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The Impact of Openness on Economic Growth: Case of Indian Ocean Rim Countries

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Abstract

This paper analyse the relationship between openness and economic growth for Indian Ocean Rim Countries in a panel data framework. The panel consists of 15 countries over the time period 1997 to 2011. Three measures of openness are used namely trade as a percentage of GDP, exports as a percentage of GDP and imports as a percentage of GDP. We adopt panel unit root and panel cointegration technique in this paper. All the variables are stationary in first difference. The statistics of Pedroni (2004) reveal the presence of long run relationship among the variables. Given the presence of cointegration, we use the Fully Modified Ordinary Least Square (FMOLS) to estimate our model. Ultimately, it is found that the three measures of openness positively affect economic growth. However, imports as a percentage of GDP has the highest impact on economic growth in terms of size.

Keywords: Openness, Growth, Panel Unit Root and Panel Cointegration

1. Introduction

Although free trade leads to many benefits, countries are rarely prepared to allow complete free trade. Most countries adopt protectionism measures in the form of tariffs barriers and non-tariff barriers for different reasons. There are two essentials reasons for the imposition of tariffs: firstly, to protect domestic industries that compete with imports, i.e. protect infant industry and secondly, to raise government revenue.

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However, many countries have adopted several measures to liberalise trade. Over the years there has been a proliferation of free trade agreements. Similarly, many developing countries have signed Economics Partnership Agreements (EPAs). One major condition of EPAs is that there should be no barriers to trade between the two countries which sign the EPA. It is believed that opening the economy will enhance economic growth. High growth rates are often associated with countries adopting trade liberalisation measures and increasing openness to the international exchange of goods and services as well as ideas and technologies. Many researchers believe that participation in the international economy was the primary source of growth in many East Asian countries that have experienced fast economic development during the past 50 years (World Bank 1993).

In this context many empirical studies have been conducted to analyse the effect of openness on growth. Almost all empirical studies have concluded that trade openness positively affect economic growth. However, these studies have concentrated mainly on African and Latin American regions. The current study analyse the impact of openness on economic growth in the Indian Ocean Rim Association for Regional Cooperation (IOR-ARC). The IOR-ARC was created in 1985 and launched in 1997. IOR-ARC disseminates information on trade and investment regimes with a view to help the region's business community better understands the impediments to trade and investment within the region. The main aims of IOR-ARC are threefold. First, to promote sustainable growth and balanced development of the region. Second, to enhance on areas of cooperation that provide maximum opportunities for development, shared interest and mutual benefits. Third, to promote trade liberalisation and remove trade barriers.

The countries forming part of the association are Australia, India, Indonesia, Kenya, Madagascar, Malaysia, Mauritius, Mozambique, Oman, Seychelles, Singapore, South Africa, Sri Lanka, Tanzania, Yemen and UAE. IOR-ARC is an outward-looking forum for economic dialogue and cooperation. It is not a preferential trade bloc and members have agreed to reduce tariff progressively and by 2020 all the members must be free of any trade barriers. Out of the 19 members in the IOR – ARC, 17 members are open economies (exception of Iran and Yemen) and 15 members are classified as average or high category in terms of openness. The open economies have constantly adopted measures towards trade liberalisation. For example, Singapore impose no barrier on trade, Mauritius is becoming more and more open and is aiming to become a duty free island.

To analyse the impact of economic growth and openness in Indian Ocean Rim (IOR), we adopt panel unit root and panel cointegration techniques. Panel data has several advantages. First, increased precision of regression estimates. From a purely statistical point of view, the size of the sample may be multiplied. A four period panel of country data could in principle quadruple size of the sample size used for a study of openness and economic growth. Second, it control for individual fixed effects. Panel data can control for the individual fixed effect which are common to individual country across time, but which may vary across country at any one point in time. Compared to cross section analysis, in a panel data one can distinguish from individual country effect from a purely random observed heterogeneity. Third, panel data has the ability to model temporal effect without the problem of aggregation bias. While time series data may be applied may be applied the examination of temporal patterns of behaviour, it suffers from aggregation bias. Aggregation bias occurs when the aggregate behaviour does not represent behaviour at micro level. Panel data analysis has the ability to control for the individual heterogeneity when examining temporal effect on behaviour.

Testing for unit root with panel data instead of individual time series adds several complications. First, panel data generally introduce a substantial amount of unobserved heterogeneity, rendering the parameters of the model cross section specific. Second, in many empirical applications it is inappropriate to assume that the cross section units are independent. To overcome these difficulties, variants of panel unit root tests are developed that allow for different forms of cross sectional dependence. Third, the panel test outcomes are often difficult to interpret if the null of the unit root or cointegration is rejected. Fourth, with unobserved nonstationary common factors affecting some or all the variables in the panel, it is also necessary to consider the possibility of cointegration between the variables across the groups (cross section cointegration) as well as within group cointegration. Finally, the asymptotic theory is considerably more complicated due to the fact that the sampling design involves a time as well as a cross section dimension. Furthermore, a proper limit theory has to take into account the relationship between the increasing number of time periods and cross section units.

