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The Impact of Cryptocurrencies on Stock Exchange Development: Empirical Evidence on Canadian firms

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Abstract

Cryptocurrencies are decentralized digital currencies secured by blockchain technology. Their growing popularity has a significant impact on traditional financial markets. The purpose of this paper is to examine the impact of cryptocurrency investment on stock financial development. Our empirical evidence is conducted on (30) Canadian firms during the period August 2017- May 2023. The firms are the most important companies in the financial sector. The results of the VECM estimation show a positive and significative impact of Bitcoin Value on each variable assessing stock market development in long term as Market Liquidity, Market Size, Market Capitalization. In short term, this same relationship is observed with Market Size and Market Liquidity. Bitcoin value has a negative impact on Market Capitalization. The Exchange Rate and Unemployment Rate provide a negative and significant relationship towards stock market development in the long-term. In contrast, the short-term relationship results show that Exchange Rate acts positively only on the Market Capitalization. In contrast, Market Liquidity has a positive impact on the Exchange Rate. Moreover, we find the absence of the impact of Unemployment Rate on Stock Financial Development in short term. But, there is a significant and negative incidence of Market Liquidity and Market Size on Unemployment Rate. Our results demonstrate also the positive and significant impact of Unemployment Rate on Bitcoin Value.

Keywords: *Cryptocurrencies, Bitcoin, Market Liquidity, Market Size, Market Capitalization, Exchange Rate and Unemployment Rate.*

Introduction

Cryptocurrencies have emerged as a disruptive force in the financial industry challenging traditional financial markets. Their complex links with the traditional financial markets are demonstrated by several studies (Balcilar et al 2017; Tossin-Amos 2023; Raymond 2022; Abdellah et Sami 2022). The rapid advancement of digital marked by the emergence of cryptocurrencies encourages us to understand that are both opportunities and dangers. Bitcoin is the first cryptocurrency ever invented. Its origins date back to a white paper published in 2008, and it remains the most well-known cryptocurrency. George (2022) shows that Bitcoin comes out on top and remains the crypto asset with the highest trading volume, dominating more than 50% of the entire market created in 2009. This new reality opens up unprecedented development prospects for businesses and financial markets. For these reasons, the investment on cryptocurrency and their impact on stock market development is crucial for shaping the financial structure of the future.

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Many empirical studies have investigated the impact of cryptocurrencies on stock market development in developed and emerging economies (Tossin-Amos, 2023; Abdellah and Sami, 2020; Pala, 2024; Bhullar and Bhatnagar, 2020; Portelinha et al, 2021; Rajaswaninathan and Sakthivel, 2024; Mansour Norman et al 2024). However, they provide inconclusive results. Interactions between cryptocurrencies and stock market development vary significantly across different countries. This study extends the previous studies and explores the association between cryptocurrency value and financial development on highlining also the role of Exchange Rate and Unemployment Rate to explain the stock market development. Our focus on Canadian firms is important for many reasons. First, the digital transformation is a priority for the Toronto Stock Exchange. Investing in cryptocurrencies has grown exponentially over the past few years. As more people invest in these digital assets, the cryptocurrency market is expanding, then creating new development opportunities for companies and financial markets. Second, existing studies mainly focus on Ethereum, neglecting the impact of a multitude of other major cryptocurrencies like Bitcoin. Third, there are lack and mixed empirical findings of the association between cryptocurrencies and Financial Development. The stock market exchange is very affected by the evolution of these cryptocurrencies. This study will provide a more comprehensive analysis of the interplay between cryptocurrencies, financial development and market stability in Canada. Finally, this study provides valuable insights for Canadian policymakers by assessing the impact of cryptocurrency value fluctuations on financial development

The purpose of this paper is twofold. The first is to investigate the impact of cryptocurrencies value on the stock market development at short and long-term. We retain Liquidity, Size and Performance as three proxies able to assess the stock market development. The second purpose is to examine whether exchange rate and unemployment rate contribute to understand the level of stock market development. To test above, we use a sample of the most important financial Canadian firms during the period August 2017- May 2023 and we applied a Vector Error Correction Model (VECM). By deciphering the complex links between these digital currencies and traditional financial markets, the significant contribution of this paper is to better understanding this new financial era. The results of this study will provide valuable insights to policymakers, investors, and financial market participants, enabling them to better understand the short term and long-term causality between Bitcoin Value and Stock Market Development.

The rest of the paper proceeds as follows. Section 2 provides a conceptual framework. Section 3 discusses the theoretical framework. Section 4 presents the literature review and develops the main hypotheses. Section 5 specifies the models used and provides a description of the data. Section 6 summarizes our main results. The last section focuses on the conclusion and recommendations for further research.

Conceptual Framework

Cryptocurrencies

Cryptocurrency is a form of virtual currency that exists exclusively in digital form and relies on the principles of encryption to process and validate digital transactions. It offers features similar to traditional currency (such as use as a unit of account, a store of value, and the ability to be exchanged for goods and services). The cryptocurrency market is considered a major fintech innovation that facilitates transactions and plays an important role as a medium of exchange. Humbert (2021) defines cryptocurrency as fully electronic crypto assets that do not have physical media such as coins or bills. These digital assets are not controlled by any state, and nothing goes through banks. Virtual currencies allow for the exchange of services, value, and money on

the internet worldwide without relying on traditional channels and also allow for secure and transparent transactions and exchanges with a community of users via the blockchain system. Three constituents of cryptocurrency are discussed by several studies. First, the protocol is a computer code that specifies how participants can transact. Second element is the ledger that stores the history of transaction. The last is the decentralized network of participants that update, store and read the ledger of transactions. Blockchain is a collection of interconnected blocks or an online ledger.

Historically, Bitcoin (BTC) was the first cryptocurrency created in 2008 in response to the global economic crisis and remains the safest investment value. It is an immaterial currency, which allows its holder to purchase goods and services on the Internet or in real life. Herbst (2018), Bitcoin is a cryptocurrency used as a peer-to-peer payment system since 2009. Individuals secure the network and are rewarded by the creation of new bitcoins. Transactions are verified and recorded in a publicly accessible blockchain.

Stock Market Development

King and Levine (1993) define financial development as the establishment of effective and strong financial institutions and markets, and the efficient use and availability of these institutions and markets to mobilize and provide financial resources to the economy. Financial development is therefore a key element in promoting the economic development of a country. It facilitates access to credit for businesses and households, mobilizes savings, and allows for better allocation of resources. It can also help reduce inequalities by promoting financial inclusion. In particular, Stock Market Development has a crucial role in the smooth running of the global economy.

