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The Moderating Role of Financial Development on the Nexus of FDI-Technological Innovation in Sri Lanka

A.M.Priyangani Adikari [1]

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Abstract

Given the significance of financial sector development for innovation, we look into the financial development - innovation connections in this study. This study investigates the moderating role of financial development (FD) between foreign direct investment (FDI) and technological innovation in Sri Lanka during the period 1978–2019. First, this study explored the direct effect of financial development on innovation. Secondly, the study has examined whether FD has a more critical role in moderating the relationship between FDI and innovation. To attain the study objectives, we used the Auto regressive Distribution Lag (ARDL) econometric technique for long-run and short-run cointegration dynamics. The empirical findings of the first study, which explored the direct effect of financial development on innovation, show that FD has no significant impact on innovation, which confirms the situation in many developing countries. In the second study, FD significantly moderates (with a positive coefficient) the effects of FDI on technological innovation. The conclusive evidence favoring the significant involvement of FD in FDI-Innovation linkages is predominantly accessible. The interplay between FDI and FD stimulates technological innovation. To develop the most potential

[1] Department of Economics, Faculty of Social Sciences and Humanities, Rajarata University of Sri Lanka. adikari@ssh.rjt.ac.lk

benefits of FDI for innovation, strategies to deepen the financial system are proposed.

Keywords: Foreign direct investment, Technological innovation, Financial development, Moderating role

Introduction

Over the last three decades, foreign direct investment (FDI) has been vital to many developing countries' development strategies. The majority of countries today realize that FDI has the potential to contribute significantly to economic growth and development. It is widely known that FDI inflows are suitable for host countries to supply more money, create jobs, and speed up economic development. Many governments place a great deal of faith in the concept that FDI creates positive externalities in the host country (Javorcik, 2008; Qu & Wei, 2017; Ravinthirakumaran et al., 2020; Thang et al., 2016).

The internationalization of economies needs the permanent innovation of processes and procedures to gain competitive advantages and compete effectively throughout new market changes. On the other side, it is believed that increased competition between businesses in terms of technological innovation and process design will increase the demand for resources in the financial system, resulting in a more developed financial system (Callegari, 2018). It is well recognized in the literature innovation is injected into host countries through FDI, accelerating economic growth. Innovation is a fundamental component in many endogenous growth models and is commonly regarded as a driving force for economic development (Aghion et al., 1997; Romer, 1990).FDI has been shown in the literature to positively impact domestic innovation activities because of the large amount of technology and the transfer of knowledge from multinational corporations (L. Erdal & Göçer, 2015; García et al., 2013; Khachoo & Sharma, 2016;Shamsub, 2014).

Multinational corporations (MNCs) bring superior technology and high productivity to the local market. It creates pressure through strong competition, encouraging domestic enterprises to invest more in research and development (R&D) in order to increase their innovation (Keller, 2010). One of the ways that FDI pervades innovation in host firms is by removing financial constraints. It allows enterprises to spend additional funds on R&D,

resulting in more innovation in their operations. Financial limitations constrain innovation. Due to the difference between internal and external financing, innovative efforts have been stifled, resulting in reduced business growth. Furthermore, because of the availability of finances, FDI firms are more likely to attract and keep better, talented workers by paying higher rates.(Aitken & Harrison, 1999). The availability of financing encourages enterprises to innovate (J. R. Brown et al., 2012; Fombang & Adjasi, 2018). Innovation and productivity are linked to the ability of the financial system to allocate money effectively (Dabla-Norris et al., 2012). The financial development threshold determines technological catch-up. Productivity is hampered by a lack of financing for innovation, which is expensive and requires established financial institutions (Aghion et al., 2005). Well-functioning financial markets are essential for encouraging innovation by lowering financing costs, distributing scarce resources, appraising new ideas, controlling risk, and monitoring managers.

Financial development (FD) occurs when the impacts of information, enforcement, and transaction cost improve on financial products, markets, and intermediaries. Increased access to external capital also fosters the launch and growth of venture enterprises, which promotes market rivalry and compels established firms to innovate in order to survive (Ang & Madsen, 2012). Financial sector expansions worldwide in recent years have significantly impacted growth and innovation (Zhu et al., 2020). By removing credit limits on capital flow, FD helps foster innovation (Aristizabal-Ramirez et al., 2017; Gorodnichenko & Schnitzer, 2013; Kapidani & Luci, 2019; Loukil, 2019). Due to several factors, FD might be regarded as a moderating element for innovation.

Financially developed countries' industries cut actual costs, which subsequently translated into innovation. Through innovation, a nation's financial improvement leads to increased production. Adopting new technologies requires enormous amounts of physical assets, which rely on well-developed financial institutions encouraging long-term investments by reducing liquidity risks (Tadesse, 2005). When a country is financially developed, small firms are more likely to invest in R&D as a proxy for innovation. By incentivizing small businesses to invest in R&D, this connection has the potential to have a favourable redistributive impact

(Sharma, 2007). It underlines that the relationship between financial development and innovation is based on the company's size and that financial development does not have the same impact on enterprises of all sizes. The Schumpeterian finance, entrepreneurship, and economic growth model predict that higher stages of financial development are related to higher levels of inventive activity. Because the financial system is such an essential part of a country's innovation infrastructure, it has the potential to positively influence innovative national capabilities (Meierrieks, 2014; Tee et al., 2014).