It should be noted that some members in the IOR are export oriented economies while others are import oriented economies. Thus, use of only one openness measure may not give the exact impact of trade on a given country.

Therefore, three measures of openness are used namely trade as a percentage of GDP, exports as a percentage of GDP and imports as a percentage of GDP. The structure of paper is as follows: Section 2 presents a brief literature review; section 3 describes the descriptive statistics and regression specification; section 4 details the empirical results and we conclude in section 5.

2. A Brief Literature Review

From followers of neo classical theories to new endogenous growth many theories have been developed giving many theoretical implication of openness on growth with most of them for a positive effect of openness on growth. The theories have been tested in many literatures with mostly in favour of a positive relationship between openness and growth. A good understanding of the effect of openness on growth necessitates good comprehension of static gains and dynamic gains from trade. From the theoretical side, it is easy to prove that there are static economic gains from openness. But it is not straightforward to generalize from this result to a dynamic context. Static gains from openness imply a level effect, not a growth effect.

Famous economist Ricardo came with a theory of comparative advantage to explain the gains that arise from trade which has indulged many countries to trade. Trade occurs because of the possible gains associated with it. According to him if a country wants to trade with another country the latter will produce goods in which it has a comparative advantage. By opening the economy the country have to compete in a larger market, the world market. Thus base on comparative advantage the country specialises in production of a good on a larger scale. Resources are allocated in an efficient manner and produce goods that are sold in the world market reaping benefits of greater efficiency and economies of scale. Ricardo found that countries trade according to its comparative advantage but makes an absolute gain in terms of growth. His theory has been further extended by other economists such as Heckscher, Ohlin and Samuelson. Heckscher-Ohlin factor-proportions theory of comparative advantage, an extension of Ricardo theory tells us that countries do not only trade in goods only but also in factors such as labour and capital.

Dynamic gains from openness may be much larger. But identifying and measuring them obviously requires an alternative theoretical approach. The renewed interest in growth theory, mainly initiated by the seminal work of Romer (1986), seems to provide such an approach.

Endogenous growth models allow for a direct and persistent link between openness and the growth rate, which is missing in the traditional

neoclassical growth model (Solow 1956). For instance, Edwards (1992), Romer (1994), and Coe *et al* (1995) use alternative endogenous growth models to explain a positive link between openness and the rate of economic growth as the result of the international diffusion and adoption of new technologies or new goods. Although convincing from a theoretical point of view, the major drawback of endogenous growth models is that they are difficult to reconcile with the growing body of empirical evidence on conditional convergence.

According to Grossman and Helpman (1991) opening the economy encourages contact with foreign businesses and markets and creates incentives for local research and development which creates a spill over benefits that contribute to growth. The steps they followed are provided below. In their theory Grossman and Helpman (1991) treat technology as being endogenous, that is a source through which an economy can grow. They developed on the idea of profit maximizing behaviour of entrepreneurs who take decisions for the long run and which invest massively in research and development (R&D). This enables them to capture monopoly rents through innovated products. With R&D know how, also known as stock of knowledge capital or technology, increases. They consider technology as having two characteristics. Technology is non rival and non excludable thus creating spill over benefits with innovation. Local research and access to world knowledge creates dynamic performance through international trade. Creation of tangible commodities in the research community facilitates exchange of intangible ideas. This views was shared by Romer (1993) and Barro and Sala-i-Martin (1995). However, there are diverging views as well. Krugman (1994) and Rodrik and Rodriguez (2001) argue that the effect of trade openness on economic growth may be doubtful. Further, if we consider the gains of trade debate we look at a longer lasting debate discussing conditions and circumstances when openness and trade may be favourable and may improve economic performance or not.

Numerous econometric studies have been conducted to analyze the impact of trade openness on economic growth. These studies can be classified into four groups. Firstly, conventional regression analysis trying to capture the effect on openness by regressing it on per capita growth.

Secondly, using Granger causality based tests on the openness and economic growth variables. The third group of studies picks up the problem of biased results in the event of cointegrated series and uses the concept of cointegration and error-correction to explore the short-run and long run dynamics between openness and economic growth. The fourth group explores the relationship between openness and growth in a panel data setting.