The stock market is a place where publicly traded corporations' shares are traded. It provides a platform on which companies can raise capital to fund their operations by selling stocks or bonds, producing and sustaining wealth for individual investors. In addition, these markets allow traders and investors to immediately speculate on stock prices and make transactions. Besides raising capital, the financial market performs four functions as control, cash creation, combination, compensation. The efficiency of execution of these functions reflects financial development. Levine (1997) argue that stock market development is assessed mainly through its size and liquidity. The stock market size is measured by stock market capitalization-to-GDP Ratio. It is a measure of the total value of all publicly traded stocks in a market to the economy's gross domestic product (GDP). The stock market size is directly related to the ability to mobilize capital and diversify risk. Liquidity is a key indicator of the health of a financial market. A liquid market is characterized by the absence of constraints, high trading volume, large number of orders at different price levels, low bid-ask spread and assets can be transformed quickly into liquidity without significant loss of value. Then, a liquid market is a market that facilitates the completion of a transaction in a quick, simple and easy manner.

Theoretical Framework

We advance here the main theories that allow us to understand innovation and bitcoin technology such as the theory of innovation, the theory of competitive substitution between technologies and the theory of Innovation Diffusion.

Competitive Substitution Theories Between Technologies

Davis et al. (1986, 1989) developed the Technology Acceptance Model (TAM), based on two

classical theories: the Theory of Reasoned Action (TAR) of Fishbein and Ajzen (1975) and the Theory of Planned Behavior (TPB) of Ajzen (1985). The disruptive innovation theory defended by Davis (1986) aims to predict the acceptability of an information system. The technology acceptance behavior is determined by the attitude toward the technology and the user's perception of the positive and negative consequences of its use. The Technology Acceptance Model (TAM) aims to predict the acceptability of an information system. The acceptability of a system is determined by its perception of usefulness and ease of use. The TAM can also be used to guide the development and implementation of new technologies by identifying the factors that are likely to influence the user's acceptance of the technology.

Innovation Theory

Schumpeter (1911) defines Innovation as a process of transformation that involves the conscious mobilization and blending of existing capabilities and resources to produce technological and economic progress. Schumpeter (1911) proves that Innovation theory proposes ways to stimulate innovation and foster entrepreneurship, which are known as "Destructive Innovation" (Destroy the old in order to create the new). The concept has been enthusiastically received by modern business thinkers and is considered a driver of economic growth. Nevertheless, Andrew (2009) considers that purpose of technological innovation is to provide the consumer with objectively new or improved services. This type of innovation corresponds to any technological modification of the product that is offered by the organization. Thus, the main idea of introducing this new element is to obtain better results.

Disruptive Innovation Theory

Disruption theory is a theory supported by Christensen (1997) that defines the role of new innovative or disruptive companies and their efforts to revolutionize existing industries. It posits that innovative companies tackle complicated and established sectors, and undertake a disruption by using innovative technology and business models to create new industries. A disruptive innovation is an evolution that breaks with the existing market. Laurendeau (2021) shows that disruptive innovation is a very popular concept since many companies have made it their spearhead to gain a competitive advantage. It is a set of activities aimed at or resulting in the creation of a new or improved product or process. This type of innovation can be based on user innovations such as Decathlon's 2-second tent, technological innovations or even both, such as the iPhone.

Incremental Innovation Theory

Incremental innovation is a form of innovation that is based on the gradual and continuous improvement of products, services or processes based on what already exists. Jaquet (2018) shows that this innovation is the most obvious and the one that is sought through continuous improvement policies. It generates significant costs in research and development, for sometimes marginal results. The major example taken by the author is the pharmaceutical laboratories that must invest very large sums, with barely perceptible developments, of active medicinal ingredients.

The Theory of Innovation Diffusion

Diffusion of Innovation (DOI) Theory, founded by Rogers (1962), is one of the oldest social science theories. It is based on communication to explain how, over time, an idea or product or behaviour gains momentum and diffuses through a specific population or social system. Rogers

(1995) considers diffusion of innovations as the process by which an innovation is communicated through certain channels over time among the members of social systems.

Wolfe (1994) argues that DOl explains diffusion rates by the characteristics of the innovation, and the surrounding social system. These characteristics include adopter characteristics, the social network belonging to, the communication process, the characteristics of the promoters, and the innovation attributes including trialability, relative advantage, cost, compatibility, observability, and complexity. Rogers (1995) further argues these last five characteristics are vital in explaining the rate of technology adoption. Diffusion of technology is a fundamental process whereby the technological potentials of innovative initiatives are transformed to be productive.

Rogers (2003) defines trialability as the degree to which an innovation is available to be experimented for a limited period prior to its actual adoption/rejection. Nevertheless, he defined observability as the degree to which the results of an innovation become clearly visible to others. Besides, compatibility is the degree to which an innovation is consistent with the existing values, past experiences and needs of potential adopters. According also to Rogers (2003) relative advantage can be defined as the degree to which an innovation is better than the idea that it is superseding. For complexity attribute, it is degree to which an innovation is perceived as difficult to understand and use. Greater complexity implies increased degree of difficulty in understanding the use of a given innovation. Tornatzky and Klein (1982) advanced that cost attribute is negatively associated with the adoption of an innovation. Lesser the cost of adopting an innovation, higher will the probability of it being adopted immediately.

3.3 Unified Theory of Acceptance and Use of Technology (UTAUT)

The theory proposed by Venkatesh et al (2003) is based on eight existing models as Theory of Reasoned Action, Technology Acceptance Model, Motivation Model, Theory of Planned Behavior, PC Usage Model, Social Cognitive Theory, and Diffusion of Innovation Theory. Venkatech et al (2003) suggest that anticipated performance, anticipated effort, and social influence have a direct influence on behavioral intention. Furthermore, they show that anticipated performance refers to the extent to which technology can have a positive impact on users' performance (Venkatech et al 2012).

The three factors anticipated performance, anticipated effort, and social influence have an influence on the intention that a person will have to use a technology. This intention of use will itself have an influence on the effective use of the technology. The fourth factor was not identified as having an influence on the intention of use, but rather directly on the use itself. This is due to the presence of favorable conditions, such as documentation, which facilitate the use.

4. Literature Review and Hypothesis Development

The literature review over the years of the interrelationship between the cryptocurrency and the stock market development has been inconclusive.

The Effect of Bitcoin Value on Stock market Development

Samuelson (1965) argues that investing in risky assets, such as cryptocurrencies, can influence stock market performance by creating large price movements and attracting investors seeking high returns. However, his argument may not apply directly to the ever-changing cryptocurrency

market. Furthermore, according to Jensen's analysis (1978), investing in risky assets can have an effect on overall stock market performance due to their volatility. Therefore, if an investor allocates a portion of their portfolio to these assets, it can positively or negatively affect the performance of their stock market portfolio.

