DIGITALIZING THE TRADE FINANCE INDUSTRY IN KUWAIT: A TRANSACTION COST PERSPECTIVE OF BLOCKCHAIN-BASED LETTERS OF CREDIT

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رؤية بنك الكويت المركزي والبنوك الكويتية لتطوير الشباب الكويتي

The 2022 First Place Research Paper Winner
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ABSTRACT

Blockchain technology has been attracted the interest of the financial sectors in order to increase efficiency and save costs and time within trade finance transactions. Transaction costs represent a concern and considerable challenge for financial and trading parties. As blockchain refers to an eliminator for transaction and friction costs, it has been considered the ideal tool to reduce the transactional costs in trade finance, particularly through the Blockchain-based Letters of Credit approach. This research investigates the transaction costs implications on LCs and international trade in Kuwait and the potential role of adopting Blockchain-based LCs in this context. The outcomes indicate that blockchain will mark positively significant implications for the trade finance industry and it would increase the financial inclusion for local enterprises through rising efficiency levels in LCs applications' processes. This investigation is carried out by analysing annual times series data for the period (2001-2019) through several econometric techniques such as unit root test, cointegration test, OLS regression model and Granger causality test.

Keywords: Trade finance, Letters of credit, Blockchain, OLS

رقمنة قطاع تمويل التجارة في الكويت: منظور تكلفة المعاملات لخطابات الائتمان على أساس تقنية البلوكتشين

الغـرض:

الهـدف مـن إجـراء هـذه الدراسـة هـي معرفـة تكلفـة المعامـلات المرتبطـة بخطابـات الائتـمان كأحـد أدوات تمويـل التجـارة و قيـاس انعكاسـها عـلى أنشـطة تمويـل التجـارة بالقطـاع المـصرفي بدولـة الكويـت و أداء الأعـمال، و تسـليط الضـوء عـلى اسـتخدام تقنيـة البلوكتشـين لرقمنـة خطابـات الائتـمان لضـمان رفـع الكفـاءة بالقطاعـين المـالي والتجـاري و تقليـل تكلفـة المعامـلات.

المنهجية:

أجريـت هـذه الدراسـة عـبر اسـتعراض الأدبيـات والدراسـات العلميـة السـابقة بمجـال موضـوع الدراسـة. و كذلـك عـبر منهجيـة كميـة بإسـتخدام بيانـات السلاسـل الزمنيـة السـنوية لعوامـل التجـارة والاقتصـاد الـكلي وتكلفـة المعامـلات الخاصـة بالكويـت للفـترة الزمنيـة مـن 2001 إلى 2019، و تحليلهـا عـبر عـدة اختبـارات خاصـة بالاقتصـاد القيـاسي لإيجـاد علاقـة العوامـل ببعضهـا البعـض عـبر اسـتخدام برنامـج Eviews11 للتحليـل الاحصـائي.

النتائج:

اظهـرت نتائـج الدراسـة أن تكلفـة المعامـلات المرتبطـة بـأدوات تمويـل التجـارة وبالتحديـد خطابـات الائتـمان لهـا أثـر سـلبي عـلى نسـبة الـواردات التجاريـة الممولـة مـن خطابـات الائتـمان. و اشـارت النتائـج إلى أن اسـتخدام تقنية البلوكتشـين عـبر خطابات الائتـمان مـن شـأنه زيـادة نسـبة الصـادرات التـي يتـم تمويلهـا مـن خطابـات الائتـمان و رفـع الكفـاءة في عمليـات تمويـل الأعـمال المحليـة لأغـراض التجـارة الخارجيـة و تقليـل فجـوة تمويـل التجـارة.

الآثار:

تدعـو نتائـج هـذه الدراسـة مؤسسـات القطـاع المـصرفي والجهـات التنظيميـة إلى الـشروع في تجربـة خطابـات الائتـمان المبنيـة عـلى تقنيـة البلوكتشـين و إلى بحـث الجوانـب القانونيـة والتقنيـة لتطبيـق تكنولوجيـا البلوكتشـين عـلى قطـاع تمويـل التجـارة مـن أجـل تقليـل تكاليـف المعامـلات التـي تجريهـا المصـارف في هـذا الشـأن.

