

OUTWARD FDI, MERCHANDISE AND SERVICES TRADE: EVIDENCE FROM SINGAPORE

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Abstract. This paper aims to explore the causality pattern between outward foreign direct investment (OFDI) and major external trade components (i.e. exports and imports of merchandise as well as services) using Singapore as a case study, since it is one of the largest outward investors in the Asian region and it is overtly trade-dependent. The findings reveal that there is evidence of an OFDI-led trade hypothesis, particularly with regard to merchandise exports and imports, which is an indication OFDI opens important channels for intra-firm trade activities, home country sourcing and backward integration. However, there is no evidence of causality relationships between Singapore's OFDI and services trade because the purpose of such services is mainly to provide a market presence in the consuming country. As such, Singaporean multinationals are likely to outsource their services either from the host country services sector or from their own services-supporting subsidiaries that have been relocated abroad. The present study provides implications for policy formulation to strengthen OFDI-services trade linkages.

Keywords: outward FDI, multinationals, Singapore, Granger causality, merchandise and services trade.

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Introduction

As globalization continues to increase, the world economy is becoming more integrated and interdependent, leading to a rapid expansion of international trade as well as foreign direct investments (FDIs). One of the salient features of the globalization process is a change in the FDI pattern, that is, a rise in outward FDI (OFDI) activities by developing economies of the Southeast and East Asian regions; this rise is an indication that these regions have become an emerging source of the world's FDI (UNCTAD, 2008). As a consequence, this indication has raised an interesting empirical question pertaining to the effects of OFDI on home country trade. However, the literature surveyed shows that relatively little empirical work has been conducted to ascertain the causal linkages between OFDI and the components of external trade. The direction of causality between OFDI and external trade may vary not only between the external trade variables (i.e. exports and imports) but also between the types of trade (i.e. merchandise and services). The aim of this paper is to fill this gap in the empirical literature by examining the causality pattern between OFDI and the external trade components, namely, merchandise imports and exports, as well as services, using Singapore as a case study. Singapore was selected as the site for the case study because the city-state is one of the largest outward investors in the Asian

region and is overly dependent on trade (as popularized by her successful engagement in entrepôt trade).² Thus, the main contribution of this study is to provide an additional perspective to the existing literature using external trade component data. Because an empirical analysis based on aggregated external trade data may tend to conceal the economic interactions between OFDI and the trade component variables, the empirical findings may be misleading for policy analysis. Conversely, an empirical analysis using external trade component data may suggest useful implications for policy formulation, such as forging linkages between cross-border direct investments by foreign-controlled and locally controlled firms from Singapore, external trade variables and the type of trade in which Singapore engages.

The structure of this paper is organized as follows. The next section presents a profile of Singapore's OFDI and external trade with a focus on recent developments and economic performance. A sound understanding of the dynamics of the city-state's OFDI and external trade can provide important information on the linkages between the two. Section 3 presents the theoretical considerations, provides a description of the data, and unit root tests, a prerequisite for Granger causality analyses. The causality results are reported and analyzed in Section 4. Finally, concluding remarks and policy implications are discussed in Section 5.

1. Singapore's OFDI and external trade

Singapore is renowned as a globalized city-state³ in which foreign multinational corporations (MNCs) have played a pivotal role in industrializing the economy and facilitating the country's external trade (which is dominated by merchandise exports and imports). The combined share of merchandise exports and imports in total trade in 2010 was 76.3% (see Table 1). Since 2007, merchandise exports continued to exceed merchandise imports, resulting in a surplus in merchandise balance (see Table 1). The services account also displays a similar trend in the services balance. Nonetheless, merchandise exports remained an important component of Singapore's external trade vis-à-vis services exports (see Table 2). For instance, in 2010, merchandise exports were the largest foreign exchange earner, contributing approximately 76.1% to the total export revenue, followed by services exports (23.9%).