For many years, Bitcoin was believed to be independent to traditional market forces. However, the evolution of cryptocurrency market proves that this assumption has incorrect as Bitcoin has grown in popularity. Historically, Bitcoin has evolved in tandem with the stock market, especially during periods of extreme prevalence. For example, when Bitcoin was launched in 2009, there was virtually no correlation between Bitcoin and the S&P 500 for the first few years of its existence. Until 2012, Bitcoin prices were very stable, while S&P 500 prices had their usual steady rise with some dips. Bitcoin prices fluctuated rapidly, while S&P 500 price changes were less drastic. Balcilar et al (2017) investigate on the causal connection between exchanging stock market volume and Bitcoin returns. They find that volume can not assist with anticipating the unpredictability of Bitcoin returns.

Tossin-Amos (2023) finds that cryptocurrencies impacted positively on the US stock market, while no evidence of causality between investment in ripple and stock market indices in the US stock market. He finds also that investment in cryptocurrencies has a significant long-run increasing effect on stock prices in United State. Raymond (2022) shows that there are many platforms for buying Bitcoin, but avoiding high fees by paying with a credit card is recommended. The value of Bitcoin is determined by supply and demand, and affected the stock market liquidity. It's no surprise that Bitcoin waxes and wanes with the stock market. A look at recent charts of Bitcoin versus stock markets shows a much greater correlation. The empirical evidence by Abdellah and Sami (2020) is conducted on the MENA region show a mixed result. The crypto Market improves the performance of stock market for countries that have flexibility in the application of the Islamic Shariah rules. The opposite findings are proved with countries that adhere strictly to Islamic Shariah rules. Portelinha et al. (2021) investigated the influence of cryptocurrencies on the performance of the Brazilian stock market using daily data from September 2014 to April 2020. The findings indicated that higher cryptocurrency returns negatively affect stock market performance, highlighting an inverse relationship between the two asset classes.

When Bitcoin was launched, there was no relationship between Bitcoin and Stock market size. Since this cryptocurrency has known its popularity, many studies prove this correlation with stock market size. When significant capital flows move from the traditional stock market to the cryptocurrency market, the cryptocurrency market size and the Bitcoin price may increase. The results by Rajaswaninathan and Sakthivel (2024) suggest that the performance of stock indices in BRICS countries negatively impacted by cryptocurrencies. The panel causality test result confirms a short run relationship exists between cryptocurrencies and stock indexes but none in a long-term-run. Pala (2024) investigated the impact of cryptocurrencies, like Bitcoin, Ethereum, and Tether, on traditional financial markets in the USA, UK, and Germany. The study used monthly financial data from April 2016 to June 2024. It employed statistical tests, including the Augmented Dickey-Fuller and Phillips-Perron unit root tests, to assess the unit root among the variables. Additionally, the ARDL (Autoregressive Distributed Lag Bound Test) approach is used to test the cointegration relationship between cryptocurrencies and stock returns. The results indicated that there is no significant relationship between cryptocurrency markets and stock returns in the UK, both in the long term and short term. In Germany, a significant and positive long-term relationship was founded between Bitcoin and Tether with stock returns,

although no meaningful short-term relationship is identified. For the USA, a significant long-term relationship exists between Bitcoin and stock returns, while no significant relationship was found for Ethereum and Tether. Again, no meaningful short-term relationship was identified.

Wang et al (2020) study the association between cryptocurrencies and the USA Stock markets by using vector autoregressive model. They find a significant relationship between these two markets. SP 500 index has a relatively large impact on bitcoin price, while the impact of bitcoin on USA SP 500 index was weak. Similarly, Bhullar and Bhatnagar (2020) examined the connection between Bitcoin prices and stock market fluctuations in two major global economies, India and China. Using daily price data from January 2, 2015, to November 29, 2019, the authors applied time series methodologies, including Johansen Co-integration, VECM, and Granger Causality, to analyze the relationship. Their findings revealed a strong long-term equilibrium nexus between cryptocurrencies and stock markets, with higher Bitcoin returns significantly influencing the stock markets of both countries. In a recent study, Mansour Nomran et al. (2024) investigated the impact of cryptocurrency returns on Islamic vs. conventional stock returns in Gulf Cooperation Council (GCC) countries using Pooled OLS, fixed effects, random effects, and generalized linear models (GLMs). Daily data were collected from stock indices in five GCC countries over the period 2016–2019. The empirical results showed that cryptocurrency returns had a negative impact on both GCC Islamic and conventional stock market returns for the full sample period (2016–2019).

Therefore, our hypotheses are:

H1: The Bitcoin Value has a negative impact on Stock Market Development

The Effect of CAD/EURO Exchange Rate on Stock market Development

Exchange rate is generally regarded as determinant of stock market development. For example, Lafrance and Schembri (2010) show that the relationship between the exchange rate and financial development is complex and bidirectional. A stable exchange rate aligned with economic fundamentals can promote financial growth by attracting investment and facilitating access to sources of financing. However, a volatile exchange rate can undermine investor confidence and weaken the financial system, which can hinder a country's financial development. Furthermore, Ho and Iyke (2017) provide large research on literature review on the determinants of stock market development. They conclude that exchange rates have adverse effects on the stock market development. The empirical evidence by Hajilee and AlNasser (2014), conducted on twelve emerging markets show that exchange rate uncertainty has a significant effect on stock market development in both the short run and long run in a majority countries. However, Suriani et al (2015) investigates on the relation between the stock market and exchange market of Pakistan. Their findings indicate the absence of the relation between exchange rate and stock performance. Each variable reacts independently of the other.

Gbadebo (2023) examined the impact of exchange rate volatility on the indicators of stock market, such as the returns, capitalization, liquidity, transaction volume, based on the Nigerian evidence using a simple static regression model of stock market indicators with autoregressive adjustment component which absorb autocorrelation over the period 1985-2020. The findings revealed that the exchange rate volatility has negative impact on stock market development-returns, capitalization and volume. However, stable exchange rates can foster stock market growth, as evidenced in Pakistan, where a stable exchange rate positively influences sustainable stock market development (Islam et al 2023). Previous studies investigated the complex

relationship between exchange rates and stock market development, though their findings vary depending on the economic context and region examined. The present study, by conducting a comprehensive empirical analysis in the Canadian context, could help to better understand the impact of exchange rate stability or volatility on stock market development.

