Foreign Direct Investment, Oil Prices and Global Financial Crisis: Evidence from Singapore

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Abstract:

    Foreign direct investment (FDI) is often cited as an important feature of the Singapore's economy. In addition to its contribution to the city-states' capital formation, it also fosters international trade, technology transfer and yields other spillover effects. Despite Singapore economy is highly internationally linked, it cannot insulate itself against external shocks e.g. the Asian financial crisis, global financial crisis, and oil price shocks, to name a few. This study attempts to ascertain whether the effects of external shocks on the sources of FDI in Singapore are transitory or permanent using the Lagrange multiplier (LM) unit root tests proposed by Lee and Strazicich (2003 and 2004). The empirical evidence reveals that the external shocks had only transitory effects on FDI regardless of the source of the FDI either by region, major investor country or other investor country. The findings provide policy measures on how the government should best respond to shocks that affect FDI in the city-state in the short run.

Keywords: foreign direct investment; unit root; multiple breaks; oil price shock; global financial crisis; Singapore

JEL Classification: E24; F21

1. Introduction

    Singapore is popularly known as one of the four Asian Tigers[2] in the region and its remarkable economic success is attributed to the adoption of export-led growth strategy through foreign direct investment (FDI). In retrospect, FDI inflows not only have been an important catalyst for the city-state's industrialization process but also have contributed to the economy in terms of employment generation, gross domestic product (GDP) and international trade (e.g., Kwong, 2001; Ghesquiere, 2007). Owing to its strategic geographical location, excellent infrastructure, high degree of trade openness and liberal investment policy[3], inward FDI is instrumental in transforming the city state into a global centre for financial and business services (see Islam and Chowdhury, 1997; Singapore Economic Development Board, 2004; Cheong and Wong, 2006).According to UNCTAD (2014), Singapore was the third largest destination country of FDI after China and Hong Kong in terms of attracting FDI projects in the Asia Pacific in 2013 (see Table 1). In 2013, the major sources of FDI by region in Singapore comprised Asia[4], Europe[5], and North America[6], which jointly accounted for 69.3% of total inward FDI (see Table 2). On the other hand, Australasia was relatively less important as a source of FDI due to its relatively much smaller share of foreign investments in the country. Moreover, in 2013, both Europe's and North America's

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[2] The other three Asian Tigers are Hong Kong, South Korea and Taiwan.

[3] There are no restrictions on foreign investment in Singapore, as the government believes that multinationals have massive resources and international network are able to stimulate international trade.

[4] The major investor countries from Asia were Japan (SGD71.9 billion), Hong Kong (SGD34.6 billion), Malaysia (SGD 27.3 billion), India (SGD24.4 billion), and China (SGD16.4 billion) (Department of Statistics, Singapore).

[5] The major investor countries from Europe were Netherlands (SGD84.4 billion), United Kingdom (SGD58.5 billion), Switzerland (SGD40.2 billion), Norway (SGD 20.8 billion) and Luxembourg (SGD22.8 billion) (Department of Statistic, Singapore).

[6] The major investor countries from North America were United States (SGD11.4 billion) and Canada (SGD6.5 billion) (Department of Statistics, Singapore).

percentage share as sources of FDI in the city-state had decreased from 22.9% and 18.9% in 2012 to 21.8% and 18.8% respectively, while the Asia's percentage share had increased to 28.7% in 2013 from 28.3% in 2012. The bulk of inward direct investments in Singapore from these three main regions were concentrated in the following industries, namely, financial and insurance services, wholesale and retail trade and manufacturing (refer to Table 2).

Table 1. Top 5 Destination countries of FDI in Asia Pacific, 2012 and 2013

COUNTRY	2012 (billion dollars)	2013 (billion dollars)
China	121	124
Hong Kong, China	75	77
Singapore	61	64
Australia	56	50
India	24	28

Source: UNCTAD (2014) World Investment Report 2014: Investing in SDGs: An Action Plan, United Nations, New York and Geneva.