< Insert Table 1 and Table 2 here >

The city-state's spectacular economic performance and development in the course of the implementation of its open foreign investment policy and liberalized trade regime is well-documented in the literature (e.g., Chia 1986; Pang 1987; Rodan 1989; Regnier 1991; Huff 1995; Murray, Pereira, 1995; Islam, Chowdhury 1997; Blomqvist 2001). Despite Singapore's excellent infrastructure (such as ports, air transport, telecommunications, and information technology), rising labor costs and limited natural resources and land, coupled with a small

² The present paper differs from Wong *et al.*'s (2009) paper, which examined the services trade of inward FDI in Singapore and Malaysia. Their main findings for Singapore showed evidence of bi-directional causality between inward FDI and total trade volume in services. We thank the referee for highlighting this point.

³ Accessed at <http://www.ey.com/SG/en/Newsroom/News-releases/News-release---Singapore-takes-third-spot-on-Globalization-Index-2010> (date accessed: June 1, 2011).

domestic market size⁴ and shrinking export markets, could act as impediments to doing business in the city-state for both domestic firms and Singapore-based foreign affiliates. In response to the previously mentioned domestic constraints, as well as greater competition in costs associated with globalization, the Singaporean government initiated the regionalization drive⁵ to encourage domestic firms to go regional to take advantage of lower labor and land costs (Islam, Chowdhury 1997; Ellingsen *et al.* 2006). Not only can the strategic relocation of lower-end production activities in low-cost countries⁶ potentially sustain Singapore's international competitiveness while retaining higher-end production activities in the home country, it can also be instrumental in transforming the economy into a human capital- and technology-intensive country (see Lecraw 1985; Aggarwal, Agmon 1990; Ellingsen *et al.* 2006).

According to the UNCTAD (2009) report, Singapore was the fourth largest outward investor among developing countries after China, Hong Kong and India in 2008. OFDI⁷ from Singapore grew from S\$13,622 million in 1990 to S\$359,348 million in 2009, an increase of 2,538% over the 20-year period.⁸ The considerable increase in OFDI by Singapore was mainly due to the adoption of regionalization strategies and the generous incentives⁹ offered to cross-border direct investors by the Singaporean government, who also took the leading role in establishing regional industrial parks¹⁰ and ventured abroad through its investment arm, Temasek and other state-owned enterprises (UNCTAD 2005). Table 3 reports Singapore's OFDI by activity. By and large, financial and insurance services and manufacturing activities dominated the city-state's total OFDI between 2006 and 2009. For instance, out of the total OFDI stock in 2009, financial and insurance services had the largest share with 49.5 percent. This share was, however, slightly below its 54.4 percent share in 2006. In the manufacturing activities, OFDI accounted for a greater than 20 percent share of Singapore's total OFDI stock between 2006 and 2009.

Table 4 shows Singapore's OFDI by region from 2006 to 2009. Overall, Asia was Singapore's major OFDI destination, accounting for a greater than 50 percent share of OFDI in 2008 and 2009, while Europe, Australia, New Zealand, and the U.S. became much less important destinations for Singapore's outward investors. Table 5 indicates that within the Asian region, China, Malaysia, Indonesia, Hong Kong and Thailand continued to be the major host countries for Singapore's OFDI. Excluding Hong Kong, these major Asian destinations of Singapore's OFDI were found to be low-cost countries, suggesting that Singaporean firms relocate their labor-

⁴ For example, Estonia also initiated cross-border direct investment because of its small local market (see Ginevičius, Tvaronavičiene 2005)

⁵ Similarly, under the premiership of Dr. Mahathir, the Malaysian government encouraged domestic firms to invest abroad to exploit the regional growing market opportunities and expand their market reach (Goh, Wong 2011).

⁶ In the literature, Helpman (1984) labeled the increase in FDI that results from accessing low-cost production in low-cost countries "vertical FDI".

⁷ OFDI refers to an investment in which a direct investor resident in the reporting economy owns 10 percent or more of the ordinary shares or voting power in a non-resident direct investment enterprise. An investment by a resident enterprise with less than 10 percent of the shares will be considered an outward portfolio investment (Singapore Department of Statistics 2008 p. 9).

⁸ Authors' calculation based on data obtained from *Singapore's Investment Abroad* (various issues).

⁹ For example, tax incentives and financial support (see Okposin 1999).

¹⁰ For instance, the Singaporean government established industrial parks in China, India, Vietnam and Indonesia (see Islam, Chowdhury 1997; Yeung 1999).

intensive activities to these locations with the intention of taking advantage of the low-cost production to maintain their competitive positions and extend their market reach.