1 INTRODUCTION

In light of the current fourth industrial revolution, digital transformation has been a crucial part of this era to deliver services and do business. The covid-19 pandemic demonstrates the importance of innovations within financial activities and the need for exploring alternative tools to maintain the sustainability of activities in a cost-effective way. While trade finance instruments represent critical approach in international trade, these instruments suffer from conventional obstacles which have been resulted in remarkable trade finance gap in the world and trigger additional costs and difficulties for both trading parties and the financial sector. Thus, looking for unconventional solutions for the current dilemma of the trade finance gap and cost represents an essential aim in order to boost trade finance provisions and eliminate inefficient patterns.

Blockchain technology is considered an innovative tool for transforming financial infrastructures into digital form and improving efficiency within markets. Since the mid of the last decade, blockchain has been used widely among financial sectors to obtain the efficiency and minimize costs and save time. In the context of trade finance transactions, blockchain was adopted by enormous financial institutions around the world to conduct letters of credit (LCs) for trade purposes, where this instrument is considered the most prominent approach between trade finance instruments. The recent trials and investigations reveal that Blockchain-based LCs generate several benefits for trading and financial parties and it's a turning point in terms of eliminating transaction costs, facilitating procedures, increasing overall efficiency and decreasing risks. The previous experiments of utilizing blockchain in LCs transactions indicate that it would generate a mutually beneficial relationship between financial sectors and trading parties, where blockchain helps banks to reduce their relevant costs of due diligence procedures and LC's issuing time, while importers and exporters will gain shorter procedures with lower costs and higher rate of seeking finance acceptance.

Therefore, this research paper attempts to conduct an empirical analysis of the potential role of applying blockchain technology to trade finance instruments in Kuwait, particularly the letters of credit approach. Moreover, the research aims to measure the extent of transaction costs' effects on trade finance activities and build estimation for adopting Blockchain-based LCs within the trade and financial transactions in order to obtain considerable concluding remarks to be considered by the financial sector and regulatory authorities in Kuwait. The empirical analysis of this research will be based on obtaining multiple datasets

to capture the magnitude of transaction costs of trade finance and trade activities to build economic estimation for using blockchain in the LCs approach. The datasets of this research are annual time series for the period from 2001 to 2019. The estimation model is structured by dependent variable and independent variables, where the dependent variable is the LCs-to-Imports ratio which refers to the share of imports that were financed by letters of credits. Independent variables in this research are divided into two categories: 1) macroeconomic variables and 2) transaction variables. Macroeconomic variables are used to be control variables, where they include GDP, Exchange rate, Trade Balance, and Oil rent. Transaction costs variables are representing the main interest of this research, and they are the Overall Economic Freedom index and Trading Across Borders score. The methodology of this research is divided into several econometric approaches as follows: descriptive statistics, data transformation, unit root test, cointegration test, OLS regression model, Granger causality test, diagnostic test and model stability tests. All the empirical approaches will be conducted by Eviews11 statistical software.

The rest of this research's parts are organised as follows: Chapter 2 provides background about trade finance and financial technology in Kuwait and its region. Chapter 3 presents the literature review about trade finance, blockchain technology and the potential use of blockchain in the letters of credit approach. Chapter 4 discusses the empirical framework of the research and the applied datasets and methods. Chapter 5 illustrates the research's results after conducting analytical techniques. Chapter 6 provides detailed discussions of the results. Chapter 7 has the concluding remarks of this research paper. Chapter 8 provides the reference list of the research.