Therefore, we put the following hypothesis:

H2: The Exchange Rate has a negative impact on Stock Market Development

The impact of Unemployment Rate on Stock Market Development

Pan (2018) examines the association between the stock market and unemployment in sample of advanced and developing and emerging. They find that the unemployment rate and stock prices are cointegrated in all country groups. Moreover, the causality between stock prices and unemployment appears in all country groups. Gonzalo and Taamouti (2017) show a significant and negative effect of unemployment on financial development. An increase in the unemployment rate leads to a decrease in stock prices and trading volumes on the Canadian market. Furthermore, Barber (1962) proves that unemployment rate has a negative influence on financial development by reducing consumption and investment. The individuals tend to save more during periods of unemployment. This limits the demand for goods and services, affects income and wage levels, and limits the capital available for businesses and investment projects. Additionally, high unemployment can lead to low aggregate demand and therefore slower economic growth, which can also negatively affect stock returns.

Many studies investigated the short-run impact of anticipated and unanticipated unemployment rates on stock prices using non parametric Granger causality and quantile regression-based tests. The empirical findings revealed that only the anticipated unemployment rate significantly impacts stock prices. Thus, an increase in the anticipated unemployment rate is, in general, good news for stock prices (Gonzalo and Taamouti 2017). Umar (2018) empirically analyzed the long-run relationship between unemployment and stock market development in Africa, using a pooled mean group (PMG) model for the sample period of 1996 to 2016. The empirical results showed that unemployment has a positive and statistically significant impact on the stock market development. In contrast, many other evidences show that financial development has a positive impact on reducing the unemployment rate by facilitating access to credit and stimulating business innovation and productivity. Blanchard and Wolfers (2000), for example, show that financial development contributes to a better allocation of resources, job creation, and a more fluid labor market.

Furthermore, Elsayed et al (2024) find that domestic credit to the private sector has a negative effect on unemployment. Nevertheless, stock market capitalization has a positive impact on unemployment, while the lending-deposit spread did not exert any significant effect on unemployment in Egypt. Raifu and Afolabi (2022) show that financial development has a conditional mean reducing effect on unemployment and a reducing effect on the distribution of unemployment. However, the reducing effect of financial development on the distribution of unemployment varies across the working-age population and youths. These different studies agree in showing that impact of financial development on the unemployment rate may vary from country to country, depending on the economic context, policies put in place and national specificities. It is also influenced by other factors such as industrial structure, the level of education of the workforce, labor market policies and financial market regulations. Previous studies found that unemployment negatively affects stock prices and financial development.

However, the empirical results of these studies cannot be generalized. The present study could offer valuable insights into the relationship between the unemployment rate and stock market development, contributing to a deeper understanding of how unemployment impacts financial markets and economic growth.

We put our following hypothesis:

H3: The Unemployment Rate has a negative impact on Stock Market Development

Research Methodology

Sample and data

Our sample consists of (30) Canadian financial firms during the period August 2017- May 2023. These firms are the most important in the financial industry which have a significant impact on the national economy and have experienced significant international growth. Our data are obtained mainly from datastream.

Variables Measures

The purpose of this paper is to examine the effect of Bitcoin Value on Stock Market Development. Our independent variable is the Bitcoin Price (BCP). It is determined by supply and demand. We assess the Stock Market Development by three variables as Market Liquidity Ratio (MLIQ), Market Size (MSIZE) and Market Capitalization (MCAP). The liquidity refers to the ability of a market to facilitate the buying and selling of stocks and other financial instruments quickly and without a significant impact on prices. It is the ratio of total trading volume to market capitalization. The MSIZE reflects the ratio of total market capitalization to Gross Domestic Product (GDP). The Market Capitalization is an indicator of a company's performance. A company's market capitalization represents the total value of a company's outstanding shares, obtained by multiplying the current market price per share by the total number of outstanding shares. We use also other control variables as CAD/EUR Exchange Rate (EXR) and Unemployment Rate (UR). EXR is generally expressed as the number of units of one currency required to purchase one unit of the other currency. UR represents the proportion of the labor force that is unemployed despite their availability to work. The Table 1 resumes all our variables.

Variable	Notation	Measure
Bitcoin Value	BCV	The ability of a market to facilitate the buying and selling of stocks and other financial instruments quickly and without a significant impact on prices.
Market Liquidity	MLIQ	The ratio of total trading volume to market capitalization
Market Size	MSIZE	The ratio of total market capitalization to Gross Domestic Product (GDP)
Market Capitalization	MCAP	The product of current market price per share and total number of outstanding shares
Exchange Rate CAD/EUR	EXR	The number of units of one currency required to purchase one unit of the other currency

Unemployment Rate	UNR	The proportion of the labor force that is unemployed despite their availability to work.

Table 1: Variables Measures

Model Specification

The model used in this study is the VAR Model (Vector Autoregressive Model). This statistical model is used to capture the relation between multiple variables as they change over time. The structure is that each variable is a linear function of past lags of itself and past lags of the other variables. VAR modeling is used in the context of impact and causality analysis. The Vector Error Correction Model (VECM) is used to analyze the long-term equilibrium relationship and short-term dynamics between multiple time series variables. The choice between VAR and VECM depends on data stationarity and cointegration. We used VAR Model when the variables are stationary and there is a short-run dynamic relationship. However, we choose VECM in the case of non-stationarity of variables and the presence of cointegrating relationships. Then, in order to specify our model, we study the stationarity of variables and the cointegration.

Stationarity Test

The Augmented Dickey Fuller (DFA) test is used to check the stationarity of the series. Table 2 resumes the results of stationarity test.

Variable	**Lag**	**Trend**	**Intercept**	**ADF**	**1%**	**5%**	**10%**
BCV	0	-	-	-0,47701	-2,598907	-1,945596	-1,63719
DL(BCV)	0	-	-	-6,462717	-2,599413	-1,945669	-1,613677
MLIQ	0	Trend	Intercept	-2,401414	-4,096614	-3,476275	-3,16561
D(MLIQ)	0	-	-	-7.963084	-2,599413	-1,945669	-1,613677
MSIZE	5	Trend	Intercept	-3.204509	-4,096614	-3,476275	-3,16561
D(MSIZE)	4	Trend	Intercept	-7.385776	-4,096614	-3,476275	-3,16561
MCAP	0	-	-	0.513310	-2,598907	-1,945596	-1,613719
D(MCAP)	0	-	-	-9.815647	-2,599413	-1,945669	-1,613677
EXR	0	-	-	0.085206	-2,598907	-1,945596	-1,613719
D(EXR)	0	-	-	-8.103546	-2,599413	-1,945669	-1,613677
UR	2	-	-	-0.649316	-2,598907	-1,945596	-1,613719
D(UR)	1	-	-	-6.440936	-2,598907	-1,945596	-1,613719

Table 2: The results of Stationarity Test

Table 2 show that all variables are considered non-stationary in level and stationary in difference

at the 5% threshold. Then, the variables are integrated of the same order I (1).