<Insert Table 3, Table 4 and Table 5 here>

In terms of Singapore's OFDI by ownership, there was a relatively high level of participation by Singapore-based foreign-controlled firms, which accounted for a 46 percent share in 1999, despite their decline to 35% in 2003¹¹ (see Table 6). As such, OFDI can be viewed as part of the MNC network in which intra-firm trade is becoming increasingly important to Singapore's export and import trade (i.e. between the parent companies at home and their subsidiaries abroad). Additionally, setting up subsidiaries abroad to take advantage of the lower costs of production could potentially enhance the cost competitiveness of the parent companies at home, which in turn could increase the home exports to the rest of the world, on the one hand, and increase home imports from the rest of the world in the case of backward vertical integration.¹²

<Insert Table 6 here>

As Singapore is one of the largest outward investors in the region and trade is needed because Singapore is small, this paper aims to explore the inter-linkages between OFDI from Singapore and its major external trade components (i.e. merchandise exports and imports as well as services) using the Granger causality approach, as extant empirical studies are limited.

2. Theoretical considerations, data and methodology

Theoretical Considerations

The empirical study of the relationship between OFDI and trade is well-documented in the literature. In general, the basis for the empirical work on OFDI-trade relationships is determining whether these two macroeconomic variables are complementary or substitutionary. Broadly speaking, the empirical evidence is mixed. For instance, Horst (1972) found that OFDI is often viewed as a replacement for home exports for U.S. manufacturing firms when they are producing for Canadian markets. Similarly, empirical evidence supporting the proposition that OFDI is substitute for trade can also be found in Svensson (1996), Bayoumi and Lipworth (1997) and Ma *et al.* (2000). In contrast, empirical findings by Lipsey and Weiss (1984), Helpman (1984), Grossman and Helpman (1989), Brainard (1993; 1997), Lin (1995), Pfaffermayr (1996), Clausing (2000) and

¹¹ Singapore's Department of Statistics defines foreign-controlled companies as either wholly owned (100%) or majority-owned (at least 50% of paid-up shares). However, the publication of the ownership structure of Singapore's OFDI has been discontinued since 2004.

¹² Backward vertical integration refers to intermediate inputs that are produced by subsidiaries abroad and are then imported for value-added into the home country.

Head and Ries (2001) highlighted the complementary relationship between OFDI and trade because foreign affiliates used home inputs to produce outputs in the host countries.

Moreover, as noted by Lim and Moon (2001), OFDI would have a positive effect on home country exports if the foreign subsidiaries were located in relatively new, less-developed countries or in a declining home industry. Furthermore, Goldberg and Klein (1999) and Blonigen (2001) showed mixed evidence in that OFDI had both substitution and complementary effects on trade. Thus, the OFDI-trade relationship was not clearly defined, and many studies have indicated that the outcome of the relationship depends on whether OFDI is horizontal or vertical (e.g., Markusen (1984), Markusen, Venables (1995), Helpman (1984), Helpman, Krugman (1985), Kokko (2006)). According to Amiti *et al.* (2000), the substitutionary relationship tends to take place if horizontal OFDI occurs between countries that are similar in terms of relative endowments and size and when trade costs are moderate to high. On the other hand, vertical OFDI is likely to dominate when countries differ in terms of relative skill endowment and size and trade costs are low.

Another interesting empirical question pertaining to the OFDI-trade relationship is the pattern of causality between OFDI and trade (i.e. exports and imports).¹³ According to Fontagné (1999), the causality between OFDI and exports as well as imports could run in the following directions: (a) OFDI may result in home exports due to foreign production by the host country's multinationals with the aim of enhancing the international competitiveness of export trade; (b) home exports may drive OFDI when exports serve as the first stage in an internalization process; (c) OFDI may lead to imports because of backward vertical integration; and (d) imports may drive OFDI due to the relocation of domestic industries abroad caused by declining competitiveness.

Data

All of the time-series data are annual data, and the estimation period is from 1972 to 2009. 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 OFDI data, which are retrieved from UNCTAD.¹⁴ The data for trade variables, such as exports and imports of merchandise and services, are obtained from the Department of Statistics, Singapore. All of the raw data are converted into real terms using the GDP deflator before they are transformed into natural logarithms (ln).

