ASSESSING THE IMPACT OF REAL EFFECTIVE EXCHANGE RATE AND ITS VOLATILITY ON NET FDI INFLOWS TO CANADA: A SECTOR-LEVEL ANALYSIS

by

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Abstract

This research investigates the relationship between REER and its volatility with FDI inflows to Canada, with a novel emphasis on sector-level analysis. The study utilizes time series data from 2007 to 2022 and employs the ARDL approach to assess short-run and long-run relationships. The findings reveal significant impacts of changes in GDP, REER, and its volatility on Total Net FDI in the short run, with lasting effects of lagged GDP, trade openness, REER, and its volatility on Total Net FDI in the long run. At the sectorial level analysis, net FDI inflows in Energy and mining, manufacturing, finance and insurance exhibit significant sensitivity with changes in REER, while volatility of REER have significant impact on FDI inflows in manufacturing industries and Finance and insurance sector in the short run. In the long-run, REER has significant influence on net FDI inflows in Energy and mining and also manufacturing industries.

Dedication

To my beloved wife, whose unwavering support and boundless love has been the cornerstone of my journey. Your encouragement has been my motivation, and your presence, my solace.

And to my cherished son, a constant source of inspiration and joy. Your innocence reminds me of the beauty in simplicity, and your laughter brightens even the darkest days.

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I wish to extend my heartfelt gratitude to Professor Murshed Chowdhury, my esteemed supervisor, whose unwavering guidance and invaluable assistance have been pivotal in bringing this report to fruition. His consistent support and weekly meetings have been a source of inspiration and motivation throughout this journey.

I am also deeply appreciative of the Examining Board for their thoughtful comments and constructive suggestions, which have greatly enhanced the quality and credibility of this report. Their expert insights have contributed significantly to its refinement.

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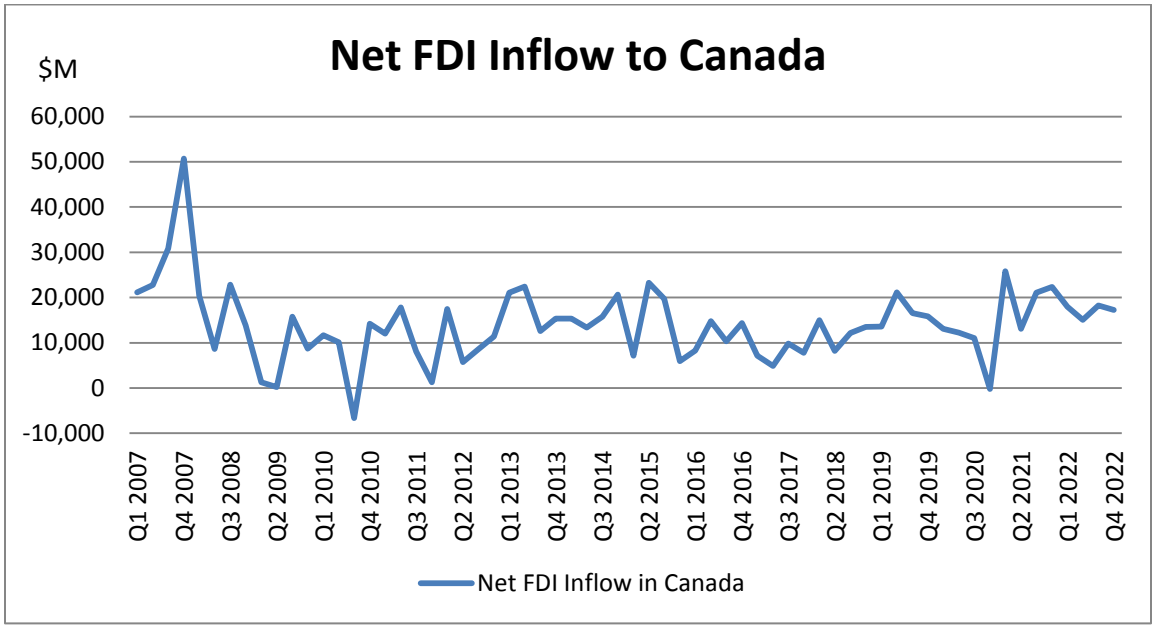
1 Introduction

Foreign direct investment (FDI) is widely recognized as a significant driver of economic growth and development (Cushman, 1985; Fauzel et al., 2015; Vincent et al., 2017). Compared to other types of capital inflows, FDI is more favorable for sustained growth (Walsh and Yu, 2010). Per the tenets of endogenous growth theory, foreign investment surpasses domestic investment in terms of productivity, owing to its ability to introduce not only capital but also advanced technology and expertise to the recipient nation (Abdullah & Chowdhury, 2020). Therefore, we should focus on two specific pathways through which FDI impacts economic growth. Primarily, FDI engenders growth by fostering trade linkages between foreign subsidiaries, local and regional suppliers, and parent enterprises, thereby capitalizing on a streamlined international division of labor (Blattner, 2006). Secondly, FDI facilitates the infusion of foreign technology and managerial proficiency, consequently enabling their dissemination across various sectors within the host country.

In light of this empirical finding, policymakers in Canada have set their sights on attracting greater inflows of FDI as a means to invigorate the economy. However, Total Net FDI trends in Canada have exhibited significant fluctuations over the past two decades, lacking a consistent and gradual trajectory, as depicted in Figure 1.

Figure 1 Total Net FDI inflows1 to Canada, Q1 2007- Q4 2022



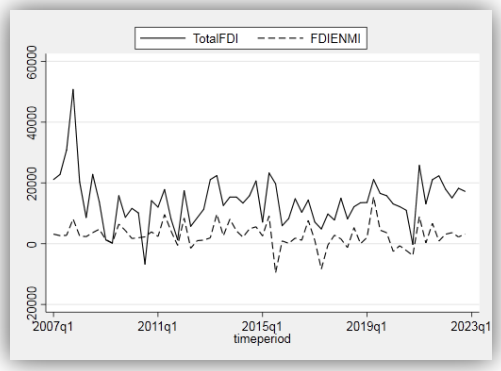
Data Source: Statistics Canada, Table 36-10-0026-01

These following figures (2 to 7 inclusive) also present graphical representations of the trends in Net FDIs in various industries or sectors during the same period. By plotting the FDI flows in six graphs, it is aimed to illustrate the dynamics of FDI in various sectors and compare them with the overall trend of Total Net FDI.

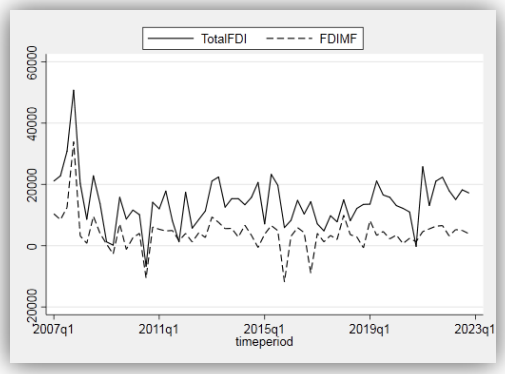
As it is perceptible from the figures, the trends of FDI in the manufacturing industries (FDIMF) and FDI in energy and mining (FDIENMI) demonstrate superior similarity with the overall trend of Total Net FDI over the majority of the observed time span, with higher count of common periods of ups and downs. In contrast, other sectors or industries display fewer resemblances to the overall trend of Total FDI during the analyzed time period.

[1] Total net FDI inflows to Canada is the sum of net FDI inflows in all sectors. The net FDI inflow for each sector is the difference between increase of investment and decrease of investment in that particular industry.

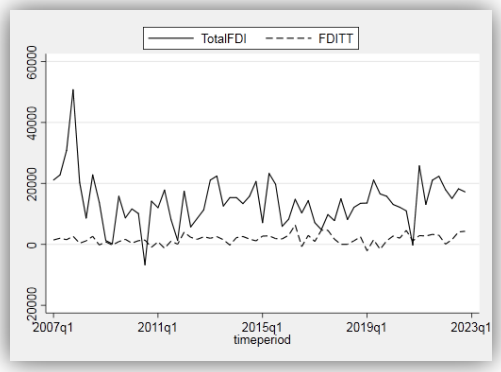
Figure 2 FDI in Sectors or Industries



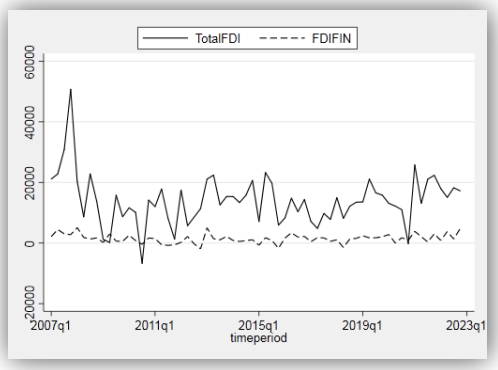
FDI in Energy and Mining



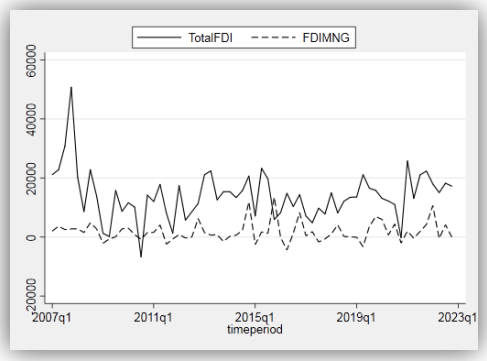
FDI in Manufacturing



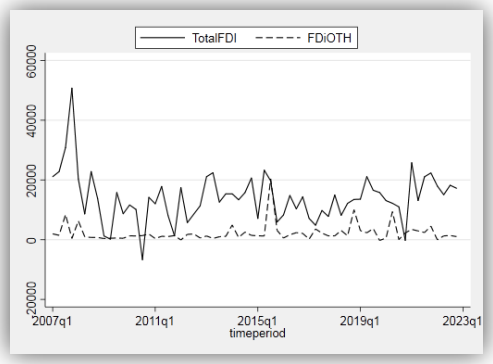
FDI in Trade and Transport



FDI in Finance and Insurance



FDI in Management of Campanies



FDI in Other Industries

Data Source: Statistics Canada, Table 36-10-0026-01

The table 1also presents the amounts and percentages of each sector's contribution to the Total Net FDI in Canada in 2022, measured in million Dollars.

Table 1 Quarterly Distribution of FDI across Industries in Canada (2022) in M$

Period	Total Net FDI	Energy and Mining (FDIENMI)	Manufacturing Industries (FDIMF)	Trade and Transport (FDITT)	Finance and Insurance (FDIFIN)	Management of Companies and Enterprises (FDIMNG)	Other industries (FDIOTH)
2022Q1	17,978	3,118 (17.35%)	3,223 (17.93%)	77 (0.42%)	908 (5.06%)	10,673 (59.36%)	-22 (-0.12%)
2022Q2	15,063	3,650 (24.23%)	5,259 (34.91%)	1,563 (10.37%)	3,784 (25.12%)	-477 (-3.16%)	1,285 (8.53%)
2022Q3	18,243	2,232 (12.23%)	5,001 (27.41%)	4,083 (22.38%)	1,344 (7.37%)	4,179 (22.91%)	1,404 (7.70%)
2022Q4	17,221	3,188 (18.51%)	3,915 (22.73%)	4,311 (25.03%)	4,804 (27.90%)	-45 (-0.26%)	1,047 (6.07%)

Data Source: Statistics Canada, Table 36-10-0026-01

In 2022, the third quarter witnessed the highest amount of Total Net FDI with 18,243 million dollars. Notably, the table illustrates substantial fluctuations in the share of each sector within the overall FDI. Initially, during the first quarter, FDI in the Management of Companies and Enterprises sector accounted for more than half of the Total Net FDI. Manufacturing Industries and Energy and Mining followed closely, constituting approximately 17% each. However, in the final quarter, the Finance and Insurance sector emerged as the leading contributor, representing almost 28% of the Total Net FDI. Overall, the Manufacturing Industries sector exhibited significant contributions, while the Management of Companies and Enterprises sector, initially holding the largest share, experienced a subsequent decline. The Energy and Mining, Trade and Transport, Finance

and Insurance, and Other industries sectors also demonstrated noteworthy contributions to the overall FDI, albeit with observed fluctuations over the quarters.

Although it is widely acknowledged that FDI inflows have a substantial impact on economic growth of host countries, the determinants of FDI inflows are still open to question.