There are several studies in the first group with a general consensus that openness is significant variable that positively affect economic growth. Studies in this category include Dollar (1992), Edwards (1998), Harrison (1996), Barro and Lee (1994), Easterly and Levine (2001), Dollar and Kraay (2002), Kazi M Matin (1992), Sachs and Warner (1995), Irvin and Tervio (2000), Islam (1995) and Sala-i-Martin (1997). The second group of studies shows a mixed picture about the relationship between trade openness and economic growth. Jung and Marshall (1985) conducted Granger causality test in a group of 37 countries for the time period 1951-1981. They found the existence of unidirectional causality from exports to growth in four countries. Chow (1987) conducted Granger causality test in eight industrialised nations and found bidirectional causality in six cases and unidirectional causality in one case. Ahmad and Kwan (1991) investigate 47 African countries and find no causality. Bahmani-Oskooee (1991) applies Granger causality tests for 20 countries and finds both positive and negative causality effects for both directions. The third group of studies is based on time series data and investigates the causalities at country level. Islam (1998) uses an error correction model for each of 15 Asian countries for the period 1967-1991. Bouoiyour (2003) applies the concept of cointegration and error correction model between trade and economic growth for Morocco for the time period 1960-2000. The author did not find long run causality. Awokuse (2007) examines the relationship between trade and openness for Czech Republic, Bulgaria and Poland. The results show bidirectional causality between exports and imports expansion for Bulgaria, unidirectional causality for Czech Republic and import led growth for Poland.

Yanikkaya (2002) used data of 100 developed and developing economies for the period 1970 to 1997 for a cross country panel regression. The variables he included are human capital, physical capital, telephone mainlines, life expectancy and a variable representing openness indicators. He used two openness indicators, one using trade shares and another one using the ratio of imports plus exports to GDP. The coefficient of openness was positive and significant.

Alesina (2005) analyses the impact of an economy's trade openness on economic growth for a sample of countries since 1960. The panel data relies on a three least squares (3 SLS) procedure. It is shown that a simultaneous consideration of an economy's openness and of its size led to strong effects of economic growth. That is, openness has a large effect on small countries but these effects become zero as the country's size increases. The measure of openness involves variables in current prices. Stoinov(2007) finds new evidence by analyzing a sample of 9 countries from the Eastern Europe , which are member states of EU. The econometric models used in the analysis are the dynamic panel data models: the "Difference" GMM (Arellano – Bond (1991) and the "system" GMM. Variables such as education rate, the money aggregates M2/M3 to the GDP and the ratio of private domestic credits to GDP are used to measure trade openness and financial integration. The study concludes that trade openness has a significant positive impact on economic growth. Falvey *et al* (2007) estimate annual data for a panel of 75 countries over the period 1960-2003. Openness to trade is measured using the terms of trade. The result shows that trade liberalization appears to increase economic growth in the long run. Rodriguez (2007) studies the existence of a cross-country empirical relationship between openness to international trade and economic growth within the period 1990-2003. The research shows that growth does not display a significant correlation with any measure of trade openness over this period in which the trade to GDP ratio was used to measure it. The regression used was the least squares dummy variable (LSDV) technique. It is found that openness may be beneficial to very poor but not middle - income as well as the idea that tariffs on intermediate and capital goods (but not tariff on consumer goods) are detrimental to growth.

3. Descriptive Statistics and Regression Specification

The Indian Ocean Rim (IOR) consists of 19 countries (see Appendix 1). It is important to identify which countries are open economies. To identify open economies, we adopt the following criteria. We assume that countries within the IOR which are members of WTO are open economies. Two countries are not members of the WTO namely Yemen and Iran (see Appendix 1) while for Oman and UAE there are many data which are unavailable. Thus, our sample of countries reduces to 15. Table 1 shows the descriptive statistics for the list of countries under analysis.

The 15 countries can be grouped as low income economies ($ 1005 or less GDP per capita), lower middle income economies ($1006 to $3975 GDP per capita), upper middle income economies ($ 3976 to $12275 GDP per capita) and high income economies ($ 12276 or more GDP per capita). Openness of 0-50% can be considered as low, 50-100% as average and above 100% as high. They can also be ranked according to growth rate and degree of openness as shown in table 3.

Table 1: Descriptive Statistics by Countries: RGDPPC and Open

Countries	RGDPPC		OPEN	
	Mean	**Std Dev**	**Mean**	**Std Dev**
Australia	19499.92	13533.94	35.94	4.24
Bangladesh	305.117	145.61	28.31	7.84
India	444.309	330.96	21.06	8.06
Indonesia	851.11	743.03	55.06	11
Kenya	402.28	170.48	56.7	7.12
Madagascar	300.88	79.29	47.2	14.11
Malaysia	3317.92	2364.36	163.4	45.98
Mauritius	3318.87	2151.16	120	12.11
Mozambique	263.74	99.04	57.09	12.05
Seychelles	5306.49	3749.66	305.6759	122.22
Singapore	15869.2	12653.98	364	44.72
South Africa	3261.914	1651.65	50.5	38.65
Sri Lanka	770.433	615.017	80.84	12.23
Tanzania	305.6759	122.22	49.94	9.11
Thailand	1690.93	1275.87	86.72	32

Source: Author own Computation from WDI Database

Table 2 shows countries classification (average over the sample period) for RGDPPC and OPEN. There is a clear pattern which is emerging. Singapore, Seychelles, Malaysia and Mauritius are in the top ten under both RGDPC and OPEN. Further, Bangladesh, Tanzania, India and Madagascar lie in the bottom ten when both RGGPPC and OPEN are taken into account. For the other countries there is a mixed picture. Table 3 shows the countries classification for the year 2011. Yet again, countries on the top ten in terms of RGDPPC tend to have high OPEN index. In this category, the countries are Singapore, Seychelles, Malaysia, Mauritius and Thailand.