Table 2. Source of FDI in Singapore by region and by major industry, 2012 and 2013

REGION	2012		2013	
	% Share	Top 3 Industry	Percentage Share	Top 3 Industry
Asia	28.3	(1st) FIS (2nd) WRT (3rd) MNF	28.7	(1st) FIS (2nd) WRT (3rd) MNF
Europe	22.9	(1st) FIS (2nd) MNF (3rd) WRT	21.8	(1st) FIS (2nd) MNF (3rd) WRT
North America	18.9	(1st) FIS (2nd) MNF (3rd) WRT	18.8	(1st) FIS (2nd) MNF (3rd) WRT
Australasia	2.6	(1st) FIS (2nd) PS (3rd) WRT	2.4	(1st) FIS (2nd) WRT (3rd) MNF
South & Central America and the Caribbean	24.8	(1st) FIS (2nd) MNF (3rd) WRT	26.0	(1st) FIS (2nd) MNF (3rd) WRT
Other Countries	2.5	(1st) FIS (2nd) RES (3rd) WRT	2.3	(1st) FIS (2nd) RES (3rd) WRT
TOTAL	100		100	

Source: Singapore Department of Statistics
Notes: FIS denotes Financial&Insurance Services; WRT denotes Wholesale&Retail Trade; MNF denotes Manufacturing; RES denotes Real Estate Activities; PS denotes Professional Scientific&Technical Administrative and Support Services

Apart from transferring resources like capital, technology and management resources to the host economy, the presence of multinational corporations (MNCs) in the city-state could bring other economic benefits to the host economy. For instance, the empirical studies show that inward FDI in Singapore could forge linkages with services trade (Wong et al., 2009); could lead to output growth of the manufacturing sector (Anwar, 2008) as well as manufacturing industries (Jayawickrama and Thangavelu, 2010); could result in employment growth in the manufacturing sector (Wong and Tang, 2011) and, could lead to productivity spill over to local manufacturing firms (Guo and Yuen, 2012).

Despite the city-state's economy is highly internationally linked, there are concerns pertaining to whether the source of FDI in Singapore by region (such Asia, Europe and North America[7]) and country

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[7] We use the U.S. as a proxy for North America due to non-availability of data for investor country from Canada from 1980-1989.

(the major investor countries from each region and other investor countries) is vulnerable or resilient to the particular type of external shocks e.g. a surge in oil prices and global financial crisis. By and large, macroeconomic time series including FDI inflows tend to respond to time specific external shocks (see Wong et al. 2009 and Wong and Tang, 2011). A literature survey shows that such empirical study is limited for the case of sources of FDI in Singapore. Hence, the empirical evidence on the vulnerability of the source of FDI in Singapore by region and by major investor and other countries to the different nature of shocks can provide useful policy measures to mitigate the these effects. The aim of this study is to ascertain whether the external shocks have a permanent or transitory effect on FDI in Singapore by region and major and other investor country using advance unit root tests which allow for structural breaks, i.e. the LM unit root test by Lee and Strazicich (henceforth LS) (2003,2004). Our aim is to investigate if the source of FDI in Singapore is found to have a unit root or non-stationarity, then the test statistic suggests that the particular external shock tends to have a permanent effect on the FDI inflows. Otherwise, the effect on FDI inflows is transitory. The findings can provide important policy measures on how the government should best respond to shocks that affect FDI in the city-state.

The remainder of the paper is as follows. Section 2 deals with data sources and measures and is also concerned with the procedure to perform the LM unit root tests. Section 3 reports and discusses the test results. The main conclusions and policy implications can be found in the last section.

2. Data and LM Unit Root Tests

Data

We examine annual FDI flows data by region and by major and other investor countries to Singapore from 1980-2010. Higher-frequency data or data spanning a longer time period would be desirable, but the frequency and sample period are based on the availability of source FDI data, which are obtained from the Department of Statistics, Singapore.[8] All series are measured in real terms using the GDP deflator before they are transformed into natural logarithms. The denominations of all the time-series data are in millions of Singapore dollar.

