Asymmetric Impact of FDI and International Trade on Economic Growth: Empirical Evidence from Taiwan

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Abstract

This research explores the dynamic impact of international business on Taiwan's economic growth. We consider three indicators: inward and outward foreign direct investment (FDI) and the total value of exports and imports. By applying a nonlinear autoregressive distributed-lag (NARDL) model, the findings prove that long- and short-term cointegrations are asymmetric with a greater effect dominated by decreasing change. Our empirical results contribute new insights on the relationships among FDI, international trade, and economic growth.

Keywords: Inward FDI, Outward FDI, Trade openness, NARDL, Economic growth

JEL Classifications: C22, F14, F21

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1. Introduction

Foreign direct investment (FDI) and international trade are the primary means of transporting advance technologies and innovative ideas in the endogenous growth theory, which clarifies growth by endogenizing technological development. FDI also can help enhance the host country's integration into the global economy. With international integration expanding worldwide, Taiwan has joined the global trend with its policy of capital openness, and FDI plays a crucial role in its economic development. Technology transfer through FDI has contributed enormously towards transforming Taiwan's industrial economy. In fact, the adoption of its trade liberalization policy since the mid-1970s has boosted the country's trade and FDI to higher growth rates. Thus, it is worthwhile to study the dynamic interconnection among its foreign investment, trade, and economic growth.

Most empirical research examines the impact of FDI on Taiwan by utilizing a foreign investment function or production function model. For instance, Chen and Ku (2000) find that FDI provides benefits to trade and domestic industries, but does not correlate with job creation in Taiwan. Chen *et al.* (2004) present empirical evidence of a substitution relationship between exports and FDI, suggesting significant consideration for promoting exports or outward FDI. When evaluating the Johansson cointegration test, the multivariate error correction model, and the Granger causality, Chang (2007) concludes that there is a positive relationship between inward FDI (IFDI) and economic growth in Taiwan. However, the potential relationships among FDI, trade, and economic growth are barely considered, especially in the multi-variant framework. In other words, most empirical studies based on Taiwan data fail to examine specific effects and dynamic changes in FDI, trade, and economic growth. Therefore, it is worthwhile to investigate the cointegration between these variables.

Another issue when estimating the impacts of FDI and international trade on economic growth is the adoption of alternative econometric techniques, by assuming that the relationship between overseas businesses and economic growth is symmetric. That means an increase in IFDI promotes economic growth, whereas a decline pulls economic growth down with the same magnitude. This assumption of linear adjustment can be excessively restrictive where transaction costs are perceptible and policy interventions are recognized in cross-border business activities. Moreover, the impacts of FDI on economic growth are dissimilar when the economy is shrinking compared to when it is developing. Given the possibility of asymmetric relationships among FDI, international trade, and economic growth, a proper test for the existence of asymmetry and a suitable econometric model are required. Regrettably, many existing studies underestimate this important issue.

We therefore believe this research offers a more comprehensive picture of economic growth-driven elements in Taiwan compared to previous literature by examining the

asymmetric impacts of FDI and international trade on economic growth using a nonlinear autoregressive distributed-lag (NARDL) model. The NARDL model offers many advantages: (i) it can estimate both short-run and long-run effects of FDI and international trade on economic growth; (ii) this approach is valid irrespective of whether all the variables are integrated on the same order of zero or one or mutually cointegrated; and (iii) this model is robust and performs well for a small sample size of data.

The research object of this study is therefore to examine the asymmetric cointegration among FDI, international trade, and economic growth of Taiwan by applying the NARDL model. Findings from data covering the period 1982-2019 prove a long-run asymmetric relationship between IFDI/OFDI and economic growth. A larger impact of IFDI on GDP growth appears during the downward trend of attracting foreign investment. Similarly, the effect of OFDI is stronger when investment overseas decreases. Asymmetry also exists in the short-run reaction of GDP growth to changes in international trade. These findings extend the literature of international economics by contributing advanced insights into the asymmetric effects of FDI and cross-border trade on economic growth. To our best knowledge, this study is the first to empirically consider the asymmetric cointegration between international business activities and economic growth in the case of Taiwan.