Table 2: Countries Classification by RGDPPC and OPEN (on Average)

Countries	RGDPPC	Category	Countries	OPEN	Category
Australia	19499.92	High Income	Singapore	364	High
Singapore	15869.2	High Income	Seychelles	305.6759	High
Seychelles	5306.49	Upper Middle Income	Malaysia	163.4	High
Mauritius	3318.87	Lower Middle Income	Mauritius	120	High
Malaysia	3317.92	Lower Middle Income	Thailand	86.72	Average
South Africa	3261.914	Lower Middle Income	Sri Lanka	80.84	Average
Thailand	1690.93	Lower Middle Income	Mozambique	57.09	Average
Indonesia	851.11	Low Income	Kenya	56.7	Average
Sri Lanka	770.433	Low Income	Indonesia	55.06	Average
India	444.309	Low Income	South Africa	50.5	Average
Kenya	402.28	Low Income	Tanzania	49.94	Low
Tanzania	305.6759	Low Income	Madagascar	47.2	Low
Bangladesh	305.117	Low Income	Australia	35.94	Low
Madagascar	300.88	Low Income	Bangladesh	28.31	Low
Mozambique	263.74	Low Income	India	21.06	Low

Source: Author own Computation from WDI Database

Table 3: Countries Classification by RGDPPC and OPEN (2011)

Countries	RGDPPC	Category	Countries	OPEN	Category
Australia	60642.24	High Income	Singapore	391.23	High
Singapore	46241.02	High Income	Seychelles	224.29	High
Seychelles	11711.47	Upper Middle Income	Malaysia	176.8	High
Malaysia	9656.24	Upper Middle Income	Thailand	148.13	High
Mauritius	8797.64	Upper Middle Income	Mauritius	122.86	High
South Africa	8070.03	Upper Middle Income	Kenya	82.15	Average
Thailand	4972.04	Upper Middle Income	Madagascar	82.15	Average
Indonesia	3494.6	Lower Middle Income	Tanzania	72.32	Average
Sri Lanka	2385.41	Lower Middle Income	Sri Lanka	60.2	Average
India	1488.51	Lower Middle Income	Indonesia	55.86	Average
Bangaldesh	734.99	Low Income	India	54.48	Average
Mozambique	534.8	Low Income	South Africa	53.95	Average
Tanzania	528.55	Low Income	Bangaldesh	53.9	Average
Kenya	477.12	Low Income	Australia	27	Low
Madagascar	466.66	Low Income	Mozambique	14.31	Low

Source: WDI Database

To model the effect of openness on economic growth we follow the standard literature in specifying a Solow Growth function pertaining to the economic model below:

$$RGDPPC = f(OPEN, X)$$

RGDPPC denotes real gross domestic product per capita, OPEN denotes measures of openness (we adopt three measures of openness, see below), X denotes a set of control variables which can affect economic growth. These variables are GOVT (government expenditure as a percentage of GDP), GCF (gross capital formation as a percentage of GDP), INFL (Inflation) and HUMAN (a proxy of human capital namely labour force as a percentage of GDP). We therefore assumed that economic growth can approximated by the following production function:

$$RGDPPC = f(OPEN, GOVT, GCF, INFL, HUMAN)$$

Based on variables data time length available two more countries have been removed from the analysis: Oman and United Arab Emirates. Due to non-availability of data of inflation for United Arab Emirates and too short time length for Oman these two countries have been dropped. Thus, the number of countries considered for this study is 15.

We specified three regressions to analyse the relationship between openness and economic growth. The regressions differ in terms of the measure of openness.

OPEN1: Imports plus Exports as a percentage of GDP
OPEN2: Imports as a percentage of GDP
OPEN3: Exports as a percentage of GDP

The three regressions in log forms are as follows:

$$LRGDPPC = \beta_0 + \beta_1 LOPEN1 + \beta_2 LGOVT + \beta_3 LGCF + \beta_4 LINFL + \beta_5 HUMAN + u_t$$
$$LRGDPPC = \beta_0 + \beta_1 LOPEN2 + \beta_2 LGOVT + \beta_3 LGCF + \beta_4 LINFL + \beta_5 HUMAN + u_t$$
$$LRGDPPC = \beta_0 + \beta_1 LOPEN3 + \beta_2 LGOVT + \beta_3 LGCF + \beta_4 LINFL + \beta_5 HUMAN + u_t$$

Note that the regression for run for the period 1997 – 2011 and the source of data is World Development Indicators

4. Empirical Results

This section present firstly, the econometric methodology adopted to achieve the objective of this paper and secondly, the empirical results.