The relationship between a country's financial development and its FDI has been posited by researchers. The underlying mechanism of the effect is that FD serves as a significant catalyst for enhancing the efficiency of a country's financial sector. The inflows of FDI are contingent upon the presence of a well-established financial mechanism characterized by an effective and transparent cost framework. The host nation's ability to foster trust and reliability is crucial in attracting foreign investors, as it is a fundamental aspect of financial development. Indicators such as validity signals, trade openness, and market trustworthiness can indicate a host country's developed financial system. Establishing a proficient financial sector is the foundation for fostering investor trust and confidence.

Furthermore, financial market development is crucial for a nation's innovation; empirical research linking financial market development and innovation is becoming more attractive among researchers and academics. Given the significance of financial sector development for innovation, we look into the financial development - innovation connections in this chapter. Hence, this chapter aims to investigate the moderating role of financial development between foreign direct investment and technological innovation in Sri Lanka.

This research adds to the body of knowledge in the field of financial economics in several ways. At first to the best of our knowledge, this is the first attempt to explain the moderating effect of financial development between FDI inflows and innovation in the context of Sri Lanka. Second, We use a complete proxy for financial development (H. Khan & Khan, 2019), the IMF's financial development index (Sahay et al., 2015; Svirydzenka, 2016), which considers financial markets and institutions' depth, access, and efficiency. The index considers all aspects of the financial system, including financial institutions (banking and non-banking) and financial markets (the stock market).

The remainder of the chapter is structured as follows. Section 1.2 takes into account the materials and methodology. It details the model specification, data and variables used in this empirical analysis. Results, discussions and efforts to test the study's robustness are presented in Section 1.3. Finally, the conclusion and suggestions for further research are exhibited in Section 1.4.

Materials and Methodology

Model Specification

This section proposes that financial development (FD) might moderate the relationship between FDI inflows and technological innovation in Sri Lanka. So, focusing on it, this study explores the moderating role of FD on the association between FDI inflows, economic growth, research and development expenditure, education expenditure, population, human capital and technological innovation.

The current analysis proposes that FD moderates the link between innovation and FDI inflows in Sri Lanka. Thus, as recommended in the current literature, an interaction variable must be incorporated into the model to validate whether FD moderates the effect of FDI on innovation in the case of Sri Lanka. At first, a proxy for financial development is added as an explanatory variable into the baseline equation to estimate the direct effect of financial development on innovation. Based on the literature, we develop the following functional form, which comprises the explanatory and control variables, to study the direct influence of FD on FDI -innovation relation.

$$TI_t = f\,(FDI_t,\ GDP_t,\ RDE_t,\ EDU_t,\ POP_t, HC_t,\ FDX_t) \quad (1.1)$$

Where;
TI_t = Granted patents to residents at time t
FDI_t = Inward FDI stock value at time t
GDP_t = Gross domestic Product growth rate t
RDE_t = Research and development expenditure at time t
EDU_t = Education expenditure at time t
POP_t = Population at time t
HC_t = Human capital at time t

FDX_t =Financial development at time t

The estimated model, consisting of financial development proxy, can be written as in Equation 1.2.

$$\ln TI_t = \beta_0 + \beta_1 \ln FDI_t + \beta_2 \ln GDP_t + \beta_3 \ln RDE_t + \beta_4 \ln EDU_t + \beta_5 \ln POP_t + \beta_6 HC_t + \ln\beta_7 FDX_t + \varepsilon_t \quad (1.2)$$

Forming interaction terms of the subject variables is a typical approach in the literature to capture the moderating influence (Islam et al., 2020; Shujah-ur-Rahman et al., 2019).To realize the moderating effect of FD on the FDI-TI relationship, we use a similar technique and create an interaction term ($FDI_t * FDX_t$) .Next, we extended our model with interaction variables. Extended models containing an interaction term can be written as;

$$\ln TI_t = \beta_0 + \beta_1 \ln FDI_t + \beta_2 \ln GDP_t + \beta_3 \ln RDE_t + \beta_{4\ln} EDU + \beta_5 \ln POP + \beta_6 HC + \beta_7 \ln(FDI_t * FDX_t) + \varepsilon_t \quad (1.3)$$

Here, ln denotes the transformation of base value to natural log in case of an appropriate variable, FDX refers to the financial development index as a proxy to financial development level at the time "t," and $FDI_t * FDX_t$, denotes the interaction term.

Data and variables

This study focuses on one of the most crucial concerns in the link between FDI inflows and innovation: the moderating role of FD in determining the relationships. We use data from different sources to illustrate and assess the theoretical implications empirically. The data used in this empirical analysis are derived from the following key sources:

1) In order to proxy technological innovation, the dataset of granted patents developed by the National Intellectual Property Office in Sri Lanka (NIPO) is employed.
2) The relevant data for the stock value of inward FDI, and population, are collected from World Development Indicators (WDIs) available on the website of the World Bank.
3) GDP growth, research and development expenditure, and expenditure on education are extracted from the Central Bank of Sri Lanka.
4) Human capital data are obtained from Penn World Table 10.
5) Financial development is proxied by the financial development

index sourced from the International Monetary Fund (IMF, 2019).