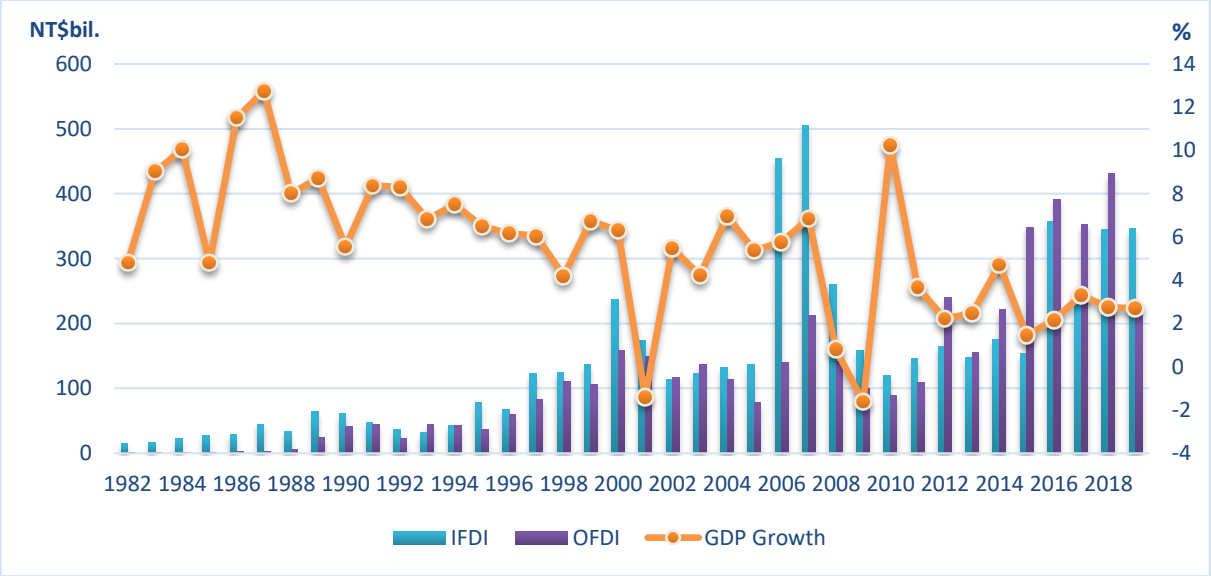
The rest of the paper proceeds as follows. Section 2 depicts the general trend of FDI, trade, and economic performance of Taiwan. Section 3 organizes a brief overview of the recent literature. Section 4 introduces the proposed NARDL model and econometric methodology. Section 5 presents the main results of the empirical data. Finally, Section 6 offers concluding remarks.

2. FDI, International Trade, and Economic Growth in Taiwan

The patterns of IFDI/OFDI in Taiwan are similar to those of Asian countries like South Korea and Japan, or European countries such as France and Germany, whose OFDI flows have always surpassed IFDI flows. These countries' firms, not only multinational corporations but also small- and medium-size enterprises (SMEs), play an important part in a wide range of global industries via huge investment in various countries worldwide. Identically, Taiwan's top overseas investments come from global-minded domestic businesses.

Figure 1 shows the different trends of IFDI and OFDI associated with GDP growth in Taiwan from 1982 to 2019. After increasing gradually and reaching a peak of about NT$500 billion in 2007, IFDI takes a significant decline in the following years. There has also been a fluctuating but upward trend of OFDI since the 1990s. The OFDI flow even starts to surpass IFDI amount from 2013, climbing to the highest point of about NT$431 billion in 2018.

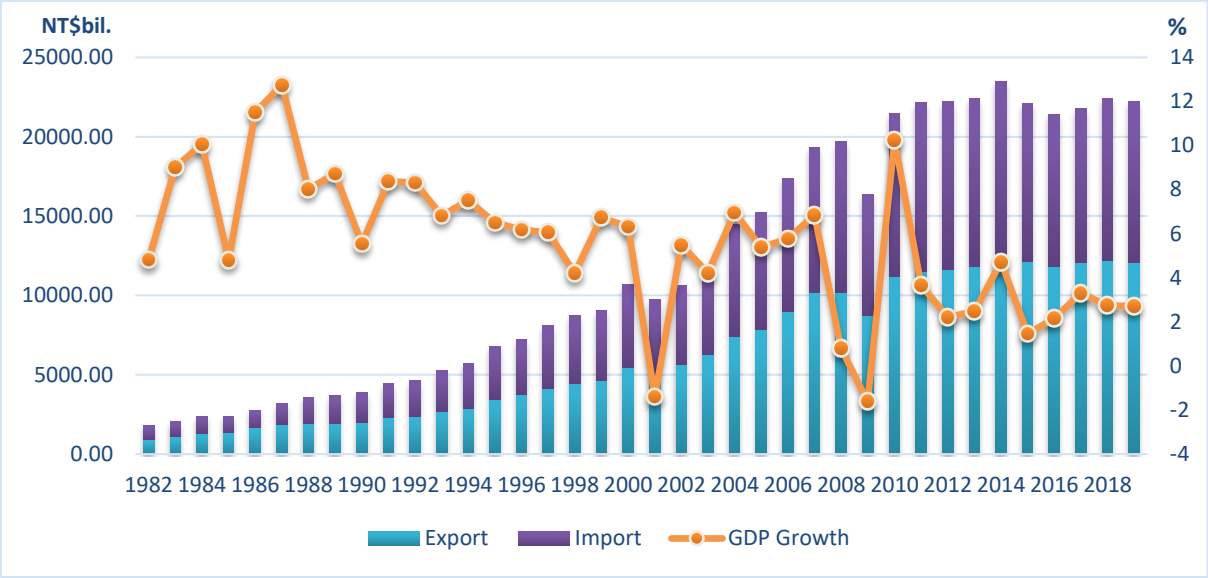
The patterns of IFDI and OFDI depend on some unique circumstances. First, Taiwan lacks natural resources, which is commonly known as a pull factor to foreign investment. Second, inward foreign portfolio investment has gradually risen in the structure of capital inflows to Taiwan and has exceeded IFDI since 1993. As a result of quickly rising income levels, Taiwanese firms have offshored their production activities to countries having low wage advantages and widened their international supply chain, which corresponds to rising OFDI flows. At the same time, Taiwan's GDP growth rate has gone up and down in the recent 40 years, but exhibits a decreasing trend. There are periods in which the growth rate declines following a fall of IFDI, like in 2008 and 2009, but sometimes it keeps decreasing in spite of a significant increase of IFDI as in the 1990s. That is why it is critical to consider the asymmetric effect of IFDI, as well as OFDI, on economic growth.