4.1 Panel Unit Roots Test

Prior to testing for cointegration, we need to confirm whether the variables are non-stationary. We adopt the unit root test introduced by Im, Pesaran and Shin (1997,henceforth IPS), basically the standard ADF- test in a panel context. IPS proposed a test for the presence of unit roots in panels that combines information from the time series dimension with that from the cross section dimension, such that fewer time observations are required for the test to have power. Since the IPS test has been found to have superior test power by researchers in economics to analyze long-run relationships in panel data, we will also employ this procedure in this study. IPS begins by specifying a separate ADF regression for each cross-section:

$$\Delta y_{i,t} = \alpha_i + \gamma_i t + \beta_i y_{i,t-1} + \sum \rho_{ij} \Delta y_{i,t-1} + u_{i,t}$$

where $y_{i,t}$ stands for each of the variables presented in section 4. The null hypothesis and the alternative hypothesis are as follows:

$H_0: \beta_i = 0$
$H_0: \beta_i < 0$

The IPS methodology uses separate unit root tests for the N countries. The test statistics is calculated as the average of the individual $t_{N,T} = \left(\frac{1}{N}\right)\sum_{i=1}^{N} t$ where t denotes the ADF test statistics for the OLS estimate in the above equation for the different country. The *t-bar* is then standardized and it is shown that the standardized t-bar statistic converges to the standard normal distribution as N and T $\rightarrow\infty$. IPS (1997) showed that t-bar test has better performance when N and T are small. They proposed a cross-sectionally demeaned version of both test to be used in the case where the errors in different regressions contain a common time-specific component.

Table 4 shows the results of panel unit root test. The IPS unit root test is conducted for both without and with a time trend. Further, it is conducted for level form and first difference form. Figures in italics denote the *p*-values. As can be seen from Table 4, the variables are non- stationary in level forms but stationary in first difference. It is important to deal with stationary data to avoid the problem of spurious regression. It is argued that differencing is a useful transformation to deal with the problem of spurious regression. However, on the other hand it causes a loss in the long term transformation that the series might include. Thus, we adopt the next step, i.e. cointegration analysis. With cointegration analysis, even though the series may contain stochastic trends (non-stationary), they will nevertheless move together over time and the difference between them will be stable (stationary.

Table 4: Panel Unit Root Test

Variable	**Level Form**		**First Difference**	
	Constant	**Constant with Trend**	**Constant**	**Constant with Trend**
LRGPPC	-1.521 *0.1874*	-1.234 *0.575*	-2.026 *0.004*	-2.456 *0.000*
LOPEN1	-1.723 *0.1723*	-1.623 *0.2345*	-2.768 *0.000*	-2.567 *0.000*
LOPEN2	-1.423 *0.1923*	-1.9212 *0.078*	-5.555 *0.000*	-7.345 *0.000*
LOPEN3	-1.456 *0.1915*	-1.2345 *0.2134*	-7.456 *0.000*	-6.567 *0.000*
LGOVT	-1.899 *0.1623*	-1.856 *0.1456*	-2.678 *0.000*	-4.567 *0.000*
LGCF	-2.026 *0.004*	-2.045 *0.004*	-5.134 *0.000*	-5.112 *0.000*
LINFL	-1.002 *0.877*	-1.123 *0.723*	-3.345 *0.000*	-4.567 *0.000*
LHUMAN	-1.111 *0.623*	-1.223 *0.543*	-4.567 *0.000*	-5.789 *0.000*

4.2 Panel Cointegration Test

The use of panel cointegration techniques to test for the presence of long run relationships among integrated variables with both a time series dimension, T, and a cross section dimension, N, has received much attention in the literature. One of the most important reasons for this attention is the increased power that may be gained by accounting not only for the time-series dimension but also for the cross-sectional dimension. In spite of this many studies fail to reject the no-cointegration null when cointegration is strongly suggested by theory.

One explanation for this failure to reject centers on the fact that most residual based cointegration tests, both in pure time series and in panels require that the long run parameters for the variables in their level are equal to the short run parameters for the variables in their differences. Banergee, Dolado and Mestre (1998) refer to this as a common factor restriction and show that its failure can cause a significant loss of power for residual based cointegration test. To test for cointegration, we adopt the test suggested by Pedroni (1999). Following Pedroni (1999), consider the following model:

$$y_{i,t} = \alpha_i + \delta_i t + \beta_{1i} x_{1i,t} + \beta_{2i} x_{2i,t} + \ldots + \beta_{Mi} x_{Mi,t} + e_{i,t}$$

where T is the number of observations over time, N is the number of cross-sectional unit in the panel and M is the number of regressors. In this set up α_i denotes the fixed effect that is allowed to vary across cross sectional units. The slope and the time effect are modified heterogeneously just like the intercept term. Pedroni (1999 and 2004) proposed two tests of panel cointegration namely the heterogeneous panel and heterogeneous group mean panel test statistics to test for panel cointegration. The following steps are followed in constructing these statistics:

