption Perceptions vs. Corruption Reality. *Journal of Public Economics,* 93(7/8): 950-964.

Pellegrini, L. & Gerlagh, R. (2004). Corruption's Effect on Growth and its Transmission Channels. *Kyklos,* 57(3): 429-456.

Polity IV Datasets. (2015). Accessed at http://www.systemicpeace.org/inscrdata.html.

Razafindrakoto, M. & Roubaud, F. (2010). Are international databases on corruption reliable? A comparison of expert opinion surveys and household surveys in sub-Saharan Africa. *World Development,* 38(8): 1057-1069.

Romer, P. (1994). New goods, old theory, and the welfare costs of trade restrictions. *Journal of Development Economics,* 43: 5-38.

Shleifer, V.& Vishny, R. W. (1993). Corruption. *The Quarterly Journal of Economics*, 108(3): 599-617.

Svensson, J. (2005). Eight Questions about Corruption. *The Journal of Economic Perspectives,* 19(3): 19-42.

Swaleheen, M. & Stansel, D. (2007). Economic Freedom, Corruption, and Growth. *Cato Journal,* 27(3): 343-358.

Swaleheen, M. (2011). Economic growth with endogenous corruption: An empirical study. *Public Choice,* 146: 23-41.

Tanzi, V. & Davoodi, H. (1997). *Corruption, Public Investment, and Growth*, IMF *working paper WP/97/139.*

Tanzi, V. (1998). *Corruption Around the World: Causes, Consequences, Scope and Cures,* IMF *staff papers,* 45(4): 559 – 594.

Transparency International. (2015). *Corruption Perception Index.* Available at http://www.transparency.org/survyes/index.html#cpi.

Verbeek, M. (2004). A Guide to Modern Econometrics.*2nd Edition.* John Wiley & Sons Ltd: West Sussex.

World Bank. (2015).*World Development Indicators Database.* Available at http://wwww.databank.worldbank.org/data/reports.aspx?source=world-development-indicators.

FIGURE 1: CORRUPTION PERCEPTIONS IN BRICS COUNTRIES
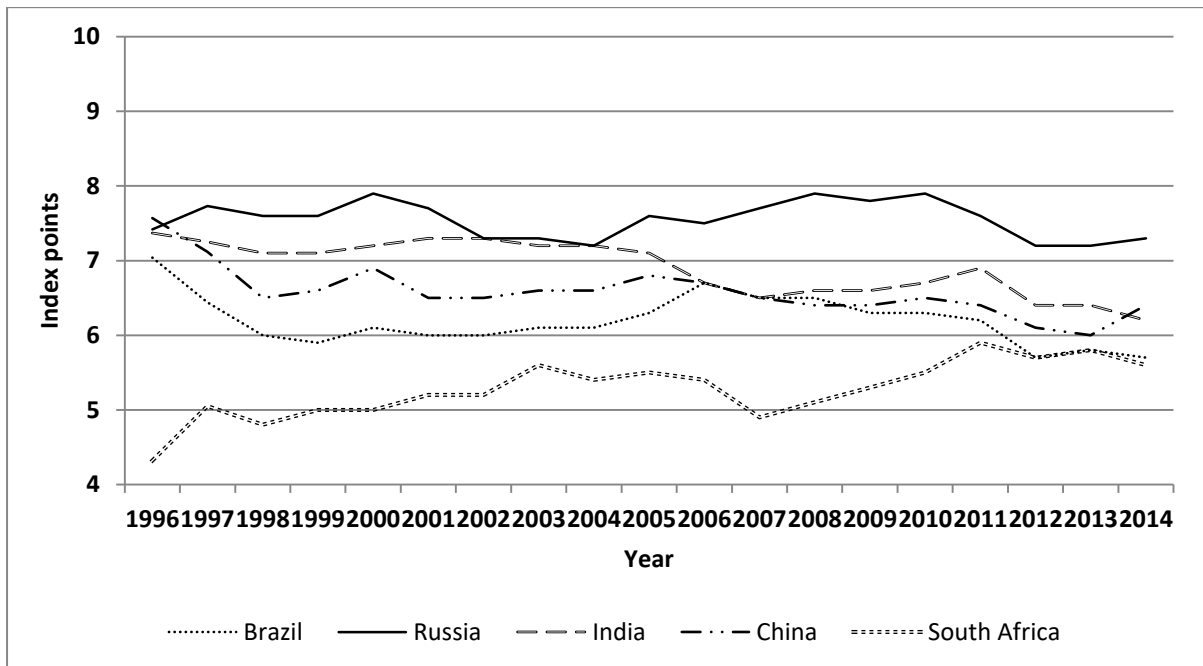
Source: Transparency International. (2015).Corruption Perception Index: index points recalculated to reflect higher perceptions of corruption with higher index points.