Source: Investment Commission, Ministry of Economic Affairs of Taiwan

Figure 1: FDI and GDP Growth in Taiwan from 1982 to 2019

Figure 2 describes the trends of international trade, export values, and import values. In general, the total of exports and imports increases steadily over the time, while GDP growth fluctuates strongly with its highest point is seen in 2014 at a value of NT$23.493 trillion. There are slight declines in 2001, 2009, and 2015, but at the same time, the GDP growth rate also reveals some dramatic falls. Once again, there might be an asymmetric effect in the connection between international trade and economic performance in Taiwan.



Source: AREMOS Taiwan

Figure 2: Export/Import Value and GDP Growth in Taiwan from 1982 to 2019

3. Literature Review

3.1. IFDI and Economic Growth

The correlation between IFDI and a host country's economic development is the center of focus of various research studies. According to past theories, the causal relation between IFDI and economic development can run in either direction. The IFDI-led growth hypothesis states that IFDI increases employment opportunities, facilitating technology transfer and capital stock. Accordingly, Kim and Seo (2003) investigate the case of South Korea in the period between 1959 and 1999 and find that the relationship between FDI and economic growth is significantly positive by using the vector auto regression model. They also conclude that IFDI does not crowd out domestic investment. Adopting panel data analysis, Tiwari and Mutascu (2011) examine the way FDI relates to the economic growth of selected Asian countries over 22 years between 1986 and 2008. Their results support the hypothesis of FDI, labor, capital, and exports propelling economic growth. With a similar methodology, Hudea and Stancu (2012) examine seven European countries from 1993 to 2009 and discover that the positive relationship between FDI and economic improvement is significant in both the long run and short run. Moreover, IFDI acts as a channel to transfer physical capital and human capital to the receiving country to increase the economic growth rate (Alvarado *et al.*, 2017).

Other studies provide evidence for a conditional or insignificant relationship between these two variables. For instance, Zhang (2001) explores FDI inflows and economic growth in eleven high- and low-income countries of East Asia and Latin America. Without opening up to international trade and an improvement in human capital, the study illustrates that

investment into these countries hardly benefits economic development. In the same vein, Mallick and Moore (2008) discover a significant positive impact from IFDI to economic growth in a high-income group of countries, but not for the case of lower-income ones. A host country's firms are also given resources and capabilities needed for internalization from foreign owners such as new products, technology, managerial, and marketing skills. It is thus inevitable that foreign firms become a monopoly in certain sectors, which leads to price distortion and misallocation of resources. Ultimately, the recipient country faces stagnant growth, because the economy is controlled by foreigners (Khatun and Ahamad, 2015). Moreover, Wong *et al.* (2020) find evidence that Malaysia's IFDI from Singapore have insignificant impacts on the former's economic growth.

3.2. OFDI and Economic Growth

There are two theoretical economic views to OFDI's potential effects on the economic growth of the home country. On one hand, OFDI is perceived to be a substitute for domestic investment, which means that an increase in overseas FDI is the culprit of diminishing domestic investment opportunities, leading to a fall in domestic output. The opposing view considers the relationship between OFDI and domestic investment to be complementary. Thanks to the engagement of foreign affiliates in intra-firm activities, increases in OFDI in the home country contribute to higher domestic output. The domestic economy also gets advantages from access to cheaper raw materials abroad and lower wages through OFDI of multinational enterprises, which in turn increase production efficiency (Herzer, 2008).

The empirical evidence of OFDI's impact on domestic economic growth is accordingly mixed. The positive effect appears in several studies. Herzer (2008) use U.S. time series data to present empirical results that OFDI encourages the home country's output and economic growth. Similarly, Lee (2010) shows a long-run positive effect from OFDI to gross domestic product per capita in Japan by using the multivariate Granger causality framework. Moreover, Hsu *et al.* (2015) show the positive impact on exports and domestic investment of Chinese multinational companies conducting investment abroad. With panel data of manufacturing enterprises, Liu *et al.* (2015) also conclude the beneficial effect of Taiwanese OFDI to developed nations on domestic outputs.