1. Compute the residual $\hat{e}_{i,t}$ from the panel regression
2. Compute the residual $\hat{c}_{i,t}$ of the following differenced regression

$$\Delta y_{i,t} = \beta_{1i} \Delta x_{1i,t} + \beta_{2i} \Delta x_{2i,t} + \ldots + \beta_{Mi} \Delta x_{Mi,t} + c_{i,t}$$

3. Compute $\hat{L}_{llt}^2 = \frac{1}{T}\sum_{t-1}^{T} \hat{C}_{i,t}^2 + \frac{2}{T}\sum_{s=1}^{k_i}\left(1 - \frac{s}{k_i + 1}\right)\sum_{i=s+1}^{T} \hat{C}_{i.t}\hat{C}_{i,t-s}$
4. Save the residuals of the ADF test for $\hat{e}_{i,t}$ and $\hat{c}_{i,t}$ and compute the following variances

$$\hat{S}_i^2 = \frac{1}{T}\sum_{i-1}^{T} e_{it}^2 \text{ and } \tilde{S} = \frac{1}{T}\sum_{i-1}^{T} \hat{S}_{it}^2$$

5. Construct the final statistics

$$\text{Panel } t = \left[\hat{S}_{N,T}^2 \sum_{i=1}^{N}\sum_{i=1}^{T} L_{lli}^{-2} \hat{e}_{i,t-1}^2\right] \sum_{i=1}^{N}\sum_{i=1}^{T} L_{lli}^{-2} \hat{e}_{i,t-1}^2 \Delta e_{it}^2$$

$$\text{Group } t = N^{-\frac{1}{2}}\sum_{t-1}^{N}\left[\sum^{N}\hat{S}_t^2\hat{e}_{i,t-1}^2\right]\sum_{i=1}^{N}\hat{e}_{i,t-1}\Delta e_{it}^2$$

The above two statistics are standardized as $\frac{\chi_{N,T}-\mu\sqrt{N}}{V}\Rightarrow N(0,1)$ where $\chi_{N,T}$ represents either of the both statistics, while μ and V are respectively mean and variance adjustment terms. The null hypothesis of no cointegration is then tested based on the standard normal distribution just described. Under the alternative hypothesis, these two statistics diverge to negative infinity. Pedroni developed seven test statistics namely:

Panel *v* statistic

$$T^2N^{3/2}Z_{\hat{V}N,T}\equiv T^2N^{3/2}\left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{i,t-1}^2\right)^{-1}$$

The panel □□ statistic

$$T\sqrt{N}Z_{\hat{\rho}N,T}\equiv T\sqrt{N}\left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{e}_{i,t-1}^2\right)^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\left(\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}-\hat{\lambda}_i\right)$$

The panel t statistic (Non-parametric)

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

The panel t statistic (parametric)

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

Tthe group □□ statistic(parametric)

$$TN^{-1/2}\tilde{Z}_{\tilde{\rho}N,T-1}\equiv TN^{-1/2}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{e}_{i,t-1}^2\right)^{-1}\sum_{t=1}^{T}\left(\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}-\hat{\lambda}_i\right)$$

The group t statistic (non-parametric)

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

The group t statistic (parametric)

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

Thus, in this paper to test for a cointegrating relationship among our variables, we adopt the methodology developed by Pedroni (described above). To recapitulate, it employs four panel statistics and three group statistics to test the null hypothesis of no cointegration against the alternative hypothesis of cointegration. In the case of the panel statistics, the first order autoregressive tern is assumed to be the same across countries, while in the case of group panel statistics the parameter is allowed to vary across countries. Table 5 shows the panel cointegration test for the three specified regression. For regression 3, there is strong evidence of panel cointegration according to the seven statistics. For regression 1 and 2 only the v-statistics reveal no evidence of panel cointegration.