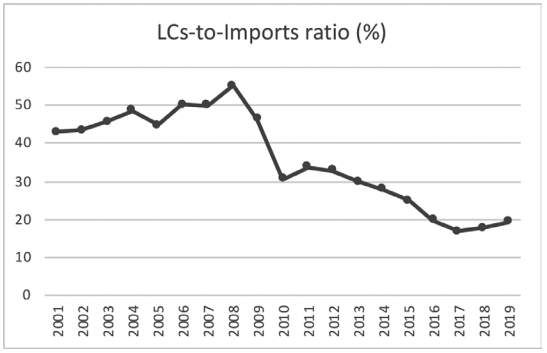
2. The context of Kuwait

In recent years, the government of Kuwait has introduced the "New Kuwait" vision, aimed at transforming the country into a global financial hub by 2035. The strategic vision seeks to diversify the national economy and reduce reliance on oil revenues and government expenditure by promoting greater participation of the private sector. Supporting entrepreneurial and innovative activities has become a key objective for the government, with the aim of stimulating the economy and alleviating the financial burdens on the public sector. However, Kuwaiti entrepreneurs face various barriers that impede their ability to establish business enterprises, including challenges related to accessing finance and bureaucratic burdens. These factors have been identified as significant obstacles and the primary reasons for business exits in Kuwait, according to the Global Entrepreneurship Monitor report of 2021.

Given the crucial role of trade finance instruments in promoting small and medium-sized enterprises (SMEs) and financial technology (Fintech), blockchain presents an opportunity to address the trade finance gap for local enterprises in Kuwait, while simultaneously enhancing the efficiency and profitability of the banking sector. The financial infrastructure in Kuwait demonstrates a willingness to embrace technological innovations and digitalization. The Central Bank of Kuwait (CBK), as the primary regulator for local and foreign banks in the country, has taken significant steps in this direction. In 2018, the CBK launched the Regulatory Sandbox Framework, which serves to stimulate the development of fintech and provide a platform for banking systems to experiment with new technologies.

Furthermore, the CBK is committed to a strategic plan presented at the 2019 global banking conference, "Shaping the Future," which aims to digitize banking activities. These initiatives align with Kuwait's broader development framework, "New Kuwait 2035," where banks have been instructed to formulate comprehensive five-year strategies encompassing digitalization, cybersecurity and other measures to promote stability and growth (Oxford Business Group, 2023). Moreover, the CBK issued guidelines in 2022 for the introduction of digital banks. On a positive note, the Oxford Business Review (2020) indicates that 83% of Kuwaiti individuals are capable of utilizing fintech solutions, suggesting that Kuwait possesses talented human capital that can position the country as a significant player in the GCC region with a cost-competitive banking sector.

Figure 1. Source: CBK



From the broad regional perspective, entrepreneurs in the MENA region face challenges related to financial inclusion, primarily due to the complex Anti-Money Laundering (AML) and Know-Your-Customer (KYC) procedures implemented by banks (Dornel, Slimane, & Mohindra, 2020). According to the World Bank's Enterprise Survey, 32% of SMEs in the MENA region are experiencing significant barriers when seeking credit, compared to the global rate of 26% for SMEs facing financing constraints. Integrating trade finance into the digitalization agenda would yield substantial benefits for SMEs in the MENA region. This includes simplifying AML and KYC processes, establishing digital accounts to facilitate credit risk assessment for lenders, and developing credit scoring mechanisms for entrepreneurs (Dornel, Slimane, & Mohindra, 2020).

In the context of the Gulf Cooperation Council (GCC), Qatar has emerged as a notable case in the application of blockchain technology within trade finance. Truby et al. (2022) highlight that despite the ban on cryptocurrencies, the Qatari government has prioritized blockchain solutions for finance, with the public sector being the largest investor in this technology in 2021. The market size of the blockchain is expected to grow by 120% in 2022, reaching $19.4 million. Qatar's Commercial Bank has also engaged in global trials, collaborating with 50 banks on the R3 Corda platforms to explore the use of blockchain in trade finance.

i. Potential obstacles and considerations

In the specific context of Kuwait, the implementation of blockchain-based LCs is likely to encounter potential barriers and considerations across multiple dimensions. The regulatory environment assumes a pivotal role, where monetary and financial authorities have to establish explicit guidelines and regulations that adopt blockchain technology for trade finance activities. Additionally, fostering collaboration among banks, official agencies, and technology providers becomes essential to assess

and enhance the digital infrastructure, thereby ensuring the successful implementation of blockchain-based LCs. Simultaneously, raising awareness and cultivating an understanding of blockchain technology among trade finance practitioners through conducting pilot projects and training programs becomes fundamental.

