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DETERMINANTS OF FDI IN BRICS COUNTRIES: PANEL DATA APPROACH

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Abstract: We empirically investigates the factors that affect Foreign Direct Investment (FDI) inflows in five BRICS countries for the period 1990–2015. We address the selection bias and unobserved heterogeneity by estimating a panel Heckman selection method and attempts to account for both selection and endogeneity within the new two-stage method. After addressing the above mentioned econometric issues, the infrastructure and GDP per capita variables under the new two-stage method remain positive and significantly similar to the coefficient of infrastructure and GDP per capita under the panel Heckman selection model. In addition, the inverse Mills ratio maintain its level of statistical significance, confirming the presence of both sample selection bias and endogeneity.

JEL classification: C22; F21; O16

Keywords: endogeneity; heterogeneity; FDI; BRICS, infrastructure

1. Introduction

BRICS[1] countries are increasingly becoming a force to reckon within the global economy (Cakır and Kabundi, 2013a, 2013b, 2017). Officially recorded foreign direct investment inflows to Brazil, Russian, India, China and South Africa (BRICS) countries reached an estimated $277 billion in 2016, growing by 7 per cent compared with 2015 (World Investment Report, 2017). A significant proportion of BRICS's FDI outflows increase tends to go to low income countries. For example,

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[1] BRICS is an acronym for Brazil, Russia, India, China, and South Africa -- emerging economies

"FDI flows from BRICs to LICs reached about US$2.2 billion in 2009, about 2–3 percent of total FDI flows from BRICs. Of this total, Sub-Saharan Africa (SSA) LICs received about US$0.9 billion" Mlachila, and Takebe (2011). BRICS FDI also exerts a significant, positive impact on growth in low-income countries and SADC exports (Clus-Rossouw et al 2015). Needless to say that this relative increase in the proportion of FDI flows from BRICs to LICs can potentially encourage beneficiaries to adopt FDI-friendly policies.

The literature concerning the factors that affect Foreign Direct Investment on various groups of countries is vast (Asiedu (2006) for Africa; Asiedu (2002) for Developing Countries; Lucas (1993) for East and South Asian economies; Beven and Estrin (2000) for transition economies (Central and Eastern Europe); Akpan, et al (2014) for BRICS and MINT; Xaypanya et al (2015) for ASEAN; Nunnenkamp & Spatz (2002) for developing countries, Sahoo (2006) for South Asian countries; Tintin (2013) for Central and Eastern European Countries). However, the empirical evidence on the determinants of Foreign Direct Investment in BRICS countries (i) remains thin and far from conclusive (ii) the statistical inference of some of these studies (such Kishor et al (2015) and Vijayakumar et al, 2010) relies heavily on panel data methods such as random effect (RE) and fixed effects (FE). While FE and RE can help to mitigate issues caused by omitted variables, these techniques do not address two other sources of endogeneity—potential reverse causality from the dependent variable (such FDI) to the explanatory variables (such as GDP), and possible error in the measurement of the variables resulting in biased estimated coefficients.

Thus, we contribute and improves on the existing literature by first investigating the determinants of FDI in the BRICS context. Secondly, we make use of appropriate panel data models (such as panel Heckman selection models and a new two-stage framework developed by Semykina and Wooldridge (2010)) in order to provide more robust estimates and address the potential bias stemming from problems such as endogeneity, heterogeneity and selection bias that may have affected previous empirical work on the determinants of FDI (Akpan, et al, 2014)

The remainder of this article is organized as follows: Section two reviews the literature on the effects of various economic factors affecting foreign direct investment. Section three discusses the methodology, database and variables and Section four presents the results. The last section provides some concluding remarks.