Cointegration Test

The results of ADF test show that the series are not stationary and integrated of the same order I (1), so we perform the cointegration test. This test determines whether there are cointegration relationships between the variables, a long-term relationship between the different variables used.

Series: CAP LIQ SIZE BCP CAP EH UR
Lags interval (in first differences): 1 to 2

Table 3: Cointegration Test of Johansen (trace Test)

Hypothetical number of CE(s)	Eigenvalue	Statistic T	Critical value 0.05	Prob
None *	0.515419	145.3663	103.8473	0.0000
At most 1 *	0.402061	96.82679	76.97277	0.0007
At most 2 *	0.345622	62.37097	54.07904	0.0076
At most 3	0.222906	33.95823	35.19275	0.0675
At most 4	0.133258	17.06121	20.26184	0.1302
At most 5	0.105626	7.479274	9.164546	0.1033

Table 3: Cointegration Test of Johansen (trace Test)

Table 3 shows the presence of three cointegration relationships between Bitcoin Price, Liquidity, Size, Market Capitalization, Exchange Rate CAD/EUR and Unemployment Rates. Then, there is a long-term equilibrium relationship between these variables, that is, in the long term they evolve at the same rate.

Estimated Model

We estimate a vector error correction model (VECM). The lag order chosen is one that minimizes the information criteria (Akaike, Schwartz). The models are represented as follows:

$$\Delta BCV_{it} = \alpha_1 + \sum_{P-1}^{K} \beta_{1ip} \Delta MLIQ_{it-p} + \sum_{p-1}^{k} \gamma_{1ip} \Delta MSIZE_{it-p} + \sum_{p-1}^{k} \delta_{1ip} \Delta MCAP_{it-p} + \sum_{P-1}^{K} \epsilon_{1ip} \Delta EXR_{it-p} + \sum_{p-1}^{K} \theta_{1ip} \Delta UNR_{it-p} + \omega_{1it} CET_{it-1} + \mu_{1it} \quad (1)$$

$$\Delta MLIQ_{it} = \alpha_1 + \sum_{P-1}^{K} \beta_{1ip} \Delta BCV_{it-p} + \sum_{p-1}^{k} \gamma_{1ip} \Delta MSIZE_{it-p} + \sum_{p-1}^{k} \delta_{1ip} \Delta MCAP_{it-p} + \sum_{P-1}^{K} \epsilon_{1ip} \Delta EXR_{it-p} + \sum_{p-1}^{K} \theta_{1ip} \Delta UNR_{it-p} + \omega_{1it} CET_{it-1} + \mu_{1it} \quad (2)$$

$$\Delta MSIZE_{it} = \alpha_1 + \sum_{P-1}^{K} \beta_{1ip} \Delta MLIQ_{it-p} + \sum_{p-1}^{k} \gamma_{1ip} \Delta BCV_{it-p} + \sum_{p\_1}^{k} \delta_{1ip} \Delta MCAP_{it-p} + \sum_{P-1}^{K} \epsilon_{1ip} \Delta EXR_{it-p} + \sum_{p-1}^{K} \theta_{1ip} \Delta UNR_{it-p} + \omega_{1it} CET_{it-1} + \mu_{1it} \quad (3)$$

$$\Delta MCAP_{it} = \alpha_1 + \sum_{P-1}^{K} \beta_{1ip} \Delta MLIQ_{it-p} + \sum_{p-1}^{k} \gamma_{1ip} \Delta MSIZE_{it-p} + \sum_{p\_1}^{k} \delta_{1ip} \Delta MCAP_{it-p} + \sum_{P-1}^{K} \epsilon_{1ip} \Delta EXR_{it-p} + \sum_{p-1}^{K} \theta_{1ip} \Delta UNR_{it-p} + \omega_{1it} CET_{it-1} + \mu_{1it} \quad (4)$$

$$\Delta EXR_{it} = \alpha_1 + \sum_{P-1}^{K} \beta_{1ip} \Delta MLIQ_{it-p} + \sum_{p-1}^{k} \gamma_{1ip} \Delta MSIZE_{it-p} + \sum_{p\_1}^{k} \delta_{1ip} \Delta MCAP_{it-p} + \sum_{P-1}^{K} \epsilon_{1ip} \Delta BCV_{it-p} + \sum_{p-1}^{K} \theta_{1ip} \Delta UNR_{it-p} + \omega_{1it} CET_{it-1} + \mu_{1it} \quad (5)$$

$$\Delta UNR_{it} = \alpha_1 + \sum_{P-1}^{K} \beta_{1ip} \Delta MLIQ_{it-p} + \sum_{p-1}^{k} \gamma_{1ip} \Delta MSIZE_{it-p} + \sum_{p\_1}^{k} \delta_{1ip} \Delta MCAP_{it-p} + \sum_{P-1}^{K} \epsilon_{1ip} \Delta EXR_{it-p} + \sum_{p-1}^{K} \theta_{1ip} \Delta BCV_{it-p} + \omega_{1it} CET_{it-1} + \mu_{1it} \quad (6)$$

Where

BCV: Bitcoin Value;

MLIQ: Market liquidity;

MSIZE: Market size;

MCAP: Market capitalization;

EXR: Exchange rate;

UNR: Unemployment rate;

α : Intercept ;

Δ: The difference operator;

$\beta, \gamma, \delta, \varepsilon$ and θ Parameters estimated;

k: Order of lag and

CET: Correction Error Term.

Results

Descriptive Analysis

Table 4 presents the main descriptive statistics of our data.

Variables	**Number of observations**	**Mean**	**Max**	**Min**	**Standard Deviation**

BCP	70	14.897	75.853	4.526	20.148
LIQ	70	87347.30	114028.4	80683.14	10146.66
SIZE	70	109.7135	113.761	104.5074	2.680
CAP	70	16.619	21.890	13.378	2.177
EXR	70	0.6721	0.7646	0.6292	0.0302
UNR	70	6.64	14.10	4.9	1.9835

Table 4 : Descriptive Statistics

Estimations Results

Table 5 presents the estimations results of the long-term relation of VECM Model.

Cointegrating Eq:	**CointEq1**	**CointEq2**	**CointEq3**
MCAP(-1)	1.000000	0.000000	0.000000
MLIQ(-1)	0.000000	1.000000	0.000000
MSIZE(-1)	0.000000	0.000000	1.000000
BCV(-1)	**-0.047546 [-4.91935]**	**-0.00177 [-3.35395]**	**-0.064472 [-6.70272]**
EXR(-1)	9.662363 [1.49655]	**1.110455 [3.33051]**	**14.86905 [2.31406]**
UNR(-1)	**0.459049 [5.90901]**	**0.016068 [4.00511]**	**0.442988 [5.72970]**

Table 6 presents the estimations results of the short-term relation of VECM Model.