Nonetheless, cultural factors and paper-based documentation practices may influence the adoption of blockchain-based LCs, demanding a paradigm shift towards digital transformation. Establishing collaborations with international financial institutions assumes ensures alignment with global standards. Paramount importance must be placed on maintaining security and safeguarding data privacy, necessitating the implementation of robust security measures and adherence to data protection regulations. By addressing these barriers and taking these considerations into account, an enabling environment for the implementation of blockchain-based LCs can be created in Kuwait, potentially leading to heightened efficiency, transparency and security in trade finance activities.

3. Related Literature

I. Trade Finance

Trade finance is defined as financing the exchange of goods and services between two commercial entities, particularly between the importer (buyer) and the exporter (seller). The procedure of financing the trade involves financial institutions, where the seller accepts the payment from the buyer according to certain period of time with a private bank's intervention (Korinek, Cocguic and Sourdin, 2010). The bank in this case refers to intra-firm financing and provides financing to the trade by different common tools such as letters of credit, cash in advance and open account (Kowalski, Lee and Chan, 2021). Although financing international trade is supplied primarily through private banks, historically there was public intervention within the international trade finance market but since the end of the 90s governments' intervention has been moved out from the market. While the majority of global trade is financed by open account approaches, companies in Asia and the Middle East are widely relying on letters of credit, where 77% of letters of credit around the world are issued in Asia alone (Patel and Ganne, 2020).

Trade finance instruments represent important element within global trade. According to the International Chamber of Commerce (2018), 80% to 90% of global trade is financed by trade finance approaches, whereas Patel and Ganne (2020) indicate that trade finance covered $12.4 trillion of merchandise exports in 2019 as it's favorable tool to provide liquidity

and mitigate risks. As a result of the trade finance's importance, the estimations by Kumar and Amin (2022) reveal that the trade finance market was worth $61.1 billion in 2020 and it's forecasted to exceed $75 billion by 2027 with a compound annual growth rate (CAGR) by 3%. The reason beyond critical role of trade finance due to solving international trade issues and common disputes between importers and exports. For instance, trade finance bridges the gap among trading partners, specifically when the importer prefers to pay after receiving goods and the exporter seeks to receive the payment after shipping the goods. Therefore, the crucial role of trade finance stems from mitigating risks between trading partners during exchanging goods stages (Kowalski, Lee and Chan, 2021; Schmidt-Eisenlohr, 2013). Meanwhile, the econometric model which was conducted by Korinek, Cocguic and Sourdin, (2010) has found that trade finance has significant effects on GDP and trade flows, as a 0.55% increase in imports financing is associated with a 1% increase in GDP.

Among trade finance approaches, the approach of letters of credit (L/C) is widely adopted in trade finance, where banks of both importers and exporters behave as intermediaries among them (Ahn and Sarmiento, 2019; Ganne, 2018; Schmidt-Eisenlohr, 2013). Letters of credit is considered a record of the mutual confidence of trading parties when exchanging goods and money, where the L/C approach is described by Grath (2012) as a combination of bank guarantee issued through a bank after a request from the buyer in favour of the seller through an advising bank, and the payment delivers after presenting documents that meet with the stated terms and conditions. Likewise, Bhogal and Trivedi (2019) have identified L/C as a more secure medium of an exchange bill, while it's issued by the buyer's bank as payment's guarantee according to a request from the buyer with considerations about underlined payment terms in the contract. The substantial aim of letters of credit is to protect both importers and exporters from the risk of non-completion and increase trade flows (Osés et al., 2020). The letter of credit is an irrevocable guarantee for payment which's issued by a bank and cannot be cancelled during the specified time period when the bank validates all documents in full compliance with L/C terms and conditions. Briefly, the procedure of issuing the letter of credit starts when the issuing bank receives the physical documentation and verifies the face value of the documents in terms of complying with L/C in order to provide immediate or scheduled payment per terms and conditions of the L/C (Khalil, Kerbache and Omri, 2021). Alsalim and Ucan (2023) have divided the process of the letter of credit into 3 main stages, the first and second stages are the flow of records that hold different information such as; the ownership and