As a result of the transition to the floating exchange rate system after the collapse of Bretton Woods System, the volatilities in exchange rates have become a major concern for countries. Exchange rate volatility refers to all movements and changes that are effective for the depreciation/valuation of a currency (Martins, 2015). In the interim, it becomes evident that fluctuations in exchange rates possess the potential to impact the anticipated advantages of FDI, thereby amplifying uncertainty for prospective investors. This rationale is substantiated by the fact that exchange rate volatility exerts influence on the projected returns of FDI, which are perceived as capital transfers. Consequently, both the degree of volatility and the level of the exchange rate may wield an influence on the level of investment (Chowdhury and Wheeler, 2008; Asmah and Andoh, 2013). Stated differently, exchange rate volatility can either stimulate or deter FDI. Pertaining to this matter, existing literature suggests a negative relationship between investment and the appreciation of the domestic currency, as well as measures of exchange rate volatility, although firm- and industry-specific attributes also emerge as crucial determining factors (Kyereboah-Coleman and Agyire-Tettey, 2008).

While extensive research has been conducted on the association between FDI and exchange rates, as well as the volatility of exchange rates in diverse countries and

regions, it has been revealed that the strength of this relationship varies across different contexts. Moreover, the duration of the relationship, whether short-term or long-term, remains a subject of exploration specifically across different economic sectors. To contribute to this research gap, this study aims to examine the existence of a long-run or short-run relationship between exchange rates and FDI in Canada. More importantly, an additional and novel dimension will be explored by investigating this relationship at the industry or sector level, providing a more nuanced understanding of how exchange rate dynamics impact FDI inflows within specific industries with regard to North American Industry Classification System (NAICS). While analyzing the total net FDI provides a broad view of foreign investment in Canada, sectorial analysis is indispensable for understanding the differential impact of the real effective exchange rate and its volatility on FDI across industries. It is challenging to isolate the individual performance of each sector of the economy unless they are studied independently (Moraghen et al., 2020). The reason is that different sectors in an economy have distinct characteristics, market structures, and exposure to exchange rate fluctuations. They may vary in their reliance on imported inputs, reliance on exports, and sensitivity to changes in currency values. Furthermore, each industry has its own set of factors driving FDI inflows. As a result, the impact of exchange rate movements on FDI can differ significantly across sectors. Through these endeavors, this research seeks to shed light on the intricacies of the FDI-exchange rate nexus in Canada between the years 2007-2022, thus advancing the existing body of knowledge in this field.

The two guiding questions of this research are:

1) To what extent do real effective exchange rate and its volatility bear significance in relation to Total Net FDI in Canada?

2) How significant are the real effective exchange rate and its volatility concerning FDI in various industries in Canada?

In order to investigate the interplay between variables and determine the significance of their associations in both the short-run and long-run, this study adopts a rigorous time series analysis methodology. It encompasses a total of seven estimations, considering not only overall FDI, but also FDI within specific industries. The analysis incorporates stationarity tests to identify the presence of stable patterns, followed by the application of suitable econometric techniques based on the outcomes of these tests. Additionally, diagnostic tests are conducted for each individual industry, providing a comprehensive understanding of the dynamics at play.

As was mentioned before, it is of great practical and theoretical significance to explore the influencing effects of exchange rate on FDI inflow in different industries since different sectors of the economy may have varying degrees of sensitivity to changes in the exchange rate. Analyzing FDI at the sectorial level helps identify which industries are more susceptible to fluctuations in exchange rates and which industries may be relatively insulated from these changes. This understanding is crucial for policymakers and investors to target and support sectors that contribute more significantly to economic growth and stability.

2 Literature Review

2.1 Theoretical Background

Concurrent with the expansion of FDI, the body of theoretical frameworks elucidating the intricate relationship between the real exchange rate and FDI has also proliferated. The association between FDI and exchange rates can manifest in two distinct ways. One line of scholarly inquiry proposes that movements in exchange rates exert an influence on FDI.

In this regard, the influential theories regarding the effect of exchange rates on FDI were proposed by Froot and Stein (1991) and Blonigen (1997). Froot and Stein (1991) present a model of FDI that explicitly elucidated the relationship between the real exchange rate and FDI. The model posits that an increase in wealth stimulates investment demand, and since foreign firms possess wealth in their home currency, a depreciation of the domestic currency enhances their relative wealth position, thereby reducing their relative cost of capital. Consequently, they can engage in more competitive bidding for domestic assets. Blonigen (1997), on the other hand, develop a theory of firm-specific FDI, asserting that exchange rate movements can impact acquisition-based FDI. Acquisitions involve firm-specific assets capable of generating returns in currencies other than the one used for their purchase. A depreciation of the domestic currency enhances the reservation bid of the foreign firm while leaving the bid of the local firm unaffected. Consequently, the foreign firm becomes more likely to acquire the asset.

Recent advancements in the literature on FDI have delved into several key factors, including the underlying motives driving FDI and the complex interplay between the exchange rate and FDI. Lin et al. (2006) contend that the extent of profit exposure to

exchange rate volatility hinges upon the motive behind FDI. Specifically, market-seeking FDI may heighten the susceptibility of profit to exchange risks, while export-substitution FDI could exert an inverse effect on profit. Conversely, Russ (2007) introduces the notion of exchange rate endogeneity into a comprehensive general equilibrium model, revealing that a multinational enterprise (MNE) response to exchange volatility is contingent upon the sources of internal shocks. According to this model, an expansionary monetary policy, accomplished through depreciation of the host country's currency, bolsters sales for MNEs. Conversely, an appreciation of the host country's currency facilitates more favorable exchange rates for profit conversion but diminishes domestic market sales for MNEs.

According to Husek and Pankova (2008), the depreciation of the currency of the host country will attract FDI inflows for two reasons. First, the depreciation of the currency declines the production costs (labor and other productive inputs) in the home country; thus makes the home country attractive for foreign investors. Second, the depreciation of the currency of the host country lowers the value of assets in the host country in other currencies, including the currency of the home country. As a result, the cost of FDI in foreign currency is decreasing and the host country is becoming attractive for FDI (Asmah and Andoh, 2013).

On the other hand, other strands of literature suggest that FDI can also have an effect on exchange rate volatility. FDI can improve productivity in the traded good sector and consequently decline real exchange rate volatility by balancing the relative prices of non-traded goods. FDI inflows cause appreciation of the real exchange rate by increasing the capital stock in the host country. Furthermore, FDI increases existing capital stock and

leads to technology to spread. Technology spillovers lead to increased production and lower prices of non-tradable goods. Therefore, FDI results in depreciation of real exchange rate. Nonetheless, the rise in the production of non-traded goods enlarges the disposable income and as a result the exchange rate appreciates (Biswas and Dasgupta, 2012).

In summary, the relationship between exchange rates and FDI remains ambiguous (Aqeel and Nishat, 2005). When investments in productive sectors thrive, it leads to the expansion of production capacities, thereby facilitating increased domestic production of goods and services, heightened satisfaction of domestic demand, higher exports, controlled imports, trade balance stability, and a positive impact on the currency exchange rate. Conversely, reduced investments in an economy necessitate higher imports to meet domestic demand, resulting in a deepening deficit that consequently influences the exchange rate adversely.

2.2 Empirical Background

According to prior literatures, exchange rate generates positive, negative, and ambiguous impacts on FDI (Kilicarslan, 2018). There have many viewpoints that have been trying to explain the relationship between exchange rate and its volatility and FDI.

Aliber (1970) stands as a pioneer in exploring the impact of exchange rate fluctuations on foreign direct investment (FDI) flows. His premise rested on the notion that countries with depreciated currencies, aiming to enhance their purchasing power, might seek to attract FDI.

Another seminal study by Froot and Stein (1991) laid the foundation for examining the correlation between the real exchange rate and inward foreign direct investment (FDI) in

the United States. Their analysis, based on quarterly data from 1973 to 1988, revealed a significant negative relationship between FDI in various industries and the value of the dollar.

Blonigen (1997) examined the exchange rate-FDI nexus in a panel dataset of Japanese acquisitions within specific industries in the USA from 1975 to 1992. The study reported that real depreciation of the dollar against the yen resulted in significant increases in acquisition FDI in industries with firm-specific assets only.

In a different context, Chen et al. (2006) employ a real options approach to explore the effects of exchange rate movements on market-oriented FDI and cost-oriented FDI in Taiwan's outward FDI to China from 1991 to 2002. Their findings indicate that exchange rate levels and volatility have a notable impact on Taiwanese firms' outward FDI in China. Moreover, exchange rate volatility exerts a negative effect on FDI activity, particularly in industries facing substantial sunk investment costs. The study also reveals that depreciation of the host country's currency discourages FDI activity for cost-oriented firms.

Shifting focus to Nigeria, Osinubi and Amaghionyeodiwe (2009) investigate the implications of exchange rate volatility on FDI from 1970 to 2004 through an error correction model (ECM). Their results suggested an insignificant positive relationship between the exchange rate and inward FDI, while exchange rate volatility had a positive impact on FDI.

Examining the Iranian context, Shariff-Renani and Mirfatah (2012) evaluate the effect of exchange rate volatility on inward FDI from 1980Q2 to 2006Q3 by Johansen and Juselius’s cointegration analysis. The estimated FDI function indicates a positive

relationship between FDI and exchange rate depreciation, while a negative relationship is observed with exchange rate volatility.

Lily et al. (2014) empirically analyze the relationship between exchange rate movements and FDI using annual data from ASEAN economies. Their findings indicate that real appreciation of the Singapore Dollar, Malaysian Ringgit, and Philippine Peso have a positive impact on FDI inflows. Additionally, bidirectional causality between FDI and exchange rates is observed for both Singapore and the Philippines. However, no long-run relationship is detected in the case of Thailand.

In their research, Kyereboah-Coleman and Agyire-Tettey (2016) investigate the impact of exchange-rate volatility on foreign direct investment (FDI) in Sub-Saharan Africa, with a specific focus on Ghana from 1970 to 2002. They use ARCH and GARCH models for the determination of real exchange rate volatility, and co-integration and ECM are used to determine both the short- and the long-term relationships. The findings reveal a significant negative relationship between real exchange rate volatility and FDI inflows, indicating that higher volatility tends to deter FDI into a country. This study concludes that the depreciation of the Ghanaian CEDI attracted FDI inflows, while exchange rate volatility discouraged such inflows, aligning with the researchers' initial expectations

In their study, Babubudjnauth and Seetanah (2019) examine the connection between the real exchange rate and net inflows of FDI in Mauritius. The research delves into both the short-term and long-term dynamics between the real exchange rate and FDI inflows, utilizing annual data spanning from 1980 to 2016. Applying the ARDL bound testing approach, the study reveals that, in addition to the real exchange rate, factors such as real domestic growth rate, human capital, terms of trade, and private investment exert

influence on FDI inflows, either in the short run, long run, or both periods. Notably, the study finds a positive relationship between the real exchange rate and net FDI inflows in both the short and long terms, emphasizing the importance of avoiding overvaluation of the domestic exchange rate to maintain an economic environment conducive to attracting FDI.

Harms and Knaze (2021) present a new dataset on bilateral de-jure exchange rate regimes, which allows characterizing exchange rate regimes based on countries' ex-ante announcements rather than ex-post observations. The authors use this dataset to examine the effect of expected exchange rate volatility on FDI. The empirical evidence generally supports the authors' theoretical predictions that announced exchange rate stability enhances bilateral FDI flows, with country pairs with no separate legal tender receiving significantly more FDI inflows from each other. The effect of exchange rate regimes differs between developed and developing countries, with the influence of announced exchange rate stability on investors' decisions being particularly strong in developing economies. Overall, the paper provides new insights into the relationship between exchange rate stability and FDI.

Goldberg and Kolstad (1995) analyze how exchange rate variations, but not volatility, affect investment by manufacturers in Japan, the U.S., Canada, and the U.K. from the 1978 to 1991 by ADF Unit root test and regression analysis. They find that industries in both the U.S. and Japan are affected by exchange rate variations when they have low markups. Their results also suggest that high export shares may cause a depreciation to increase investment, while high import shares may cause a depreciation to decrease

investment. Manufacturing industries in the U.K. and Canada did not appear responsive to exchange rate variations.

