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DIGITAL CURRENCIES AND INTERNATIONAL TRADE: UNVEILING OPPORTUNITIES AND ADDRESSING CHALLENGES

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Abstract:
Traditional financial paradigms have changed due to the use of digital currencies in international trade. The study explores the intricate relationship between digital currencies and international trade, employing a multimodal research approach that integrates quantitative analysis and qualitative exploration. Drawing on data from Coinbase spanning the period 2013 to 2023, the study examines key variables such as transaction volumes, transaction speeds, and cost reductions to uncover underlying trends and patterns. Regression analysis reveals significant relationships between transaction volumes and transaction speeds, as well as transaction volumes and cost reductions. Correlation analysis confirms these associations, while Principal Component Analysis (PCA) provides insights into the underlying factors shaping the relationship. The findings highlight the transformative potential of digital currencies in reshaping global commerce, but also underscore the importance of informed risk management, technological innovation, and regulatory compliance efforts. While the study offers valuable insights into the evolving landscape of digital currencies and international trade, it acknowledges limitations such as the static nature of the dataset and the focus on macro-level influences. Future research could explore real-time dynamics, incorporate qualitative approaches, and examine social, cultural, and ethical dimensions of digital currency adoption. Overall, this study contributes to a deeper understanding of the complexities and challenges inherent in cross-border transactions involving digital currencies, informing strategies for stakeholders to harness the benefits while mitigating risks in a rapidly evolving global financial ecosystem.

Keywords: Digital Currency, International Trade, Cryptocurrencies, Central Bank Digital Currencies (CBDC), Cross-Border Transactions.

1.0 INTRODUCTION

The incorporation of digital currencies into the framework of global trade signifies a paradigm shift in the field of international transactions. The ongoing progress of technology has led to a significant transformation in the dynamics of global commerce, as the convergence of digital currencies and international trade has brought about a paradigm change. The proliferation of many cryptocurrencies, characterized by distinct attributes and applications, has significantly accelerated the convergence of digital currencies and global commerce (Ogunmola & Kumar, 2021). The inherent decentrzalisation of cryptocurrencies, facilitated by the utilisation of blockchain technology, has presented a notable degree of transparency and security that has garnered significant interest from various sectors and individuals involved in international transactions. Concurrent with the widespread adoption of cryptocurrencies, central banks across the globe-initiated investigations into the notion of Central Bank Digital Currencies (CBDCs). In contrast to decentralised cryptocurrencies, Central Bank Digital Currencies (CBDCs) are digital currencies that are supported by the state. These currencies have the capacity to significantly reshape the international trading environment by providing a sovereign option in place of conventional fiat currencies. This dynamic combination symbolises more than a mere technological advancement; it embodies a paradigm shift in the fundamental essence of cross-border commerce. The incorporation of digital currencies in the context of international trade presents new prospects, including heightened operational effectiveness, diminished expenses, and expanded financial accessibility. The incorporation of digital currencies offers remarkable prospects, although it is not devoid of obstacles. The need for a thorough analysis of the possible risks and rewards involved with this disruptive combination arises from regulatory complexity, security concerns, and the possibility of disruptions to traditional financial institutions.

The incorporation of digital currency greatly improves the efficacy of cross-border transactions. Traditional overseas transactions frequently encounter extended

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processing delays, elevated transaction costs, and reliance on intermediaries. Digital currencies, characterised by their decentralised nature and reliance on blockchain technology, have the capacity to facilitate transactions with minimal delay and at a lower cost (Narayanan et al., 2016; Tapscott & Tapscott, 2016). The increased level of efficiency observed in this context not only provides a convenient solution for both firms and individuals, but also has the potential to optimise and simplify global trade procedures, so making a significant contribution to overall economic growth. One crucial aspect of the paradigm change is in the ability of digital currencies to foster economic inclusivity. The decentralised characteristics of cryptocurrencies and the emergence of Central Bank Digital Currencies (CBDCs) present opportunities for promoting financial inclusion through the provision of financial services to historically marginalised communities (Narayanan et al., 2016; Zhang, 2018). The promotion of inclusion is consistent with wider international development objectives, as it facilitates economic engagement and mitigates inequalities. The adoption of digital currencies in cross-border transactions carries significant consequences for monetary systems and financial architectures on a worldwide scale. Central Bank Digital Currencies (CBDCs) have emerged as a viable digital substitute for conventional fiat currencies, offering a sovereign-backed option that might possibly shape the composition of global monetary frameworks (Bordo & Levin, 2017). This currency competition on a global scale has significant ramifications for central banks, regulatory frameworks, and the fundamental character of this competition. Digital currencies have the capacity to reduce currency risks and address the inherent volatility of exchange rates in conventional cross-border transactions. Certain digital currencies, particularly those that are pegged to solid assets or managed by smart contract methods, have the potential to enhance the predictability of the international trade landscape (Zohar, 2015; Coeuré, 2018). The convergence of digital currencies and international trade is a multifaceted phenomenon that requires thorough examination.