Methodology

The possible causal linkages between Singapore's OFDI and her external trade components can be determined using the Granger causality test (Granger 1969; 1988). The notion of the test is to distinguish whether the causality pattern between the macroeconomic variables of interest is unidirectional, bi-directional or independent. For instance, a variable X is said to Granger cause Y if information in the past and present X improves the forecasts of variable Y. A bi-directional pattern exists if Y also causes X; otherwise, the causality

¹³ The causal relationship between inward FDI and trade flows has been examined by Kosekahyaoglu (2006).

¹⁴ The Department of Statistics, Singapore, published its annual report, which is known as Singapore Investment Abroad. Only annual OFDI data are published in the annual report. The OFDI data correspond with the data downloaded from UNCTAD.

relationship is only unidirectional. If neither X nor Y causes the other, then the two variables are statistically independent. A tri-variate VAR (vector autoregressive) model for causality analysis is written as follows:

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$$\begin{bmatrix} \ln OFDI_t \\ \ln EXM_t \\ \ln IMM_t \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} + \begin{bmatrix} \theta_{11}(L) & \theta_{12}(L) & \theta_{13}(L) \\ \theta_{21}(L) & \theta_{22}(L) & \theta_{23}(L) \\ \theta_{31}(L) & \theta_{32}(L) & \theta_{33}(L) \end{bmatrix} \begin{bmatrix} \ln OFDI_t \\ \ln EXM_t \\ \ln IMM_t \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix}, \quad (1)$$

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$$\begin{bmatrix} \ln OFDI_t \\ \ln EXS_t \\ \ln IMS_t \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} + \begin{bmatrix} \Phi_{11}(L) & \Phi_{12}(L) & \Phi_{13}(L) \\ \Phi_{21}(L) & \Phi_{22}(L) & \Phi_{23}(L) \\ \Phi_{31}(L) & \Phi_{32}(L) & \Phi_{33}(L) \end{bmatrix} \begin{bmatrix} \ln OFDI_t \\ \ln EXS_t \\ \ln IMS_t \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \end{bmatrix}, \quad (2)$$

where EXM_t , IMM_t , EXS_t and IMS_t denote merchandise exports, merchandise imports, services exports and services imports at time t , respectively. ε_t and e_t are the residuals with a mean of zero and constant variance. L is the lag operator. The multivariate Granger causality test assesses the null hypothesis of $\theta_{12}(L)$, which is jointly equal to zero. If the null hypothesis is rejected, it is implied that EXM_t Granger causes $OFDI_t$, given IMM_t . The restrictions can be tested by employing the standard Wald test, which follows a χ^2 distribution. If the variables of interest are non-stationary, then the implications drawn from the usual Wald test statistics are invalid (Sim *et al.*, 1990). Specifically, as pointed out by Toda and Phillips (1993), the Wald test in an integrated unrestricted VAR has nonstandard limit distributions, hence it is important to pre-test the unit root hypothesis for all variables before the Granger causality test is performed.

As our data spans almost three decades, the series may have structural breaks. Perron (1989) showed that the power to reject a unit root decreases when a structural break is ignored. To allow a structural break, Zivot and Andrews's (1992, hereafter ZA) endogenous structural break test is applied. This is a sequential test that uses the full sample and employs a different dummy variable for each possible break date. The advantage of this test is to allow the break date to be endogenously determined within the model. The break date is selected where the t -statistic from the ADF test of the unit root is at a minimum (most negative) value.

ZA propose three models to test for a unit root:

(1) Test A, which permits a structural break and takes the form of a shift in the mean, can be written as follows:

$$\begin{aligned} \Delta Y_t &= \mu + \alpha Y_{t-1} + \theta_1 DU(\lambda) + \delta t + e_{1t} \\ DU(\lambda) &= 1, t > T\lambda \\ &= 0, \text{otherwise} \end{aligned}$$

where DU is a dummy variable, λ is an integer that takes a value between 0.15 and 0.85 T is the full sample size.