We provide only a concise overview here as analogous topics have been examined in preceding sections. The tabular presentation of the data description is given in Table 1.1.

Technological innovation: With the research objectives at the forefront of our analysis, we have selected technological innovation as our dependent variable. Economists generally use the term “innovation” to denote the increase in the quality and variety of goods and services or reductions in the market's cost of goods and services (Broughel & Thierer, 2019). Measuring innovation is challenging because it is a complex, multifaceted phenomenon without direct indicators. Scholars from various disciplines have studied innovation from different perspectives and used other indicators such as “*input, intermediate, or direct output measures.”*

In this analysis, granted patents to residents are used to represent innovation following the previous researchers (Adikari et al., 2021). They have pointed out that Patents that have been granted are considered to indicate technological innovation, as opposed to patent applications, because particular inventions aren't patentable. Hence, as an explained variable, we utilize granted patents as a proxy for the technological innovation of the host country.

Consistent with prior research and preceding sections, we have elected to utilize the subsequent control variables to examine the role of FD in FDI – innovation relation.

Financial Development (FD): Financial development (FD) is a complex subject that demonstrates the development of a country's overall financial system. The financial system has two dimensions: financial markets (FM) and financial institutions (FI). Financial institutions are often a country's banking and nonbanking financial institutions, whereas financial markets are the country's established stock exchanges, bonds, and derivative markets.

Instead of conventional FD proxies, we use the financial development index (FDX) developed by IMF (Svirydzenka, 2016). According to recent research (Islam et al., 2020; M. A. Khan et al., 2019), this index can account for the financial system's multidimensionality and complexity. Thus, FDX is the control for our model.

Inward Foreign direct investment (FDI): It is evident that some nations have higher levels of technical development than others; Some countries get more FDI than others, and FDI is considered as a primary avenue of technology transfer (Fu, 2007; X. Liu et al., 2019). The extant literature posits that foreign direct investment stock has the potential to capture the long-term outlook (Islam et al., 2020). The inward FDI stock pertains to the productive capacity that foreign investors possess within a host nation.

Gross domestic product (GDP) growth: In practical terms, a potential feedback loop exists between innovative activities and economic growth, whereby each can stimulate the other. Furthermore, the empirical model takes into account the influence of GDP growth, as the capacity for innovation may differ depending on the economic growth stage of a given economy (Hammar & Belarbi, 2021; Sivalogathasan & Wu, 2014).

Research and development (R&D) expenditure: Increased research and development spending is one example of structural approaches to foster innovation. And also, research and development spending reflects the country's absorptive capability and shows innovation initiatives (Griffith et al., 2006; Pegkas et al., 2019; Shamsub, 2014; Xie et al., 2018). Many previous contributions have addressed the various types of links between R&D, innovation, and economic consequences. Countries with higher levels of innovation and growth rates have also invested more resources in research and development in recent decades. But, the relationship between R&D expenditure and innovation is not always clear and appears to fluctuate according to economic growth (Hammar & Belarbi, 2021; Meierrieks, 2014). Therefore, we control research and development spending in this model.

Education expenditure (EDU): According to classical economic growth theory, economic growth in a country is determined by capital expansion, human capital and labour growth, technological progress, and higher education. (Zhou & Luo, 2018). Higher education is a crucial strategy for increasing human capital, and education and economic development are said to impact and complement each other. On the one side, higher education fosters technological innovation by improving worker quality and increasing economic growth. On the flip side, the growth of an economy provides the material basis and conditions for educational advancement (Zhou & Luo, 2018). Education has four different effects on creating new ideas.

First, a high-quality education system emphasizing science will result in a larger and more qualified pool of scientists. Employed scientists, for example, are regarded as input into the knowledge production function but output in the education production function (Acs et al., 2002; Griliches, 1998). Second, highly skilled labour is a relatively fixed asset within a country's borders. As a result, creating this highly trained labour pool is due to the education and training system. Third, education contributes to developing a countrywide collection of industrialists who, to remain competitive, require innovation, new goods, and more efficient production processes. Fourth, education improves customers' cognitive capacity, making them more demanding of high-quality goods and services (Furman et al., 2002). The government's allocation of resources to education is a key predictor of human capital formation. The effective distribution of educational resources will raise the pace of human capital growth and support economic growth (Ramli et al., 2016). The educational system enhances societal understanding of new technology's role in expanding growth potential and promotes a business climate favouring technological innovation (Furman et al., 2002).

Human capital: Human capital (HC) is widely recognized as a significant contributor to the advancement of technological innovation (Ang et al., 2011; Diebolt & Hippe, 2022). Synthesizing the literature, we propose that HC can induce innovation. We included the human capital index per person (HCI) based on years of schooling (Barro & Lee, 2013) and returns to investment in education (Psacharopoulos, 1994) as a control variable in the model.