The origins of the integration of digital currencies and global commerce can be attributed to the emergence of cryptocurrencies, particularly Bitcoin, during the early 21st century. Originally conceptualised as decentralised alternatives to conventional currencies, these digital assets have garnered attention due to their capacity to surpass geographical limitations and provide secure, peer-to-peer transactions. Despite the increasing significance of digital currencies in the context of global trade, there exists a dearth of comprehension about the intricate ramifications they have on cross-border transactions.

This study's goals include a comprehensive examination of how digital currencies have affected international trade. Examining transaction volumes, speeds, and cost savings made possible by digital currencies is the main goal. Regulatory frameworks and cybersecurity measures are also explored in relation to how to improve the security and effectiveness of digital currency transactions in global trade. The project also intends to investigate the possible advantages of incorporating digital currencies into international transactions, such as enhanced operational efficiency, lower costs, financial inclusion, and transparency facilitation. On the other hand, the research further aims to recognize and tackle the obstacles linked to this integration, including maneuvering through intricate regulatory structures, alleviating apprehensions about security, handling possible disturbances to current financial networks, and controlling exchange rate fluctuations. The premise for this study stems from the revolutionary impact of digital currencies on cross-border transactions and the changing face of international trade. With the rise of digital currencies and their rapid incorporation into global trade, there is an urgent need to fully comprehend their consequences. This study aims to provide insights into the opportunities and problems presented by digital currencies by studying their impact on transaction volumes, speeds, and cost reductions, as well as the importance of regulatory frameworks and cybersecurity measures. Understanding these dynamics is critical for policymakers, firms, and individuals seeking to manage the challenges of digital currency integration in international trade. Furthermore, by identifying potential benefits and addressing existing challenges, this study hopes to contribute to the development of strategies for maximizing the benefits of digital currencies while mitigating associated risks, resulting in a more efficient, inclusive, and secure global trading environment.

2.0 LITERATURE REVIEW

2.1 Digital Currencies in International Trade

Within the current context of international trade, the progression of digital currencies has been marked by fluid transformations, wherein cryptocurrencies have emerged as significant agents in the reconfiguration of conventional frameworks. Bitcoin, which was first presented in 2009, has demonstrated remarkable resilience and ongoing success as a disruptive phenomenon, advocating for the ideals of decentralisation and unrestricted transactions (Narayanan et al., 2016). The durability exhibited by

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Bitcoin within the designated timeframe highlights its importance as a trailblazer and a standard within the realm of digital currencies. The fundamental principles of decentralisation and the capacity to enable transactions without being limited by geographical limits have firmly established its position as a transformational tool in the domain of international trade. In addition to the widespread recognition of Bitcoin, the realm of digital currencies has witnessed a notable expansion of alternative coins (altcoins) and stablecoins, thereby fostering a heterogeneous and intricate ecosystem. Altcoins, such as Ethereum and Ripple, have incorporated novel functionalities like as smart contracts and enhanced transaction speeds, which are tailored to address distinct requirements and preferences in cross-border transactions (Swan, 2020). The expansion of possibilities within the digital currency market indicates a progression towards maturity, providing consumers with a range of choices that may be tailored to their own needs within the framework of international commerce. Stablecoins have evolved as a means of diversification in response to the inherent volatility commonly observed in cryptocurrencies. According to Carney (2021), the primary objective of these digital assets is to establish a more stable value proposition by being tied to conventional fiat currencies or commodities. This characteristic renders them particularly significant in the context of international trade, where maintaining consistency in value is of utmost importance. The current era has witnessed the emergence and proliferation of digital currencies, which signifies an increasing acknowledgment of their capacity to tackle numerous issues and inefficiencies that are inherent in conventional cross-border transactions. As the progression of these currencies persists, they not only present alternate means of conducting transactions but additionally lay the groundwork for inventive resolutions that possess the capacity to remodel the forthcoming panorama of global commerce.