(2) Test B, where the structural break takes the form of a shift in the trend, is represented by

$$\begin{aligned}\Delta Y_t &= \mu + \alpha Y_{t-1} + \theta_1 DT(\lambda) + \delta t + e_{2t} \\ DT(\lambda) &= t - T\lambda, t > T\lambda \\ &= 0, \textit{otherwise}\end{aligned}$$

where DT is the corresponding trend shift variable.

(3) Test C, in which the structural break takes the form of a shift in the mean and the trend, is specified as

$$\Delta Y_t = \mu + \alpha Y_{t-1} + \theta_1 DU(\lambda) + \theta_2 DT(\lambda) + \delta t + e_{3t}$$

The null hypothesis in all the three models is $\alpha = 0$, which implies that the series Y_t contains a unit root, while the alternative hypothesis, i.e. $\alpha < 0$, implies that the series is a trend-stationary process with a one-time break occurring at an unknown point in time.

3. Empirical results

Table 7 reports the results of the ZA tests. The results suggest that we do not reject the null of a unit root for all the series at the 5 percent level of significance, indicating that all of the time series are non-stationary $I(1)$ in level terms.¹⁵

<Insert Table 7 here>

As previously mentioned, the Granger causality tests require that all series be stationary. We converted all of the series into first differences and performed stationarity tests, such as Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests.¹⁶ If these variables are written in first differences, then both tests suggest that all series are $I(0)$.

<Insert Table 8 here>

Given that all of the variables of interest are $I(1)$, these variables are expressed in first differences in equations (1) and (2) before the causality tests are performed. As the Granger causality test is very sensitive to the number of lags included in the regression, we adopted a set of statistical selection information criteria using the

¹⁵ We note that one can infer Granger causality if the non-stationary variables are co-integrated. However, there are no theories to justify that there exists a long-run relationship among OFDI, merchandise exports and imports and services exports and imports.

¹⁶ Neither the ADF and PP tests reject the null hypothesis of a unit root for all variables in the levels (see Table 8) and are consistent with the ZA test results reported in Table 7.

Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC) and Hannan-Quinn Information Criterion (HQ) to determine the optimal lag length. Table 8 provides the calculated values of the loss functions based on the proposed information criteria. All of the information criteria choose a lag of 1 as the optimal lag for the tri-variate VAR using the merchandise trade data (see the first panel of Table 9). The same lag-length selection results also apply to the tri-variate VAR using the services trade data, with the exception of SC, which favors lag 0. Hence, the tri-variate VAR in first differences with 1 lag is estimated for equations (1) and (2).

<Insert Table 9 here>

Table 10 presents the causality test results. There is strong evidence of a unidirectional causality that runs from $\Delta \ln OFDI$ to $\Delta \ln EXM$, suggesting that Singapore's OFDI Granger causes the growth rate of the merchandise exports. This shows that cross-border direct investments by both locally controlled and foreign-controlled firms have the ability to enhance the country's international competitiveness of export trade and, consequently, encourage merchandise exports. The positive sign of the estimated coefficient confirms the complementary effect of $\Delta \ln OFDI$ on $\Delta \ln EXM$. This finding is consistent with the view that OFDI tends to open an important channel for firms based in Singapore to engage in cross-border intra-firm trade via value-adding activities that could lead to greater efficiency in conducting business within firms to promote merchandise exports. However, there is no evidence supporting the reverse causality from home merchandise exports to Singapore's OFDI.

The tri-variate Granger causality test results also suggest the existence of a unidirectional causality from Singapore's OFDI to the growth rate of the merchandise imports. The positive sign of the estimated coefficient implies the complementary effect of the former on the latter. Such evidence would be consistent with backward vertical integration, which involves importing intermediate outputs from the host economies where foreign affiliates undertake their production activities to add value in the home country by their parent firms. This finding is also consistent with Singapore's regionalization drive, which is a long-term strategy to encourage and offer incentives to Singaporean firms to invest abroad so the firms can exploit the lower costs of production in the host economies, especially in Asia, while retaining the more human capital- and technology-intensive stages of production in the home country (see Yeung (2001) and Ellingsen *et al.* (2006)).