Other scholars contrastingly report a negative relationship between the two. Goh and Wong (2014) argue that the relocation of relatively scarce financial capital from domestic to overseas through OFDI causes a reduction in domestic output. At the same time, Liu *et al.* (2015) find evidence that OFDI from Taiwan to low-wage countries negatively affects domestic production. Ali and Wang (2018) detect a one-way long-run negative causality from OFDI to domestic investment by applying the autoregressive distributed-lag (ARDL) model for China data, which supports the view that Chinese outbound FDI crowds out domestic

investment. In the same case of China's economy, Ali *et al.* (2018) provide evidence of the significant effect of human capital and OFDI on economic growth. Noticeably, by utilizing NARDL, asymmetry in the long run effect appears with a stronger impact dominated by upward changes in outbound FDI.

3.3. International Trade and Economic Growth

Several papers in recent years intensively examine the debate on the correlation among imports/exports or trade openness and economic expansion (Hye *et al.*, 2016; Malefane and Odhiambo, 2018). In general, most of them highlight the positive effect from trade openness to economic growth. Hye *et al.* (2016) provide evidence for the existence of both long- and short-run positive impact of trade openness on economic performance from 1975 to 2009 in China. Olabisi and Lau (2016) argue that trade openness enhances economic growth by promoting technological innovation transfer and strengthening the domestic competition environment. Adopting the ARDL approach, Malefane and Odhiambo (2018) find a relatively positive effect of trade openness on South Africa's economic growth.

Some studies like Sun and Parikh (2001) investigate the causality relationship between economic development and exports. They find that the degree of a home country's development and economic structure moderates the correlation between exports and economic growth. In general, the effect of expanding exports is not significant during the period of low-leveled development. Besides, Bajwa and Siddiqi (2011) note a short-run negative impact of trade openness on economic growth by adopting the error correction model from 1972 to 1985.

From the summary of the literature review, IFDI, OFDI, exports, and imports are all determinants of economic growth and affect it significantly. Therefore, this study's contribution is to examine the dynamic relationship among these indicators. Moreover, by using the NARDL model, we are able to empirically support the asymmetric cointegration among these macro-level indicators for Taiwan.

4. Methodology and Data

Many related papers rely on linear regressions to explore the relationships among FDI, trade, and economic growth. However, if their examined data are a time series, then a linear regression is an inappropriate method for interpretation, because of the spurious correlation producing probability (Newbold and Granger, 1974). Moreover, one critical assumption commonly used in classical methods like ordinary least squares (OLS) when analyzing time series data is that the variances and means of the series are constants that are independent of time (i.e., processes are stationary). In case of non-stationary time series, biased or misleading results will arise.

To address this issue, Engle and Granger (1987) formalize the cointegrating vector approach, which conceptualizes in the long term that at least two non-stationary times series data are integrated together in such a manner as to prevent them moving away from some equilibrium. The cointegration test then becomes a very important approach to examine the correlation and causal effect of multiple time series. The literature has proposed many popular alternative cointegration methods, including Engle-Granger two-step method, Phillips–Ouliaris test, Johansen test, and ARDL model.[1] However, one drawback is that they assign one parameter for one explanatory variable and use it to explain the effects of an explanatory variable. To capture a dynamic picture of cointegration among IFDI, OFDI, and international trade with economic growth, we thus propose to apply the NARDL model promoted by Shin *et al.* (2014).

4.1. NARDL Model

Based on the ARDL model of Pesaran and Shin (1998) and Pesaran *et al.* (2001), Shin *et al.* (2014) extend it with nonlinear approach to develop a flexible dynamic parametric framework to form relationships revealing both long- and short-run asymmetries. Initially, the general form of the asymmetric long-run regression is:

$$GDP_t = \alpha_0 + \alpha_1 IFDI_t^+ + \alpha_2 IFDI_t^- + \alpha_3 OFDI_t^+ + \alpha_4 OFDI_t^- + \alpha_5 OP_t^+ + \alpha_6 OP_t^- + e_t . \quad (1)$$

where GDP_t, $IFDI_t$, $OFDI_t$, and OP_t are GDP growth rate, inward FDI, outward FDI, and trade openness in year t, respectively; $\boldsymbol{\alpha} = (\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6)$ is a vector of asymmetric long-term parameters; and e is the error term. $IFDI_t^+$ and $IFDI_t^-$ are partial sum processes of positive and negative changes in IFDI, which we calculate as follows:

$$IFDI_t^+ = \sum_{j=1}^{t} \Delta IFDI_j^+ = \sum_{j=1}^{t} \max\left(\Delta IFDI_j, 0\right); \quad IFDI_t^- = \sum_{j=1}^{t} \Delta IFDI_j^- = \sum_{j=1}^{t} \min\left(\Delta IFDI_j, 0\right). \quad (2)$$

Moreover, $OFDI_t^+$ and $OFDI_t^-$ are partial sum processes of positive and negative changes in outward FDI, while OP_t^+ and OP_t^- are partial sum processes of positive and negative changes in trade openness, which we define below.