operation of the business, delivery orders, mate's receipt and bill of lading for trading parties. While the third stage within the process is the flow of funds where the issuing bank of the letter of credit helps the importer by paying the exporter in cash transactions. The system of the L/C has four actors playing pair-based relationships as outlined by (Osés et al., 2020): importer, issuing bank, exporter and advising bank. The information, documents and money are exchanged between these four actors, where the validation and authentication of documents are conducted through the intermediation of both banks and each of the four actors have to trust the other. In the context of the L/C process, it's notable to be mentioned that 90% of the L/C around the world are governed and subjected to subject to UCP 600 "Uniform Customs and Practice for Documentary Credits 600 published by ICC in 2007", according to Khalil, Kerbache and Omri (2021).

Letters of credit have considerable advantages to trading parties due to their several features throughout exchanging goods and money. From the importer side, the L/C provides the importer credit facilities from the issuing bank and the assurance about delivery of goods, while the exporter benefits from the assurance of payment to the L/C issuing bank and has the ability to secure pre-shipment advance from his bank against the L/C (Bhogal and Trivedi, 2019). The security properties of the letter of credit have increased usage of this financial instrument, specifically after the 2008 financial crisis, where it accounted for 41% of short-term trade finance in Q2 2009, up from 37.5% in Q4 2007 (Korinek, Cocguic and Sourdin, 2010). Subsequently, the total transactions of letters of credit in 2019 were worth $15 trillion and over 6 million L/Cs were issued between 2008 and 2018 from 25 banks only, as reported by ICC Trade Register Report 2019 (ICC 2020).

However, letters of credit have various pain points and gaps that restrict the financial inclusion for trading parties and limit banks' capability to provide this sort of financial products at the same time, where the trade finance gaps reached its widest extent to $1.5 trillion, according to (Patel and Ganne, 2020). Both authors have attributed the gap due to the variety of involved actors and numerous steps within L/C's process that create costly manual checking and time-consuming along with carrying paper documentation from ports and cargos that need to be checked, signed and faxed to different trading and financial parties with little clarity about the procedure by any single party. Moreover, Khalil, Kerbache and Omri (2021) have attributed the existence of inefficiencies within trade finance transactions due to the massive use of papers and physical delivery of trade documents that require an enormous workforce and human intervention among all parties, while the overall involved

parties per a transaction could reach more than 20 parties. Referring to Ramachandran et al. (2017), the interaction between a small number of parties within the trade finance transaction could include 5,000 data field interactions and the global number of the data field is expected to be 20 billion each year, while 4 billion papers are used annually for trade finance procedures. Furthermore, the response towards errors and changes within the transaction are low because of the physical pattern of procedure that causes notable delays. For instance, the process will return to the seller (exporter) if there is any deviation in the presented documents in order to amend the document to send it again to its bank then to the buyer's bank (importer's bank) and then again to the buyer (Khalil, Kerbache and Omri, 2021).In addition, the paper of Chang, Chen and Wu (2019) has revealed that the presence of several parties within cross-border transactions with emerging counterparties creates miscommunications and coordination challenges that trigger high costs and poor user experiences, where these difficulties have minimized the adoption of letters of credit. The annual report of the African Development Bank in 2017 indicated that the considerable gap between the supply and demand of trade finance negatively affects international trade, emerging economies and small and medium enterprises (SMEs) in particular (AfDB, 2017). However, Osés et al. (2020) have divided the multiple causes of trade finance's gap into two directions: the supply side which is about the capacity of capital provision from banks, and the demand side which is referred to importers and exporters' firms that deal with each other.