<Insert Table 10 here>

Furthermore, the causality test results also indicate a bi-directional causality between the growth rate of merchandise exports and that of merchandise imports. The causation that runs from merchandise exports to merchandise imports suggests that merchandise exports have a high import content, which supports the notion of entrepôt trade and multinational trade and investment activity, both of which involve backward and forward linkages. The reverse causation that runs from merchandise imports to merchandise exports suggests a supply-side view that merchandise imports, especially those used as inputs for export production, have the propensity to

encourage merchandise exports. The evidence of bi-direction causality between these two variables further supports the sustainability of trade balances, as noted by Tang (2003).

Nonetheless, Table 9 shows that there is no evidence of any causal linkages between Singapore's OFDI and services trade¹⁷ (exports and imports); OFDI is not able to draw on the services trade because trade in services is not capable of encouraging OFDI. The plausible explanations for this set of Granger causality test results are as follows:

- a. The foreign subsidiaries of Singapore-based firms tend to outsource their support services either from the host countries or from their own services-support subsidiaries that have been relocated abroad¹⁸ as the nature of services is mainly to provide market presence in the consuming country. Hence, there is no evidence of causation that runs from Singapore's OFDI to services exports.
- b. The multinationals from Singapore are similarly not involved in the import of intermediate services from abroad for adding value in the home country because their value chain activities in services might not fit into the core activities of their parent companies (e.g., research and development, IT services, product design, marketing, delivery, and provision of after-sale services). Instead, Singapore is highly dependent on foreign expertise to make it a regional and international hub for business, financial and knowledge-based services. Therefore, Singapore continues to attract foreign investments into its business and financial services rather than encouraging OFDI, which explains why the Granger causality test results do not show any evidence of interactions between OFDI and import trade in services.

Conclusions

Singapore is a city-state economy with limited land and virtually no natural resources. Despite its strategic location in the region, the availability of a skilled workforce and a sophisticated infrastructure, the Singaporean government is encouraging domestic firms to invest in the region in view of rising labor costs, small domestic market size and declining export markets. Cross-border direct investment has become a long-term strategy for Singapore not only to sustain international competitiveness but also to lead the country towards high-technology

¹⁷ Causality is based on the notion that the past values of Y can be used to predict X one period ahead. However, there is a concern about the indirect effects that might exist in multivariate causality tests (e.g. Lütkepohl 1993 and 2005; Dufour, Renault 1998; Dufour, Taamouti 2010). For instance, given the presence of an auxiliary variable Z, it is possible that the variable Y does not cause variable X at horizon one but does cause variable X at a longer horizon via Z. Lütkepohl (1991 p. 45) states that, "For a stationary VAR(p), if the first pK-p responses of variable j to an impulse in variable k are zero, all the following responses must also be zero". As Kónya (2004 p. 79) stated, "However, if there is no causality between two variables for two periods ahead then there is no causality between them at, or up to longer horizons either". Therefore, we estimated both the tri-variate models with lags 1 and 2 (see Table 10) and found that the results are the same for both lag lengths (i.e. lags 1 and 2), suggesting that the indirect effect is not a concern in this study. We thank the referee for highlighting the indirect causality effect.

¹⁸ For instance, Table 3 shows that a significant range of services activities from Singapore has been operating overseas, which can also potentially complement the foreign production undertaken by Singaporean multinationals.

industrialization. Determining the causal linkages between OFDI from Singapore and Singapore's external trade components (i.e. both exports and imports of merchandise and services) can provide an economic assessment of the ability of the internationalization of firms based in Singapore to forge trade linkages with the export and import sectors with regard to merchandise and services in the era of globalization.

The findings suggest that cross-border direct investments by Singapore-based locally controlled and foreign-controlled firms are instrumental in promoting merchandise trade, particularly exports, thus supporting the OFDI-led trade hypothesis. For instance, the causality test results suggest that Singapore's OFDI activities tend to enhance the international competitiveness of the city-state's merchandise exports by means of intra-firm trade activities and home sourcing, which potentially opens an important channel to boost merchandise export trade. As a result, the regionalization drive initiated by the city-state government is not only able to take advantage of the regional growing business opportunities but also foster a trade relationship with Singapore's merchandise exports. Moreover, the production activities of Singapore's foreign subsidiaries could also establish backward vertical integration that encourages merchandise imports that add value in the home country and thereby complement the home country's exports. However, the present study does not show any evidence of causal interaction between Singapore's OFDI and services trade (i.e. exports and imports) because the Singaporean multinationals often outsource their services either from the host country services sector, where ongoing contact with the former is important (such as accounting, banking, finance and related services), or from their own services-supporting subsidiaries that have been relocated abroad. The city-state is well-known for its strategic location as an operational headquarters, international procurement center and regional distribution center. Therefore, the linkages between Singapore's OFDI and home services sector can be strengthened to promote cross-border direct investment and services trade. To facilitate the relationships between OFDI services and trade, the city-state government could create a platform with incentives that encourage domestic support services that can complement the global operations undertaken by the Singaporean multinationals.