$$OFDI_t^+ = \sum_{j=1}^{t} \Delta OFDI_j^+ = \sum_{j=1}^{t} \max\left(\Delta OFDI_j, 0\right); OFDI_t^- = \sum_{j=1}^{t} \Delta OFDI_j^- = \sum_{j=1}^{t} \min\left(\Delta OFDI_j, 0\right). \quad (3)$$

$$OP_t^+ = \sum_{j=1}^{t} \Delta OP_j^+ = \sum_{j=1}^{t} \max\left(\Delta OP_j, 0\right); \quad OP_t^- = \sum_{j=1}^{t} \Delta OP_j^- = \sum_{j=1}^{t} \min\left(\Delta OP_j, 0\right). \quad (4)$$

[1] The ARDL estimation reveals less significant results in our study, and so we do not present them, but do offer them upon request.

Eq. (1) shows the long-term relationship between FDI and trade openness and GDP growth. The long-term effect of the positive changes in IFDI on GDP growth is α_1. Concurrently, α_2 captures the long-term effect of the negative changes in IFDI. Following the IFDI-led growth hypothesis, we expect α_1 and α_2 to be positive. Similarly, α_3 and α_4 grab the long-term relation effects of the positive and negative adjustments in OFDI on GDP growth, respectively. Following Herzer (2008) and Liu *et al.* (2015), who find a favorable relationship from OFDI to economic growth in selected developed countries, we expect that the estimations α_3 and α_4 are both greater than zero. We also expect a beneficial impact of international trade on economic growth; i.e., α_5 and α_6 should be positive.

According to Shin *et al.* (2014), we rewrite Eq. (1) in an error correction model setting as:

$$\begin{aligned}\Delta GDP_t &= \rho + \beta_0 GDP_{t-1} + \beta_1 IFDI^+_{t-1} + \beta_2 IFDI^-_{t-1} + \beta_3 OFDI^+_{t-1} + \beta_4 OFDI^-_{t-1} + \beta_5 OP^+_{t-1} + \beta_6 OP^-_{t-1} \\ &+ \sum_{i=1}^{p-1} \phi_i \Delta GDP_{t-i} + \sum_{i=0}^{q-1} \left(\gamma_i^+ \ \Delta IFDI^+_{t-i} + \gamma_i^- \ \Delta IFDI^-_{t-i} \right) + \sum_{i=0}^{s-1} \left(\theta_i^+ \ \Delta OFDI^+_{t-i} + \theta_i^- \ \Delta OFDI^-_{t-i} \right) \\ &+ \sum_{i=0}^{r-1} \left(\pi_i^+ \ \Delta OP^+_{t-i} + \pi_i^- \ \Delta OP^-_{t-i} \right) + \varepsilon_t .\end{aligned} \tag{5}$$

where all variables are defined above; $\rho, \beta_0, \phi_i, \gamma_i^+, \gamma_i^-, \theta_i^+, \theta_i^-, \pi_i^+$, and π_i^- are coefficients; p, q, s, and r are lag orders chosen by comparing alternative models' AIC. We illustrate the relation of Eq. (1) and Eq. (5) as follows. $\alpha_1 = -\beta_1 / \beta_0$, $\alpha_2 = -\beta_2 / \beta_0$, $\alpha_3 = -\beta_3 / \beta_0$, $\alpha_4 = -\beta_4 / \beta_0$, $\alpha_5 = -\beta_5 / \beta_0$, and $\alpha_6 = -\beta_6 / \beta_0$ are the aforementioned long-term impacts in Eq. (1) of an increase and decrease in IFDI, OFDI, and trade openness on GDP growth, respectively. $\sum_{i=0}^{q-1} \gamma_i^+$ illustrates the short-term effects of an increasing trend of inward FDI on GDP growth, while $\sum_{i=0}^{q-1} \gamma_i^-$ captures the short-term impacts of inward FDI reduction on GDP growth. Similarly, $\sum_{i=0}^{s-1} \theta_i^+$ and $\sum_{i=0}^{r-1} \pi_i^+$ measure the short-term influences of outward FDI and trade openness increases on GDP growth, while $\sum_{i=0}^{s-1} \theta_i^-$ and $\sum_{i=0}^{r-1} \pi_i^-$ capture the short-term influences of outward FDI and trade openness decreases on GDP growth.

Although the ARDL-type models could be employed to variables with different integration orders of I(0), I(1), and their combination, this method is not appropriate when a series is integrated of order I(2) (Pesaran *et al.*, 2001). The I(2) variables' appearance has large effects on the estimation process of ARDL-type models and makes the computations of F-statistics for cointegration testing become invalid (Ibrahim, 2015). Therefore, it is crucial to test the integration order of all variables included in our model with a unit root test before applying NARDL model.