Population: Population density fosters the diffusion of innovation information among subjects in order to boost innovation. The rate of evolution of innovation potential accelerates in proportion to population expansion. The population is always an important aspect of technological innovation since it is the foundation of the market and a source of skilled labour. According to the economic literature, the relationship between population growth and technology improvement can have fascinating and diverse consequences (N. Calvo et al., 2022). We use population as the control variable in our analysis based on the moderating role of FD on FDI –innovation nexus. The tabular presentation of the data description is given in Table 1.1.

Table 1.1 Description of the Variables

Variable name (Abbreviation)	Brief definition	Measure	Data Source	Expected sign
Technological innovation (Proxied by granted patents (LnTI))	The number of patents granted reveals a country's innovative capacity in terms of new technology, new products, and new procedures.	Total number	NIPO	
The stock of inward FDI (LnFDI)	The overseas investors' equity value and net loans made them the reporting country.	USD	WDI	+
GDP growth (LnGDP)	Gross domestic product growth rate	Rate	CBSL annual reports	+
Expenditure on research and development (LnRDE)	Capital and current expenditure for research applied research, and experimental development.	USD	CBSL annual reports	+
Education expenditure (LnEDU)	Government expenditure for education	USD	CBSL annual reports	+
Population (LnPOP)	Total number of Populations.	Total number	WDI	+/-
Human capital (Proxied by HCI)	An index based on years of schooling and returns to education	Index	Penn World Table 10.0	+
Financial Development Index (FDX)	The index is constructed in a combination of financial market and institution variables.	Index	IMF	+

Source: Author's selection of variables based on prior studies

Since data is available for the financial development index from 1990, data from 1990 to 2019 are employed for this analysis. Data analysis is completed following a standard procedure suitable for small sample analysis (Menegaki, 2019; Pesaran et al., 2001; Sohag et al., 2015), and the moderation effect is arbitrated with an interaction term of financial development and inward foreign direct investment.

Results and Discussion

Descriptive Statistics of key variables

In this section, we give descriptive statistics for the variables employed in the current study. Before doing empirical analysis, the descriptive characteristics (Table 1.2) of selected variables are the first stage in understanding variables' patterns and average behaviour. The variables in the model and period are subjectively selected solely based on the maximum data availability in Sri Lanka related to the study's objective.

Table 1.2 Summary Statistics of the Variables

Variable	Mean	Std. Dev.	Min.	Max.
TI	56.733	37.601	11	220
FDI	486000000	411000000	43355120	1610000000
GDP	5.205	2.245	-1.545	8.669
EDU	213000000	171000000	48414795	711000000
RDE	11512357	9578384	200813.8	8296607
POP	4885233	344896	4884875	5450750
HC	2.807	0.118	2.505	2.899
FDX	0.223	0.038	0.143	0.281

Source: Author's computation in EViews 10

The average value of TI is approximately 56.73 granted patents, with a standard deviation of 37.60 granted patents. The FDI, on average, is 486000000 USD, ranging from 43355120 USD to 1610000000 USD. The average GDP growth value is 5.2, with substantial fluctuation ranging from -1.54 to 8.66. The average value of FDX is 0.22, ranging from 0.14 to 0.28. The average figures for education expenditure are 213000000 USD and 11512357 for research and development expenditure. The minimum number of populations is 4884875, while it records a 4885233 average value.

Results of unit root test

We assessed the stability of the variables in the model to determine the conditions for applying the ARDL test expressed in the degree of integration of time series for the variables so that the degree of integration of the variables must be either (0) I or (1) I, or both**.** It must be verified that no variable is I (2). Table 1.3 depicts the degree of integration of the time series under consideration on ADF and PP unit root tests Statistics.

Time series stability at the level and in first differences indicates that there is a chance of a co-integration relationship between these time series, which is supported by the data. A summary of the unit root results confirms that none of the variables exceeds the order of integration I (1). Variables are a mixture of I (1) and I(0), which justifies the ARDL method's suitability.

Table 1.3 PP and ADF Tests Statistics

Variable	ADF test (with trend and intercept)		PP test (with trend and intercept)		Order of Integration
	Levels	First difference	Levels	First difference	
TI	-2.929	-5.487***	-7.256***	-18.335***	I (1)
FDI	-6.175***	-6.955***	-5.551***	-7.384***	I (0)
GDP	-4.438***	-3.911**	-4.438***	-13.929***	I (0)
EDU	-2.232	-4.187**	-1.770	-4.119**	I (1)
RDE	-2.053	-4.007**	-1.746	-12.735***	I (1)
POP	-2.801	-4.438***	-2.404	-15.322***	I (1)
HC	-1.739	-2.454**	-2.307	-2.446**	I (1)
FDX	-2.493	-5.923***	-2.493	-9.405***	I(1)

Note: (*) Significant at 10%; (**) Significant at 5%; (***) Significant at 1%.