More recent research has also incorporated the effects of both exchange rate variations and volatility on manufacturing industries in Canada, and the results suggest a complicated relationship (Harchoui, Tarkhani, and Yuen, 2005). Harchoui et al. provide a detailed empirical analysis on investment by Canadian manufacturing industries and exchange rate instability from 1981 to 1997. Their results suggest that an exchange rate depreciation increases investment in periods of low volatility, and decreases investment during periods of high volatility. Furthermore, it appears that investment in non-information technology machinery and equipment (non-IT investment) is the most responsive to exchange rate variations and drives the results for total investment. Their work provides evidence that exchange rate variations and volatility have an economically low impact on manufacturing investment, but their results also suggest that the relationship is complex, asymmetrical, and influenced by important industry characteristics such as export orientation and markup levels.

Chowdhury and Wheeler (2008) also investigated the relationship between real exchange rate volatility and FDI in Canada, Japan, the United Kingdom, and the United States. The analysis employs vector autoregressive models (VAR) encompassing key variables such as the price level, real output, real exchange rate, volatility of the real exchange rate, interest rate, and FDI. The outcomes of the variance decompositions carry significant implications for public policy. In Canada, Japan, and the United States, innovations in exchange rate uncertainty account for substantial proportions of the forecast error variance in FDI over longer time horizons. The impulse response functions indicate that,

if shocks to exchange rate volatility do indeed influence FDI, their impact is positive and occurs with a time lag.

In summary, the existing body of research has extensively investigated the correlation between FDI and exchange rates, as well as the volatility of exchange rates, across various countries and regions. However, it has been established that the strength of this relationship varies within different contexts and industries. Consequently, this study seeks to address this research gap by specifically examining the impact of real exchange rate volatility on FDI within the Canadian context. The study aims to explore the presence of a long-run or short-run relationship between exchange rates and FDI in Canada at the industry or sector level, thereby providing a more refined understanding of how exchange rate dynamics influence the inflow of FDI within specific industries. Through this focused analysis, the study endeavors to contribute valuable insights to the existing body of knowledge.

3 Methodology

3.1 Econometric Model

Given the absence of definitive insights from foreign direct investment theories regarding the determinants of FDI, our model is designed to examine the relationship between the volatility of the real effective exchange rate and FDI. Drawing inspiration from the works of Sharifi-Renani and Mirfatah (2012), Castro et al. (2012), and Kyereboah-Coleman and Agyire-Tettey (2008), our model is formulated as follows:

$$\mathbf{FDI_t = \beta_0 + \beta_1 LNREER_t + \beta_2 LNVOL_t + \beta_3 LNGDP_t + \beta_4 LNOPEN_t + \epsilon_t}$$

where FDI is the net flows of foreign direct investment in period t which is the dependent variable. We replace FDI in our secondary estimations with FDI in different industries: FDIENMI (FDI in Energy and Mining), FDIMF (FDI in Manufacturing) FDITT (FDI in Trade and Transportation), FDIFIN (FDI in Finance and Insurance), FDIMNG (FDI in Management of companies and enterprises), FDIOTH (FDI in Other Industries).

LNGDP represents the natural logarithm of Canada's gross domestic product (GDP) at time t as one of the control variables, measured in millions of dollars. This logarithmic index is considered the most suitable measure for capturing the magnitude and scale of the country's economy. A larger GDP implies a potentially more favorable environment for foreign investments.

The LNOPEN variable reflects the level of trade openness as another control variable, which signifies the extent of economic integration between the national economy and the global economy. This index quantifies the total volume of trade (sum of import and export) relative to GDP, indicating the degree to which the host economy embraces the inflow and outflow of goods and services. It is evident that a higher degree of openness,

facilitating the entry and exit of goods and services, tends to enhance the incentives for FDI.

The main independent variables are LNREER and LNVOL which present the natural logarithm of real effective exchange rate and natural logarithm of volatility of real effective exchange rate respectively. The real effective exchange rate is anticipated to positively influence foreign investment, as it is closely associated with efficiency-seeking strategies that aim to reduce costs and long-term asset acquisitions.

In the research conducted by Sharifi-Renani and Mirfatah (2012) and Serenis and Tsounis (2012), the measurement of exchange rate volatility employed a method based on the moving average standard deviation. Similarly, we adopted and applied same methodology to assess exchange rate volatility in this study which is defined as follows:

$$\text{Moving Average Standard Deviation}_t = \sqrt{\frac{\sum_{i=1}^{t}(x_i-\bar{x})^2}{t-k+1}}$$

- x_i represents the value of the real effective exchange rate at each time period.
- $\bar{x}_t$ denotes the window mean value of the effective exchange rate.
- t represents the total number of periods (t=64).
- k denotes the length of the moving average window (k=4).

To enable the analysis at a quarterly level, the retrieved monthly data for the REER from is converted using the averaging method.

To facilitate interpretation, all variables, with the exception of FDI_t, have been logarithmically transformed. The decision to log-transform is aimed at enhancing the understanding and analysis of their relationships. However, FDI_t cannot undergo

logarithmic transformation due to the presence of negative observations within the net inflows of foreign direct investment.

For robustness, the alternative model in this research explores the impact of structural breaks or shocks on Net FDI inflows in Canada, focusing on two significant events - the global financial crisis (GFC) in 2008 and the COVID-19 pandemic in 2020. According to Government of Canada's report (2021) about state of trade with special focus on FDI, foreign direct investment in Canada experienced a notable 49% drop in 2020, which was comparatively less severe than the 60% decline witnessed during the GFC from 2008 to 2009. Notably, research conducted by Moran, Stevanovic, and Touré (2022) suggests that the unpredictable COVID-19 shock primarily impacted the Canadian economy in the second quarter of 2020. Additionally, the Bank of Canada's 2008 annual report highlights that the GFC led to a sharp drop in the value of Canadian Dollar in the fourth quarter of 2008. To account for these major events, dummy variables representing 2020q2 and 2008q4 have been included in the alternative model for analysis. This model aims to examine how these structural breaks or shocks influenced FDI patterns in Canada and shed light on the dynamics surrounding these pivotal economic moments. The alternative model is follows:

$$\mathbf{FDI_t = \beta_0 + \beta_1 LNREER_t + \beta_2 LNVOL_t + \beta_3 LNGDP_t + \beta_4 LNOPEN_t + \beta_5 Dum2008q4 + \beta_6 Dum2020q2 + \epsilon_t}$$

It should be notified that Other variables, such as interest rate, quality of infrastructures, political stability, financial stability, human capital, corporate tax rate, market size, and labor cost, have been considered in prior research (Korsah et al., 2022; Babubudjnauth and Seetanah, 2019; Asiamah et al., 2018; Adhikary, 2017; Alam and Ali Shah, 2013;

Daly and Tosompark, 2011). However, for this study, we have deliberately focused on a specific set of variables to maintain a clear and limited scope of analysis. Including additional variables could result in a more complex and extensive analysis, which may distract from our core objective of examining the relationship between the real effective exchange rate, volatility and FDI in Canada.

Furthermore, the incorporation of extra variables might require access to reliable and high-quality data. Unfortunately, data availability on a quarterly basis and potential measurement errors pose limitations for certain variables. To ensure the validity of our analysis, we have chosen to exclude these variables from the current study.

By keeping the model relatively simple and focused, we aim to enhance the interpretability of our findings. This approach allows us to better understand the specific drivers of FDI in Canada and how the main independent variables (real effective exchange rate, volatility, GDP, and openness) influence FDI dynamics within our research scope. Overloading the model with too many variables could obscure these relationships and make it challenging to draw meaningful conclusions regarding the impact of the chosen variables on FDI in Canada.

3.2 Source of data

The data pertaining to GDP, trade openness, total FDI, and FDI in all industries were obtained from StatCan. Additionally, the data regarding the real effective exchange rate was acquired from Bank of Canada.

3.3 Unit Root Tests

The presence of non-stationarity in time series data can lead to spurious regression, rendering the obtained results misleading. To mitigate the risk of "false regression," it is crucial to determine the stationarity of the variables under investigation. To address this concern, we employ both the Augmented Dickey-Fuller (ADF) unit root test and the Philips-Perron test to assess the time series properties of the variables included in this study. By subjecting the variables to these tests, we can ascertain their stationarity and ensure the robustness of our analysis.

Table 2 ADF Unit Root Test Result

Variables	Test Statistic	P-value	Stationary Status
FDITOTAL	-4.278**	0.0034	Stationary in level
FDIENMI	-5.479**	0.0000	Stationary in level
FDIMF	-5.238**	0.0001	Stationary in level
FDITT	-4.412**	0.0021	Stationary in level
FDIFIN	-4.659**	0.0008	Stationary in level
FDIMNG	-6.530**	0.0000	Stationary in level
FDIOTH	-5.683**	0.0000	Stationary in level
LNGDP	-3.521*	0.0372	Stationary in level
LNOPEN	-2.688	0.2411	Non-stationary in level
LNREER	-2.431	0.3633	Non-stationary in level
LNVOL	-2.855	0.1774	Non-stationary in level
Critical values	α=0.01 , -4.124	α=0.05 , -3.488	α=0.1 , -3.173
	** ,*significant at 1 percent and 5 percent level respectively		

Table 3 Philips-Perron Unit Root Test Result

Variables	Test Statistic	P-value	Stationary Status
FDITOTAL	-5.630***	0.0000	Stationary in level
FDIENMI	-8.267***	0.0000	Stationary in level
FDIMF	-7.031***	0.0001	Stationary in level
FDITT	-7.257***	0.0000	Stationary in level
FDIFIN	-6.914***	0.0000	Stationary in level
FDIMNG	-8.193***	0.0000	Stationary in level
FDIOTH	-8.279***	0.0000	Stationary in level

LNGDP	-3.778**	0.0177	Stationary in level
LNOPEN	-2.805	0.1952	Non-stationary in level
LNREER	-2.704	0.2343	Non-stationary in level
LNVOL	-2.541	0.2615	Non-stationary in level
Critical values	α=0.01 , -4.121	α=0.05 , -3.487	α=0.1 , -3.172
	*** ,** Significant at 1 percent and 5 percent level respectively		

It is important to note that both non-stationary variables, LNOPEN, LNREER and LNVOL, exhibit stationary properties following the application of first differencing (I(1)).

Table 4 Unit Root Tests for first differences of non-stationary variables in level

Variables	Test Statistic ADF in first difference	P-value ADF In first difference	Test Statistic PP In first differencing	P-value PP In first difference	Stationary Status in first difference
D_LNOPEN	-5.161***	0.0001	-8.454***	0.0000	Stationary
D_LNREER	-5.398***	0.0000	-6.884***	0.0000	Stationary
D_LNVOL	-5.733***	0.0000	-6.289***	0.0000	Stationary
Note:	*** Significant at 1 percent level.				

The above results present a combination of integrated of order 0 (I(0)) and integrated of order 1 (I(1)) variables. Given this mixture, it is reasonable to consider the autoregressive distributed lag (ARDL) bound testing approach proposed by Pesaran et al. (2001) as a theoretically sound method for examining a robust long-run relationship between the real exchange rate and FDI.

3.4 F-bound Test

In order to mitigate potential misspecification issues and address the problem of serial correlation in the error terms during the regression analysis, the Pesaran/Shin/Smith ARDL Bounds Test tests are conducted using one lag for both the dependent and

independent variables based on AIC criteria. Following that, the F-Statistic is calculated to assess the conditional autoregressive distributed lag (ARDL) model. The corresponding results are presented in Table 5.

Table 5 F-bounds Test for Cointegration

Significance level	[I(0)] L(10%)	[I(1)] L(10%)	[I(0)] L(5%)	[I(1)] L(5%)	[I(0)] L(2.5%)	[I(1)] L(2.5%)	[I(0)] L(1%)	[I(1)] L(1%)
Critical values	2.45	3.52	2.86	4.01	3.25	4.49	3.74	5.06
Equation	ARDL totalfdi lngdp lnopen lnreer lnvol, lags(1 0 1 1 0) ec btest							
F-Statistic	7.994				Result		Cointegration	
Equation	ARDL fdienmi lngdp lnopen lnreer lnvol, lags(1 0 0 0 0) ec btest							
F-Statistic	15.474				Result		Cointegration	
Equation	ARDL fdimf lngdp lnopen lnreer lnvol, lags(1 0 0 1 1) ec btest							
F-Statistic	12.922				Result		Cointegration	
Equation	ARDL fditt lngdp lnopen lnreer lnvol, lags(1 0 0 1 0) ec btest							
F-Statistic	10.148				Result		Cointegration	
Equation	ARDL fdifin lngdp lnopen lnreer lnvol, lags(1 0 0 1 1) ec btest							
F-Statistic	10.780				Result		Cointegration	
Equation	ARDL fdimng lngdp lnopen lnreer lnvol, lags(1 0 0 0 1) ec btest							
F-Statistic	14.224				Result		Cointegration	
Equation	ARDL fdioth lngdp lnopen lnreer lnvol, lags(1 1 0 0 1) ec btest							
F-Statistic	14.923				Result		Cointegration	

As shown in the table above, the calculated F-Statistic for the Total FDI ARDL model is 7.994 which exceeds the critical values at all significance levels for the upper bound I(1).Therefore, the null hypothesis of *No Cointegration* is rejected, indicating the presence of a long-term relationship among the variables. This implies that the variables move together in the long run.