After we make sure that each order of integration is less than two, we screen for the existence of a cointegration relationship within the examined variables by adopting the Bounds-testing approach proposed by Pesaran *et al.* (2001) and extended by Shin *et al.* (2014). Specifically, we apply the Wald F-test into Model (5) and test the null hypothesis that

$\beta_0 = \beta_1 = ... = \beta_6 = 0$. If the above F-test proves the cointegration relationship of our variable, then we run NARDL model and evaluate the suitability of the dynamic specification through several model diagnostic statistics like serial correlation (Portmanteau test), heteroscedasticity, functional form (Ramsey's RESET test) and normality. The next step is to examine asymmetry in the long- and short-run relations between each of the explanatory variables and GDP growth. The last step consists of deriving the asymmetric cumulative dynamic multiplier impacts of an increase or decrease in each regressor on GDP growth, which we illustrate by the estimations of $\alpha_i (i = 1,...,6)$.

4.2. Data

This research focuses on investigating the asymmetric effects of FDI and trade openness on economic growth in Taiwan. FDI is separated into IFDI and OFDI, measured by the value of FDI inflows and outflows expressed in NTD trillion. Trade openness is captured by the values of total exports and imports, also expressed in NTD trillion. Economic growth is captured by real annual GDP growth rate. We base the analysis of the empirical models on annual time series data for the period 1982-2019 due to FDI data availability. We assemble the data entirely from AREMOS Taiwan Economic Statistical Databanks and annual reports of the Investment Commission, Ministry of Economic Affairs, Taiwan. Tables 1 and 2 present the description and statistics of the examined variables.

Table 1: Variable Explanation

Variable	Explanation	Data Source
GDP	Annual GDP growth rate	AREMOS Taiwan Economic Statistical Databanks
IFDI	Inward FDI, measured by total value of IFDI flows	Investment Commission, Ministry of Economic Affairs, Taiwan
OFDI	Outward FDI, measured by total value of OFDI flows	Investment Commission, Ministry of Economic Affairs, Taiwan
OP	Trade Openness, measured by total exports and imports value	AREMOS Taiwan Economic Statistical Databanks

Table 2: Descriptive Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
GDP	38	0.737	0.335	-0.417	1.138
IFDI	38	0.144	0.122	0.015	0.504
OFDI	38	0.119	0.114	0.000	0.431
OP	38	11.913	7.816	1.799	23.493

5. Empirical Results

Before investigating the dynamic linkages among FDI, trade openness, and economic growth, we check for the stationary and integrated order of each variable using the augmented

Dickey–Fuller (ADF) test. Table 3 shows that all the selected variables are I(0) and I(1). This result satisfies the requirement that all examined series must be integrated with order less than two (Pesaran *et al.*, 2001), and therefore all of our variables are suitable to estimate for the long-run and short-run relationships using the NARDL model.

Table 3: Unit Root Test Results Based on the ADF Test

Variable	**I(0)**	**I(1)**
GDP	-6.411***	-9.200***
IFDI	-3.392*	-6.182***
OFDI	-3.347*	-5.939***
OP	-2.273	-7.232***

Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

After checking the order of integration for all variables, we next check for the cointegration relationship among these variables. Following Shin *et al.* (2014), this study uses two Bounds-testing approaches to check for the existence of a cointegration relationship for all examined variables. One is the t-statistic of Banerjee *et al.* (1998) that tests the null hypothesis $\beta_0 = 0$ against $\beta_0 < 0$ in Eq. (5). Another is the F-test of the joint null, $\beta_0 = \beta_1 = ... = \beta_6 = 0$, as by Pesaran *et al.* (2001). We show the results of these two tests in Table 4 and denote them as t_{BDM} and F_{PSS}. The test statistics present that both null hypotheses are rejected, because t_{BDM}= -4.5979 is smaller than the critical value at I(1)= -3.847 at the 5% level of significance, and F_{PSS}= 8.8857 surpasses the critical value at I(1)= 7.003 at the 1% significance level. These critical values are calculated for our finite sample of 3 variables (IFDI, OFDI, and OP) and 36 observations, following Kripfganz and Schneider (2020), who present an extension from Perasan *et al.* (2001).

The approach of Perasan *et al.* (2001) derives the asymptotic distributions of their test statistics under the null hypothesis of no level relationship and then uses stochastic simulations to compute near-asymptotic critical values. However, the asymptotic distributions might be poor approximations of the actual distributions in small samples. Kripfganz and Schneider (2020) fill that gap to provide more precise critical values for our model estimation with a small sample size like our case of 36 observations. In general, both tests are significant at the 5% and 1% levels, respectively. This statistical evidence favors the existence of the cointegration relationship between all examined variables.

