THE NEXUS OF OUTWARD FOREIGN DIRECT INVESTMENT AND INCOME: EVIDENCE FROM SINGAPORE
LEE, Chew Ging*

Abstract
This paper examines the relationship between economic growth and outward foreign direct investment (FDI) in Singapore with cointegration and Granger causality analyses. Although we find gross domestic product (GDP) per capita and outward FDI are cointegrated, there is no evidence of long run causality between these two variables because the coefficient of error correction term is either statistically insignificant or with wrong sign. With the standard Granger causality test, the results indicate that increased outward FDI leads to higher GDP per capita, but higher GDP per capita actually leads to a decline in outward FDI.

Keywords: Granger Causality; Outward FDI; Income
JEL classification: F20, O10

1. Introduction

Existing empirical and theoretical studies focus mainly on the impact of inward foreign direct investment (FDI) on economic growth (Chakraborty and Basu, 2002; Lim, 2001; Hansen and Rand; 2006). It is generally believed that inward FDI has positive impacts on economic growth of the host countries (Campos and Kinoshita, 2002). Although there are numerous studies on the relationship between inward FDI and economic growth, the number of studies on the interaction between outward FDI and economic growth is limited, for instance the work of Herzer (2008) is the first to examine this issue. His results support increased outward FDI is both a consequence and a cause of increased domestic output. Therefore, this study is conducted with two main aims: to assess the interrelationship between outward FDI and economic growth of a high income Asian country, Singapore, and to test the proposition of Herzer (2008). We believe that this study will contribute significantly to existing empirical literature because, generally, there is a concern that outward FDI may reduce economic activities of the home countries, which in turn may adversely affect the economic growth of these countries. This study will identify the possible short-run and long-run causalities between outward FDI and economic growth. We will also determine the sign of the effects of outward FDI on economic growth, and economic growth on outward FDI if we can identify any causality between these two variables.

I consider Singapore in this study because, being a city state with limited natural endowments of land and resources, Singapore is experiencing an impressive economic performance. In 1972, its gross domestic product (GDP) per capita measured at constant

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2000 US$ was just more than $5500. However, in 2006, its GDP per capita reached slightly more than $27000. In just 3 decades, it was able to increase its real GDP per capita by approximately 400%. This is shown in Figure 1. To maintain its international competitiveness, Singaporean government embarks on aggressive strategy in developing external economy. Singapore’s FDI concentrates mainly in Asian countries. Developing countries host more than 80% of Singapore’s FDI stock (Ellingsen et al., 2006). The regional distributions of Singapore’s FDI are different from that of other high income Asian countries, in particular Japan which is one of the world’s most prominent outward investor (Head and Ries, 2005). Japan’s FDI focuses mainly in European and North American countries. Table 1 and Table 2 report the outward FDI flows and stocks of Singapore from 1990 to 2005, respectively. Singapore’s outward FDI stock rose almost fourteenfold over the period 1990-2005. The share of Singapore’s outward FDI stock in the world increased from 0.43% in 1990 to slightly more than 1% in 2005. Figure 2 provides the time series plot of Singapore’s net outflows of FDI measured as a percentage of GDP over the period 1972-2006.

Figure 1 Time series plot of Singapore’s GDP per capita measured at constant 2000 US$.

![Figure 1](image1.png)

Figure 2 Time series plot of Singapore’s net outflows of FDI measured as a percentage of GDP.

![Figure 2](image2.png)

Source of Figures 1 and 2: World Development Indicators Online (www.worldbank.org)
The remainder of this paper proceeds as follows. Section 2 describes the data sources and discusses the methodological aspects of this study. Results of empirical analyses are also discussed in the same section. Section 3 contains concluding comments.