Source: Author’s computation in EViews 10

Cointegration, long-run, and short-run coefficient estimation

The unit root tests result consistently recommend the application of ARDL cointegration for this model. The bounds-testing approach to cointegration is appropriate given the mixed order of integration of the respective variables. The ARDL versions of Equation 1.2 (without interaction terms) and Equation 1.3 (with interaction terms) can be specified as Equation 1.4 and Equation 1.5.

$$\Delta \ln TI = \beta_0 + \sum_{i=1}^{n} \gamma_{1i}\, \Delta \ln TI_{t-i} + \sum_{i=0}^{n} \gamma_{2i}\, \Delta \ln FDI_{t-i} + \sum_{i=0}^{n} \gamma_{3i}\, \Delta \ln GDP_{t-i} + \sum_{i=0}^{n} \gamma_{4i}\, \Delta \ln RDE_{t-i} + \sum_{i=0}^{n} \gamma_{5i}\, \Delta \ln EDU_{t-i} + \sum_{i=0}^{n} \gamma_{6i}\, \Delta \ln POP_{t-i} + \sum_{i=0}^{n} \gamma_{7i}\, \Delta HC_{t-i} + \sum_{i=0}^{n} \gamma_{8i}\, \Delta FDX_{t-i} + \beta_1 \ln TI_{t-1} + \beta_2 \ln FDI_{t-1} + \beta_3 \ln GDP_{t-1} + \beta_4 \ln RDE_{t-1} + \beta_5 \ln EDU_{t-1} + \beta_6 \ln POP_{t-1} + \beta_7 HC_{t-1} + \beta_8 FDX_{t-1} + e_t \quad (1.4)$$

$$\Delta \ln TI = \beta_0 + \sum_{i=1}^{n} \gamma_{1i}\, \Delta nTI_{t-i} + \sum_{i=0}^{n} \gamma_{2i}\, \Delta \ln FDI_{t-i} + \sum_{i=0}^{n} \gamma_{3i}\, \Delta \ln GDP_{t-i} + \sum_{i=0}^{n} \gamma_{4i}\, \Delta \ln RDE_{t-i} + \sum_{i=0}^{n} \gamma_{5i}\, \Delta \ln EDU_{t-i} + \sum_{i=0}^{n} \gamma_{6i}\, \Delta \ln POP_{t-i} + \sum_{i=0}^{n} \gamma_{7i}\, \Delta \ln HC_{t-i} + \sum_{i=0}^{n} \gamma_{8i}\, (\Delta \ln FDI_{t-i} * \Delta FDX_{t-i}) + \beta_1 TI_{t-1} + \beta_2 FDI_{t-1} + \beta_3 GDP_{t-1} + \beta_4 RDE_{t-1} + \beta_5 EDU_{t-1} + \beta_6 POP_{t-1} + \beta_7 HC_{t-1} + \beta_8 (FDI_{t-1} * FDX_{t-1}) + e_t \quad (1.5)$$

Where Δ denotes the first difference operator, while the summation symbol in the first part of the above equation shows the dynamics of error correction, and the second half of the above equation (which is free of summation) denotes the relationship for the long run. On the other hand, calculating equations 1.4 and 1.5 necessitates determining the ideal lag time. This analysis lag order selection is based on Akaike Information criteria (AIC). The ARDL models proceed with the lag length of each variable in equations 1.4 and 1.5 are presented below.

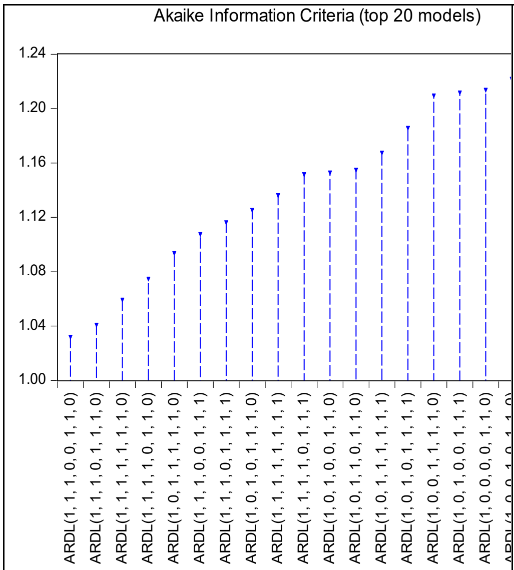

Figure 1.1 Lag length selection in equation 1.4

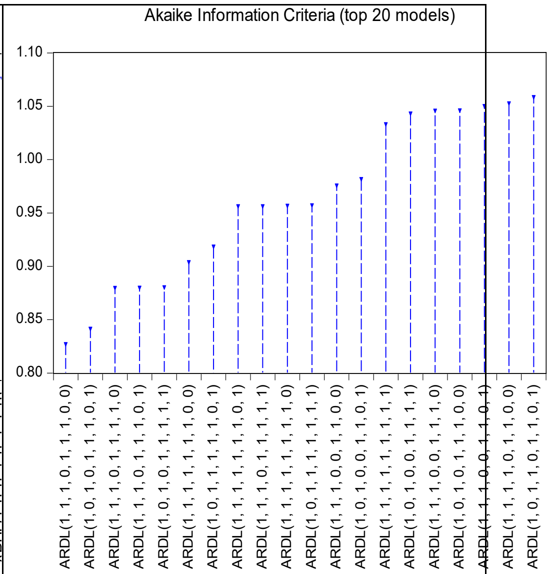

Figure 1.2 Lag length selection in equation 1.5

Source: Author's computation in EViews 10 Source: Author's computation in EViews 10