Table 4: Bounds-Test for Nonlinear Cointegration

Cointegration Test Statistics	**Statistics Value**	**1% Critical Value at I(1)**	**5% Critical Value at I(1)**	**P-value**
t_{BDM}	-4.598	-4.680	-3.847	<0.05
F_{PSS}	8.886	7.003	4.988	<0.01

We now use the estimated coefficients from the NARDL model to examine the cointegration relationships of IFDI, OFDI, and OP with GDP. The AIC result shows that the NARDL model with lag order $\{p,q,s,r\}=\{1,1,1,1\}$ is the best option among alternative choices of lag orders. Moreover, most of the model diagnostic tests suggest a normal distribution of residuals and the absence of autocorrelation and heteroscedasticity. To find out more details about the relationships of IFDI, OFDI, and OP toward GDP, Table 5 shows the results of the dynamic asymmetric estimation and simultaneously the calculation of the long-run effect for each change in FDI and trade openness response to GDP growth using the NARDL model. Moreover, Table 6 indicates the results of the Wald F-test, which checks for the existence of long- and short-run asymmetric effects of IFDI, OFDI, and OP on GDP.

The results from the Wald F-tests reject the null hypothesis of long-run symmetry in the cases of IFDI and OFDI at the 5% and 1% significance levels, respectively. Specifically, the estimated long-run parameters of $IFDI^+$ and $IFDI^-$ are -0.770 and 10.979, respectively. However, the parameter of $IFDI^+$ is insignificant while the parameter of $IFDI^-$ is significant at the 5% confidence level. It means that an increase of IFDI seems not to have any effect on GDP, while an IFDI decrease of 9.11% lowers economic growth by 1%. The associated values for OFDI are -4.017 and -17.017, which are both significant. Accordingly, it is estimated that an OFDI rise of 25.89% triggers a reduction of economic growth by 1%, whereas a decrease of merely 5.88% returns the opposite. In other words, the greater effect is sourced from the negative movement of both IFDI and OFDI in the long run.

Table 6 shows no significant evidence of long-run asymmetry for OP. The coefficient of OP^+ is 0.101 and significant at the 10% level, while the figure of OP^- is -0.399 and negatively insignificant. Hence, the long-run effect of trade openness is symmetrically positive and relatively small in size compared with effect of FDI. The short-run dynamic asymmetry tests reveal a different result. The Wald test in Table 6 fails to reject the null hypothesis of a summative symmetric adjustment in the case of IFDI, but it is rejected at the 5 % level in OFDI and at the 1% level in OP.

Table 5: Dynamic NARDL Estimation

Variable	**Coefficient**	**Std. Error**	**T-Stat**	**P-value**
GDP_{t-1}	-1.079***	0.235	-4.600	0.000
$IFDI_{t-1}^{+}$	-0.831	1.527	-0.540	0.594
$IFDI_{t-1}^{-}$	11.847***	3.637	3.260	0.005
$OFDI_{t-1}^{+}$	-4.335***	1.165	-3.720	0.002
$OFDI_{t-1}^{-}$	-18.363***	3.121	-5.880	0.000
OP_{t-1}^{+}	0.109**	0.043	2.540	0.022
OP_{t-1}^{-}	-0.365	0.258	-1.420	0.177
ΔGDP_{t-1}	0.121	0.111	1.680	0.114
$\Delta IFDI_{t}^{+}$	-2.032**	0.765	-2.660	0.018
$\Delta IFDI_{t-1}^{+}$	-1.156	1.257	-0.330	0.744
$\Delta IFDI_{t}^{-}$	4.913**	1.846	4.460	0.000
$\Delta IFDI_{t-1}^{-}$	-8.404***	2.458	-1.410	0.179
$\Delta OFDI_{t}^{+}$	-3.79*	2.014	-1.880	0.079
$\Delta OFDI_{t-1}^{+}$	-1.948	1.963	-0.990	0.337
$\Delta OFDI_{t}^{-}$	-3.221*	1.753	-1.840	0.086
$\Delta OFDI_{t-1}^{-}$	14.958***	3.634	4.120	0.001
ΔOP_{t}^{+}	0.11	0.066	1.670	0.115
ΔOP_{t-1}^{+}	-0.188**	0.068	-2.740	0.015
ΔOP_{t}^{-}	0.359**	0.132	2.730	0.016
ΔOP_{t-1}^{-}	0.168	0.130	1.300	0.214
constant	1.107***	0.247	4.490	0.000
Observations	36			
R-squared	0.964			

Long-run effect	**Coefficient**	**F-Stat**	**P-value**
$IFDI^+$	-0.770	0.282	0.603
$IFDI^-$	10.979**	5.983	0.027
$OFDI^+$	-4.017**	8.769	0.010
$OFDI^-$	-17.017***	14.340	0.002
OP^+	0.101*	3.530	0.080
OP^-	-0.339	1.666	0.216
Model diagnostics		**Stat.**	**P-value**
Portmanteau test (chi-squared)		9.437	0.894
Breusch/Pagan heteroskedasticity test (chi-squared)		2.599	0.107
Ramsey RESET test (F)		4.956	0.018
Jarque-Bera test on normality (chi-squared)		1.777	0.411

Note: ***, **, are * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 6: Asymmetry Test