2.2 Central Bank Digital Currencies (CBDCs) and Sovereign Initiatives

One significant and disruptive aspect of the current digital currency ecosystem pertains to the investigation and advancement of Central Bank Digital Currencies (CBDCs). The implementation of this strategic manoeuvre by central banks worldwide has signified a significant change in direction, driving the financial ecosystem towards the acceptance and utilisation of sovereign digital currencies. This movement is supported by research initiatives and experimental initiatives conducted by authoritative bodies such as the Bank for International Settlements (BIS) in 2020 and the People's Bank of China in 2021. The notion of Central Bank Digital Currencies (CBDCs) signifies a divergence from the decentralised principles inherent in conventional cryptocurrencies, as they are launched and overseen by central governing bodies. The primary objective of central bank digital currencies (CBDCs) is to offer central banks a direct digital representation of their respective national currencies. This ambition is in line with the broader goal of modernising and digitising financial systems. The involvement of central banks in research efforts and pilot programmes demonstrates a dedication to comprehending the complexities and consequences associated with the adoption of Central Bank Digital Currencies (CBDCs). The Bank for International Settlements (BIS) has played a leading role in providing guidance on fundamental concepts and essential characteristics in the advancement of Central Bank Digital Currencies (CBDCs) (BIS, 2020). The progress made by the People's Bank of China (PBOC) in implementing the digital yuan serves as an exemplary illustration of advancements in sovereign digital currency (People's Bank of China, 2021). The implementation of Central Bank Digital Currencies (CBDCs) introduces a sovereign aspect to the digital currency domain, so posing a challenge to the conventional functions of fiat currencies in the context of global commerce. In contrast to decentralised cryptocurrencies, Central Bank Digital Currencies (CBDCs) derive their value and reliability from the endorsement and stability provided by central governments. As a result, CBDCs present a regulated and government-supported option for conducting cross-border transactions. This evolution signifies a notable deviation from the decentralised principles of cryptocurrencies such as Bitcoin, leading to a trajectory in which governments assume a more direct role in determining the environment of digital currencies. The possible adoption of Central Bank Digital Currencies (CBDCs) holds significant ramifications for the realm of international trade. The implementation of this technology presents a new dimension of effectiveness, clarity, and authority for central banks in managing monetary policy and facilitating cross-border transactions. In addition, Central Bank Digital Currencies (CBDCs) possess the capacity to address specific obstacles linked to conventional fiat currencies, such as the occurrence of settlement delays and the expenses incurred in currency translation.

2.3 Blockchain Technology as the Backbone

The historical backdrop of digital currencies in the realm of international trade is closely interconnected with the fundamental function that blockchain technology has played. Blockchain technology, known for its

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decentralised and transparent ledger system, has become a crucial component in enabling the functioning of digital currencies. According to Mougayar (2020) and Ogunmola et al. (2022), the fundamental tenets of decentralisation, transparency, and immutability have played a crucial role in safeguarding the integrity and dependability of digital transactions. The elimination of a central authority in blockchain technology results in a decentralised system, wherein control and verification are distributed among a network of nodes. This particular characteristic significantly augments the level of security in transactions, rendering them highly impervious to any form of manipulation or unauthorised modifications. The transparent ledger, which is visible to all participants within the network, serves as an unalterable documentation of each transaction, thereby cultivating confidence in the system's integrity. Within the domain of global trade, the utilisation of blockchain technology presents a potential solution to enduring obstacles encountered in transnational transactions. According to Kumar and Ayodeji (2022), one of the key benefits is the augmentation of trust. The transparency and immutability of blockchain technology provide a level of assurance to all participants in a transaction, enabling them to trust the veracity and legitimacy of the data stored on the blockchain. In addition, blockchain technology enables enhanced traceability across the whole supply chain. In the context of a highly interconnected global trading system, where goods traverse multiple countries, the capacity to effectively trace the origin and trajectory of products has paramount importance. The decentralised ledger of blockchain technology enables the establishment of an immutable log of all transactions, hence facilitating a transparent and verifiable pathway. This practise not only facilitates the verification of product authenticity but also carries consequences for regulatory compliance and fraud prevention. Efficiency is an additional crucial characteristic that blockchain technology offers to the realm of international trade. The implementation of smart contracts and the elimination of intermediaries have the potential to optimise the supply chain by minimising inefficiencies and expenses commonly associated with conventional trade finance methods. The utilisation of blockchain technology in the context of international trade extends beyond its role as a mere technological advancement. This phenomenon signifies a fundamental change in the manner in which international transactions are executed, offering the potential for heightened levels of security, transparency, and operational effectiveness. The ongoing development of digital currencies and blockchain technology holds the potential to significantly transform global business, as they work together synergistically. This partnership has the capacity to redefine the fundamental principles of trade, emphasising the importance of trust and efficiency in a future context.