LM Unit Root Test

It is well documented in time series literature, standard Augmented Dickey-Fuller (ADF) test is not appropriate for variables that may have undergone structural changes and the test statistics could be biased towards non-rejection of the null hypothesis of a unit root with no break (Perron, 1989). To deal with this problem, Zivot and Andrew (henceforth ZA) (1992), Perron (1997) and Lumsdaine and Papell (henceforth LP) (1997) proposed to determine the break point "endogenously" from the data (LS, 2001). The main deficiency of ZA (1992) and Perron (1997) models is that they incorporate only one structural break, which could potentially lead to a loss of information when there are two breaks in the data (LP, 1977).

Therefore, to test for a unit root and allow for structural break(s) under both the null and the alternative hypotheses, we apply the Lagrange multiplier (LM) unit root tests proposed by LS (2003, 2004). In contrast to the ADF test, the LM unit root test is unaffected by structural breaks under the null hypothesis and as a result, it does not suffer from size distortions, and can be more powerful than ADF tests in many cases (Vougas, 2003). The LM unit root test statistic, which is an extension of the Schmidt and Phillips (1992) test, is based on the following equation:

$$x_t = \delta' Z_t + e_t \quad \text{and} \quad e_t = \beta e_{t-1} + \varepsilon_t$$

where Z_t consists of exogenous variables and ε_t is the error term with classical properties. There are two variants with respective to the LM unit root test with one structural break, specifically, Models A and C. The former allows for one structural break in the intercept and can be described by $Z_t = [1, t, D_t]'$, where $D_t = 1$ for $t \geq T_B + 1$, and zero otherwise. T_B is the date of the structural break. The latter allows for one structural break in the intercept as well as the slope (or trend) and can be described by $Z_t = [1, t, D_{1t}, D_{2t}]'$, where $DT_t = t - T_B$ for $t \geq T_B + 1$, and 0 otherwise.

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[8] The authors would like to thank the Department of Statistics, Singapore for kindly allow us to have access to the FDI data by country and by region.

In addition, there are also two variants in the case of LM test with two structural breaks, which are known as Models AA and CC. The former, which is an extension of Model A, allows for two breaks in the intercept and is represented by $Z_t = [1, t, D_{1t}, D_{2t}]'$ where $D_{jt} = 1$ for $t \geq T_{Bj}+1$, j=1, 2, and 0 otherwise. On the other hand, Model CC, which is an extension of Model C, incorporates two structural breaks in the intercept as well as the slope and is represented by $Z_t = [1, t, D_{1t}, D_{2t}, DT_{1t}, DT_{2t}]'$, where $DT_{jt} = t - T_{Bj}$ for $t \geq T_{Bj}+1$, j = 1,2, and 0 otherwise.

To choose the unknown break dates, LS (2003 and 2004) follow ZA method by using the so-called minimum t-statistic procedure. This procedure estimates the chosen unit root testing equation considering all possible break dates in the trimmed sample and chooses the break date(s) so that the t-statistic for the unit root hypothesis is minimized.

3. Results

The results of the standard unit root tests i.e. ADF and PP (Phillips-Perron) tests for the FDI in Singapore time series by region, major investor and other investor countries can be found in Table 3. The lag length (K) of ADF test is selected based on the "general to specific" approach suggested by Hall (1994).[9] Both the test statistics cannot reject the null hypothesis of a unit root for FDI in Singapore by region at 5% significance level except for the U.S.[10] However, both the test statistics show rejection of the unit root null hypothesis for FDI in Singapore by major investor and other countries except Thailand. As highlighted in the previous section, the standard unit root tests could be biased towards non-rejection of a unit root if a structural break is present in the time series.