The results of the F-bounds test for other equations also indicate that cointegration is supported in all examined models based on the comparison of calculated F-statistics and the critical values at all significance levels for the upper bound I(1). This means that the

variables within each equation share a stable long-term relationship, and changes in one variable are associated with changes in the others in a meaningful way over time.

In the forthcoming chapter, the models will be executed, and the results will be presented and subsequently analyzed using an appropriate approach based on the findings of the unit root test and F bound test. This approach aims to ensure a rigorous and comprehensive evaluation of the results to draw meaningful conclusions and insights from the empirical analysis.

4 Empirical work

4.1 ARDL Error Correction Model (ECM)

After confirming the co-integration relationship, the error correction model (ECM) is utilized, with the choice of the ECM framework being supported by empirical evidence. The F bounds test was employed, and the resulting computed F statistics surpassed the upper bound, providing strong evidence of co-integration among the variables under investigation. Moreover, the unit root tests conducted using the Augmented Dickey-Fuller (ADF) and Philips-Perron methods indicated a combination of stationary (I(0)) and non-stationary (I(1)) variables. This finding signifies the presence of both short-term fluctuations and long-run relationships within the data, aligning with the underlying assumptions of the ECM. By employing a simple linear transformation, an ARDL-based dynamic error correction model can be derived. The ECM effectively incorporates the short-run dynamics with the long-run equilibrium, preserving important long-run information and mitigating issues associated with spurious relationships arising from non-stationary time series data (Shrestha and Bhatta, 2018).

The ARDL ECM model for assessing the relationship among the dependent variables and explanatory variables is as follows:

$$\Delta \boldsymbol{FDI_t} = \boldsymbol{\beta_0} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{p}} \boldsymbol{\beta_{1i}} \Delta \boldsymbol{FDI_{t\text{-}i}} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{q}} \boldsymbol{\beta_{2i}} \Delta \boldsymbol{LNGDP_{t\text{-}i}} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{q}} \boldsymbol{\beta_{3i}} \Delta \boldsymbol{LNOPEN_{t\text{-}i}} +$$

$$\sum_{\boldsymbol{i=1}}^{\boldsymbol{q}} \boldsymbol{\beta_{4i}} \Delta \boldsymbol{LNREER}_{\boldsymbol{t\text{-}i}} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{q}} \boldsymbol{\beta_{5i}} \Delta \boldsymbol{LNVOL_{t\text{-}i}} + \boldsymbol{\lambda ECT_{t\text{-}1}} + \boldsymbol{\epsilon_i}$$

- ECT_{t-1} is the lagged error correction term.
- λ is the ECT coefficient, which denotes the parameter reflecting the rate of correction for adjustments.
- p is the lag order for the dependent variable.

- q is the lag order for the independent variables.

To begin, the analysis explores the results for Total Net FDI as the dependent variable. The objective is to investigate the extent to which the independent variables are associated with Total Net FDI within the framework of the ARDL ECM model. Afterwards, this examination provides insights into the relationship between the chosen independent variables and their impact on FDI in different industries or sectors in Canada.

It should be notified that ARDL model is more suitable for the small and finite sample data period (Pesaran et al., 2001). As noted by Pesaran and Shin (1999): "appropriate modification of the orders of the ARDL model is sufficient to simultaneously correct the residual serial correlation and the problem of endogenous regressors." Therefore, given that it is free of residual correlation, the ARDL method can handle the eventual phenomenon of endogeneity among variables.

4.2 Results for Total Net FDI

The short-run results of the aforementioned model for Total Net FDI are presented in following table:

Table 6 EC and short-run dynamics in ARDL model for Total Net FDI

Variable	Coefficient	STD Error	T statistics	P-value
ECT (-1)	-0.7958685	0.1283949	-6.20***	0.000
$\Delta LNGDP_t$	55686.17	26944	2.07**	0.043
$\Delta LNOPEN_t$	-4058.413	48260.94	-0.08	0.933
$\Delta LNREER_t$	127713.6	38599.68	3.31***	0.002
$\Delta LNVOL_t$	3880.538	2216.76	1.75*	0.086
Constant	-1012511	473346.8	-2.14**	0.037
R^2	0.5061	Adjusted R^2		0.4433
Note: ***,**, * Significant at 1%, 5% and 10% level respectively.				

In the short run, changes in GDP and REER have statistically significant positive effects on Total Net FDI in Canada at 5% and 1 % level respectively. Furthermore, volatility of REER has positive impact on Total Net FDI at 10% significance level. However, changes in the trade openness do not show a significant impact.

As predicted before, the relationship between FDI and GDP is significant and positive in the short run. The positive relationship between FDI and GDP can be attributed to the larger market size, profit opportunities, economic stability, access to resources, and conductive business environment in countries with higher GDP levels. Foreign investors seek to capitalize on growth potential and profit prospects in these economies. This result is consistent with the findings of numerous prior studies, for instance, those by Castro et al. (2012), Renani and Mirfatah (2012), Babubudjnauth and Seetanah (2019), and Kyereboah-Coleman and Agyire-Tettey (2008).

Furthermore, the coefficient of $\Delta LNREER_t$ is 127713.6 which implies that one percent increase in real effective exchange rate in the current period (depreciation) is associated with an increase of approximately 127713.6 units in Total Net FDI in the short run. The coefficient is statistically significant at the 1% level (P-value = 0.002), indicating that changes in the real effective exchange rate have a significant impact on the dependent variable in the short run. This finding aligns with those of previous research, namely conducted by Froot and Stein (1991), Xing (2004), Vincent et al. (2017), and Babubudjnauth and Seetanah (2019). This can be explained in three supporting reasons. Firstly, it lowers the cost of production and labor in the host country when measured in foreign currency terms, enhancing cost-effectiveness for foreign investors. Additionally, the reduced cost of acquiring assets, including real estate and machinery, presents

attractive opportunities for foreign companies to invest in physical infrastructure at a relatively lower expense. Moreover, the depreciated currency renders the host country's exports more competitively priced in global markets, thereby amplifying export opportunities and appealing to foreign investors seeking to capitalize on international trade prospects. These combined advantages make a country with a depreciated currency an appealing destination for FDI, promoting increased investment inflows and potentially bolstering economic growth.

Meanwhile, the coefficient of ΔLNVOLt is approximately 3880. It suggests that one percent increase in volatility of REER in the current period is associated with an increase of approximately 3880 units in Total FDI in the short run. The coefficient is also statistically significant at the 10% level (P-value = 0. 086), indicating that changes in volatility have a significant impact on the dependent variable in the short run. As we discussed earlier in the theoretical background, volatility in the REER introduces uncertainty and exchange rate risk for foreign investors. However, some investors may be willing to tolerate higher levels of volatility if it presents opportunities for higher returns. A positive and significant relationship between REER volatility and FDI can indicate that certain investors are attracted to the potential gains that can arise from capitalizing on fluctuations in exchange rates. This result is in line with the findings of Darby et al. (1999), and Sung and Lapan (2000) who also discovered a positive relationship between the two variables.

Moreover, the statistically significant adjustment term λ at 1% level (-0.7958685) shows that the dependent variable adjusts by approximately 79 % towards its long-run equilibrium for each unit of deviation from the equilibrium in the previous quarter.

The long-run result of the aforementioned model for Total Net FDI is presented in the Table 7.

Table 7 Estimated long-run coefficient using ARDL model for Total Net FDI

Variable	Coefficient	STD Error	T statistics	P-value
$LNGDP_{t-1}$	69969.07	33166.74	2.11**	0.039
$LNOPEN_{t-1}$	87694.13	37910.07	2.31**	0.024
$LNREER_{t-1}$	65256.19	24877.63	2.62**	0.011
$LNVOL_{t-1}$	4875.854	2673.373	1.82*	0.074
Note: **, * Significant at 5% and 10%				

The long-run results indicate that lagged GDP, lagged trade openness variable, lagged real effective exchange rate are all positively and significantly associated with Total Net FDI in the long run. This implies that changes in these variables have a lasting impact on Total Net FDI, supporting the presence of long-run relationships in the model.

Trade openness has a positive significant impact on FDI in the long run. This is in line with the result of previous research, for instance Castro et al. (2013), Shariff-Renani and Mirfatah (2012) and Saleem et al. (2020). Trade openness allows countries to access larger and diverse markets. Foreign companies investing in a trade-open economy can gain easier access to a wider consumer base, enabling them to sell their products and services to a more extensive customer pool. Companies often seek locations for FDI that are part of global supply chains. Trade-open economies tend to have well-established supply chain networks, making them attractive to foreign investors who can utilize these networks to facilitate their own production and distribution processes.

Moreover, the coefficient of LNVOLt-1 is 4875.854 which suggests that a 1% increase in the lagged logarithm of volatility is associated with an increase of approximately 6658.596 units in Total FDI in the long run. The coefficient is statistically significant at

the 10% level (P-value = 0.074), indicating a significant positive relationship between lagged volatility and Total FDI in the long run. The significant and positive coefficient for the lagged volatility may indicate that foreign investors view past exchange rate fluctuations as manageable risks. The historical volatility may signal that the Canada's economy has demonstrated resilience and the ability to cope with currency fluctuations, which can enhance investor confidence and encourage long-term FDI commitments. This result complies with the findings of Chowdhury and Wheeler's (2008) research, which revealed a positive relationship between shocks to exchange rate volatility and FDI in Canada.

In the meantime, the coefficient of $LNREER_{t-1}$ is 65256.19 which implies that a 1% increase in the lagged logarithm of REER (depreciation) is associated with an increase of approximately 65256.19 units in Total Net FDI in the long run. The coefficient is statistically significant at the 5% level (P-value = 0.011), indicating a significant positive relationship between lagged real effective exchange rate and Total Net FDI in the long run. My findings are consistent with some other research regarding the relationship between exchange rates and FDI. Shariff-Renani and Mirfatah (2012) found a positive relationship between FDI and exchange rate depreciation, which aligns with my results. Babubudjnauth and Seetanah (2019) also identified a positive relationship between the real exchange rate and FDI inflows in both the short and long terms, which is line with my findings. Moreover, in the study conducted by Castro et al. (2012), the exchange rate showed a positive signal in long term relationship for FDI in Mexico.

Regarding diagnostic tests, Durbin-Watson d-statistic and Breusch-Godfrey LM test are applied to the residuals of the model to find out whether its residuals are serially

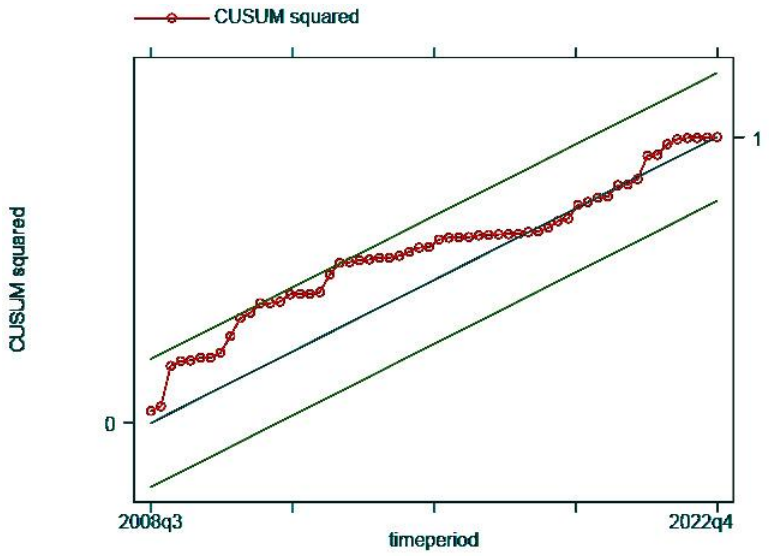
correlated. In this particular instance, the calculated d-statistic is 2.150871, suggesting the absence of positive autocorrelation in the residuals. Likewise, the P-value of 0.1316 obtained from the Breusch-Godfrey LM test (chi2=2.274) indicates that there is no evidence of serial correlation in the residuals.