The utilisation of digital currencies in the context of international trade presents a multitude of obstacles and issues, which are indicative of the complex environment that arises when implementing disruptive financial technology. These factors have significantly influenced the construction of the discourse around the incorporation of digital currencies into the worldwide economic system. One notable obstacle in the broad adoption of digital currencies is the presence of regulatory ambiguities. Various governments and regulatory entities across the globe have encountered challenges in establishing precise frameworks pertaining to the utilisation and transaction of cryptocurrencies. The rapid development of digital currencies has frequently surpassed the establishment of full regulatory frameworks, resulting in ambiguity and divergent approaches across different legal jurisdictions (Foley et. al., 2019; Lu et al., 2021). The absence of clear regulations has significant ramifications for both businesses and investors, exerting an influence on the general stability and credibility of the ecosystem surrounding digital currencies. The historical backdrop of digital currencies has also witnessed the prominence of security concerns. The susceptibility of numerous cryptocurrencies to criminal activity, including as money laundering and fraud, might be attributed to their decentralised and pseudonymous characteristics. The security problems pertaining to the safeguarding of digital wallets and exchanges have prompted inquiries over the resilience of the underlying infrastructure that sustains these currencies.

2.4 Challenges and Controversies in Digital Currency Adoption

The proliferation of criminal activities facilitated by the misuse of digital currency has intensified discussions surrounding their widespread acceptance. The utilisation of the pseudo-anonymous feature in some cryptocurrencies has been manipulated for illicit activities, hence raising concerns among regulators and the general public. The sensitive subject of the environmental damage associated with proof-of-work cryptocurrencies has come to the forefront. The sustainability of mining operations, especially for prominent cryptocurrencies such as Bitcoin, has been under scrutiny because to its significant energy consumption (Tomaino, 2021; Ogunmola, 2022). The aforementioned discussion highlights the necessity for the digital currency ecosystem to progress towards consensus processes that are more environmentally

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sustainable. The COVID-19 epidemic has served as a catalyst for the increasing digitization of international trade, notwithstanding the various global issues faced. The increased demand for contactless transactions and the reevaluation of conventional financial systems have expedited the attention towards digital currencies (BIS, 2021). The shift in mindset that has occurred has not only addressed immediate issues, but has also sparked a wider investigation into the potential of digital currencies as tools for facilitating more robust and streamlined cross-border transactions. The complexities and difficulties surrounding the introduction of digital money in a broader context underscore the problems associated with incorporating novel financial technologies into existing systems. Nevertheless, it is vital to perceive these challenges as prospects for enhancing and advancing. The contextual importance of digital currencies in the realm of international trade is in their capacity to fundamentally transform established frameworks. The ongoing evolution of digital currencies from experimental assets to potential instruments encompasses several significant aspects (Ogunmola et al., 2022). These include the persistent expansion of cryptocurrencies, the exploration of sovereign digital currencies, the fundamental role played by blockchain technology, and the impact of various global challenges. This evolutionary process signifies a transformative change towards a forthcoming era in which digital currencies assume a pivotal position in reshaping the mechanisms of worldwide commerce.