Table 3. Unit Root Tests

SERIES	ADF	PP
FDI in Singapore by region		
Asia	-0.52 (1)	-2.59
Europe	-2.58 (8)	-1.89
U.S.	-3.93***(4,10)	-5.81***
FDI in Singapore by major investor country		
Hong Kong	-3.52**(3)	-3.07**
Japan	-4.86***(5)	-3.88**
Malaysia	-5.16***(2,4)	-4.46***
Switzerland	-4.79***(1,5)	-4.80***
U.K.	-5.00***(0)	-5.17***
FDI in Singapore by other investor country		
Australia	-3.09**(0)	-3.12**
Germany	-4.79*** (1)	-5.21***
Indonesia	-4.15***(0)	-4.15***
Philippines	-5.26***(1,2,3)	-10.37***
Taiwan	-3.57** (4,5)	-3.77***
Thailand	-0.41 (0)	0.09

Notes: Only constant term has been included in the ADF equation as there is no obvious trend from plotting all country and regional FDI data. The optimum lag (.) is selected based on the general to specific approach. *,** and *** denote rejection of the unit root null at the 10%, 5% and 1% level, based on MacKinnon's (1996) critical values.

In this regard, the LM unit root tests with one structural break in the intercept (i.e. Model A) as well as with one structural break in the intercept and slope (i.e. Model C) were performed and their test results are reported in Tables 4 and 5 respectively. Model A shows that apart from the U.S., the test statistics for FDI in Singapore by region do not reject the null hypothesis. In contrast, if the unit root for FDI in Singapore by major investor and other investor countries are tested, the test statistics appear to reject the

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[9] The main advantage of this method is that it is able to produce stable size and higher power than information based method such as Akaike information criterion (Ng and Perron, 1995; Perron, 1997).

[10] Due to the data on cross border direct investment in Singapore by Canada is only available from 1990 onwards, the U.S. is used as a proxy for North America (which constitutes U.S. and Canada) as a source of FDI in Singapore by region.

null hypothesis for Switzerland, U.K., Germany, the Philippines, Taiwan (at the 1% significance level), Hong Kong, Japan, Malaysia (at the 5% significance level). Also, the structural breaks of the major and other FDI investor countries in the city-state correspond to the following shocks (refer to the last column of Table 4). For instance, the structural break in 2000 for Germany as the source of FDI was associated with the crash of the dot-com bubble and the recession that affected the European Union (EU). Similarly, the structural break in 2004 (2007) in Hong Kong (Taiwan) was caused by the sudden rise in oil prices as a result of the rapid growth of global oil demand especially from China in particular (sub-prime loan crisis originated from the U.S.).

With reference to Model C, the unit root null is rejected for the source of FDI by region (except for Asia) and by major investor and other investor countries at 1% significance level. The major investor and other investor countries that experienced the break in the intercept and slope are Hong Kong in 2006, Malaysia in 2004, Switzerland, the U.S. in 2003, U.K. in 2007, Australia in 1997, Germany in 2005 and Taiwan in 2003. The structural breaks that occurred between 2003 and 2007 were associated with Iraq War and the SARS (severe acute respiratory syndrome) that affected Singapore and other parts of Asia in 2003; the sudden rise in oil prices due to rapid growth of global oil demand especially from Asia (China in particularly) in 2004, Hurricane Katrina in 2005 and the global financial crisis in 2007.

According to Sen (2003a),Model C is preferred to Model A especially the former suggests different results. Moreover, the Monte Carlo simulations reported in Sen (2003b) show that Model C tends to yield more reliable estimates of the breakpoint than Model A.

Table 4. Results of LM unit root test with one structural break in the intercept (Model A)