2. Data, Methodology and Results

In order to identify the short-run and the long-run dynamic interactions between outward FDI and economic growth in this study, we use GDP per capita measured at constant 2000 US$ (GDP) and annual net outflows of FDI as a percentage of GDP (OFDI) over the period 1972 to 2006. The data we use are annual data obtained from World Development Indicators Online. GDP is used as a proxy for economic growth. OFDI is used following previous studies, such as Herzer et al. (2008) and Herzer (2008).

In order to understand the short-run and the long-run dynamic interactions between GDP and OFDI, we perform the following econometric analyses: unit root tests, cointegration tests and Granger causality tests. To identify the order of integration of each variable, augmented Dickey and Fuller (1979 and 1981) test (ADF test) and the test proposed by Kwiatkowski et al. (1992) (KPSS test) are used. These two tests are used jointly, because of the confirmatory data analysis. The null hypotheses of these two tests are set up differently. The null hypothesis of ADF test suggests that a series is non-stationary, whereas the null hypothesis of KPSS test states that a series is stationary. We use Schwarz Information Criterion (SIC) to determine the number of lagged first differences to be used in the ADF test. Newey-West (1994) data-based automatic bandwidth parameter method is used to determine the bandwidth parameter in the Bartlett kernel based sum-of-covariances estimator of the KPSS test. The results of unit root tests are reported in Table 3. Both ADF and KPSS tests suggest that GDP is integrated of order 1. Its level is non-stationary, but its first difference is stationary. The results of unit root tests for OFDI are problematic. Both tests suggest that OFDI is stationary at level, but non-stationary at first difference. It is unlikely that a stationary series can be transformed into a non-stationary series after first differencing is applied on the series. Therefore, I
conclude that the order of integration of these variables is at most at 1. This is because most of macroeconomic variables have order of integration at the maximum equal to 1.

### Table 3 Results of unit root tests

<table>
<thead>
<tr>
<th></th>
<th>ADF Test</th>
<th>KPSS Test</th>
<th></th>
<th>ADF Test</th>
<th>KPSS Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level</td>
<td>First Difference</td>
<td></td>
<td>Level</td>
<td>First Difference</td>
</tr>
<tr>
<td>GDP</td>
<td>-2.0826[0]</td>
<td>-6.2278[0]***</td>
<td></td>
<td>0.1756[4]**</td>
<td>0.0729[5]</td>
</tr>
<tr>
<td>OFDI</td>
<td>-3.3051[8]*</td>
<td>0.4793[6]</td>
<td></td>
<td>0.1037[1]</td>
<td>0.2141[15]**</td>
</tr>
</tbody>
</table>

*, ** and *** indicate statistically significant at the 10%, 5% and 1% levels, respectively. Values in parentheses are either the number of lagged first differences used in ADF test or the choice of bandwidth parameter in the Bartlett kernel based sum-of-covariances estimator in KPSS test.

The commonly used cointegration tests, such as the Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990) approaches, require the analyzed variables to be non-stationary with the same order of integration. In this study, our results of unit root tests are unable to suggest the order of integration for OFDI. Therefore, an alternative approach has to be used. We have selected the bounds testing approach to cointegration based on autoregressive distributed lag (ARDL) framework developed by Pesaran et al. (2001) for this study. This is mainly because this approach can be used irrespective of whether the variables are pure I(1), I(0) or mutually cointegrated. Furthermore, we required a cointegration test with better small sample properties because we have only 35 observations in our sample. Pesaran and Shin (1999) show that the OLS estimators of ARDL parameters are $\sqrt{T}$-consistent, where T is sample size and the estimators of the long-run coefficients are super-consistent in small sample sizes.