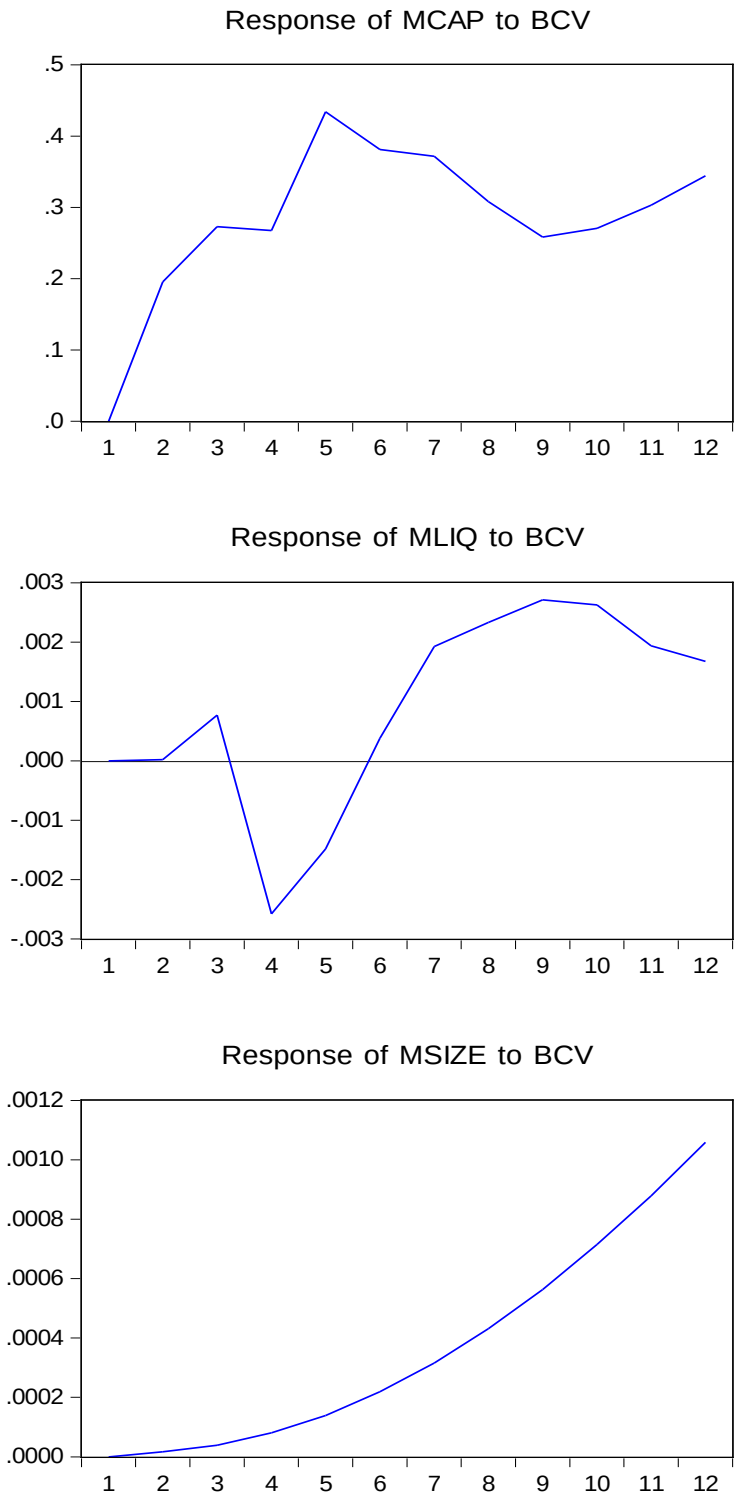
ErrorCorrection:	**D(MCAP)**	**D(MLIQ)**	**D(MSIZE)**	**D(BCV)**	**D(EXR)**	**D(UNR)**
CointEq1	-1.167979 [-3.76474]	0.002928 [0.55625]	-1.21E-05 [-0.26858]	-0.370883 [-0.16004]	-0.000355 [-0.06075]	-0.092476 [-0.32287]
CointEq2	9.873301 [1.69517]	-0.183216 [-2.85385]	-0.000459 [-0.54423]	-77.66213 [-1.78503]	-0.095240 [-0.86895]	-6.534822 [-1.21529]
CointEq3	0.424319 [1.83748]	0.007701 [1.83748]	-0.037502 [-2.12314]	-5.174901 [-2.99996]	0.007710 [1.77429]	-0.441835 [-2.07246]

D(MCAP(-1))	**0.537684 [2.17100]**	-0.004252 [-1.01185]	-9.46E-06 [-0.26403]	0.741236 [0.40066]	-0.004419 [-0.94812]	**-0.439725 [-1.97314]**
D(MCAP(-2))	**0.592924 [2.38916]**	-0.001087 [-0.25804]	2.55E-05 [0.70978]	0.112164 [0.06050]	-0.001985 [-0.42506]	**-0.222458 [-1.97093]**
D(MCAP(-3))	**0.551736 [2.46838]**	0.004349 [1.14675]	2.49E-06 [0.07687]	0.326987 [0.19584]	-0.002728 [-0.64846]	**-0.121689 [-2.58970]**
D(MLIQ(-2))	6.945540 [0.81985]	-0.076200 [-0.53008]	-6.48E-05 [-0.05285]	**26.3269 [4.12951]**	0.060468 [0.37930]	-6.763989 [-0.86483]
D(MLIQ(-3))	-9.990481 [-1.04640]	0.089540 [0.55270]	0.000774 [0.56011]	**21.21676 [3.29749]**	**0.035839 [2.19948]**	**-6.170709 [-2.70007]**
D(MSIZE(-2))	-1611.198 [-1.10278]	**22.38184 [1.98281]**	**0.569683 [2.69536]**	3036.996 [0.27827]	-36.22128 [-1.31745]	-529.1584 [-0.39230]
D(MSIZE(-3))	837.2797 [1.12547]	**7.438873 [2.58929]**	**-0.725568 [-6.74193]**	-6269.433 [-1.12818]	21.33424 [1.52395]	-159.5793 [-0.23235]
D(BCV(-2))	**-0.046144 [-2.26134]**	0.000118 [0.33958]	-1.31E-06 [-0.44490]	0.008867 [0.05817]	-0.000218 [-0.56829]	0.010050 [0.53350]
D(BCV(-3))	**-0.041818 [-2.11393]**	**0.000994 [2.96191]**	**1.55257 [2.05406]**	-0.071128 [-0.48134]	-0.000109 [-0.48134]	0.013218 [0.72375]