Series	TB	K	S_{t-1}	B_t
FDI in Singapore by region				
Asia	2007	2	-0.6773 (-2.8748)	0.5041** (2.2436)
Europe	1997	0	-0.3858 (-2.6327)	0.2403 (1.0807)
U.S.	1995	0	1.1888*** (-6.5191)	-0.0023 (-0.0126)
FDI in Singapore by major investor country				
Hong Kong	2004	1	-0.9897** (-4.2385)	0.1658** (2.1431)
Japan	1993	0	-0.6602** (-3.7800)	0.1424 (1.1979)
Malaysia	2007	0	-0.6391** (-3.6903)	-0.0041 (-0.0453)
Switzerland	2006	0	-1.1277*** (-6.1227)	-0.0791 (-0.6001)
U.K.	2002	0	-1.0368*** (-5.5869)	0.2753 (0.3763)
FDI in Singapore by other investor country				
Australia	2006	0	-0.4945 (-3.0863)	0.0394 (0.7056)
Germany	2000	1	-1.7852*** (-7.8129)	0.1847*** (3.4788)
Indonesia	2007	0	-0.3840 (-2.6250)	0.0374 (0.6971)
Philippines	2002	0	-1.3095*** (-7.4163)	-0.0152 (-0.8297)
Taiwan	2007	0	-1.3982*** (-8.2085)	-0.1719*** (-6.5775)
Thailand	1993	0	-0.2686 (-2.1209)	-0.0455 (-1.2002)

Notes: TB is the date of the structural break; k is the lag length; S_{t-1} is the LM test statistic; B_t is the dummy variable for the structural break in the intercept. Numbers in the parentheses are t-values. Critical values for the LM test at 10%, 5% and 1% significant levels = -3.211, -3.566, -4.239. *, **and *** denote statistical significance at the 10%, 5% and 1% levels respectively.

Table 5. Results of LM unit root test with one structural break in the intercept and slope (Model C)

Series	TB	K	S_{t-1}	B_t	D_t
FDI in Singapore by region					
Asia	2005	2	-0.8318	-0.8741***	0.4728***
			(-4.1854)	(-4.0393)	(2.7947)
Europe	2004	0	-1.1650***	-0.0291	0.3051***
			(-6.3607)	(-0.1684)	(2.8936)
U.S.	2003	1	-2.0406***	0.1140	-0.2362***
			(-7.3280)	(0.6937)	(-3.1068)
FDI in Singapore by major investor country					
Hong Kong	2006	1	-1.3150***	-0.3426***	0.3233***
			(-6.9735)	(-4.2967)	(5.3179)
Japan	2003	0	-1.1893***	0.1361	-0.0306
			(-6.5224)	(1.4092)	(-0.7485)
Malaysia	2004	0	-0.9869***	0.1981**	0.0231
			(-5.3153)	(2.6653)	(0.6273)
Switzerland	2003	2	-2.0205***	-0.6426***	0.3581***
			(-6.7984)	(-4.4784)	(4.8772)
U.K.	2007	1	-2.2563***	3.2154***	-2.8589***
			(-10.4357)	(5.6831)	(-7.8473)
FDI in Singapore by other investor country					
Australia	1997	0	-1.0551***	0.0880*	-0.0917***
			(-5.6907)	(1.8348)	(-3.6765)
Germany	2005	2	-2.4045***	-0.3921***	0.1955***
			(-6.7807)	(-5.1956)	(5.5892)
Indonesia	2006	0	-1.1922***	0.0085	0.0308
			(-6.5422)	(0.2193)	(1.1978)
Philippines	1994	0	-1.3061***	-0.0096	0.0030
			(-7.3880)	(-0.5216)	(0.4406)
Taiwan	2003	2	-1.9408***	-0.1019***	0.0785***
			(-7.2002)	(-3.5432)	(4.7805)
Thailand	2007	0	-1.5418***	-0.0032	0.0187
			(-9.8786)	(-0.1585)	(1.3383)
Critical Values for S_{t-1}					
location of break, λ	0.1	0.2	0.3	0.4	0.5
1% significant level	-5.11	-5.07	-5.15	-5.05	-5.11
5% significant level	-4.50	-4.47	-4.45	-4.50	-4.51
10% significant level	-4.21	-4.20	-4.18	-4.18	-4.17

Notes: TB is the date of the structural break; k is the lag length; S_{t-1} is the LM test statistic; B_t is the dummy variable for the structural break in the intercept. D_t is the dummy variable for the structural break in the slope. Numbers in the parentheses are t-values. Critical values for the LM test statistics are symmetric around λ and (1-λ). Critical values for other coefficients follow the standard normal distribution. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels respectively.