Table 5: Panel Cointegration Test for the three Specified Regression

Regression 1	**Panel**		**Group**	
	Constant	**Constant with Trend**	**Constant**	**Constant with Trend**
v-statistics	1.567	1.621	NA	
ρ-statistics	-1.765*	-2.123*	-1.876*	-1.889*
t-statistics (non-parametric)	-2.345*	-2.567*	-2.789*	-2.546*
t-statistics (parametric)	-3.456*	-2.879*	-2.134*	-2.456*
Regression 2	**Panel**		**Group**	
	Constant	**Constant with Trend**	**Constant**	**Constant with Trend**
v-statistics	1.605	1.578	NA	
ρ-statistics	-1.875*	-2.317*	-2.342*	-2.134*
t-statistics (non-parametric)	-1.978*	-1.988*	-1.651*	-1.712*
t-statistics (parametric)	-2.137*	-2.091*	-2.545*	-2.145*
Regression 3	**Panel**		**Group**	
	Constant	**Constant with Trend**	**Constant**	**Constant with Trend**
v-statistics	1.654*	1.789*	NA	
ρ-statistics	-3.456*	-3.245*	-1.789*	-1.782*
t-statistics (non-parametric)	-1.800*	-1.878*	-1.739*	-1.967*
t-statistics (parametric)	-2.164*	-2.185*	-2.138*	-2.119*

Note: All reported values are asymptotically distributed as standard normal. The variance ratio is right sided while the other Pedroni tests are left sided. A * indicated the rejection of the null of unit root or no cointegration at 5% level of significance.

4.3 Fully Modified OLS (FMOLS) Analysis

Having established that there is a linear combination that keeps the variables in proportion to one another in the long run, we can proceed to generate individual long run estimates for our regression. However, when there is cointegration in a panel data setting OLS estimates is biased and inconsistent. Thus, we adopt the "group-mean" panel fully modified OLS estimator developed by Pedroni (1999, 2001). The FMOLS estimator not only generates consistent estimates of the parameters in small samples but is control for endogeneity of the regressors and serial correlation. Further, it addresses the problem of simultaneity biases.

The starting point of the FMOLS is the OLS in the following cointegrated system for panel data:

$$y_{it} = \alpha_i + x'_{it}\beta + u_{it}$$
$$x_{it} = x_{i,t\ 1} + \varepsilon_{it}$$

Where the vector error process $\xi_{it} = [u_{it}, \varepsilon'_{it}]$ is stationary with asymptotic covariance Ω_i. If y_{it} is integrated of order one, we say that the variables x_i and y_i are cointegrated for each member of the panel. The term a_i allows the cointegrating relationship to include member specific fixed effects. There is no requirement for exogeneity of the regressors, consistent with the cointegration literature. The variable x_i is an m dimensional vector of regressors, which are not cointegrated with each other. The vector error process $\xi_{it} = [u_{it}, \varepsilon'_{it}]$ is divided into two elements. The first component is a scalar series and the second component is an m dimensional vector of the differences in the regressors ε_{it} □ x_{it} □ x_{it}□1 □ □x_{it} so that we can construct:

$$\Omega_i = \begin{bmatrix} \Omega_{11i} & \Omega^1_{21i} \\ \Omega_{21i} & \Omega_{22i} \end{bmatrix}$$

Ω_{11i}: scalar long run variance of the residual u_{it}.

Ω_{22i}: m x m long run covariance vector among the ε_{it}

Ω_{21i}: m x 1 vector which gives the long run covariance between the residual u_{it} and each of the ε_{it}

The lower triangular matrix of Ω_i is denoted as L_i whose components are related as follows:

$$L_{11i} = (\Omega_{11i} - \frac{\Omega_{21}^2}{\Omega_{22i}})^{1/2}, L_{12i} = 0, L_{21i} = \frac{\Omega_{21i}}{\Omega_{21i}^{1/2}}, L_{22i} = \Omega_{22i}^{1/2}$$

Then, the Pedroni FMOLS estimator is constructed as follows:

$$\hat{\beta}_{NT}^{*} - \beta = \left(\sum_{i=1}^{N} \hat{L}_{22i}^{-2} \sum_{i=1}^{T} (x_{it} - \bar{x}_i)^2 \right)^{-1} \sum_{i=1}^{N} \hat{L}_{11i}^{-1} \hat{L}_{22i}^{-1} \sum_{i=1}^{T} (x_{it} - \bar{x}) \mu_{it}^{*} = T\hat{\gamma}_i$$

Where $\mu_{it}^{*} = \mu_{it} - \frac{\hat{L}_{21i}}{\hat{L}_{22i}} \Delta x_{it}, \hat{\gamma} \equiv \hat{\Gamma}_{21i} + \hat{\Omega}_{21i}^{0} - \frac{\hat{L}_{21i}}{\hat{L}_{22i}} (\hat{\Gamma}_{22i} + \Omega_{22i}^{0})$. The FMOLS is asymptotically unbiased for both the standard case without intercepts as well as the fixed model with heterogeneity

Table 6 below presents estimates of the cointegration vectors and *p*-value for model for models (1), (2) and (3)

Table 6: FMOLS Estimates

Variable	Model 1		Model 2		Model 3	
	Coefficient	***p-value***	***Coefficient***	***p-value***	***Coefficient***	***p-value***
LOPEN1	0.03379	0.000	-		-	
LOPEN2	-		0.04083	0.000	-	
LOPEN3	-		-		0.05949	0.000
LGOVT	0.08292	0.000	0.0857	0.000	0.0876	0.000
LGCF	0.05272	0.000	0.05719	0.000	0.06612	0.000
LINFL	-0.00468	0.124	-0.00104	0.634	-0.00195	0.000
LHUMAN	-1.0362	0.000	-1.0316	0.000	-1.02566	0.000

Interpretation of the FMOLS model shows that one variable LINF is not significant whereas the other variables are significant at 1%. Openness has the expected sign and is significant.