After the lag length selecting procedure, we used the ARDL bound testing approach to construct F-statistics (Wald joint significance test) to analyze the long-term association between the variables. Nonetheless, it is worth noting that Pesaran et al. (2001) provide asymptotic critical values based on 1000 observations. As a result, these asymptotic critical values are prone to small sample bias (P. Narayan, 2004; P. K. Narayan, 2005; Pesaran et al., 2001), making them inappropriate for our study with only 30 years annual data. We use the Narayan critical values (Pesaran et al., 2001). Table 1.7 shows the estimated F-statistics for cointegration and the critical values.

Based on the F- Bounds testing to Cointegration results in Table 1.7, we discovered that the calculated F-statistic is higher than the I (1) critical bounds' values at 10%, 5%, and 1% significance levels. Accordingly, we have appropriate evidence to reject the null hypothesis of a non-existent cointegrating association. It is found that a long-run association exists between technological innovation, inward foreign direct investment, economic growth, research and development expenditure, expenditure for education, population, human capital and financial development with interaction variable (FDIFDX).

Table 1.4 ARDL Bounds Test results

Equation 1.4 –without interaction variable				
Test Statistic	Value	Sig: Level	I (0)	I (1)
F-statistic	16.049	10%	2.03	3.13
K	7	5%	2.32	3.50
		1%	2.96	4.26
Equation 7.5 –with interaction variable				
Test Statistic		Sig: Level	I (0)	I (1)
F-statistic	17.361	10%	1.95	3.06
K	8	5%	2.22	3.39
		1%	2.79	4.10

Note: The critical values are from (Pesaran et al., 2001).

Source: Author's computation in EViews 10.

The estimated long-term coefficients for the model with the interaction term, and the model without the interaction term, using the ARDL technique, are presented in Table 1.5, and short-run coefficients and ECM representations for both models (without interaction terms and with interaction terms) are presented in Table 1.6 and 1.7 respectively.

Table 1.5 Results of Long-Run Coefficient Estimation

	Equation 1.4 ARDL (1, 1, 1, 0, 0, 1, 1, 0)			Equation 1.5 ARDL (1, 1, 1, 0, 1, 1, 1, 0, 0)		
Variable	Coeff.	t-stat.	p value	Coeff.	t-stat.	p value
LFDI	-0.022	-0.157	0.877	-8.284**	-1.939	0.078
LGDP	0.882***	3.081	0.008	0.905**	3.652	0.003
LRDE	0.061	0.451	0.658	-0.006	-0.052	0.959
LEDU	-0.605	-1.599	0.133	-1.238**	-2.573	0.025
LPOP	8.036	1.539	0.147	18.111**	2.700	0.020
HC	0.704	0.256	0.801	-3.167	-1.048	0.316
FDX	10.196	1.712	0.110	-19.973	-1.102	0.293
LFDIFDX				8.310*	1.954	0.076
R^2	0.820			0.874		
Adj- R^2	0.655			0.715		

Note: (*) Significant at 10%; (**) Significant at 5%; (***) Significant at 1%.

Source: Author's computation in EViews 10

Table 1.5, empirical findings without financial development (FD) as a moderator, show that FDI inflows have a negative and insignificant effect technological innovation. It indicates no significant effect of inward FDI on innovations. But, this effect does not align with previous studies (Girma et al., 2009; Nyeadi & Adjasi, 2020). But, some researchers (Fu, 2007; Liu et al., 2019; Sultana & Turkina, 2020) found that the extent to which FDI benefits the host region is determined by the host region's embeddedness and the availability of complementary resources for innovation.

The long-run estimation evidence that GDP growth is positively and significantly associated with technological innovation. A 1% increase in GDP growth will cause to increase the innovation by 0.88 %.

Initially, we estimate the direct effect of FD on innovation, adding the financial development index as an explanatory variable into the model. The coefficient of financial development is 10.19, but not significant. Some recent studies have found this relationship is strong in developing countries (Ang & Kumar, 2014; Dabla-Norris et al., 2012; Kapidani & Luci, 2019; LoukilLoukil, 2019; Meierrieks, 2014). But we did not find any significant direct relationship between FD and innovation in Sri Lanka for the study period.

Table 1.5 depicts the empirical findings of the model in which financial development moderates our analysis. In terms of interaction, the interaction of FDI and FDX substantially impacts the FDI- innovation relationship. The coefficient of FDI*FDX is 8.31, statistically significant at a 10 % level. The final argument supporting the presence of a substantial role of FD in FDI-IN connections is principally available. The interaction between FDI and FD induces technological innovation. These findings align with previous studies of (Aristizzbal-Rammrez et al., 2015; Tee et al., 2014; Trinugroho et al., 2021).