Tables 6 and 7 present the test results based on the LM unit root tests with two structural breaks in the intercept (Model AA) and with two structural breaks in the intercept and slope (Model CC). Relating to Model AA, the unit root null hypothesis is rejected for the source of FDI by region (excluding Europe), by major investor country and by other investor country (excluding Australia, Indonesia and Thailand). Whereas Model CC suggests that the unit root null is rejected for both the source of FDI by region, by major investor as well as other investor countries. Overall, the results in Model CC are preferred to Model AA because the former is the least restrictive and has the advantage of encompassing the latter.

The significant endogenously determined structural breaks for both models are reported in Tables 6 and 7. The breaks for FDI in Singapore by region, viz. Asia (both models), Europe (Model AA) and U.S. (Model CC) are linked to the increase in oil prices in 2003 and 2004, and the global financial crisis in 2007. Pertaining to the significant breaks associated with the FDI in Singapore by major investor and other investor countries, viz. Hong Kong (both models), Malaysia (both models), Switzerland (both models), U.K. (Model CC), Germany (both models), the Philippines (Model CC), Taiwan (both models) and Thailand (Model CC), both the individual and common external shocks that affected the source of FDI are the

Mexican crisis in 1994, the sharp appreciation of the dollar in 1995 and 1996, the Asian financial crisis in 1997 and 1998, the crash of the dot-com bubble in 2000, skyrocketed oil prices due to Hurricane Katrina in 2005 and the global financial crisis in 2007.

Table 8 summarizes the unit root test results whether the impacts of the external shocks on the source of FDI in Singapore are transitory or permanent. Overall, the test statistics cannot reject the null hypothesis of a unit root, suggesting that the external shocks mentioned above had only a transitory effect on FDI in the city-state regardless of the source of the FDI either by region, major investor country or other investor country. The temporary sensitivity of FDI to shocks reveals that (i) The FDI source regions and countries were susceptible to the financial crises and the sharp increase in oil prices, which could adversely affect the growth performance of the parents as well as the subsidiaries of foreign firms operating in Singapore. As a consequence, these temporary adverse shocks could discourage equity capital investment, reinvested earnings and inter-company loans, of which FDI predominantly comprises, during bad times. (ii) The financial crises have a tendency to delay the cross-border direct investments by foreign firms in the host economy. (iii) Singapore has a high degree of trade openness and hence, its major sources of FDI in the economy are vulnerable to external shocks.

Table 6: Results of LM unit root test with two structural breaks in the intercept (Model AA)

SERIES	TB1	TB2	K	S_{T-1}	$B1_T$	$B2_T$
FDI in Singapore by region						
Asia	1993	2004	0	-0.9541***	0.1852	0.6962***
				(-4.7753)	(0.9594)	(3.5567)
Europe	1997	2007	0	-0.5940	0.1651	-0.5862***
				(-3.2501)	(0.8629)	(-3.0239)
U.S.	2000	2003	0	1.2892***	0.2408	0.1122
				(-6.7340)	(1.2570)	(0.6029)
FDI in Singapore by major investor country						
Hong Kong	2004	2006	1	-1.0534***	0.1077	-0.1712**
				(-4.6992)	(1.3530)	(-2.1662)
Japan	1987	1993	0	-0.7158*	0.1073	0.1226
				(-3.7331)	(0.8632)	(0.9834)
Malaysia	2000	2005	2	-0.7588***	0.2634***	-0.4186***
				(-5.3441)	(3.7079)	(-4.9810)
Switzerland	1993	2005	0	-1.2157***	0.2130	0.4085**
				(-6.2250)	(1.5905)	(2.6779)
U.K.	1999	2002	0	-1.0738***	-0.3550	0.1195
				(-5.3838)	(-0.4610)	(0.1561)
FDI in Singapore by other investor country						
Australia	1994	2006	0	-0.5665	-0.0410	0.0378
				(-3.1430)	(-0.7046)	(0.6486)
Germany	1994	2000	1	-1.8248***	0.0440	0.1749***
				(-7.3101)	(0.8261)	(3.0738)
Indonesia	1993	2007	0	-0.4304	0.0359	0.0443
				(-2.6182)	(0.6737)	(0.7754)
Philippines	1994	1996	0	-1.3293***	-0.0002	0.0070
				(-7.0388)	(-0.0082)	(0.3639)
Taiwan	1997	2007	0	-1.5077***	0.0572**	-0.1763***
				(-8.7495)	(2.2839)	(-6.9012)
Thailand	1993	2007	0	-0.3141	-0.0451	-0.0192
				(-2.1583)	(-1.1185)	(-0.4547)