The chi-square statistic for the White's test is 44.84 (P-value: 0.1231) which confirms that the error terms are homoscedastic.

The normality test of residual provides a Jarque–Bera value of 2.745 with probability value of 0.2535, which means that residuals are normally distributed.

The CUSUM test is used to examine the stability of a regression model over time. By plotting the CUSUM statistic and its upper and lower bounds, it helps to identify any structural changes or instability in the model.

Figure 3 Stability of Total Net FDI Model



As CUSUM statistic falls between the upper and lower bounds, it suggests that there is no evidence of significant structural change or instability in the model. This indicates that

the coefficients and relationships in the regression model remain stable over the analyzed time period.

4.3 Results for FDI in industries

The short-run results of the same model for FDI in different industries are presented in the following table:

Table 8 EC and short-run dynamics in ARDL model for FDI in Industries

Industry/Sector	Variable	Coefficient	STD Error	T statistics	P-value
Energy and Mining (FDIENMI)	ECT (-1)	-1.121983	0.128131	-8.76***	0.000
	$\Delta LNGDP_t$	20290.28	13950.67	1.45	0.151
	$\Delta LNOPEN_t$	-5445.683	15652.36	-0.35	0.729
	$\Delta LNREER_t$	26247.58	10300.41	2.55**	0.014
	$\Delta LNVOL_t$	728.6559	1147.577	0.63	0.528
	Constant	-418765.3	243999.8	-1.72*	0.092
Overall Fit Measures	R^2	0.5758	Adjusted R^2		0.5386
Manufacturing Industries (FDIMF)	ECT (-1)	-0.9861048	0.1241345	-7.94***	0.000
	$\Delta LNGDP_t$	14048.73	18372.53	0.76	0.448
	$\Delta LNOPEN_t$	40466.99	20709.41	1.95*	0.056
	$\Delta LNREER_t$	74235.58	25149.04	2.95***	0.005
	$\Delta LNVOL_t$	5552.736	2499.272.688	2.22**	0.030
	Constant	-327461.1	321617.7	-1.02	0.313
Overall Fit Measures	R^2	0.5889	Adjusted R^2		0.5366
Trade and Transport (FDITT)	ECT (-1)	-0.9573658	0.1360218	-7.04***	0.000
	$\Delta LNGDP_t$	5408.358	5773..209	0.94	0.353
	$\Delta LNOPEN_t$	4385.413	6427.042	0.68	0.498
	$\Delta LNREER_t$	10026.85	7832.668	1.28	0.206
	$\Delta LNVOL_t$	355.7322	479.5271	0.74	0.461
	Constant	-71558.11	100375.6	-0.71	0.479
Overall Fit Measures	R^2	0.4847	Adjusted R^2		0.4295
Finance and Insurance (FDIFIN)	ECT (-1)	-1.013493	0.1396756	-7.26***	0.000
	$\Delta LNGDP_t$	5078.019	5458.375	0.93	0.356
	$\Delta LNOPEN_t$	4360.178	6079.007	0.72	0.476
	$\Delta LNREER_t$	14094.35	7527.826	1.87*	0.066
	$\Delta LNVOL_t$	1459.764	771.5681	1.89*	0.064
	Constant	-80405.18	95216.37	-0.84	0.402
Overall Fit Measures	R^2	0.4981	Adjusted R^2		0.4342

Management of Companies and enterprises (FDIMNG)	ECT (-1)	-1.070065	0.1310698	-8.16***	0.000
	$\Delta LNGDP_t$	14834.43	11997.36	1.24	0.221
	$\Delta LNOPEN_t$	10718.42	13390.37	0.80	0.427
	$\Delta LNREER_t$	4551.116	8690.936	0.52	0.603
	$\Delta LNVOL_t$	-1018.394	1632.55	-0.62	0.535
	Constant	-230676.6	209110.9.5	-1.10	0.275
Overall Fit Measures	R^2	0.5595	Adjusted R^2		0.5123
Other industries (FDIOTH)	ECT (-1)	-1.134691	0.1320199	-8.59***	0.000
	$\Delta LNGDP_t$	-39251.69	21029.02	-1.87	0.067
	$\Delta LNOPEN_t$	24425.95	12235.82	2.00*	0.051
	$\Delta LNREER_t$	-12124.32	8183.108	-1.48	0.144
	$\Delta LNVOL_t$	2045.576	1444.99	1.42	0.163
	Constant	187245.5	195445.2	0.96	0.342
Overall Fit Measures	R^2	0.6157	Adjusted R^2		0.5668
Note: *** , **, * Significant at 1%, 5% and 10% level respectively.					

According to the table 8, the significance of the error correction term (ECT) in adjusting the short-run dynamics and restoring the long-run equilibrium is noteworthy across all industries or sectors, as it is statistically significant at the 1% level. This highlights the crucial role of the ECT in ensuring the adjustment of short-term fluctuations and maintaining the long-term balance in all industries or sectors.

Changes in the real effective exchange rate have a significant impact on FDI in the short run within energy and mining sector (FDIENMI). The coefficient of $\Delta LNREER_t$ is 26247.58 which imply that one percent increase in real effective exchange rate is associated with an increase of approximately 23937.12 units in FDI in the energy and mining industry in the short run. The coefficient is statistically significant at the 5% level.

In the manufacturing industries (FDIMF), changes in trade openness and REER and Volatility of REER have positive impact on FDI in this sector and they are significant at 10%, 1% and 5% respectively. The coefficient of $\Delta LNREERt$ is 74235.58 which implies that one percent increase in the real effective exchange rate is associated with an increase

of approximately 83641.73 units in FDI in the manufacturing industries in the short run. Furthermore, the coefficient of ΔLNVOLt is 5552.736 which suggests that one percent increase in the volatility is associated with an increase of approximately 5552 units in FDI in the manufacturing industries in the short run. Manufacturing industries are typically export-oriented, and exchange rate volatility can impact export earnings. A positive relationship between REER volatility and FDI may indicate that foreign investors are attracted to Canada where exchange rate fluctuations create opportunities for export-oriented businesses to benefit from potential currency gains and increased competitiveness in foreign markets. This result is in alignment with the research done by Cushman (1988) that demonstrated that when there is exchange rate variability, manufacturing goods directly in the target market becomes an attractive alternative to exporting. This is particularly true if the domestically produced goods are not intended for re-export. Therefore, Cushman's study also revealed a positive relationship between exchange rate volatility and inward FDI.

In the Finance and Insurance sector (FDIFIN), changes in the real effective exchange rate and volatility of REER exhibit positive significant impacts on FDI in the short run (significant level at 10%). The coefficient of ΔLNREERt is 14094.35 which indicate that a one percent increase the real effective exchange rate is associated with an expected increase of approximately 14094.35 units in FDI in this sector. Moreover, the coefficient of ΔLNVOLt is 1459.764 which suggest that a one percent increase in volatility of REER is associated with an expected increase of approximately 1459.764 units in FDI in these industries.

There is no significant relationship between independent variables and FDI in the short run within Trade and Transportation Sector (FDITT) and Management of Companies and Enterprises sector (FDIMNG) and other industries (FDIOTH) at 5% significance level. On the other hand, in other industries (FDIOTH), only changes in GDP and trade openness exhibit significant impacts at 10% significance level.

These results prove the fact that different sectors in the economy have unique characteristics, distinctive risk profiles, and specific sensitivities to various economic variables. The Trade and Transportation sector and Management of Companies and Enterprises sector are less affected by changes in exchange rates and their volatility compared to other industries. Factors such as the nature of their business activities and reliance on domestic markets can influence the significance of the relationship between REER, volatility, and FDI.

Table 9 Estimated long-run coefficient using ARDL for FDI in industries

Industry	Variable	Coefficient	STD Error	T statistics	P-value
Energy and Mining (FDIENMI)	$LNGDP_{t-1}$	18084.31	12371.58	1.46	0.149
	$LNOPEN_{t-1}$	4853.625	13967.01	-0.35	0.729
	$LNREER_{t-1}$	23393.93	9008.224	2.60**	0.012
	$LNVOL_{t-1}$	649.436	1020.102	0.64	0.527
Manufacturing Industries (FDIMF)	$LNGDP_{t-1}$	14246.69	18571.79	0.77	0.446
	$LNOPEN_{t-1}$	41037.21	20857.86	1.97*	0.054
	$LNREER_{t-1}$	31202.02	13531.79	2.31**	0.025
	$LNVOL_{t-1}$	577.2225	1571.322	0.37	0.715
Trade and Transport (FDITT)	$LNGDP_{t-1}$	5649.208	5922.851	0.95	0.344
	$LNOPEN_{t-1}$	4580.708	6696.589	0.68	0.497
	$LNREER_{t-1}$	-710.5176	4362.839	-0.16	0.871
	$LNVOL_{t-1}$	371.5739	490.9721	0.76	0.452
Finance and Insurance (FDIFIN)	$LNGDP_{t-1}$	5010.415	5357.417	0.94	0.354
	$LNOPEN_{t-1}$	4302.13	5993.253	0.72	0.476
	$LNREER_{t-1}$	2112.857	3901.402	0.54	0.590
	$LNVOL_{t-1}$	353.1931	453.4005	0.78	0.439
Management of Companies and	$LNGDP_{t-1}$	13863.11	11447.45	1.21	0.231
	$LNOPEN_{t-1}$	10016.6	12485.86	0.80	0.426

enterprises (FDIMNG)	$LNREER_{t-1}$	4253.121	8213.515	0.52	0.607
	$LNVOL_{t-1}$	1520.994	969.5335	1.57	0.122
Other industries (FDIOTH)	$LNGDP_{t-1}$	-7024.7	9848.779	-0.71	0.479
	$LNOPEN_{t-1}$	21526.52	10527.39	2.04**	0.046
	$LNREER_{t-1}$	-10685.13	7093.479	-1.51	0.138
	$LNVOL_{t-1}$	56.44542	817.9582	0.07	0.945
Note: ***,** Significant at 1% and 5% level respectively.					

In the long run, the majority of explanatory variables do not exhibit statistically significant impacts on foreign direct investments across various industries[1]. However, there are a few exceptions. Specifically, changes in the real effective exchange rate (REER) have a positive and significant influence on FDI in the energy and mining sector, as well as in the manufacturing industries at 5% level. Additionally, trade openness demonstrates a positive and significant impact on FDI in manufacturing sector as well as on FDI in other industries. The significant and positive short-run and long-run relationship between the REER and FDI in the Energy and Mining sector can be justified by the impact of exchange rate fluctuations on commodity prices. As these sectors heavily rely on commodities priced in foreign currencies, a depreciated domestic currency (increased REER) makes these resources relatively cheaper for foreign investors, making investments more attractive.

[1] In pursuit of enhancing the robustness of our analytical framework specifically for the effect of Volatility of REER, we embarked on a comprehensive examination as derived from a shifting window, from a 4-quarter window to a 5-quarter window. Our meticulous investigation revealed that this transition yielded no substantive changes at the sectorial level. Notably, the relationship between volatility of REER and Total FDI demonstrated a regrettably diminished explanatory potency, notably eroding the previously observed long-term statistical significance of this association. Intriguingly, this transition also engendered an unexpected attenuation in the previously established interdependence LNGDP and Total FDI. Furthermore, this transition instigated the emergence of autocorrelation and heteroscedasticity in residuals.

Additionally, given the substantial capital requirements in energy and mining projects, a favorable exchange rate environment can enhance cost competitiveness for foreign investors, reducing overall investment expenses. Furthermore, the positive relationship suggests that REER fluctuations influence the appeal of export-oriented FDI in these sectors, as a weaker domestic currency boosts export earnings for foreign investors, providing further incentives for FDI. This result is in line with the theories mentioned in chapter 2 with regard to the relationship between exchange rate and FDI inflow.

The following tables present the results of diagnostic tests conducted for residual analysis in the FDI models in industries.