2. Literature review

Using Dunnings (1973) eclectic paradigm as theoretical lenses, several studies have used different explanatory variables as determinants of inward FDI. Though many variables have been used in the empirical literature, most studies we surveyed have used the following as main determinants of inward FDI: Market size (Ranjan and Agrawal, 2011; Lokesha and Leelavathy; 2012; Forte and Santos, 2015), trade openness (Demirhan and Masca, 2008; Sekkat and Venganzones-Varoundakis, 2007; Phung, 2016; Ranjan and Agrawal, 2011), The quality and cost of labor force (Ranjan and Agrawal, 2011; Forte and Santos, 2015; Bevan and Estrin,

2004; Sharma, Nayagam and Chang, 2012; Carstensen and Taubal, 2003), quality of infrastructure (Sharma, Nayagam and Chang, 2012; Demirhan and Masca, 2008; Vijayakumar, Sridharan and Sekhara Rao, 2010) and macroeconomic stability (Ranjan and Agrawal, 2011; Lokesha and Leelavthy; 2012).

Starting with the host country market size, most studies we surveyed found that the size of the host country market (measured by GDP or GDP per capita) is significant in attracting inward FDI (see for example Phung, 2016; Ranjan and Agrawal, 2011 and Mottlaled and Kalirajan, 2010). In support of a host country market size, Phung (2016) investigated the determinants of FDI inflows in developing countries using OLS, fixed effect and random effect panel data models. He found that GDP (used as proxy for country market size) was an important determinant of FDI inflows. Obtaining similar results, Mottlaled and Kalirajan (2010) used a panel random effect generalized least square model to investigate the determinants of FDI inflows in a panel of 68 developing countries. They found that the size of countries GDP (also used as proxy for country market size) was important in determining FDI inflows in developing countries. These empirical results seem to also hold in developed countries as well (see for example Bevan and Estrin, 2004; Carstensen and Toubal, 2004). A study by Carstensen and Toubal (2003) employed a dynamic panel data to examine the determinants of FDI inflows in Central and East European countries. They found that country market size was significant in explaining FDI inflows.

Infrastructure, like market size, has been found to be a significant driver of FDI inflows, this is besides different proxies used to measure infrastructure. On theoretical grounds, infrastructure reduces transportation cost and improves efficiency in a host country. Ang (2008) employed 2SLS technique to investigate the determinants of inward FDI in Malaysia for the period 1960-2005. He found that infrastructure is a significant driver of FDI inflows in Malaysia. Similar results were obtained by Kumur (2001), using different proxies of infrastructure Kumur (2001) found that infrastructure development contributes to the attraction of inward FDI. Others studies that found infrastructure to be significant include Demirhan and Masca (2008), Ranjan and Agrawal (2011), Phung (2016) and Sharma, Nayagam and Chang (2012).

In contrast to country market size and infrastructure, empirical results on trade openness are mix. Montero (2008) employed a panel data econometric technique in fifteen Latin America countries over the period 1985-2003 and found that trade openness has no significant impact on FDI inflows. Similarly, Taylor (2000) found that trade openness has no significant impact in the USA manufacturing sector. In contrast, trade openness is significant in the studies of Shahmoradi and Baghbanyan (2011), Ranjan and Agrawal (2011), Williams (2015), Al-Sadig (2009).

Macroeconomic stability (measured by inflation), like trade openness, has received mix empirical results. While there are studies that found macroeconomic stability to be a significant driver of FDI inflows (see Ranjan and Agrawal, 2011, Williams, 2015; Al-Sadig, 2009) some found macroeconomic stability to be insignificant (Adams, 2010; Montero, 2008). Using fixed effect estimation technique on a panel of 117 countries (both developing and developed countries) over the period 1984-2004, Al-Sadig (2009) found that macroeconomic stability is significant in determining FDI inflows. In contrast, Adams (2010) surveyed the significance of macroeconomic

stability in 75 countries and found that it was insignificant in countries he studied. Notwithstanding these mix empirical results, most studies we reviewed found macroeconomic stability to be significant.

Another FDI candidate variable that has received mix empirical results is labor force. While the cost of labor force has been found to drive FDI inflows to countries that have low unit labor cost (see for example Bevan and Estrin, 2004; Carstensen and Toubal, 2003), the importance of quality of labor in explaining FDI inflows has received mix empirical result (Ranjan and Agrawal, 2011; Phung, 2016). For example, a study by Phung (2016) found that quality of labor force was insignificant in explaining FDI. In contrast, a study by Carstensen and Toubal (2003) found that quality of labor force was a significant determinant of FDI inflows. Perhaps the mix results are due to different proxy used to measure the quality of labor force.