Notes: Critical values for the LM test at 10%, 5% and 1% significant levels = -3.504, -3.842, -4.545. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels respectively.

Table 7. Results of LM unit root test with two structural breaks in the intercept and slope (Model CC)

SERIES	TB1	TB2	K	S_{T-1}	$B1_T$	$B2_T$	$D1_T$	$D2_T$
FDI in Singapore by region								
Asia	1986	2003	0	-1.5510***	0.0988	-0.4526***	0.1016	0.4595***
				(-8.9132)	(0.6911)	(-2.8302)	(1.4255)	(5.5601)
Europe	1993	2004	0	-1.3700***	0.2481	-0.0716	0.0128	0.1930*

SERIES	TB1	TB2	K	S_{T-1}	$B1_T$	$B2_T$	$D1_T$	$D2_T$
				(-7.0725)	(1.5918)	(-0.4283)	(0.2014)	(1.9984)
U.S.	2003	2007	1	-2.0482***	0.1916	-1.4431***	-0.4441***	0.6882***
				(-8.3133)	(1.0516)	(-6.1821)	(-4.2858)	(4.8753)
FDI in Singapore by major investor country								
Hong Kong	2000	2006	1	-1.7496***	-0.1767***	-0.3799***	0.0438*	0.3469***
				(-10.7777)	(-3.5810)	(-6.4605)	(1.9633)	(7.1477)
Japan	1999	2003	0	-1.3780***	-0.2511**	0.1171	0.0794	-0.0268
				(-7.1384)	(-2.5612)	(1.2581)	(1.4803)	(-0.4456)
Malaysia	1994	2003	0	-1.4888***	-0.0080	-0.0699	0.0687**	0.1755***
				(-8.1844)	(-0.1322)	(-1.0459)	(2.4887)	(4.6191)
Switzerland	1998	2003	2	-2.2169***	0.2603**	-0.7198***	-0.1804**	0.6484***
				(-7.2408)	(2.0681)	(-4.8085)	(-2.7914)	(5.9344)
U.K.	2001	2006	1	-2.5292***	0.6430	3.4584***	-0.0548	-2.9249***
				(-12.7594)	(1.5865)	(7.1535)	(-0.2770)	(-8.1966)
FDI in Singapore by other investor country								
Australia	1986	2003	0	-1.2294**	0.0154	0.1386***	0.0009	-0.0388
				(-6.0574)	(0.3528)	(2.9345)	(0.0393)	(-1.6750)
Germany	1996	2005	2	-2.6740***	0.2178***	-0.4452***	-0.1040***	0.2728***
				(-8.1448)	(4.5466)	(-6.1436)	(-4.7041)	(7.2483)
Indonesia	2003	2007	0	-1.6869***	-0.0692***	-0.0309	0.0132	-0.0147
				(-11.1309)	(-3.0328)	(-1.1513)	(1.0700)	(-0.6742)
Philippines	1994	2007	0	-1.5062***	-0.0151	-0.1555***	0.0100	0.0932***
				(-8.3764)	(-0.9905)	(-8.1256)	(1.6636)	(7.1081)
Taiwan	1995	2000	2	-2.5343***	-0.0692***	0.1943***	0.0687***	-0.1191***
				(-9.6702)	(-3.2568)	(8.7775)	(5.4547)	(-7.8520)
Thailand	1996	2007	0	-1.6286***	-0.0327*	0.0013	0.0137**	-0.0004
				(-10.0423)	(-2.0162)	(0.0618)	(2.1496)	(-0.0242)