Table 10 Serial Correlation Tests for FDI in Industries

Equation	Durbin-Watson d-statistic	Breusch-Godfrey LM test	Result
Energy and Mining (FDIENMI)	2.006071	Chi2 = 0.014 P-value = 0.9044	No serial correlation
Manufacturing Industries (FDIMF)	2.114834	Chi2 = 1.563 P-value = 0.2112	No serial correlation
Trade and Transport (FDITT)	1.913474	Chi2 = 0.967 P-value = 0.3254	No serial correlation
Finance and Insurance (FDIFIN)	1.927294	Chi2 = 0.144 P-value = 0.7047	No serial correlation
Management of Companies and Enterprises (FDIMNG)	2.043401	Chi2 = 0.752 P-value = 0.3858	No serial correlation
Other industries (FDIOTH)	1.987832	Chi2 = 0.003 P-value = 0.9535	No serial correlation

The table 10 presents the results of diagnostic tests for residual analysis in different industry sectors. The Durbin-Watson d-statistic indicates no evidence of serial correlation in the residuals. Similarly, the Breusch-Godfrey LM test shows no significant serial

correlation based on the chi-square values and associated P-values. Overall, the results indicate the absence of serial correlation in the residuals across all industry sectors examined.

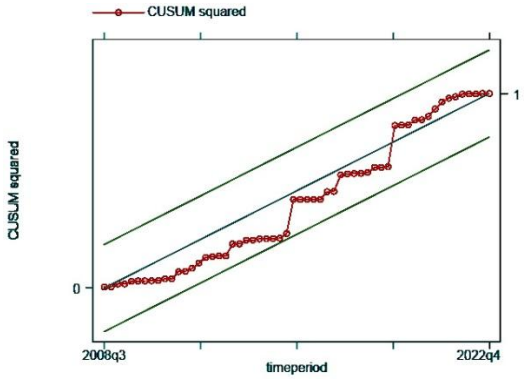
Table 11 Homoscedasticity and Normal Distribution Tests for FDI in Industries

Equation	White's test for Homoscedasticity	Result	Jarque-Bera normality test	Result
Energy and Mining (FDIENMI)	Chi2 (20) = 21.65 P-value = 0.3601	Homoscedastic	chi2 = 16.5 P-value = 0.00026	Not Normally Distributed
Manufacturing Industries (FDIMF)	Chi2 (35) = 50.18 P-value = 0.046	Heteroscedastic	chi2 = 113.1 P-value = 2.7e-25	Not Normally Distributed
Trade and Transport (FDITT)	Chi2 (27) = 27.34 P-value = 0.4454	Homoscedastic	chi2 = 1.787 P-value = 0.4092	Normally distributed
Finance and Insurance (FDIFIN)	Chi2 (35) = 35.68 P-value = 0.4361	Homoscedastic	chi2 = 2.416 P-value = 0.2988	Normally distributed
Management of Companies and enterprises (FDIMNG)	Chi2 (27) = 28.85 P-value = 0.3681	Homoscedastic	chi2 = 19.34 P-value = 6.3e-05	Not Normally Distributed
Other industries (FDIOTH)	Chi2 (35) = 39.32 P-value = 0.2826	Homoscedastic	chi2 = 676 P-value = 2.e-147	Not Normally Distributed

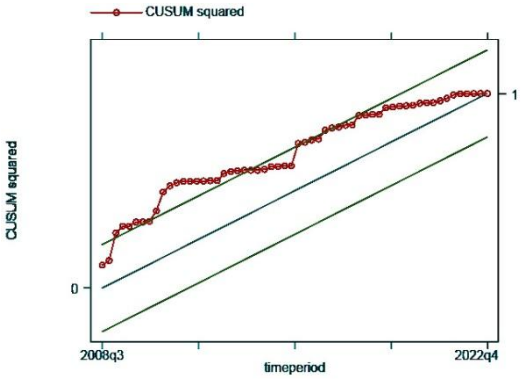
The table 11 presents the results of diagnostic tests for homoscedasticity and normality of residuals in different industry sectors. The White's test for homoscedasticity indicates that the residuals have equal variance across all observed levels in all industries, except for FDIMF. The Jarque-Bera test for normality reveals that the residuals are not normally distributed in the Energy and Mining, Manufacturing Industries, Management of Companies and Enterprises, and Other Industries sectors. Nevertheless, they are normally distributed in the Trade and Transport and Finance and Insurance sectors.

The following figures illustrate the results of CUSUM tests conducted for all models of foreign direct investment in various industry sectors.

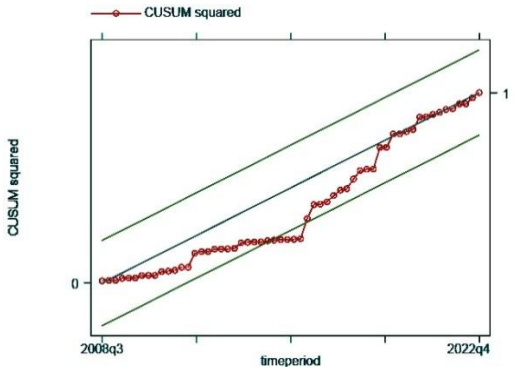
Figure 4 Stability of Models for FDI in industries



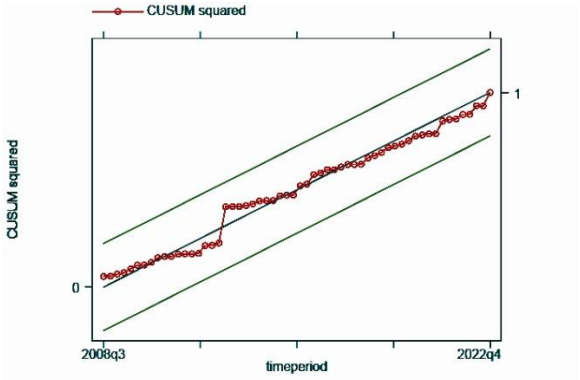
Stability of FDIENMI Model



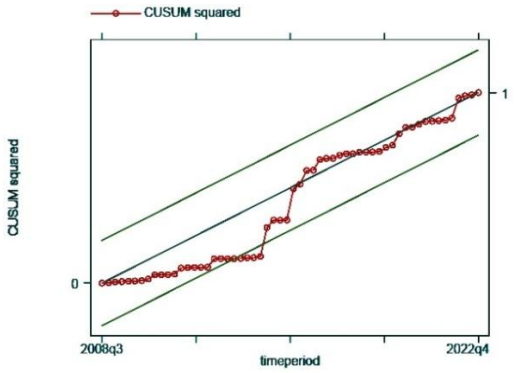
Stability of FDIMF Model



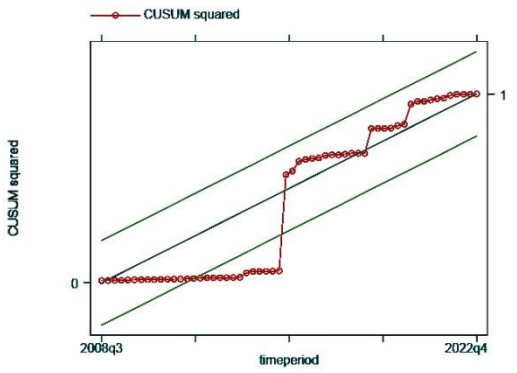
Stability of FDITT Model



Stability of FDIINF Model



Stability of FDIMNG Model



Stability of FDIOTH

The figures presented above provide compelling evidence of the stability of all the models based on the CUSUM tests. The plots demonstrate that the models consistently fluctuate within the upper and lower bounds, indicating a stable relationship between the variables over time. In instances where the plots temporarily exceed the bounds, they eventually revert back within the acceptable range, further affirming the stability of the models. These findings suggest that the estimated models adequately capture the underlying dynamics of FDI in different industry sectors.

4.4 Results of alternative model

This section investigates the impact of two significant events, the GFC in 2008 and the COVID-19 pandemic in 2020, on Net FDI inflows in Canada. The inclusion of dummy variables representing 2020q2 and 2008q4 aims to analyze how these structural breaks influenced FDI patterns and provides insights into the dynamics surrounding these pivotal economic moments.

Regarding the illustrations in chapter 1, in spite of some similarities, the trends and shocks observed in Net FDI within sectors or industries do not appear to precisely align with the overall trend of Total FDI. Specifically, the largest shocks of each trend, is not in compliance with the Total FDI. Consequently, the inclusion of same dummy variables for these specific periods in the analysis of sectoral FDI may not be logically justified. Instead, our focus remains on examining the impact of including dummy variables solely on Total FDI in our model.

Table 12 EC and short-run dynamics in ARDL Alternative model for Total Net FDI

Variable	Coefficient	STD Error	T statistics	P-value
ECT (-1)	-0.8197537	0.1254389	-6.54***	0.000
$\Delta LNGDP_t$	74449.34	28101.16	2.65**	0.011
$\Delta LNOPEN_t$	76998.87	30570.11	2.52**	0.015
$\Delta LNREER_t$	156240	41417.96	3.77***	0.000
$\Delta LNVOL_t$	5173.725	2334.7	2.22**	0.031
$dum2008q4_t$	15627.67	8592.137	1.82*	0.074
$dum2020q2_t$	17380.83	8559.968	2.03**	0.047
Constant	-1341135	493876.3	-2.72***	0.009
R^2	0.5399	Adjusted R^2		0.4717

Note: ***,**,* Significant at 1% , 5% and 10% level respectively.

A comparison of the this result with table 4 proves that the coefficient for the change in the real effective exchange rate ($\Delta LNREER_t$) remains significant (at 1% level) and positive in both cases. However, the coefficient for the volatility of the real effective exchange rate ($\Delta LNVOL_t$) is significant at the 5% level when dummies are included (P-value = 0.031) which was statistically significant at 10% level when they are excluded (P-value = 0.086).

Furthermore, the coefficient for the trade openness ($\Delta LNOPEN_t$) was negative and statistically insignificant when dummy variables are excluded (P-value = 0.933), while it is positive and significant at the 5% level when they are included (P-value = 0.015). This suggests that the presence of dummies may attenuate the impact of trade openness on short-term FDI.

The coefficients for the dummy variables themselves (dum2008q4 and dum2020q2) are significant at the 10% and 5% levels, respectively, indicating their influence on short-term FDI. The positive coefficients imply that these specific periods (fourth quarter of 2008 and second quarter of 2020) had a positive impact on FDI flows during the short run.

The long-run results of the aforementioned model for Total FDI are presented in following table:

Table 13 EC and long-run dynamics in ARDL Alternative model for Total Net FDI

Variable	Coefficient	STD Error	T statistics	P-value
$LNGDP_{t-1}$	90819.16	33526.86	2.71***	0.009
$LNOPEN_{t-1}$	93929.27	35825.29	2.62**	0.011
$LNREER_{t-1}$	78548.72	24867.09	3.16***	0.003
$LNVOL_{t-1}$	6311.317	2707.447	2.33**	0.024
$dum2008q4_{t-1}$	19063.86	10635.04	1.79*	0.079
$dum2020q2_{t-1}$	21202.51	10243.03	2.07**	0.043
Note: ***,**, * Significant at1%, 5% and 10% respectively				

A comparison of this result with the outcome of the model shown in table 5 suggests that the coefficient for the lagged change in GDP ($LNGDP_{t-1}$) has higher level of significance when dummy variables are included (1% level) compared to when they are excluded (5% level).

The coefficient for the change in the trade openness and volatility of REER remains significant (at 5% level) and positive in both cases. However, the coefficient for the lagged change in the real effective exchange rate ($LNREER_{t-1}$) has a higher level of significance (1%) when dummies are involved, compared to 5% level of significance when dummies are not incorporated.

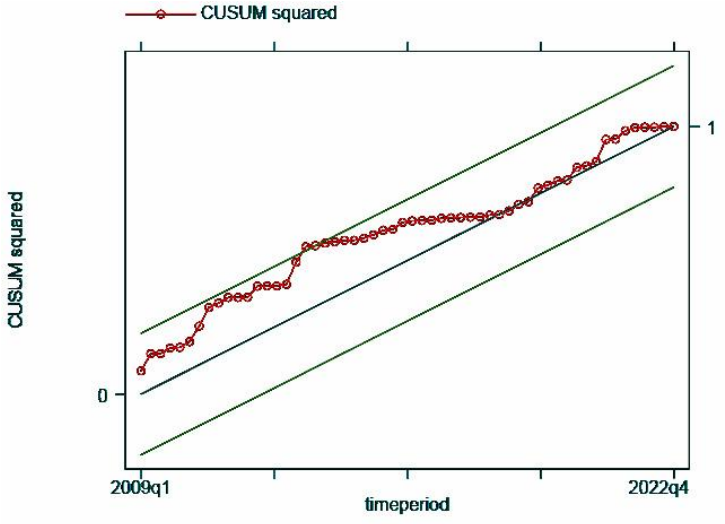
The coefficients for the dummy variables themselves (dum2008q4t-1 and dum2020q2t-1) are both positive and significant at the 10% and 5% level respectively when included in the long-run analysis. This indicates that the specific periods (fourth quarter of 2008 and second quarter of 2020) had a positive impact on FDI flows in the long run.