Table 1.6 Short-Run Coefficients and ECM Representations (The Model without Interaction Term)

Selected Model: ARDL (1, 1, 1, 0, 0, 1, 1, 0) Equation 1.4			
Variable	Coeff.	t-stat.	P value
D(LFDI)	0.399***	3.381	0.004
D(LGDPG)	0.795***	5.511	0.000
D(LPOP)	66.933***	7.210	0.000
D(HC)	45.329***	10.269	0.000
ECT(-1)	-1.827***	-14.054	0.000
R^2	0.915		
Adjusted R^2	0.894		

Note: (***) Significant at the 1%.

Source: Author's computation using EViews 10

Tables 1.6 and 1.7 reports the two equations' short-run estimates (Equations 1.4 and 1.5). In both cases (with and without interaction variable), the coefficients of the error correction term are negatively significant at a 1% level of significance which further confirms the long-run relationship between innovation, FDI, GDPG, RDE, EDU, POP, HC and interaction variable(FDIFDX). Error correction terms -1.827770 and -1.923362 for equations 1.4 and 1.5, respectively. It reveals that in the current year, nearly 182 % and 192 % of disequilibrium in innovation in both cases are adjusted back to long-run equilibrium.

Table 1.7 Short-run Coefficients and ECM Representations (The Model with Interaction Term)

Selected Model: ARDL (1, 1, 1, 0, 1, 1, 1, 0, 0) Equation 1.5			
Variable	Coeff.	t-stat.	P value
D(LFDI)	-15.452***	-16.428	0.000
D(LGDPG)	0.788***	-16.193	0.000
D(LEDU)	-1.156***	6.322	0.000
D(LPOP)	84.066***	-4.036	0.002
D(HC)	59.234***	9.870	0.000
ECT(-1)	-1.923***	13.128	0.000
R^2	0.940		
Adjusted R^2	0.922		

Note: (***) Significant at the 1%. Source: Author's computation using EViews 10

Diagnostic tests results

Concerning the estimated models' fitness, we can refer the Table 1.8 and Figures of 1.3, 1.4, 1.5, and 1.6. Tests included in Table 1.8 imply the findings of diagnostic tests, and the Jarque-Bera statistic demonstrates that residuals are regularly distributed. The statistics of the LM test, Breush Pagan Godfrey heteroscedasticity test, and Ramsey Reset test show that none of the models utilized in this study suffers from serial correlation, heteroscedasticity, or multicollinearity. In this case, we can conclude that all models have been quite described and that the calculated coefficients have been accurately and reliably estimated.

Table 1.8 Diagnostic Tests Results

Test	Equation 1.4 P value	Equation 1.5 P value
Breusch-Godfrey Serial Correlation LM Test	0.191	0.137
Heteroskedasticity test (Breusch-Pagan-Godfrey)	0.368	0.109
Ramsey Reset test	0.411	0.325
Jarque-Bera stat	0.733	0.800

Source: Author's computation using EViews 10

Furthermore, we used CUSUM and CUSUMSQ tests, constructed on the recursive residuals projected by Brown et al. (1975), to check that our estimated parameters of the long-run relationship were stable in the long term. Parameter consistency and model stability were notable when both plots remained within the 5 per cent threshold boundaries (R. L. Brown et al., 1975).

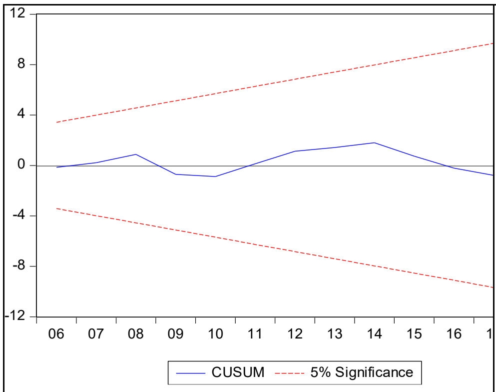

Figure 1.3 CUSUM Plot for Equation 1.4

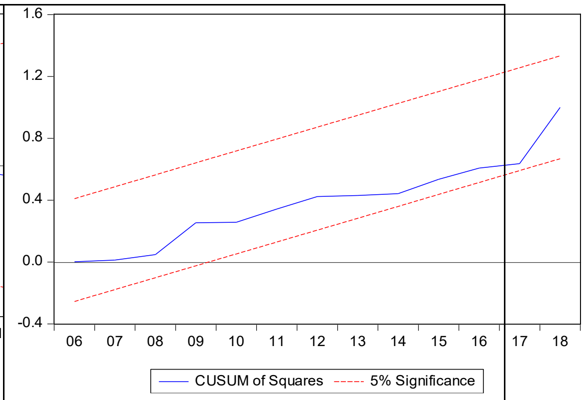

Figure 1.4 CUSUMSQ plot for Equation 1.4

Source: Author's computation using EViews 10 Source: Author's computation using EViews 10