3. Data and methodology

3.1 Methodology

We extend the cross-sectional Heckman two-step estimator to a panel data setting (i.e. panel Heckman two-step estimator). The panel Heckman two-step estimator is similar the cross-sectional method in that it is estimated in two stages. First it estimates a probit equation (choice of whether to invest or not) and a Pooled OLS (investment levels), including the Mills ratio.

Thus, the panel Heckman two-step estimator can be expressed as follows:

Participation equation:

$$I_{it}^{*} = x_{1it}\beta_1 + \forall_i + \varepsilon_{1it} \tag{1}$$

The first stage describes the choice of whether to invest or not (I_{it}^{*}) as influenced by a set of independent variablesX_{it} (such as trade openness, and General Government Expenditures, etc). $\forall_i$ represents time-invariant unobservables. The first stage is estimated by a probit model. I_{it}^{*} is a dichotomous variable that takes a value of 1 if the firms decide to invest, and 0 otherwise. More formally, we have

$$\begin{matrix} I_i = 1 \; if \; I_i^{*} > 0 \\ 0 \; if \; I_i^{*} \leq 0 \end{matrix} \tag{2}$$

Outcome equation:

$$Y_{it}^{*} = x_{2it}\beta 2 + \forall_i + \varphi_{it} + \varepsilon_{2it} \tag{3}$$

$$\begin{pmatrix} \varepsilon_{1,i} \\ u_i \\ \varepsilon_{2,it} \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho\sigma_u & 0 \\ \rho\sigma_u & \sigma_u^2 & 0 \\ 0 & 0 & \sigma^2 \end{pmatrix}\right] \quad (3.1)$$

The outcome equation (eq 3) describes the determinants of the level of investment. Y_{it}^* shows our dependent variable (the logarithm of investments), x_{2it}indicate the factors affecting the FDI, and φ_{it} shows inverse Mills ratios estimated in the first selection stage using the probit model for each year ε_{1it} and ε_{2it} follow a normal distribution – N (0,1) and N (0,σε), respectively. Moreover the disturbance terms in equation 3.1 (ε_{1i} and ε_{2i}) are assumed to be independent – the decisions of whether or not to invest (participation decision) and the amount of investment are made sequentially rather than simultaneously.

The Heckman selection model with independent error terms can be estimated by the following log-likelihood function.

$$LL = \sum_0 \ln\left[1 - \Phi\left(\frac{x_{2i}\beta_2}{\sigma_i}\right)\right] + \sum_+ \ln\left[\Phi(x_{1i}\beta_1)\frac{1}{\sigma_i}\phi\left(\frac{y_i - x_{2i}\beta_2}{\sigma_i}\right)\right] \quad (4)$$

The estimation of equations (1) to (3) presume strict exogeneity of the regressors. This assumption is implausible because the GDP variable is likely to be endogenous and failure to address this problem, can result in biased estimates. So we employed a recent two-stage Heckman selection procedure proposed by Semykina and Wooldridge (2010) in an attempt to account for the possible endogeneity of the GDP. Their method employs a two-stage Heckman selection procedure approach to correct for the selection bias, and then explicitly addressing the problems caused by the endogenous explanatory variable. In the first stage, a probit model was estimated for each time period to derive inverse Mills ratios. In the second stage, a pooled instrumental variable regression was used to estimate the effects of the explanatory variables on FDI, with the inverse Mills ratios from the first stage's probit models included as covariates to control for selection effects.

3.2. The database

We employ annual data for the period 1990–2015 for BRICS countries – Brazil, Russia, India, China and South Africa. The time period and the number of countries used in this study is carefully chosen based on the availability of data. All the variables used in this paper are sourced from World Development Indicators of World Bank. Following prior studies (Williams, 2015; Al-Sadig, 2009; Ranjan and Agrawal, 2011; Lokesha and Leelavthy; 2012; Forte and Santos, 2015, Demirhan and Masca, 2008; Sekkat and Veganzones-Varoudakis, 2007; Phung, 2016; Ranjan and Agrawal, 2011 and others), we include the following variables in the models: TRADE OPENNESS – ratio of imports plus exports to GDP, (Montero (2008), Shahmoradi Baghbanyan (2011), Ranjan and Agrawal (2011), Williams (2015), Al-Sadig (2009)); INFRASTRUCTURE – measured by fixed number of telephones per