For a relative percentage increase in government expenditure, there is a relative decline in growth of around 0.085 % at less than 1% level of significance. Theories indicate that government expenditure may have a positive impact on economic growth because government expenditure may encourage production by increasing subsidies to producers. Public spending on the economy may improve infrastructure and education conditions which increase living standard essential for growth. A relative percentage increase in investment leads to an increase in growth by around 0.06% at less than 1 % level of significance. This is an expected result since theories state that domestic investment is linked in the development of human capital. Investment is accumulation of increase stock for future production. Thus increase in investment is likely to increase growth. Investment in R&D improves production techniques and enhances future growth.

Human capital has a negative impact on growth. Human capital depends on productivity of labour. Human capital impact has been ambiguous in theories as it depends on relative education, skills and training of labour. With knowledge and skills an increasing return to human capital can be noted. But the problem is that with increase capital intensive production, human capital may lead to decreasing return to scale. For a relative percentage increase in human capital there is fall in growth of around 1% at less than 1% level of significance. This fall is mainly because of fall in productivity of the labour force and unemployment. Though the countries in consideration are developing countries with high investment in education, there is a likely decline in productivity of the labour force. There is a trend for labour to leave developing countries and going to work in developed countries. These labours are often the highly educated and skilled one of the labour force. Massive use of capitals is made now in production process. The relative productivity of labour to capital is low and firms like to increase use of machinery rather than labour which are quite expensive. This increases the dependency ratio, necessitating more government expenditure. Despite having high quality and educated labour force jobs available in developing countries do not suite them and they get jobs which are not in their field. Thus these labours being use in sectors where they are not efficient is likely to reduce their productivity and consequently growth. Having a huge labour force does not mean having full employment. Unemployment rate are high in these countries and this affect growth through social unrest.

All three measures of openness have a positive impact on economic growth. From model 1 a relative percentage increase in OPEN1 leads to a percentage increase of 0.034 % in growth.

When OPEN2 is used for a relative percentage increase in openness, there is 0.059% increase in growth while OPEN3 leads to an increase of 0.013%. The openness coefficients are high but coefficients changes when each measure of openness is used. It is confirmed that openness has a positive impact on economic growth but other things can be inferred from the results is that each measure have a different impact implying that being open in different manner affects growth differently. OPEN2 (imports) has the greatest impact on economic growth. Countries which are high importers will tend to have an increase in growth of 0.059%. With imports better technology and better raw materials are imported. There is also import of education and highly trained workers. With more and more countries indulging into trade countries which have comparative advantage in production of a given product produce them at lower cost and more efficiently and these are imported by other countries. Thus with specialization, R&D in other countries there is a spillover effect of imports which contribute to high positive growth rate. Imports allow imitation of goods and allow production at lower cost and in large quantity. This model is more appropriate in the sense that most of the countries in the panel are net importers.

5. Conclusion

Trends in openness and growth suggest that there is a positive relationship between openness and growth. Most of the studies conducted have concentrated on Asian and Latin American countries. The present study concentrates on countries that are members of IOR-ARC. Fifteen countries consisted the panel and the time period 1997-2011. Singapore, Seychelles, Malaysia and Mauritius are among those countries which are more open and have the highest growth rate. To our knowledge, this is the first study that analyse the effect of openness on economic growth in this region. After reviewing recent empirical studies regarding the link between openness and economic growth we use recent panel estimation methods to explore the link between economic growth (proxied by RGPPPC) and openness in IOR. In the first step we check for stationarity using the IPS test. After that we apply a panel cointegration test for the specified regressions. Finally, we estimated the FMOLS. Three measures of openness were used namely trade as a percentage of GDP, imports as a percentage of GDP and exports as a percentage of GDP. It is found that openness positively affect economic growth. Openness is not an engine of growth but acts as a catalyst for promoting growth through research and development, wider market access and allowing reduction in production cost.

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Appendix 1

Table A1: List of Countries Forming the Indian Ocean Rim and Members of WTO (3)

Countries	Membership with WTO (Hence open economy)
Australia	Yes
Bangladesh	Yes
India	Yes
Indonesia	Yes
Iran	No
Kenya	Yes
Madagascar	Yes
Malaysia	Yes
Mauritius	Yes
Mozambique	Yes
Oman	Yes
Singapore	Yes
South Africa	Yes
Seychelles	Yes
Sri Lanka	Yes
Tanzania	Yes
Thailand	Yes
United Arab Emirates	Yes
Yemen	No