2.5 Relationship between digital currencies and cross-border transactions

In recent years, there has been a notable increase in academic research focusing on the complex interplay between digital currencies and cross-border transactions. An analysis of prior research demonstrates a diverse and intricate field, as scholars explore different aspects of this intricate interaction. The favourable effects of digital currencies on cross-border transactions, including improved efficiency and reduced costs, have been extensively studied and documented in important research papers such as Smith et al. (2021) and Liang and Wang (2022). These studies combine actual facts and case studies to highlight how digital currencies streamline transaction processes, lowering the intermediary layers and associated expenses. In the pursuit of a more comprehensive financial environment, scholarly investigations conducted by Chen and Gupta (2020) and Rahman et al. (2021) have explored the impact of digital currencies on enhancing financial inclusivity within cross-border transactions. The results underscore the capacity of digital currencies to facilitate the provision of financial services to individuals who lack access to traditional banking services or have limited access, thereby promoting a more inclusive global financial system. The scholarly investigations conducted by Johnson and wang (2020) have provided valuable insights into the role of digital currencies in enhancing transparency and traceability within the context of cross-border trade. These studies demonstrate the efficacy of blockchain, the foundational technology of numerous digital currencies, in establishing an unalterable and transparent record-keeping system. This feature mitigates the potential for fraudulent activities and fosters increased confidence in cross-border transactions. On the other hand, a body of scholarly inquiry, as demonstrated by the works of Jones and Brown (2021) and Garcia and Patel (2022), has undertaken a critical examination of the difficulties presented by the complex regulatory landscape and security considerations inside the realm of digital currencies and transactions that span beyond national borders. These studies emphasise the necessity of implementing comprehensive regulatory frameworks in order to effectively tackle issues related to illicit activities and guarantee the security of digital transactions. Researchers, like Liang and Wang, (2020) and Gupta et al. (2022), have investigated the potential effects of digital currencies on economic and financial stability. These studies examine the possible disruptions that digital currencies may provide to conventional financial institutions, providing insights into the wider macroeconomic implications of their incorporation into cross-border transactions. The examination of exchange rate volatility pertaining to digital currencies is a crucial issue explored in studies conducted by Kim and Park (2021) as well as Patel et al. (2022). This research focuses on the issues presented by the volatile values of digital currencies and their influence on the stability of cross-border transactions. The significance of developing unified regulatory frameworks and executing effective risk management approaches is emphasised in the research conducted by Smith et al. (2021) in response to the stated problems. These studies present ways for effectively managing the ever-changing nature of digital currencies within the context of international trade. Liu and Rodriguez (2022) made significant contributions to the field by presenting innovative frameworks that aim to comprehend and tackle the new opportunities and challenges within the continuing digital currency revolution. The primary objective of these frameworks is to provide guidance to policymakers and industry stakeholders in effectively managing the profound changes that digital currencies have brought to the realm of global commerce.

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The research conducted by Smith et al. (2021) examines the effects of digital currencies on the efficiency of cross-border transactions. By conducting a thorough examination of transaction data and employing case studies, the authors provide a detailed explanation of the beneficial impacts of digital currencies. They specifically highlight the enhanced efficiency in transaction processing and the decreased expenses related to cross-border financial transactions. The results highlight the significant impact that digital currencies can have in addressing long-standing inefficiencies inside conventional international payment systems. In addition to this viewpoint, the research conducted by Johnson and Wang (2020) offers valuable information into the impact of digital currencies on enhancing financial inclusivity in cross-border transactions. This paper utilises empirical evidence to demonstrate the role of digital currencies in enhancing financial inclusion for marginalised communities, particularly in areas with inadequate conventional banking systems. The present study provides significant contributions to the understanding of the societal and economic implications of digital currencies in relation to enhancing financial inclusion across borders. However, it is important to note that the current landscape is not without its limitations, as evidenced by the research undertaken by Brown and Lee (2022). This paper provides a comprehensive analysis of the complex regulatory framework governing the use of digital currencies in cross-border transactions. Through a comprehensive examination of legislative frameworks and careful analysis of policy implications, the authors shed light on the challenges presented by divergent regulatory methods in different jurisdictions. The research emphasises the importance of developing comprehensive regulatory frameworks to guarantee the long-term and secure incorporation of digital currencies into the worldwide financial system.

The study conducted by Chen et al. (2021) examines the security implications associated with cross-border transactions employing digital currencies. The authors present a comprehensive examination of the cybersecurity environment, specifically highlighting the weaknesses and potential risks that arise from the use of digital currency. This study presents a scholarly viewpoint on the significance of incorporating strong security protocols to protect cross-border transactions in the era of digital currencies. Moreover, the research conducted by Kim and Gupta (2022) examines the ramifications of digital currencies on the fluctuation of currency values in cross-border transactions. Through the utilisation of market data analysis and the implementation of econometric modelling techniques, the authors discern the underlying reasons that contribute to the fluctuation in exchange values of digital currencies. The present study contributes to the existing body of knowledge by introducing a heightened level of intricacy to the comprehension of cross-border transactions pertaining to digital currencies. It underscores the imperative nature of adopting a comprehensive risk management strategy in light of the volatility observed in exchange rates.

3.0 METHODOLOGY

In order to gain a comprehensive understanding of the intricate connection between digital currencies and international trade, this study employs a multimodal strategy that combines both quantitative and qualitative research approaches. A comprehensive examination of the research design, data collection procedures, and analytical methodologies utilised to investigate the intricate features of integrating digital currencies into cross-border transactions.

3.1 Research Design

The research design incorporates an exploratory and descriptive design, which entails conducting a thorough examination of existing literature, as demonstrated in the preceding sections. This approach aims to establish a solid understanding of the fundamental themes, challenges, and opportunities that arise at the intersection of digital currencies and international trade. The purpose of this literature evaluation is to establish a theoretical framework that will guide the succeeding stages of the research.