CRITICAL VALUES FOR THE LM TEST									
λ_2		0.4			0.6			0.8	
λ_1	1%	5%	10%	1%	5%	10%	1%	5%	10%
0.2	-6.16	-5.59	-5.27	-6.41	-5.74	-5.32	-6.33	-5.71	-5.33
0.4	-	-	-	-6.45	-5.67	-5.31	-6.42	-5.65	-5.32
0.6	-	-	-	-	-	-	-6.32	-5.73	-5.32

Notes: λ_j denotes the location of breaks. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels respectively.

Table 8. Summary of all the LM unit root tests

Series	Model A: H_0: Unit Root	Model C: H_0: Unit Root	Model AA: H_0: Unit Root	Model CC: H_0: Unit Root	Conclusion based on the four models: H_0: Unit Root
FDI in Singapore by region					
Asia	Do not reject	Do not reject	Reject	Reject	Reject
Europe	Do not reject	Reject	Do not reject	Reject	Reject
U.S.	Reject	Reject	Reject	Reject	Reject
FDI in Singapore by major investor country					
Hong Kong	Reject	Reject	Reject	Reject	Reject
Japan	Reject	Reject	Reject	Reject	Reject
Malaysia	Reject	Reject	Reject	Reject	Reject
Switzerland	Reject	Reject	Reject	Reject	Reject
U.K.	Reject	Reject	Reject	Reject	Reject
FDI in Singapore by other investor country					
Australia	Do not reject	Reject	Do not reject	Reject	Reject
Germany	Reject	Reject	Reject	Reject	Reject
Indonesia	Do not reject	Reject	Do not reject	Reject	Reject
Philippines	Reject	Reject	Reject	Reject	Reject
Taiwan	Reject	Reject	Reject	Reject	Reject
Thailand	Do not reject	Reject	Do not reject	Reject	Reject

Conclusions

A large part of Singapore's economy is dominated by MNCs, which use the city-state as regional hub for international trade, financial and business services. Hence, apart from fostering international trade and serving as an important regional financial centre, FDI has become an important feature of city-state's economy in terms of the transfer of the best available technology, employment generation and other spillover effects. Despite its economy is highly open to both international trade and capital flows, it cannot insulate itself against external shocks. In the empirical literature, there has not been any attempt to ascertain whether the effects of external shocks on the source of FDI in Singapore are transitory or permanent. In this study, we applied the LM unit root tests proposed by LS (2003 and 2004) on the source of FDI in Singapore by region, major investor and other investor countries. The main advantages of the LM unit root tests over the standard unit root tests are firstly, the structural breaks are endogenously determined from the data, and secondly, the structural breaks could vary by the source of FDI by region, major investor and other investor country.

Our findings suggest that the impacts of the various external shocks on the source of FDI in the city-state are temporary irrespective of the origin of investors i.e. either by region, major investor country or other investor country. The significant break dates identified for the external shocks are closely linked to the Mexican crisis, the Asian financial crisis, the global financial crisis and high oil prices. Since the external shocks and FDI inflows are closely linked in the short run, the Singapore government should take mitigating measures to alleviate the external shocks on FDI inflows. For instance, the devaluation of the Singaporean dollar during the financial crisis period is instrumental in reducing the acquiring cost for and financing of foreign operations in the city-state. These measures to some extent might be able to impede either the cancelled or postponed investment plans by the foreign MNCs. Moreover, the home currency depreciation also tends to increase the nominal competitiveness of existing export-oriented FDI on one hand, and to discourage the outflows of FDI on the other. In addition, the Singapore government should assist the crisis-affected foreign affiliates to gain access to credit facilities so that they would not experience financial difficulties to self-finance their operations or through reinvestments.

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