D(EXR(-2))	**11.90050 [2.24101]**	-0.097040 [-0.59637]	-0.002270 [-1.63623]	2.846045 [0.03973]	-0.219391 [-1.21578]	6.772167 [0.76495]
D(EXR(-3))	**17.54630 2 [2.79789]**	-0.077741 [-0.48441]	0.000577 [0.42162]	23.92030 [0.33858]	0.103359 [0.58074]	-0.980087 [-0.11225]
D(UNR(-2))	0.175057 [1.04234]	0.000480 [0.16833]	1.75E-05 [0.71876]	**3.298480 [2.62924]**	0.001643 [0.51997]	-0.239367 [-1.54380]
C	-4.727994 [-0.85307]	-0.110777 [-1.17791]	0.000151 [0.18840]	**151.1812 [3.65164]**	-0.148000 [-1.41904]	**13.10450 [2.56108]**
R-squared	**0.652539**	**0.614837**	**0.599981**	**0.614667**	**0.567528**	**0.618556**

Table 6: Estimations Results of the short-term relation of VECM Model

Figure 1: Response to Cholesky One S.D. Innovations



The Figure 1 Presents the Function of Impulse Responses.

The Figure 1 shows that in the first curve the increase in Bitcoin Value generates an appreciation of Market Capitalization which leads to a hyper-persistent effect in the long term. Thus, the increase in Bitcoin Value leads to a decrease in Liquidity in the 5th month from the 6th month onwards; this is a sustainable development which promotes a positive hyper-persistent relationship in the long term. Finally, Bitcoin Value has a positive effect on the Market Size according to the third graph since it is a persistent effect in the long term between these two variables.

Validity Tests of Models

Linear Fit Quality

Table 6 shows that values of R-squared are close to 1. They are 0.652539, 0.614837, 0.599981, 0.614667, 0.567528, 0.618556 respectively for the models explaining MCAP, MLIQ, MSIZE, BCV, and UNR. The linear goodness of fit is considered as good.

Residuals tests

- Normality test

The Table 7 shows that the residuals are Gaussian white noise (normal) because the Jarque-Bera statistics are all less than 5.99, so we accept the hypothesis of normality of the residuals.

Component	Jarque-Bera	Df	Prob.
1	19.1110	2	0.0000
2	0.699205	2	0.7050
3	0.376042	2	0.8286
4	0.195406	2	0.9069
5	0.010376	2	0.9948
6	7.412628	2	0.0246
Joint	27.8046	12	0.3219

Table 7 : Normality Test of JB

- Heteroskedasticity test of residuals (White Test)

The White test allows us to know whether the errors are homoscedastic or not. Heteroscedasticity describes data (or series) that do not have a constant variance. However, the series must be homoscedastic to present the best estimators. The Table 7 shows that homoscedasticity hypothesis is accepted since the probability of making an error is equal to p=0.64 greater than α =5%. Therefore, the estimates obtained are optimal.

Chi-sq	Df	Prob.
865.845	**882**	**0.644**

Table 7: White Test

Error Autocorrelation Test

The results of Table 8 show that the errors are relatively independent hence the null hypothesis of no autocorrelation is accepted (because the probability is greater than 5% for the different orders of autocorrelations).

Lags	LM-Stat	Prob
1	38.57450	0.3540
2	33.33519	0.5960
3	44.36853	0.1596
4	27.94267	0.8292
5	36.93771	0.4254
6	29.98959	0.7493
7	42.44544	0.2130
8	40.41406	0.2816
9	40.24836	0.2877
10	36.28044	0.4556
11	33.70262	0.5783
12	25.26528	0.9095
13	31.19334	0.6965
14	44.86957	0.1475
15	41.25683	0.2516

Table 8: Autocorrelation of Residuals

The various econometric tests presented show that our model is well specified. There is no autocorrelation and homoscedasticity of errors, and the model is structurally and conjuncturally stable. The econometric robustness of the model is satisfactory.

Interpretations of Results and Discussion

The results of the VECM estimation show that the coefficients of the error correction terms are negative and statistically significant at 5%. These coefficients judge the stability of system. They measure the speed by which a variable returns to the long-term equilibrium level. The error correction relations materialize the joint combination between the long and short-term relations.

The Table 5 shows the presence of positive and significative causality relationship from Bitcoin Value to Market Capitalization. The increase in the Bitcoin Value generates the inflow of capital which leads to the appreciation of Market Capitalization. This result corroborates the empirical findings of Pala (2024), and Bhullar and Bhatnagar (2020) which reveal a significant and positive long-term relationship between Bitcoin and stock Market. However, these results are not consistent with the empirical evidence by Samuleson (1965). Table 5 shows also that Bitcoin Value is in a positive and significant causal relationship also towards Market Liquidity (t-Statistic is 3.353) and towards Market Size (t-Statistic is equal to 6.702). Canada has experienced a growing institutional and retail interest in Bitcoin, exemplified by the launch of various Bitcoin ETFs, such as the Purpose Bitcoin ETF (Exchange Traded Fund). An increase in Bitcoin's value may result in heightened investment in various financial instruments, hence enhancing overall market capitalization. Furthermore, we demonstrate a negative and significant causal association

from the Unemployment Rate to Market Capitalization, the t- Statistic is equal to 5.909. A negative and significant causal relationship from the Unemployment Rate to Liquidity is also proved (t- Statistic = 4.005). Our findings show also a negative and significant causal relationship from the Unemployment Rate to Market Size, the t- Statistic is equal to 5.729. These results are in line with the empirical findings of Barber (1962), and Gonzalo and Taamouti (2017). Nevertheless, these empirical results do not confirm the findings of Umar (2018) which show a significant positive impact of Unemployment rate on stock market development. This difference may be attributed to the difference of economic structure, government policies, and market behavior between Canada and Africa.

The Table 5 proves also that Exchange Rate provides a negative and significant relationship towards Liquidity and Market Size with respectively t-Statistic equal to 3.330 and 2.314. These results corroborate the empirical findings of Iyke and Ho (2017), and Gbadebo (2023), which establish a significant negative impact of Exchange rate volatility on stock market development.