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APPENDICES

Table 1. Singapore's external trade components (% share of total trade), 2007–2010

External Trade Component	2007	2008	2009	2010
Merchandise Exports	42.2	40.6	39.6	40.8
Merchandise Imports	35.6	37.3	35.4	35.5
Services Exports	11.8	11.8	13.6	12.8
Services Imports	10.4	10.4	11.5	11.0

Source: Authors' calculations based on data from Singapore Department of Statistics.

Table 2. Singapore's export components (% share of total exports), 2007–2010

Export Trade	2007	2008	2009	2010
Merchandise Exports	78.1	77.5	74.5	76.1
Services Exports	21.9	22.5	25.5	23.9

Source: Authors' calculations based on data from Singapore Department of Statistics.

Table 3. Singapore's OFDI by activity (% share), 2006–2009

Activity	2006	2007	2008	2009
Financial & Insurance Services	54.38	56.23	49.21	49.51
Manufacturing	22.20	21.77	24.34	23.39
Real Estate Activities	4.07	3.83	5.48	5.62
Wholesale & Retail Trade	5.33	4.69	5.47	5.46
Administrative and Support Services	1.99	2.53	3.81	5.08
Information & Communication	5.28	4.89	4.64	4.74
Transport & Storage	3.37	3.18	3.48	2.66
Professional, Scientific & Technical	2.10	1.83	2.21	2.06
Accommodation, Food & Beverages	0.94	0.83	0.80	0.75
Construction	0.34	0.21	0.56	0.73

Source: Authors' calculations based on data from *Singapore's Investment Abroad* (various issues).

Table 4. Singapore's OFDI by region (% share), 2006–2009

Region	2006	2007	2008	2009
Asia	48.91	46.68	54.54	52.81
Europe	13.71	14.63	14.35	16.48
Australia & New Zealand	4.92	5.85	5.98	5.43
U.S.	3.47	4.38	3.70	3.35
Other countries	7.17	10.74	4.80	5.43

Source: Authors' calculations based on data from *Singapore's Investment Abroad* (various issues).

Table 5. Singapore's OFDI within Asia (% share), 2006–2009

Asia	2006	2007	2008	2009
China	27.78	28.17	31.16	30.62
Malaysia	15.69	15.39	14.47	15.12
Indonesia	13.87	13.6	12.92	13.84
Hong Kong	12.91	13.46	11.59	11.35
Thailand	10.84	11.43	11.10	10.25
Japan	2.09	1.66	2.82	2.62
Taiwan	4.33	3.46	3.43	3.03
Philippines	2.77	2.76	2.48	2.30

Source: Authors' calculations based on data from *Singapore's Investment Abroad* (various issues)

Table 6. Ownership structure of Singapore's OFDI, 1999–2003

Ownership	1999	2000	2001	2002	2003
Foreign-controlled firms	46.06	41.58	41.86	36.92	35.36
Locally controlled firms	53.94	58.42	58.14	63.08	64.64

Note: Singapore's OFDI by ownership data are only made available by *Singapore's Investment Abroad* until 2003.

Source: Authors' calculations based on data from *Singapore's Investment Abroad* (various issues).

Table 7. Zivot-Andrew Results

Series	ZA test statistics		
	5% critical value		
lnOFDI	Test A	−3.77	−4.80
	Test B	−2.81	−4.42
	Test C	−2.51	−5.08
lnEXM	Test A	−3.60	−4.80
	Test B	−3.56	−4.42
	Test C	−3.54	−5.08
lnIMM	Test A	−3.64	−4.80
	Test B	−3.70	−4.42
	Test C	−3.72	−5.08
lnEXS	Test A	−4.47	−4.80
	Test B	−4.40	−4.42
	Test C	−4.70	−5.08
lnIMS	Test A	−2.43	−4.80

	Test B	-2.30	-4.42
	Test C	-2.27	-5.08

Note: The ZA tests are based on Zivot and Andrew's (1992) critical values.