The bounds test investigates the existence of a long-run relationship between the variables with the following unrestricted error correction models:

\[
\Delta\text{GDP}_t = a_0 + \sum_{i=1}^{n} a_{Gi}\Delta\text{GDP}_{t-i} + \sum_{i=0}^{n} a_{Oi}\Delta\text{OFDI}_{t-i} + a_1\Delta\text{GDP}_{t-1} + a_2\text{OFDI}_{t-1} + u_{1t} \quad (1)
\]

\[
\Delta\text{OFDI}_t = b_0 + \sum_{i=1}^{n} b_{Oi}\Delta\text{OFDI}_{t-i} + \sum_{i=0}^{n} b_{Gi}\Delta\text{GDP}_{t-i} + b_1\text{OFDI}_{t-1} + b_2\text{GDP}_{t-1} + u_{2t} \quad (2)
\]

The null hypothesis of no cointegration amongst the variables is stated in the column 2 of Table 4. This null hypothesis will be tested with the F-test, which follows a non-standard distribution. The critical values are obtained from Table CI(iii) reported in Pesaran et al. (2001) when k=1. The critical value bounds required by this study are (4.04, 4.78) at 10% significance level, (4.94, 5.73) at 5% significance level and (6.84, 7.84) at 1% significance level. The null hypothesis is rejected if the calculated F-value is greater than the upper bound of the critical values. The null hypothesis is accepted if the calculated F-value is smaller than the lower bound of the critical values. If the calculated F-value is between the upper and the lower bounds of the critical values, no decision can be made. The value of n corresponding to each equation is increased till the Breusch-Godfrey Lagrange multiplier test is unable to reject the null of no autocorrelation with lag order 2 at 5% significance level.
Results of cointegration tests reject the null of no cointegration at 5% significance level for both equations. The results suggest that there is a long-run relationship between OFDI and GDP when either OFDI or GDP is assigned as the dependent variable. In order to obtain the long-run coefficients, the following ARDL models are estimated:

\[
(1-e_1L-\ldots-e_pL^p)OFDI_t = f_0 + (1-f_1L-\ldots-f_sL^s)GDP_t + u_{3t} \\
(1-e_1L-\ldots-e_pL^p)GDP_t = d_0 + (1-d_1L-\ldots-d_qL^q)OFDI_t + u_{4t}
\]

The optimal lags of each ARDL model are selected based on SIC. Because of relatively small sample size and annual data used in this study, the maximum possible values of \(p, q, r,\) and \(s\) are set at 4. The selected values of \(p, q, r,\) and \(s\) are reported in Table 5. We reparameterized each of these ARDL models to obtain the long-run coefficients. The results of long-run coefficients are reported in Table 6. The estimated coefficient of GDP when OFDI is the dependent variable and the estimated coefficient of OFDI when GDP is the dependent variable are both positive. Both of these coefficients are also statistically significant at least at 10% level. These results suggest that GDP may have positive effects on OFDI. Similarly, OFDI may have positive impacts on GDP. The occurrence of these positive effects can be confirmed by the presence of statistically significant negative coefficient of error correction term in the error correction model.
\[ \Delta GDP_t = g_0 + \sum_{i=1}^{n} g_{Oi} \Delta OFDI_{t-i} + \sum_{i=1}^{n} g_{Gi} \Delta GDP_{t-i} + \gamma \text{ECT}_{Gt-1} + u_{st} \]  
\[ \Delta OFDI_t = h_0 + \sum_{i=1}^{n} h_{Oi} \Delta OFDI_{t-i} + \sum_{i=1}^{n} h_{Gi} \Delta GDP_{t-i} + \zeta \text{ECT}_{Ot-1} + u_{st} \]

ECT\text{Gt-1} of equation 5 and ECT\text{Ot-1} of equation 6 are the error correction terms which cannot be observed. Therefore, ECT\text{Gt-1} is replaced by EC\text{Gt-1}=GDP\text{t-1}+5340.4-1192OFDI\text{t-1} and ECT\text{Ot-1} is replaced by EC\text{Ot-1}=OFDI\text{t-1}+2.5331-0.5213x10^{-3}GDP\text{t-1}.