For the short-term causality, Table 6 shows that BCV has a negative and significant impact on Market Capitalization. After two and three periods, the increase in BCV results in a decrease in Market Capitalization. We confirm then the supposition which stipulates the negative association between the Bitcoin Value and Market Capitalization. This result corroborates the findings by Rajaswaninathan and Sakthivel (2024) which show that the performance of stock indices in BRICS countries is negatively impacted by cryptocurrencies. These results are also in line with the empirical findings of Portelinha et al. (2021), and Mansour Nomran et al. (2024) which find that cryptocurrency returns had a negative impact on stock market returns. Furthermore, after three periods, the coefficient on BCV is 0.0009, indicating higher Bitcoin Value of 0.09% for each increase of 1% Market Liquidity. Our results show also the positive and significant impact of BCV on MSIZE, the coefficient is equal to 1.522. The evolution of investment in Bitcoin cryptocurrency has a positive impact on the liquidity and size of stock markets, which promotes financial development. These results are consistent with empirical evidence by Raymond (2022), Demyanyk and Iftekhar (2009) and Herbest (2018). Moreover, after three periods, the coefficient on Market Size is 7.438, indicating higher ratio of Market Liquidity of 743% for each increase of 1% Total Market Capitalization to Gross Domestic Product (GDP).

A rising Bitcoin value (BCV) suggests that investors may be shifting their capital from traditional stocks into cryptocurrencies. In Canada, where institutional and retail investors increasingly have access to Bitcoin ETFs and other crypto-related financial instruments, this shift could reduce demand for equities, which could lead to a decline in market capitalization. Moreover, the positive correlation between Bitcoin value and market liquidity suggests that increasing investment in Bitcoin is contributing to higher capital inflows into the financial markets. In Canada, Bitcoin ETFs, such as those authorized by the Canadian Securities Administrators (CSA), have allowed investors to trade Bitcoin in regulated financial markets. This has increased liquidity by allowing investors easier access to cryptocurrency investments through traditional exchanges. The results show also an important relationship between Bitcoin value and Market size: As Canada keeps controlling and endorsing the use of cryptocurrencies, Bitcoin's impact on traditional financial markets is probably going to get more significant.

The Table 6 shows the positive and significant impact of CAD/EUR Exchange Rate on the Market Capitalization for two and three periods, with respectively coefficients equal to 11.909 and 17.546. In the short term, an increase in the value of the Canadian dollar against the euro

can lead to an improvement in the profits of Canadian companies that import from Eurozone countries, thereby raising stock prices and increasing market value. For the impact of stock market development on CAD/EURO Exchange Rate, only the MLIQ variable has a positive and significant impact on EXR during three periods. The coefficient on MLIQ is 0.0358, indicating higher Market Liquidity of 3.58% for each increase of 1% CAD/EURO Exchange Rate. Market Liquidity has a positive and significant impact on the exchange rate. The Market Liquidity which stimulates foreign investment and stabilize the local currency. Canada is taking a series of measures aimed at ensuring the liquidity of the financial market and attracting foreign investors, as well as ensuring the stability of the local currency exchange rate. For two periods, our results prove the negative and significant impact of MCAP on UNR. The coefficient on MCAP is -0.222, indicating lower Market Capitalization of 2.22% for each increase of 1% of unemployment rate. For three periods, the coefficient on MCAP is -0.021. Furthermore, we find for three periods the negative and significant incidence of MLIQ variable on UR variable, the coefficient on MLIQ is -6.17. These results underscore the importance of maintaining strong financial markets and liquid capital markets in Canada, as they play a vital role in boosting economic growth and reducing the unemployment rate. The results of Table 6 demonstrate, also, that UR Variable has a positive and significant impact on BCV variable. The coefficient on UR is 3.298 indicating higher Unemployment Rate of 329.8% for each increase of 1% of Bitcoin Value

Conclusion

The technological evolution of cryptocurrencies has enabled the emergence of new functionalities and possibilities improved the security and confidentiality of transactions, and opened the way to innovative decentralized applications. This development continues to shape the financial landscape and could have a lasting impact on how we transact and manage the digital assets. The relationship between cryptocurrencies and stock market development is complex. The rise of cryptocurrencies has reshaped financial markets, impacting traditional stock exchanges in diverse ways. While a few studies report a high correlation and integration between these markets, others report a weak or no long-term relationship. In addition, existing studies are constrained to individual countries or regions (US, Brazil, BRICS, MENA, GCC) and do not give a comprehensive global overview. Given this, it is likely that the effect of cryptocurrencies on stock markets for the Canadian case may be substantially different than one would observe elsewhere, and thus it deserves attention.

Using a VECM model, the investigation on the causal relationships between cryptocurrencies and stock market development in Canada conducts us to several important results. For the long-term causality, we find a positive and significative impact of Bitcoin Value on Stock Market Development. This relation is traced through each variable of stock market development as Market Capitalization, Market Size and Market Liquidity. The hypothesis H1 is not confirmed. The increase in the Bitcoin Value generates the inflow of capital which leads to enhance stock market development. Ours findings confirm the hypothesis H2. The Exchange Rate provides a negative and significant relationship towards Market Liquidity and Market Size. A high Exchange Rate can undermine investor confidence and weaken the financial system, which can hinder a country's financial development and hence stock market development. Our results demonstrate also a negative and significant causal relationship from the Unemployment Rate to Market Capitalization, Market Size and Market Liquidity. The hypothesis H3 is confirmed. The unemployment rate has a negative influence on financial development by reducing consumption and investment. high unemployment can lead to low aggregate demand and therefore slower

economic growth, which can also negatively affect stock market development.

Given Bitcoin's positive impact on stock market development, Canadian policymakers should reinforce a well-regulated cryptocurrency market to maintain capital inflows and financial stability. Meanwhile, the negative impact of exchange rate on market liquidity and size underscores the importance of policies aimed at stabilizing the Canadian dollar and maintaining investor confidence. The strong negative correlation between unemployment and stock market growth underscores the need for proactive labor market policies that promote job creation and economic expansion. In addition, encouraging financial innovation that increases market liquidity is critical to ensuring a dynamic and resilient financial system.

Short-term relationships show a negative and significant impact of Bitcoin Value on Market Capitalization after two and three periods, due to increased market volatility. However, the evolution of investment in Bitcoin cryptocurrency has a positive impact on the Liquidity and Size of Stock Markets, which promotes financial stock development. Furthermore, the Market Size is significantly and positively related to Market Liquidity. Our results show also that Exchange rate acts positively only on the Market Capitalization for two and three periods. In contrast, Market Liquidity has a positive impact on the Exchange Rate. Moreover, we find the absence of the impact of Unemployment rate on financial development in short term. The inverse causality is confirmed, there is a significant and negative incidence of Market Liquidity and Market Size on Unemployment Rate. Our results demonstrate also the positive and significant impact of Unemployment Rate on Bitcoin Value. The increase of unemployment rate can create a sense of economic uncertainty, which may lead investors to seek investment alternatives such as investment on cryptocurrencies. This increased demand can potentially drive up the value of cryptocurrencies.

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Authors' contributions

All authors contributed to the study conception and design. Data collection and analysis were performed by MS and IA. The first draft of the manuscript was written by HE and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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