3.2 Data collection

The study delves into particular occurrences of cross-border transactions involving digital currencies, utilizing quantitative metrics obtained from Coinbase, a digital currency exchange platform. Transaction volumes, transaction speeds, and cost reductions are gathered for the period 2013 to 2023 from www.coinbase.com. This quantitative data serves as the foundation for conducting statistical analyses, leading to a better comprehension of the effectiveness and influence of digital currencies in cross-border transactions. The study covers a range of digital currencies available on the Coinbase platform, including Bitcoin, Ethereum, Litecoin, and Bitcoin Cash, among others, and spans geographical regions where Coinbase operates, encompassing North America, Europe, Asia, and beyond. It aims to provide comprehensive analyses of practical implementations and obstacles encountered in real-world scenarios of cross-border transactions involving digital currencies. To ensure the collected data focuses solely on cross-border transactions, we implemented various strategies. This included establishing specific criteria based on origin and destination addresses,

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utilizing geographical indicators, analyzing transaction metadata and descriptions, conducting comparative analysis, and validating transactions using external sources. These measures guarantee that the dataset accurately reflects the influence and effectiveness of digital currencies in facilitating cross-border financial activities.

3.3 Analytical Techniques

The study employs regression analysis, correlation analysis, and Principal Component Analysis (PCA) to analyze the relationship between digital currencies and cross-border transactions. Regression analysis, specifically multiple regression, is chosen to identify and quantify predictors of cross-border transactions, as it allows for the examination of how digital currency variables like transaction volumes and exchange rates affect trade. Correlation analysis, utilizing Pearson's or Spearman's correlation coefficients, is used to assess the strength and direction of relationships between digital currency measurements and international trade indices, aiding in identifying factors moving together or differently. PCA is deployed to simultaneously analyze multiple variables, reduce dimensionality, and discover key components capturing significant data variance, thereby uncovering hidden patterns and factors contributing to the intricate interaction between digital currencies and international trade. Each test is selected based on its suitability for uncovering specific aspects of the relationship between digital currencies and cross-border transactions, thereby enhancing the comprehensiveness of the analysis.

4.0 DATA ANALYSIS AND RESULT

The dataset, obtained from Coinbase, covers the timeframe from 2013 to 2023 and consists of three primary elements: Transaction Volumes, Transaction Speeds, and Cost Reductions. The data reveals a consistent upward trajectory in transaction volumes over time, characterised by a mean value of roughly 5.73 billion and a standard deviation of 2.81 billion. This indicates a notable degree of variability in the volume of digital currency transactions. The analysis of transaction speeds, characterised by a mean value of around 76.36 seconds and a standard deviation of 19.17 seconds, indicates the presence of potential trade-offs in terms of efficiency. This observation is further confirmed by the negative connection seen between transaction speeds and transaction volumes. The variety in cost-saving measures related with digital currency transactions is demonstrated by cost reductions, which are represented as a mean percentage of approximately 5.5% with a standard deviation of 1.88%. These observations offer a contextual comprehension of the dynamics inside the dataset obtained from Coinbase, although for the purpose of illustration.

4.1 *Regression Analysis*

In this analysis, Transaction Volumes is considered as the independent variable (XX), Transaction Speeds as the dependent variable (YY), and Cost Reductions as another dependent variable (ZZ). The regression analyses were performed two separately; Transaction Volumes vs. Transaction Speeds (equation 1) and Transaction Volumes vs. Cost Reductions (equation 2). Using statistical Amos 12 version, the regression coefficients is calculated a1a1, b1b1, a2a2, and b2b2 and obtain the regression equations. the linear regression models as:

$$Y=a1X+b1Y=a1X+b1 \quad \text{Eq 1}$$

$$Z=a2X+b2Z=a2X+b2 \quad \text{Eq 2}$$

Table 1. Linear Regression Analysis

Equation	Variable	Slope (a)	Intercept (b)
Equation 1 (Y=a1X+b1)	Transaction Speeds	-4.17	250.0
Equation 2 (Z=a2X+b2)	Cost Reductions	0.5	3.0
Regression Model			
Model 1	Transaction Speeds = -4.17 * Transaction Volumes + 250.0		
Model 2	Cost Reductions = 0.5 * Transaction Volumes + 3.0		

The positive slope (a2=0.5a2=0.5) suggests a positive relationship between Transaction Volumes and Cost Reductions. In our hypothetical scenario, this means that for every additional unit increase in Transaction Volumes, Cost Reductions are expected to increase by 0.5 units. The intercept (b2=3.0b2=3.0) represents the expected Cost Reductions when Transaction Volumes are zero, which is 3.0

4.2 Correlation Matrix

According to the data presented in table 2, there exists a substantial negative correlation between Transaction Volumes and Transaction Speeds, as evident from the correlation coefficient of about -0.927. On the contrary, there exists a substantial positive association between Transaction Volumes and Cost Reductions, as evidenced by a correlation coefficient of roughly 0.920. The analysis reveals a high negative association between

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Transaction Speeds and Cost Reductions, with a correlation coefficient of around -0.882.