Overall, the inclusion of dummy variables in the model appears to have some influence on the estimated coefficients for both short-run and long-run analysis for Net Total FDI inflows in Canada.

As per the diagnostic tests, the Durbin-Watson d-statistic of 2.144373 indicates no positive autocorrelation in the residuals. Additionally, the P-value of 0.2142 from the Breusch-Godfrey LM test (chi2=1.543) suggests no evidence of serial correlation in the residuals. However, the White's test chi-square statistic of 42.44 (P-value: 0.0513) indicates heteroscedasticity at the 10% level. Moreover, the normality test of residuals shows a Jarque-Bera value of 2.745 with a probability value of 0.2667, indicating that the residuals are normally distributed.

As CUSUM statistic falls between the upper and lower bounds, it suggests that there is no evidence of significant structural change or instability in the model. This indicates that the coefficients and relationships in the regression model remain stable over the analyzed time period.

Figure 5 Stability of Total Net FDI in Alternative model



However, our extended thorough analysis indicates that the inclusion of dummy variables in FDI within sectors or industries does not yield significant changes in the results compared to when dummies are excluded (Appendix A). In fact, in certain cases, their inclusion even leads to a deterioration of the model's performance. For instance, in the Finance and Insurance sector (FDIFIN), the inclusion of dummies eliminates the observed impact of REER and its volatility on short-term FDIFIN. Similarly, the inclusion of dummies nullifies the effect of REER and volatility on short-term FDI in the Manufacturing sector (FDIMF). Additionally, the inclusion of dummies introduces heteroscedasticity in the errors of the FDIMF model. Moreover, the majority of the dummies included in the model turn out to be statistically insignificant.

Overall, our findings suggest that incorporating these specific dummy variables does not substantially improve the model's explanatory power or provide meaningful insights into the FDI dynamics within individual sectors which is attributed to the presence of diverse trends, shocks, and structural breaks in the data. These factors create unique dynamics within each sector, leading to variations in the impact of specific explanatory variables. Consequently, the inclusion of dummies for certain periods may not capture the full complexity of sector-specific FDI patterns, and their presence may even mask the influence of other important variables.

5 Conclusion and Policy Recommendation

This report attempted to investigate the relationship between real effective exchange rate and its volatility with FDI in Canada. We also examined these relationships at sector level which is the main contribution of this study. The theoretical background suggested that depreciation in the REER can signal an increase in productivity and efficiency in the host country, making it more attractive for foreign investors seeking to benefit from cost savings and improved productivity. However, the empirical background showed varied results.

Initially, we constructed a theoretical model based on existing literature to explore the proposed relationship between FDI and the real effective exchange rate.

Then, we conducted a time series analysis using quarterly data from 2007 to 2022 and began by performing a unit root test. The results of these tests indicated that most variables were stationary in level, except for LNOPEN, LNREER, and LNVOL, which were non-stationary in level but became stationary after first differencing.

To determine the presence of a long-run relationship, the study employed the ARDL (autoregressive distributed lag) approach, which is suitable for analyzing data with a mix of integrated of order 0 (I(0)) and integrated of order 1 (I(1)) variables. The F-bounds test was conducted, and the results indicated the presence of cointegration.

Based on the results of the ARDL model, the study found significant short-run and long-run relationships between the variables and FDI. In the short run, changes in GDP, REER, and volatility of REER had statistically significant positive effects on Total Net FDI. However, changes in trade openness did not show a significant impact.

In the long run, lagged GDP, lagged trade openness, lagged REER, and lagged volatility of REER were positively and significantly associated with Total Net FDI, indicating lasting impacts of these variables on FDI.

Based on the sector-level analysis of FDI in Canada, the findings indicate that the error correction term (ECT) also plays a crucial role in adjusting short-term fluctuations and restoring long-term equilibrium across all industries. In the energy and mining sector, a one percent increase in REER is associated with a substantial short-term increase in FDI. Similarly, in the manufacturing industries, REER, trade openness, and the volatility of REER have positive and significant effects on FDI. REER and its volatility can also influence FDI inflows into the Finance and Insurance sector in the short run. In the long run, REER and trade openness show positive and significant impacts on energy and mining sector and the manufacturing industries.

It can be concluded that effects that are significant at the aggregate level may be diluted when specific sectors with distinct characteristics are analyzed separately. The lack of impact of REER volatility on FDIs in sectors in both the short run and long run could be attributed to various economic and sector-specific factors. In the short-run, some sectors, like energy and mining or trade and transport, might be less influenced by short-term fluctuations in exchange rates due to their inherent stability or the presence of long-term contracts that mitigate immediate impacts. In other words, these sectors could be less sensitive to exchange rate volatility if investors have a high degree of confidence in the sector's performance and outlook. Furthermore, the dynamics of sectors can differ significantly. For instance, FDI in energy and mining might be driven more by global commodity prices or geopolitical factors than by short-term currency movements. On the

other hand, long-term FDI decisions involve a multitude of considerations and other variables beyond exchange rate volatility, such as market size, infrastructure, labor availability, and regulatory environment. Certain sectors might involve significant sunk costs, where firms have invested heavily and are less likely to alter their strategies due to exchange rate fluctuations.

As for the policy recommendation, we emphasize on the importance of avoiding the overvaluation of the domestic exchange rate. Maintaining an economic environment that is attractive to FDI necessitates preventing the domestic exchange rate from being overvalued. Additionally, considering the export-oriented and import-dependent nature of the domestic economy, an overvalued exchange rate can hinder export growth while increasing imports. Therefore, Canada's government and central bank should pursue fiscal and monetary policies that promote exchange rate stability and avoid excessive currency appreciation. This may include measures to manage inflation and money supply, tax policy and public investment while ensuring transparency and communication about exchange rate policies.

The study also highlights the importance of considering sector-level dynamics when analyzing the relationship between FDI, REER, and its volatility. Policymakers should tailor their policies to specific sectors.

To attract and sustain FDI in the manufacturing sector, policymakers should adopt a balanced exchange rate policy that prevents overvaluation of the domestic currency. This can be achieved through monitoring exchange rate movements and implementing targeted policies to mitigate excessive appreciation. Additionally, efforts to promote

export-oriented manufacturing industries should be intensified through trade agreements and incentives that enhance competitiveness in global markets.

Policymakers should prioritize maintaining exchange rate stability in the finance and insurance sector to promote investor confidence and long-term commitments. This can be achieved through proactive exchange rate management and clear communication of the central bank's monetary policy intentions. Additionally, financial market reforms and regulatory enhancements should be pursued to create a robust and resilient financial sector that attracts foreign investment.

Given the sensitivity of the energy and mining sector to commodity prices and currency movements, policymakers should focus on managing REER volatility and fostering a stable investment climate. Measures to stabilize commodity prices through strategic reserves and hedging mechanisms can reduce the sector's vulnerability to currency fluctuations and attract long-term investments.

These policy recommendations should be viewed as dynamic and subject to periodic evaluation. Policymakers should continuously monitor the effectiveness of implemented measures, assess changing market conditions, and adapt policies accordingly. Regular reviews and evaluations can ensure that policies remain aligned with the evolving needs and demands of the global investment landscape.

As per the limitations, the study's data for FDI and FDI in sectors are available only from 2007, which might limit the analysis's ability to capture long-term trends. Extending the data period to include a longer timeframe may yield different results and provide a more comprehensive understanding of FDI patterns. The study only considers GDP, trade

openness, real effective exchange rate (REER), and REER volatility as independent variables. However, other variables, such as interest rate, quality of infrastructures, political stability, financial stability, human capital, corporate tax rate, market size, and labor cost, could also influence FDI. Future research could explore the impact of these additional variables to gain a more comprehensive understanding of the factors affecting FDI inflows.

The categorization of FDI in sectors into Energy and Mining, Trade and Transport, Finance and Insurance, Manufacturing, Management of Enterprises and Companies, and Other Industries might oversimplify the sector-specific dynamics. A more detailed and refined classification of industries could provide deeper insights into sector-specific FDI patterns. For instance, evaluating industries like Real Estate, Healthcare and Social Assistance, Agriculture-Forestry-Fishing, Information Technology, Wholesale Trade, and Retail Trade separately may also uncover unique relationships between FDI and independent variables within each sector.

The findings presented in this study are predicated upon a meticulous analysis of the provided dataset. It is important to recognize that these results remain contingent upon the prevailing limitations, and any alterations or modifications to the aforementioned constraints could potentially yield disparate outcomes. Furthermore, this report underscores the pivotal role of FDI as an economic catalyst, exerting a positive influence on developmental progression and economic expansion. Nevertheless, it is imperative to acknowledge the nuanced perspective surrounding the impact of FDI, a viewpoint that is inherently influenced by its characteristics and diverse forms. The multifaceted nature of

FDI warrants a comprehensive examination that encompasses distinct economic and political standpoints.

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Appendix A

This appendix provides the outcomes of the alternative model, which includes dummy variables representing structural breaks, for each individual industry or sector.

Table 14 EC and short-run dynamics in Alternative model for FDI in industries

Industry/Sector	Variable	Coefficient	STD Error	T statistics	P-value
Energy and Mining (FDIENMI)	ECT (-1)	-1.133073	0.1299878	-8.72***	0.000
	$\Delta LNGDP_t$	22556.9	15313.59	1.47	0.146
	$\Delta LNOPEN_t$	-5475.977	16241.05	-0.34	0.737
	$\Delta LNREER_t$	28426.21	11451.36	2.48**	0.016
	$\Delta LNVOL_t$	653.9039	1247.344	0.52	0.602
	$dum2008q4_t$	4504.844	4246.032	1.06	0.293
	$dum2020q2_t$	-469.144	4706.247	-0.10	0.921
	Constant	-461930.3	269209.3	-1.72*	0.092
Manufacturing Industries (FDIMF)	ECT (-1)	-0.9998202	0.1263539	-7.91***	0.000
	$\Delta LNGDP_t$	34941.81	20103.97	1.74*	0.088
	$\Delta LNOPEN_t$	48588.93	21732.66	2.24**	0.030
	$\Delta LNREER_t$	104189.1	30185.91	3.45***	0.001
	$\Delta LNVOL_t$	2233.68	1643.957	1.36	0.180
	$dum2008q4_t$	11215.03	6283.111	1.78*	0.080
	$dum2020q2_t$	7979.858	6180.196	1.29	0.202
	Constant	-688826.5	354427.6	-1.94*	0.057
Trade and Transport (FDITT)	ECT (-1)	-0.9898658	0.1399664	-7.07***	0.000
	$\Delta LNGDP_t$	8892.871	6488.606	1.37	0.176
	$\Delta LNOPEN_t$	5474.374	6582.213	0.83	0.409
	$\Delta LNREER_t$	2558.357	4667.742	0.55	0.586
	$\Delta LNVOL_t$	746.8691	541.0069	1.38	0.173
	$dum2008q4_t$	-1432.237	1711.246	-0.84	0.406
	$dum2020q2_t$	1784.162	1953.307	0.91	0.365
	Constant	-137237.8	113210.4	-1.21	0.231
Finance and Insurance (FDIFIN)	ECT (-1)	-0.9336565	0.1452506	-6.43***	0.000
	$\Delta LNGDP_t$	6360.518	6221.34	1.02	0.311
	$\Delta LNOPEN_t$	2329.423	6464.888	0.36	0.720
	$\Delta LNREER_t$	3208.174	4574.123	0.70	0.486
	$\Delta LNVOL_t$	424.9676	518.3715	0.82	0.416
	$dum2008q4_t$	655.2439	1679.355	0.39	0.698
	$dum2020q2_t$	-596.1568	1922.85	-0.31	0.758
	Constant	-105193.1	109112.1	-0.96	0.339
Management of Companies and enterprises (FDIMNG)	ECT (-1)	-1.110984	0.1352438	-8.21***	0.000
	$\Delta LNGDP_t$	22322.42	13409.68	1.66	0.102
	$\Delta LNOPEN_t$	14804.33	13901.8	1.06	0.292
	$\Delta LNREER_t$	10016.39	9710.9	1.03	0.307
	$\Delta LNVOL_t$	-1113.214	1648.263	-0.68	0.502

	$dum2008q4_t$	3239.111	3669.66	0.88	0.381
	$dum2020q2_t$	4498.6	4189.421	1.07	0.288
	Constant	-363631.9	234461.5	-1.55	0.127
Other industries (FDIOTH)	ECT (-1)	-1.167358	0.1276006	-9.15***	0.000
	$\Delta LNGDP_t$	-1349.782	11176.98	-0.12	0.904
	$\Delta LNOPEN_t$	28531.04	12242.6	2.33**	0.023
	$\Delta LNREER_t$	-8976.513	8332.249	-1.08	0.286
	$\Delta LNVOL_t$	1136.336	923.1475	1.23	0.224
	$dum2008q4_t$	-2094.12	3113.389	-0.67	0.504
	$dum2020q2_t$	8847.518	3430.621	2.58**	0.013
	Constant	77328.82	196213.3	0.39	0.695

Note: *** , **, * Significant at 1%, 5% and 10% level respectively.