Variable	**Long-run asymmetry**		**Short-run asymmetry**	
	F-Stat	**P-value**	**F-Stat**	**P-value**
IFDI	6.403	0.023	0.006	0.939
OFDI	13.050	0.003	5.547	0.033
OP	2.127	0.165	19.280	0.001

According to Shin *et al.* (2014), the long-run F test becomes over-sized, whereas there is a small gap between the alternative and the null, the error correction parameter is around zero, and sample size is less than 100. It reflects the well-known limitations of asymptotic inferences under adverse conditions. In dealing with these limitations, it is common to compute empirical p-values for the long- and short-run Wald F-statistics by use of a bootstrap. Nevertheless, Shin *et al.* (2014) propose a more flexible and visualized approach. By computing 95% bootstrap confidence intervals for the difference between the asymmetric cumulative dynamic multipliers defined respectively for positive and negative changes, we are able to convey relevant information about the statistical significance of any observed asymmetries.

The bootstrap confidence intervals for the difference between the asymmetric dynamic multipliers illustrated in Figure 3 support the findings from Table 6. For the cumulative effect of IFDI and OFDI, the economy clearly reacts to decreasing changes in the short run and then achieves full adjustment to the long-run equilibrium in about 5 years. However, the GDP growth reacts just slightly to the upturn, followed by a quick adjustment to the long-run equilibrium within 2 years. The asymmetry lines for both IFDI and OFDI are quite far from the horizontal zero line, which indicates significant asymmetric effects in the long run. In the case of OP, the asymmetric effect of trade openness on economic growth exists in about two to three years, and then OP shows a symmetric impact on economic growth by the asymmetry line close to the zero line. In other words, the asymmetry line and its range of 95% confidence intervals are far from zero in the cases of IFDI and OFDI, which is consistent with the significant long-run effect estimations in Table 6. At the same time, OP's asymmetry line and its 95% confidence intervals locate at a very short distance away from the zero line after a strong fluctuation, which supports the insignificance of OP's long-run asymmetric effect after significant short-run adjustments.

Figure 3: Cumulative Effect of IFDI, OFDI, and OP on GDP Growth

6. Concluding Remarks

This paper explores the dynamic cointegration among FDI, international trade, and economic growth by exploiting annual time series data of Taiwan during the period 1982-2019. We adopt the NARDL method proposed by Shin *et al.* (2014) and find evidence on the potential asymmetric impacts of two opposing flows of FDI and international trade on GDP growth in both the long run and short run.

The empirical evidence shows that the relationship between IFDI and OFDI and economic growth is asymmetric in the long run with the greater effect dominated by negative movement, which runs in contrast to previous studies that simply assume a symmetric relationship. The findings reveal that the negative changes in IFDI have significantly decreased economic growth in Taiwan, while positive changes seem to have zero effect. By contrast, OFDI has a significantly negative relationship with economic growth. The effect of OFDI's decreasing movements exceeds that of increasing changes. More specifically, an OFDI upturn of 25.89% reduces economic growth by 1%, while a downturn of just 5.88% achieves the opposite effect. These findings support the idea that a reduction in overseas investment might relax the pressure on domestic credit constraints in the source country, implying an expansion in domestic investment that ultimately stimulates economic growth. Overall, the results of this study lend strong support to the hypothesis that OFDI is a substitute for domestic investment. In comparison to FDI, the long-run effect of trade openness is symmetrically positive and relatively weaker.

Our research contributes to the related literature with a better understanding of the asymmetric dynamic relationships among IFDI, OFDI, trade openness, and economic growth. Since decreasing changes in IFDI have a stronger effect in lowering GDP growth in Taiwan, there is a necessity to attract more foreign investors to pour money into the country or at least make the existing investors not leave. Hence, the local business environment should continue to improve. Moreover, OFDI negatively relates to Taiwan's economic growth, which can be explained partly by the structure of Taiwanese OFDI. According to the reports of Investment Commission, Ministry of Economic Affairs, Taiwan, the main destination of Taiwanese investors for a long time has been China, and in recent years the target has been Southeast Asian countries to exploit their low-wage advantage, which helps reduce manufacturing costs significantly. However, this kind of vertical FDI likely leads to a hollowing out effect in the home country, causing job losses and decreasing domestic output (Liu *et al.*, 2015). Therefore, encouraging Taiwanese enterprises to expand more into other high-wage developed markets like European countries may bring a complimentary effect of OFDI on Taiwan's economy.

Although our research contributes some valuable insight, the main limitations are its restriction to yearly data of the whole economy only and a small set of two indicators, FDI

and international trade, which may narrow the generalizability of its findings. Future studies may apply a wider group of economic indicators such as human capital or financial market to extend our research's empirical results. If available, quarterly or monthly data should be collected and divided into categories of different industries. Moreover, it is imperative to see the asymmetric effects when accounting for the different types of FDI and the unique characteristics of each host country. More detailed data may provide a deeper understanding of FDI, trade, and economic growth on a particular industry.

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