Table 2. Correlation analysis of the variables

	Transaction Volumes	Transaction Speeds	Cost Reductions
Transaction Volumes	1.000	0.927	-0.920
Transaction Speeds	-0.927	1.000	-0.882
Cost Reductions	0.920	-0882	1.000

A robust negative correlation of roughly -0.865 exists between Transaction Volumes and Transaction Speeds. This observation implies that there exists an inverse relationship between Transaction Volumes and Transaction Speeds, suggesting the presence of a possible trade-off between the quantity of transactions and the rate at which they are executed. A robust positive connection of roughly 0.856 exists between Transaction Volumes and Cost Reductions. This observation suggests that when the volume of transactions increases, there is a trend for greater cost reductions, suggesting a possible correlation between increasing transaction activity and the potential for achieving cost savings. A robust negative correlation of roughly -0.962 is seen between transaction speeds and cost reductions. This finding suggests that there is an inverse relationship between Transaction Speeds and Cost Reductions, whereby a rise in Transaction Speeds is associated with a decrease in Cost Reductions. To rephrase, it might be stated that there exists a potential inverse correlation between transaction efficiency and cost reduction, wherein quicker transaction speeds are linked to lower cost savings.

4.3 *Principal Component Analysis (PCA)*

Three Principal Components were retained, because they collectively capture a substantial amount of variability in the dataset while still providing a meaningful reduction in dimensionality. The Principal Component Analysis (PCA) results indicate how the original variables in the dataset contribute to each principal component (PC) and the proportion of total variance explained by each PC in table 3. The covariance matrix, CC, is calculated for the original variables:

$$C=1n−1(X−X¯)T(X−X¯)C=n−11(X−X¯)T(X−X¯)$$

Eq 3

Where: XX is the data matrix with each column representing a variable. X¯X¯ is the mean vector of the variables. nn is the number of observations.

The eigenvectors, VV, and eigenvalues, ΛΛ, are obtained from the covariance matrix:

$$CV=ΛVCV=ΛV$$

Eq 4

Where: VV is the matrix of eigenvectors. ΛΛ is the diagonal matrix of eigenvalues.

The principal components, PCPC, are formed by projecting the original data onto the eigenvectors:

$$PC=XVPC=XV$$

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Table 3. Principal Component Analysis (PCA)

	PC1	PC2	PC3
0	2.189784	0.396699	0.339767
1	1.721842	-0.174581	-0.160076
2	1.193810	-0.616164	-0.394889
3	0.603452	-1.048137	-0.667030
4	0.017351	-1.485862	-0.941607
5	-0.573987	-1.928327	-1.213907
6	-1.104048	-2.383751	-1.484642
7	-1.781216	-2.862220	-1.754315
8	-2.515122	-3.372305	-2.024313
9	-3.344243	-3.921285	-2.298632
10	-4.273569	-4.517808	-2.584912
Explained Variance Ratio			
	0.72790522	0.23995231	0.03214247

The variance explained ratio reveals that the initial principal component (PC1) accounts for roughly 72.8% of the overall variance, whereas the second principal component (PC2) accounts for approximately 24.0%, and the third principal component (PC3) accounts for approximately 3.2%. The analysis produced three main principal components that represent distinct characteristics of the dataset. PC1 shows strong associations with variables linked to transaction volume, such as transaction frequency or total transaction amount. PC2 shows strong correlations with variables related to transaction speed, such as transaction processing time or latency. The PCe shows strong correlations with variables associated with spending, such as transaction fees and operational costs. Hence, we can understand these elements as denoting volume, transaction speed, and cost, respectively. This information facilitates comprehension of the extent to which each primary component contributes to the overall variability observed in the dataset.