100 persons, (Asiedu (2006) ,Ang (2008), Kumur (2001), Ranjan and Agrawal (2011), Phung (2016), Demirhan and Masca (2008)); INFLATION – measure of macroeconomic stability, (Adams (2010), Montero (2008), Ranjan and Agrawal, (2011)); GDP PER CAPITA – measure of country market size, (Phung (2016), Mottlaled and Kalirajan (2010), Carstensen and Taubal, (2003), Bevan and Estrin, (2004)); GOVERNMENT EXPENDITURE (General government final consumption expenditure).

4. Empirical analyses

Before reporting the empirical results, we start first by reviewing some descriptive statistics. Figure 1, 2 and 3 plots a log of foreign direct investment variable against log of infrastructure development, log of inflation and log of economic growth variables respectively in BRICS countries for the period 1990 to 2015. Though there are number of variables identified as determinants of FDI in the literature, we only provide descriptive analysis of infrastructure, inflation and economic growth as there are mostly used variables in the FDI literature.

Unsurprisingly, figure 1 depicts a neat positive relationship between foreign direct investment and infrastructure. Countries that have a good quality infrastructure are more likely to attract inward FDI due to lower production cost and increased efficiency of doing business. The availability of good physical infrastructure such as road, railways and ports makes it easy for goods to be transported between cities quickly and more efficiently while the availability of intangibly infrastructure such as Information and Communication Technology (ICT) has increased efficiency of doing business (Rehman, Ilyas and Akram, 2011; Ranjan and Agrawal, 2011; Phung, 2016)

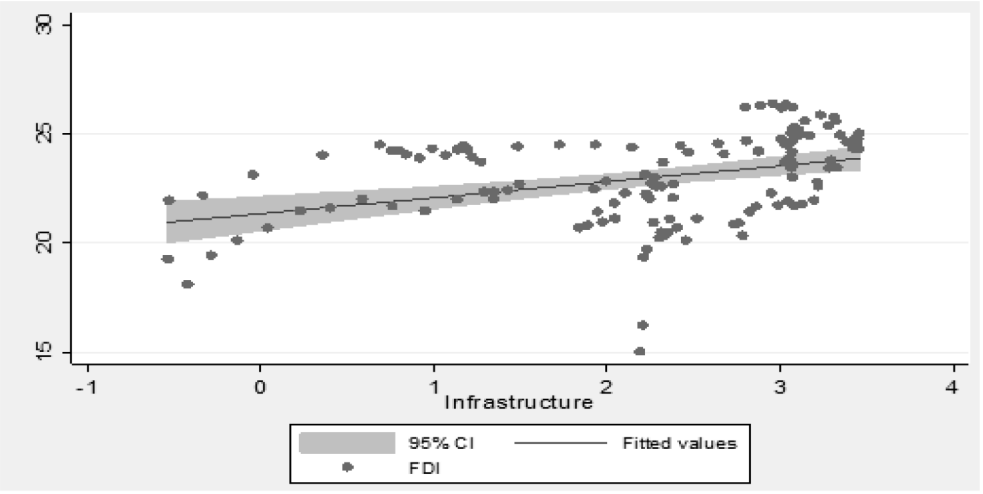

Fig. 1. FDI and infrastructure in BRICS countries, 1990-2015

Figure 2 depicts a negative relationship between FDI and inflation. The reason for this is twofold: firstly, lower inflation leads to macroeconomic stability and reduce uncertainty in the host country. Secondly, lower inflation reduces real interest rate, making it easy for international firms (MNC) to raise capital in the host country (Adams, 2010; Al-Sadig, 2009; Montero, 2008)