The value of n in each equation is determined with the Breusch-Godfrey Lagrange multiplier test. It is the lowest value where this test is unable to reject the null of no autocorrelation with lag order 2 at 5% significance level. The short-run Granger causality is implemented with the standard F-test on the null hypothesis of the lagged first differences of an independent variable are jointly insignificant. The results of short-run Granger causality test are reported in Table 7. These results suggest that a) there is a short-run Granger causality running from GDP to OFDI and b) there is a short-run Granger causality running from OFDI to GDP.

Table 7 Results of short-run Granger causality test

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>ΔGDP</th>
<th>ΔOFDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔGDP</td>
<td>6.6195[1]**</td>
<td></td>
</tr>
<tr>
<td>ΔOFDI</td>
<td>4.2361[3]**</td>
<td></td>
</tr>
</tbody>
</table>

*, ** and *** indicate statistically significant at 10%, 5% and 1% levels, respectively. The number in parenthesis is the value of n selected based on either equation 5 or equation 6.

The results of long-run Granger causality test are reported in Table 8. To implement this test, we investigate whether the coefficient of the error correction term is zero with the standard t-test. The coefficient of error correction term of equation 5 is statistically significant but with incorrect sign. Narayan and Smyth (2003) suggest that a function of disequilibrium in cointegrating relationship does not exist for this type of result. They also indicate that there is non-existent of long-run Granger causality even if the coefficient of lagged error correction term of is significant as long as its sign is positive. Therefore, we conclude that there is no long-run Granger causality from OFDI to GDP, although we should have taken into account some problems that usually appear in the application of this test as seen in Guisan (2004). The coefficient of lagged error correction term of equation 6 is statistically insignificant even at the 10% level but it has the correct sign. The result also suggests that there is no long-run Granger causality from OFDI to GDP.

Table 8 Results of Granger’s causality test: long-run

<table>
<thead>
<tr>
<th>Equation</th>
<th>Coefficient of ECT\text{t-1}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(5)</td>
<td>0.0954*** (3.2801)</td>
</tr>
<tr>
<td>(6)</td>
<td>-0.6159 (-1.2520)</td>
</tr>
</tbody>
</table>

*, ** and *** indicate statistically significant at 10%, 5% and 1% levels, respectively, t-ratios in parentheses.
To understand the sign of the impacts of an independent variable on the dependent variable in the short-run, the approaches of Ram (1988) and Zhang (2001) are used. The sign of each short-run causal relationship is determined by checking whether the summation of all coefficients of the lagged first differences of the independent variables is positive or negative. If the sign is positive, the result suggests that an independent variable has positive effects on the dependent variable. And, if the sign is negative, the result suggests that an independent variable has negative effects on the dependent variable. The sign of the short-run Granger causality running from GDP to OFDI is negative because the summation of the coefficients of all lagged first differences of GDP in equation 6 is negative (0.001031+0.001558-0.003698=-0.001109). The sign of the short-run Granger causality running from OFDI to GDP is positive because the estimated coefficient of $\Delta FDI_{t-1}$ of equation 5 is 63.3704.

3. Conclusion
In this paper, we explore the relationship between economic growth (in terms of GDP per capita) and outward FDI in Singapore. The short-run and the long-run dynamic interactions between outward FDI and GDP per capita are investigated with cointegration and Granger causality analyses. Although we find GDP per capita and outward FDI are cointegrated, there is no evidence of long run causality between these two variables because the coefficient of error correction term is either statistically insignificant or with wrong sign. Therefore, there is no evidence to support the suggestion of Herzer (2008) which emphasizes that increased outward FDI is both a cause and a consequence of increased domestic output in the long-run. The obtained results for Singapore also do not support Herzer’s suggestion in the short-run. For Singapore, increased outward FDI leads to higher GDP per capita, but higher GDP per capita actually leads to a decline in outward FDI. One possible explanation will be with higher income domestic firms invest more domestically. However, to have a proper understanding about the negative impact of increased GDP on FDI outflows, further detailed analysis has to be conducted. This is beyond the focus of current study.

References


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