Table 15 long-run coefficient for FDI in industries in Alternative Model

Industry	Variable	Coefficient	STD Error	T statistics	P-value
Energy and Mining (FDIENMI)	$LNGDP_{t-1}$	19907.72	13523.06	1.47	0.147
	$LNOPEN_{t-1}$	-4832.855	14337.74	-0.34	0.737
	$LNREER_{t-1}$	25087.72	10031.55	2.50**	0.015
	$LNVOL_{t-1}$	577.1066	1100.869	0.52	0.602
	$dum2008q4_{t-1}$	3975.776	3747.688	1.06	0.293
	$dum2020q2_{t-1}$	-414.0457	4149.274	-0.10	0.921
Manufacturing Industries (FDIMF)	$LNGDP_{t-1}$	34948.09	19883	1.76*	0.084
	$LNOPEN_{t-1}$	48597.67	21462.17	2.26**	0.028
	$LNREER_{t-1}$	43632.12	1471.74	2.96***	0.005
	$LNVOL_{t-1}$	2234.082	1621.047	1.38	0.174
	$dum2008q4_{t-1}$	11217.05	6307.13	1.78*	0.081
	$dum2020q2_{t-1}$	7981.293	6107.035	1.31	0.197
Trade and Transport (FDITT)	$LNGDP_{t-1}$	8983.916	6291.386	1.43	0.159
	$LNOPEN_{t-1}$	5530.421	6584.006	0.84	0.405
	$LNREER_{t-1}$	2584.549	4669.949	0.55	0.582
	$LNVOL_{t-1}$	754.5155	521.9845	1.45	0.154
	$dum2008q4_{t-1}$	-1446.901	1768.218	-0.82	0.417
	$dum2020q2_{t-1}$	5140.623	2729.306	1.88*	0.065
Finance and Insurance (FDIFIN)	$LNGDP_{t-1}$	6812.482	6495.739	1.05	0.299
	$LNOPEN_{t-1}$	2494.946	6896.495	0.36	0.719
	$LNREER_{t-1}$	3436.14	4814.895	0.71	0.478
	$LNVOL_{t-1}$	455.1649	537.9405	0.85	0.401
	$dum2008q4_{t-1}$	701.804	1799.372	0.39	0.698
	$dum2020q2_{t-1}$	-638.5184	2087.698	-0.31	0.761
Management of Companies and enterprises (FDIMNG)	$LNGDP_{t-1}$	20092.47	12203.51	1.65	0.105
	$LNOPEN_{t-1}$	13325.42	12419.07	1.07	0.288
	$LNREER_{t-1}$	9015.783	8834.66	1.02	0.312
	$LNVOL_{t-1}$	1943.575	1028.07	1.89*	0.064
	$dum2008q4_{t-1}$	2915.533	3269.263	0.89	0.376
	$dum2020q2_{t-1}$	4049.202	3702.068	1.09	0.279

Other industries (FDIOTH)	$LNGDP_{t-1}$	-1156.271	9576.462	-0.12	0.904
	$LNOPEN_{t-1}$	24440.7	10188.45	2.40**	0.020
	$LNREER_{t-1}$	-7689.598	7080.924	-1.09	0.282
	$LNVOL_{t-1}$	973.4258	782.154	1.24	0.219
	$dum2008q4_{t-1}$	-1793.897	2658.658	-0.67	0.503
	$dum2020q2_{t-1}$	7579.096	3058.899	2.48**	0.016
Note: ***,** Significant at 1% and 5% level respectively.					

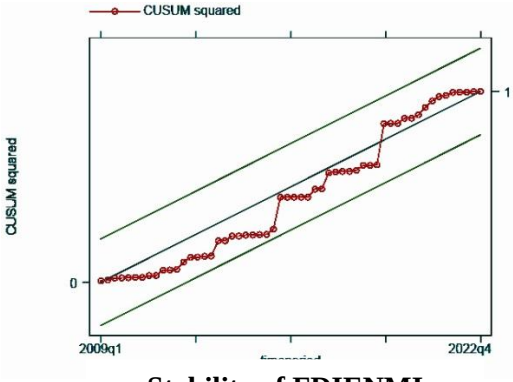
Table 16 Serial Correlation Tests for Alternative Model

Equation	Durbin-Watson d-statistic	Breusch-Godfrey LM test	Result
Energy and Mining (FDIENMI)	2.005731	Chi2 = 0.009 P-value = 0.9239	No serial correlation
Manufacturing Industries (FDIMF)	2.125308	Chi2 = 1.758 P-value = 0.1849	No serial correlation
Trade and Transport (FDITT)	1.947361	Chi2 = 0.104 P-value = 0.7467	No serial correlation
Finance and Insurance (FDIFIN)	1.869075	Chi2 = 0.005 P-value = 0.9436	No serial correlation
Management of Companies and Enterprises (FDIMNG)	2.088997	Chi2 = 2.088 P-value = 0.1484	No serial correlation
Other industries (FDIOTH)	1.991335	Chi2 = 0.000 P-value = 0.9942	No serial correlation

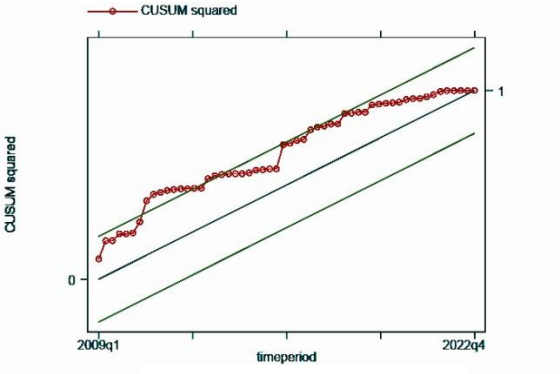
Table 17 Homoscedasticity and Normal Distribution Tests for Alternative model

Equation	White's test for Homoscedasticity	Result	Jarque-Bera normality test	Result
Energy and Mining (FDIENMI)	Chi2 (22) = 21.55 P-value = 0.4870	Homoscedastic	chi2 = 17.62 P-value = 1.5e-04	Not Normally Distributed
Manufacturing Industries (FDIMF)	Chi2 (29) = 50.09 P-value = 0.0088	Heteroscedastic	chi2 = 106.9 P-value = 6.1e-24	Not Normally Distributed
Trade and Transport (FDITT)	Chi2 (23) = 19.97 P-value = 0.6439	Homoscedastic	chi2 = 1.984 P-value = 0.3709	Normally distributed
Finance and Insurance (FDIFIN)	Chi2 (22) = 25.90 P-value = 0.2561	Homoscedastic	chi2 = 1.484 P-value = 0.4761	Normally distributed
Management of Companies and enterprises (FDIMNG)	Chi2 (29) = 32.51 P-value = 0.2978	Homoscedastic	chi2 = 23.03 P-value = 1.0e-05	Not Normally Distributed
Other industries (FDIOTH)	Chi2 (22) = 21.19 P-value = 0.5092	Homoscedastic	chi2 = 790.9 P-value = 2.e-172	Not Normally Distributed

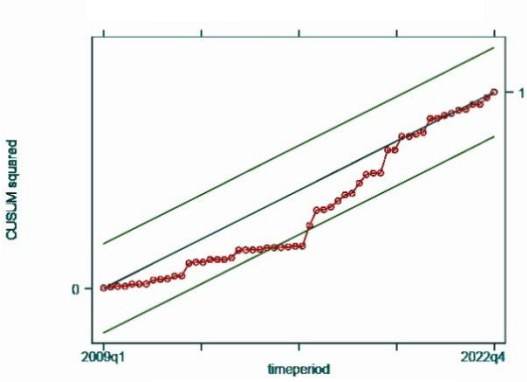
Figure 6 Stability of FDI in Industries based on the Alternative models



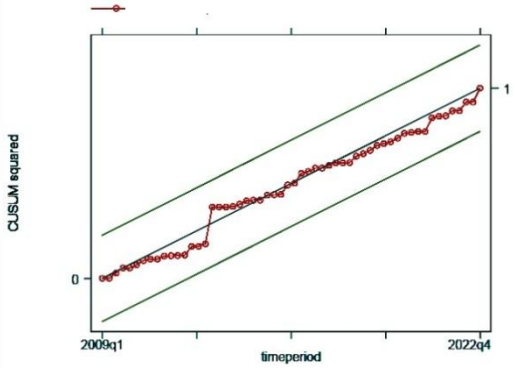
Stability of FDIENMI



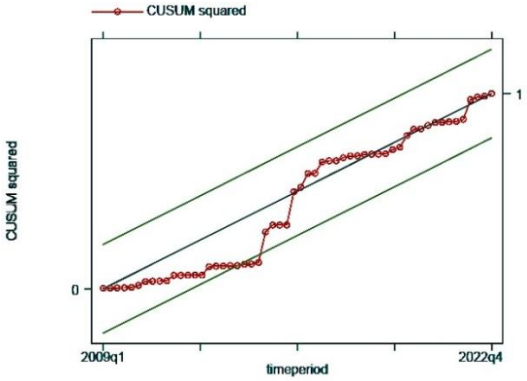
Stability of FDIMF



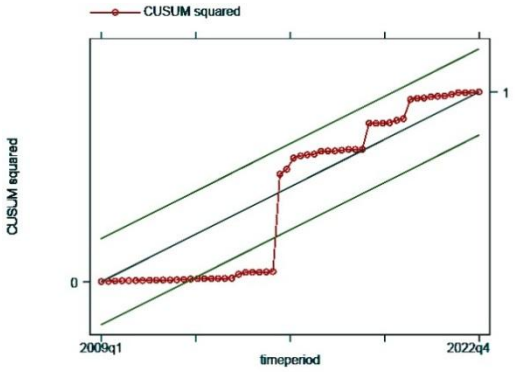
Stability of FDITT



Stability of FDIFIN



Stability of FDIMNG



Stability of FDIOTH

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Publications:

1. Lajevardi, H., Jafarbekloo, M. (2022). "Investigating and Prioritizing Factors Affecting the Marketing Strategies of Social Media (Case of Study: Bank Shahr)'', *Journal of Economics and Administrative Sciences*, Vol 5, Supplementary Issue 1, pp: 632-643. http://www.jeasweb.org/index.php/archive/24-2022/vol-5-supplement-issue-no-1-february-2022/16-vol-5-s-1-feb-2022
2. Lajevardi, H., Ghahramani, S., Nasehifar, V. (2020). "Effect of Internet Services on Customer's Online Purchase Intention, Case Study: BehPakhsh Pharmecuitical Co.", *International Journal of Applied Research in Management and Economics*, Vol.3, No.2 , pp: 36-45. www.dpublication.com/journal/IJARME/article/view/285
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Conference Presentations:

1. Lajevardi, H., Ghahramani, S., Nasehifar, V. (2020). "Effect of Internet Services on Customer's Online Purchase Intention, Case Study: BehPakhsh Pharmecuitical Co." The 3rd International Conference on Business, Management and Economics, 6-8 March 2020, Budapest, Hungary. https://www.icbmeconf.org/abstract-of-3rd-icbme/1040/