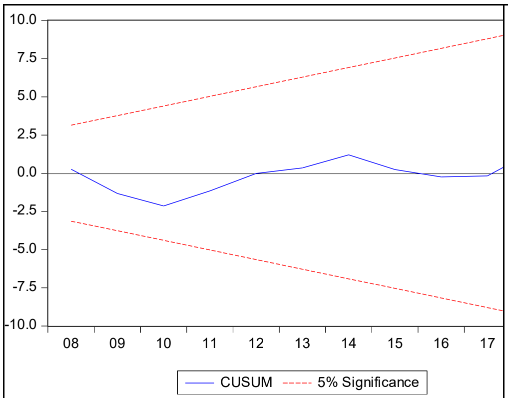

Figure 1.5 CUSUM Plot for Equation 1.5

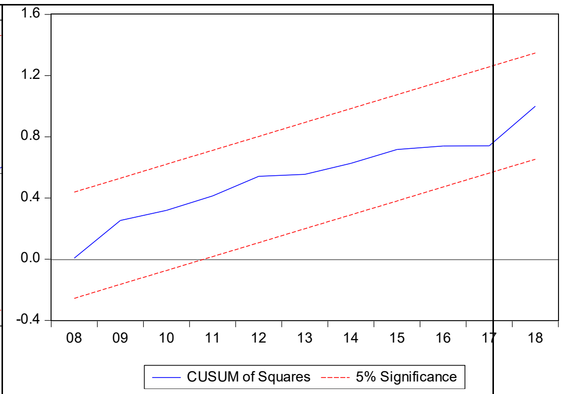

Figure 1.6 CUSUMSQ Plot for Equation 1.5

Source: Author's computation using EViews 10 Source: Author's computation using EViews 10

The CUSUM and CUSUMSQ plots in Figure 1. 3, and 1.4 (for the model without interaction variables) and Figure 1. 5 and 1.6 (for the model with interaction variables) stayed within the 5% critical boundaries. It shows "parameter reliability" and "no recognizable systematic change" in the coefficients at the 5% significance level in the data series (R. L. Brown et al., 1975).

Conclusion

In the literature, it is argued that financial development positively impacts innovation. It is mostly accepted that sophisticated financial markets improve information accessibility, successfully reducing the risk of uncertain creative initiatives and encouraging investors to support innovative young companies (Levine, 2005; LoukilLoukil, 2019; Trinugroho et al., 2021; Yagi & Managi, 2016; Yu & Fu, 2021). In contrast, more financial growth has a detrimental impact on innovation, as increased financial development encourages market monopolization, discouraging innovation. Inward FDI has a more significant detrimental impact on the innovativeness of technologically advanced enterprises. Only the most technologically advanced companies devote additional financial resources to R&D. Despite increased R&D spending, technology leaders cannot transform those R&D investments into innovation. (J. R. Brown et al., 2009; Hsu et al., 2014; Jin et al., 2019; Ülgen, 2013). The contradiction of findings in the finance–innovation relationship leads to a much-argued question. Innovation activities in an economy can reflect the country's possible technological development, and FDI can mirror the potential technological progress of foreign countries (Liao & M. Drakeford, 2019). Therefore, it is imperative to study the role of financial development in FDI-innovation relations.

First, this study explored the direct effect of FD on innovation in the case of Sri Lanka. Second, the study has examined whether financial development has a more critical role in moderating the relationship between FDI and innovation. We used the ARDL econometric technique for long-run and short-run cointegration dynamics to attain the study objectives. We also used diagnostic tests to demonstrate that our model is stable and suited for policymaking in the case of Sri Lanka.

The empirical findings of this study suggest that FD has no significant impact on innovation, which confirms the situation in developing countries. However, according to the literature, the outcomes are quite different when developed countries are compared to developing countries. Government investment in innovation in developing nations is characterized by less research and development financing (Adikari et al., 2021; Kapidani & Luci, 2019) and fewer research-oriented academic institutions than in developed ones. Furthermore, poorer enterprise competitiveness for private innovation results from public innovation.(Aristizabal-Ramirez et al., 2017; Kapidani & Luci, 2019; Moguillansky, 2006; Sharma, 2007).

On the other hand, when financial development is used as a moderator and interaction terms/variables are included in the main model, the results differ from the first model. When the level of financial development proxied by the financial development index is contained in the model as an interaction variable or moderator at that point, it significantly moderates (with a positive coefficient) the impact of FDI on technological innovation. The conclusive evidence favoring the significant involvement of FDX in FDI-IN linkages is predominantly accessible. The interplay between FDI and FD stimulates technological innovation.This association, however, is not always clear in developing countries (Akoum, 2016; Chowdhury & Maung, 2012; Hammar & Belarbi, 2021).

The significance of the moderating influence of financial development on FDI inflows and in explaining innovation in Sri Lanka is highlighted in this study, which is unique because it is the first time it has been done.

Even though this study makes substantial contributions to the literature on innovation, foreign direct investment, research and development spending, and financial development, particularly in Sri Lanka and similar developing nations, the study has certain limitations. Due to the limited availability of data and the usage of just Sri Lankan data, there is a limitation to the length of time covered. As a result, future research will investigate a broader period and may even use panel data. Because the impact of FD extends beyond national lines, this will provide more comprehensive knowledge for a larger audience.

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