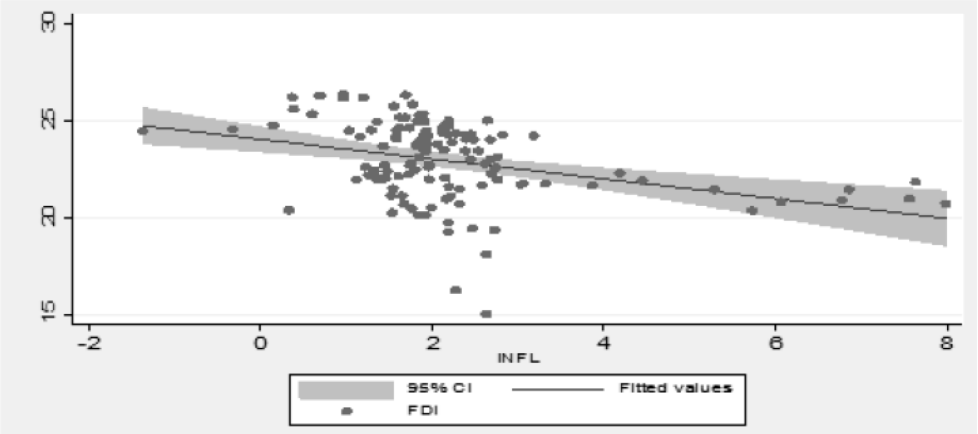

Fig. 2. Inflation and FDI in BRICS countries, 1990-2015

Interestingly, figure 3 shows a strong positive relationship between FDI and economic growth. High and increasing economic growth is an indication of growing market size in the host country. This implies an increasing local demand for goods and services in a host country some of which can only be produced by MNC (Phung, 2016; Bevan and Estrin, 2004; Mottlaled and Kalirajan, 2010).

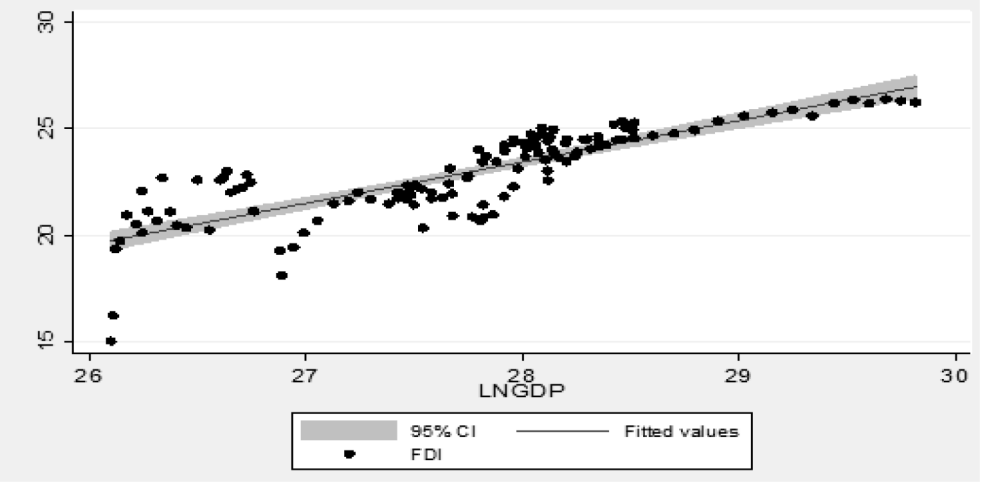

Fig. 3. Growth and FDI in BRICS countries, 1990-2015

5. Empirical Results

This section discusses the empirical results of both Panel Heckman Selection model and Semykina and Wooldridge models. Our first round of results, obtained when we estimate Panel Heckman Selection model, is reported in Table 1. As explained in the methodology section, Heckman Selection model is estimated in two stages, the first stage is a selection equation (likelihood of FDI inflow) and the second stage is an outcome equation (volume of FDI inflow).

Selection equation estimates

All specified variables from the first stage (selection equation) have expected signs with few being statistically insignificant (inflation and trade openness). The coefficient of infrastructure is positive and statistically significant as expected. This implies that availability of infrastructure in BRICS countries increases the likelihood of FDI inflow. This result is consistent with most studies in this field (see for example, Rehman, Ilyas, Alam and Akram, 2011; Ahmad, Ismail and Nordin, 2015; Oqunjimi and Amune, 2017). Moreover, beside methodological differences our results are also consistent with most studies conducted in BRICS countries (see for example, Narender and devi, 2013; Ranjan and Agrwal, 2011).