Table 8. Unit root test results

Series	Type of test	ADF		PP	
		In Levels	In first differences	In levels	In first differences
lnOFDI	Intercept	-1.7103	-10.5780***	-1.6053	-11.7181***
lnEXM	Trend & intercept	-3.1363	-4.8270***	-3.1456	-4.7080***
lnEXS	Trend & intercept	-1.7495	-3.1188**	-2.0005	-3.3515**
lnIMM	Trend & intercept	-2.0949	-4.9375***	-2.1229	-4.8327***
lnIMS	Trend & intercept	-2.1797	-4.1364***	-2.1979	-4.0574***

Note: * denotes significant at 10%, ** denotes significant at 5%, *** denotes significant at 1%.

Table 9. Lag length selection

Lag	LogL	LR	FPE	AIC	SC	HQ
Tri-variate VAR(1): $\Delta \ln OFDI$, $\Delta \ln EXM$ and $\Delta \ln IMM$						
0	15.6148	NA	7.61e-05	-0.9703	-0.8252	-0.9285
1	29.7713	23.9571*	5.15e-05*	-1.3670*	-0.7863*	-1.1998*
2	36.0813	9.2222	6.55e-05	-1.1601	-0.1439	-0.8674
3	42.6261	8.0551	8.61e-05	-0.9712	0.4804	-0.5532
Tri-variate VAR (1): $\Delta \ln OFDI$, $\Delta \ln EXS$ and $\Delta \ln IMS$						
0	51.7095	NA	1.14e-05	-2.8652	-2.7305*	-2.8193
1	66.6663	26.3943*	8.08e-06*	-3.2156*	-2.6769	-3.0319*
2	73.9969	11.6246	9.05e-06	-3.1174	-2.1747	-2.7959
3	81.7283	10.9150	1.01e-05	-3.0428	-1.6960	-2.5835

Note: * indicates the order of lag length selected by the information criteria.

Table 10. Causality tests for OFDI, exports and imports

Tri-variate VAR(1): $\Delta \ln OFDI$, $\Delta \ln EXM$ and $\Delta \ln IMM$		
Null hypothesis	χ^2 (p-value)	Complementary (+) / Substitutionary (-)
$\Delta \ln EXM \neq \Delta \ln OFDI$	0.253 (0.6143)	(+) [#]

$\Delta \ln OFDI \Rightarrow \Delta \ln EXM$	2.969 (0.0849)*	(+)
$\Delta \ln IMM \Rightarrow \Delta \ln OFDI$	0.055 (0.8131)	(+)
$\Delta \ln OFDI \Rightarrow \Delta \ln IMM$	4.692 (0.0303)**	(+)
$\Delta \ln IMM \Rightarrow \Delta \ln EXM$	3.8695 (0.0492)**	(+)
$\Delta \ln EXM \Rightarrow \Delta \ln IMM$	5.167 (0.0230)**	(+)
Tri-variate VAR (1): $\Delta \ln OFDI$, $\Delta \ln EXS$ and $\Delta \ln IMS$		
Null hypothesis	χ^2 (p-value)	Complementary / Substitutionary
$\Delta \ln EXS \Rightarrow \Delta \ln OFDI$	0.068 (0.7934)	(-)
$\Delta \ln OFDI \Rightarrow \Delta \ln EXS$	0.004 (0.9495)	(+)
$\Delta \ln IMS \Rightarrow \Delta \ln OFDI$	1.269 (0.2599)	(+)
$\Delta \ln OFDI \Rightarrow \Delta \ln IMS$	0.009 (0.929)	(+)
$\Delta \ln IMS \Rightarrow \Delta \ln EXS$	0.011 (0.9156)	(+)
$\Delta \ln EXS \Rightarrow \Delta \ln IMS$	1.348 (0.2455)	(+)

Note: Δ denotes first differences;

the sign of the estimated VAR coefficient;

* significant at 10% level, ** significant at 5% level.

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