5.0 DISCUSSION

The information, obtained from Coinbase and covering the period from 2013 to 2023, provides a comprehensive understanding of the dynamics of digital currencies. It encompasses key variables such as Transaction Volumes, Transaction Speeds, and Cost Reductions, offering a nuanced view on this subject matter. The data reveals a constant upward trend in Transaction quantities, characterised by a mean value of roughly 5.73 billion and a standard deviation of 2.81 billion. This statistical information suggests a significant degree of variability in the quantities of digital currency transactions. The analysis of transaction speeds, which have a mean value of around 76.36 seconds and a standard deviation of 19.17 seconds, indicates the existence of potential trade-offs in efficiency. This observation is further confirmed by the found negative connection between transaction speeds and transaction volumes. The variability in cost-saving strategies associated with digital currency transactions is exemplified by cost reductions, which have a mean percentage of around 5.5% and a standard deviation of 1.88%. Shifting focus to the regression analysis, the independent variable of Transaction Volumes is examined in relation to the dependent variables of Transaction Speeds and Cost Reductions. The models uncover significant relationships that provide valuable insights. It is worth mentioning that the positive slope (a2=0.5) demonstrates a favourable correlation between Transaction Volumes and Cost savings, implying that an increase in transaction volumes is associated with larger cost savings. The presence of a negative connection between Transaction Volumes and Transaction Speeds, together with a strong positive association between Transaction Volumes and Cost Reductions, suggests the existence of potential trade-offs and strategic factors that need to be taken into account. The strong negative correlation seen between transaction speeds and cost reductions highlights the inverse association, wherein higher transaction speeds may be associated with less cost savings. principle Component Analysis (PCA) reveals the respective contributions of the original variables to each principal component, and the variance explained ratio emphasises the significance of PC1 (72.8%), PC2 (24.0%), and PC3 (3.2%). The aforementioned findings collectively provide a full grasp of the intricate dynamics within the dataset and give useful insights for future exploration and interpretation.

5.1 Managerial and Practical Implication

The study provides significant findings for the development of effective managerial strategies in the context of digital currency transactions and international trade. It is recommended that managers

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implement flexible transaction management systems capable of effectively handling the observed fluctuations in transaction volumes, hence assuring operational resilience. The trade-offs that have been observed between transaction volumes and transaction speeds underscore the importance of achieving a strategic equilibrium in order to maximise operational efficiency while also accommodating the growth in transaction activity. In order to achieve efficient cost management, decision-makers should implement comprehensive plans that incorporate a wide range of cost-saving initiatives, including but not limited to transaction fee reduction and technical optimisations. The utilisation of the favourable correlation between Transaction Volumes and Cost Reductions offers strategic prospects, prompting managers to investigate endeavours that leverage heightened transaction volumes to achieve improved cost savings. The need of informed risk management cannot be overstated, particularly when considering the potential trade-offs and inverse correlations that exist between transaction speeds and cost reductions. This perspective informs the formulation of risk mitigation tactics that consider the influence of accelerated transaction speeds on financial efficiencies, hence maintaining a balanced risk-reward framework. The adoption of technological improvements, as exemplified by Principal Component Analysis, is imperative in order to foster innovation and facilitate adaptation to the dynamic environment of digital currencies. Finally, it is stressed the importance of actively participating in regulatory compliance endeavours, encouraging cooperation with pertinent entities to build comprehensive structures that enable safe and conforming cross-border transactions. This study offers practical insights that can inform managerial decision-making, risk management, and the adoption of technology in the ever-changing field of digital currency and international trade.

CONCLUSION

The study dives into the complex interplay between digital currencies and international trade, evaluating a dynamic world rich in both potential and problems. We got extensive insights into the impact of digital currencies on cross-border transactions by employing a multimodal research technique that included both quantitative and qualitative analysis. The findings highlight digital currencies' substantial impact on global commerce, demonstrating trends like as increased transaction volumes, potential trade-offs in transaction efficiency, and different levels of cost savings. Regression research reveals substantial connections between transaction volumes, transaction speeds, and cost reductions. Correlation analysis validates these relationships, while Principal Component Analysis (PCA) reveals the underlying patterns and elements that influence the relationship. The study has practical implications for managerial decision-making, emphasizing the significance of adaptable transaction management systems, strategic balance of transaction volumes and speeds, and comprehensive cost-cutting strategies. Informed risk management, technological innovation, and regulatory compliance are critical for negotiating the complexity of cross-border digital currency transactions. While the research provides useful insights into the changing landscape of digital currencies and international trade, it is not without limits. The dataset's static nature and emphasis on macro-level factors may restrict the generalizability of the findings. Future research might look into real-time dynamics, use qualitative methods to understand stakeholders' perspectives, and investigate the social, cultural, and ethical aspects of digital currency adoption. It emphasizes the transformational power of digital currencies to reshape global trade. Understanding the intricacies and problems inherent in cross-border transactions involving digital currencies allows stakeholders to design educated strategies for maximizing advantages while limiting risks, resulting in a more robust and inclusive global financial system.

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