Perhaps unsurprisingly, we found that the likelihood of FDI inflow is influenced by the level GDP per capita. This result is expected because the level of GDP is an indicator of a host country market size, thus GDP per capita is an important driver of FDI inflows. Our results are consistent with those found in the relevant literature (see for example, Phung, 2016; Ranjan and Agrawal, 2011 and Mottlaled and Kalirajan, 2010).

As just noted above, inflation (a measure of macroeconomic stability) is negative as expected but insignificant. Our results suggest that the likelihood of FDI inflow in BRICS is not influenced by the level of inflation, in line with the works of Ranjan and Agrawal (2011), Williams (2015), Al-Sadig (2009) and contrary to those found by Adams, (2010), Montero (2008).

Although not significant, the coefficient of trade openness is positive – trade openness increases the likelihood of FDI inflow, similar to those of Montero (2008). In contrast, Shahmoradi and Baghbanyan (2011), Ranjan and Agrawal (2011), Williams (2015), Al-Sadig (2009) found trade openness to be significant.

Outcome equation estimates

Having discussed the factors that influence the likelihood of FDI inflow, we now turn to the factors responsible for the volume of FDI inflow. With a few exceptions, estimates of the outcome equation retain the same direction and magnitude to those discussed above. Most of the parameters (such as infrastructure, GDP per capita and government expenditure) remain significant in the outcome equation of the panel Heckman selection model.

Regarding the effect of infrastructure, we find the results from the outcome equations to be consistent with those from the selection equations. In other words, infrastructure is shown to be important in determining of both the likelihood of FDI inflow and the volume of FDI inflow. Similarly, GDP per capita is found to be positive in both the outcome and selection equations.

The noticeable difference between the selection and outcome equation estimates relate to inflation variable. The estimated coefficient for inflation, which was negative and insignificant in the selection equation, is now negative and significant in the outcome equation, indicating that inflation affect the volume of FDI inflow.

Table 1: Panel Heckman selection estimates of the effects of infrastructure on FDI in BRICS countries, 1990-2015

Outcome Equation		
FDI inflow	Coef.	Robust Std. Err.
Infrastructure	0.595295*	0.309764
Inflation	-0.34455***	0.062178
GDP_PC	0.000435***	7.69E-05
GGOVT	-0.45905***	0.088827
IMR	-7.06839*	7.093007
Selection Equation		
Infrastructure	0.904827*	0.35831
Inflation	-0.01139	0.094463
GDP_PC	0.000525*	0.000206
GOVT EXP	-0.8065***	0.249923
OPEN	0.469549	0.436461

Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors, adjusted for clustering at the individual level, are given in parentheses

To delve deeper into the determinants of FDI in BRICS countries, Table 2 reports Semykina and Wooldridge estimates which address both selection and endogeneity concerns, with lag of GDP per capita used as an instrument for the current value. As discussed in the methodology section, while Panel Heckman selection model controls for individual-specific heterogeneity and sample selection bias, it fails to control for endogeniety problem. From Table 2, the estimate of inverse mill ratio estimated in the selection stage of the model is significant, implying the presence of selection bias. Moreover, the Cragg-Donald Wald F statistic for the first stage is large (2417) indicating there is not a weak instruments problem.

Interestingly, some estimates of selection equation from Semykina and Wooldridge selection model are similar to those of Heckman selection model both in terms of signs and significance. The infrastructure variable is positive and significant in both equations of two models. These results confirm that improvement of infrastructure is an important driving force of increasing the probability of FDI inflows in BRICS countries.

Also consistent with estimates obtained from the Heckman selection model is the level of inflation – not statistically significant in influencing either likelihood of FDI and the volume of FDI inflow. In contrast, the government expenditure exerts a negative impact both the likelihood of FDI inflow and the volume of FDI inflow. However, its impact is significant only for the likelihood of FDI. Though the level of GDP per capita has a positive impact on the volume of FDI, it is not a statistically significant determinant of the likelihood of FDI.

Table 2: Semykina & Wooldridge (2010) estimates of the effects of infrastructure on FDI in BRICS countries, 1990-2015

Outcome equation		
FDI inflow	Coef.	Robust Std. Err.
Infrastructure	0.373958***	0.0355905
Inflation	-0.11622	0.120889
GDP_PC	0.000449***	9.62E-05
GGOVT	0.07082	0.116844
IMR	-9.4275***	2.64792
Cragg-Donald Wald F	2417	
Chi-sq(1) P-val	0.000	
Selection equation		
Infrastructure	.62279***	.076351
Inflation	-0.34913	0.191846
GDP_PC	-0.0003	0.00016
GOVT EXP	-1.13548*	0.455155
OPEN	2.70621*	1.223476

Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors, adjusted for clustering at the individual level, are given in parentheses

5.1. Discussion

Some important findings and associated policy implication emerge from our paper. When accounting for sample selection bias and endogeneity, the coefficient of infrastructure under Semykina and Wooldridge (2010) remain positive and significantly similar to the coefficient of infrastructure under the panel Heckman selection method. The results on infrastructure and FDI is consistent with those found in the relevant literature (see for example, Rehman, Ilyas, Alam and Akram, 2011; Ahmad, Ismail and Nordin, 2015; Oqunjimi and Amune, 2017). Moreover, beside methodological differences our results are also consistent with most studies conducted in BRICS countries (see for example, Narender and devi, 2013; Ranjan and Agrwal, 2011).

This particular finding offers useful policy implications towards promoting FDI inflows into BRICS countries. Given the importance of infrastructure in enhancing FDI inflows, the government should prioritize infrastructure development and its quality for foreign firms. Furthermore, each member country should establish country specific factors that might hinder FDI. For example, a country like South Africa, could attract more FDI (particularly from Western industrialised countries, traditionally the major source of FDI to the country) by reducing policy uncertainty generated by the South African government.

In line with many studies in this field we found that the likelihood of FDI inflow is influenced by the level GDP per capita. This is not surprising because the level of GDP is an indicator of a host country market size – GDP per capita is an important driver of FDI inflows. Our results are consistent with those found in the relevant literature (see for example, Phung, 2016; Ranjan and Agrawal, 2011 and Mottlaled and Kalirajan, 2010). Implicit from this finding is that each member country should try to find mechanisms to stimulate their economic activities if they are serious about attracting FDI. They could learn a great deal from one of the member countries like China which has been growing at the average of more than 7% for the past years and have a large share of FDI inflows.

As expected our finding suggest that the degree of trade openness is important in determining the total amount of FDI inflows into BRICS countries, similar to those of Montero (2008). While Brazil, Russia, South Africa and India have long open their doors to international markets, China which recently open its door has improved significantly in attracting FDI inflows. However, trade and investment barriers still exist in BRICS countries. Perhaps reduction in trade and investment barriers can be an important tool for attracting FDI inflows.

6. Conclusion

We have explored the factors that affect Foreign Direct Investment inflows in 5 BRICS countries for the period 1990–2015. To this end, we have used the estimator (or panel Heckman selection) proposed by Wooldridge (1995) and corrected for both selection and endogeneity within the new two-stage framework developed by Semykina and Wooldridge (2010). The baseline empirical estimates carried out using the panel Heckman selection has provided some evidence on the determinants of Foreign Direct Investment.

Our Semykina and Wooldridge analyses, which were performed to reduce endogeneity bias, and selection bias produced qualitatively similar results (in terms of direction), although the level of significance of some variables were larger compared to those obtained using panel Heckman selection. This highlights the importance of controlling for sample selection bias and endogeneity in order to infer a less-biased determinants and FDI. Failing to do so may lead to spurious inferences, as indicated by the results. Therefore, future studies on the on the determinants of Foreign Direct Investment should take into account these econometric complications.

While our results shed some important light on the determinants of FDI in the BRICS countries, it should be highlighted that our findings are not without limitation. The main limitation of this paper was the failure to include data for the period 2016 and 2017 – data constraint. Therefore future research including the most recent periods would shed light more light on the determinants of FDI.

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