Trade finance gap causes	Supply-related	Demand-related
Increased capital ratio requirements in banking regu-(lations (e.g.: Basel III	X	
(Regulatory due-diligence requirements (e.g. KYC	X	
Minimal non-bank capital	X	
High processing costs	X	X
Document verification problems	X	X
Insufficient knowledge about trade finance	X	X
Firm related high level of risk		X
Country related high level of risk		X
Insufficient size of transactions		X

Table 1. Causes of trade finance gap (Henríquez et al., 2020)

Regarding the supply side from private banks as intermediaries, trade finance transactions are subjected to the trust mechanism as the probability of fraud is high and multiple invoices might be issued for the same batch of goods, therefore trade finance banks are expecting bad debts as generated costs from trade finance transactions (Morris, 2019; O'Neill, 2018; Wragg, 2018). Notably, Standard Charted Plc lost around $200 million in 2014 as a result of trade finance fraud due to fake purchase orders and invoices were presented to obtain letter of credit (Chanjaroen and Boey 2016). Thus, trade finance banks are cautious from liquidity crisis hits and they are using several measures during the letters of credit process to secure themself by conducting extensive manual processing checks and circulating physical documents between involved parties (Khalil, Kerbache and Omri, 2021). Fruad's risks are considered the main obstacle for banks to expand their trade finance transactions, where trade finance has been subjected to high levels of inefficiency, uncertainty and time-consuming (Chang et al., 2020). Meanwhile, the report of OECD (2021) revealed that Due-diligence requirements, particularly those related to anti-money laundering (AML) and Know Your Customer (KYC) are hindering the supply of credit for importers because these measures lead to high transaction costs with a lack of profitability. In the same context, Mendicino et al. (2019) found that rising capital requirements will trigger negative implications on credit supply and overall economic activity. Consequently, the trade finance market is relatively small in comparison with other financial markets due to centralization patterns, asymmetric and high transaction costs from regulatory measures that aim to counter fraud and risks (OECD, 2021).

However, on the demand side which is represented by importers and exporters firms, various critical elements minimize their tendency towards seeking trade finance instruments. Initially, letters of credit have remarkable disadvantages to the importer which has listed by Bhogal and Trivedi (2019) such as; the expensive fees from banks to issue a letter of credit, delays in delivering documents on time from banks and also delays in receiving goods. Similarly, exports disadvantage from L/Cs in terms of delays in documents and discrepancies in documents, particularly when the exporter is new to L/Cs procedure. Moreover, the importer subjects to cover all associated fees from the bank during the L/C and should expects errors due to various repetitive inspections and authentications of documents (Deloitte, 2018). Therefore, the high cost and long process of L/C application offset the importers' ability to obtain credit from banks and widen rejections for L/Cs applications. Letter of credit applications from small and medium-sized enterprises (SMEs) are more likely to be rejected by banks as they on average engage in lower-size transactions than large

firms and they are classified as higher-risk applicants with less reputation within the financial sector (Osés et al., 2020). As a result, each of Alsalim & Ucan (2023) and Risius & Spohrer (2017) argue that there is an urgent need for advancements in trade finance that tackle trust issues between financial and trading parties in order to form a foundation of efficient and trust-free economic transactions.

II. Blockchain

The concept of blockchain was introduced in 2008 to establish a decentralized platform for transferring bitcoins, with a focus on accessibility and transparency. Blockchain technology is central to bitcoin and operates by recording digital transactions on blocks (Wright, 2008). Wang et al. (2019) further elaborate that blockchain's distributed network and unique agreement structure have the potential to enhance auditability and transparency. According to Kowalski, Lee, and Chan (2021), a blockchain is a fully distributed system that captures and stores a consistent, immutable, and linear event log of transactions between networked actors. This means that blockchain is a digital distributed ledger that records time-stamped data records on a cluster of computers where no single entity has control, and the information is visible to all parties. Transactions are broadcasted to the network, and full-node participants validate them directly through the operation of a consensus mechanism, as noted by Ioannou and Demirel (2021).

In a blockchain, every block contains transactional data that is combined with timestamps to create the following block and validate the previous one. Proof-of-work (PoW) is employed to communicate these results to every block on the network, which confirms their accuracy and prevents malicious attacks. Blockchain technology has three main types: private, public, and consortium chains. Private chains are more restrictive and allow only specific businesses or organizations to access them. On the other hand, public chains are fully decentralized systems that reward nodes for their contributions via PoW (Alsalim and Ucan, 2023). Consortium chains are a hybrid of public and private chains, and while they are partially centralized, they still offer some decentralization. the validation of the successful delivery of a transaction from the sender to the recipient, as well as the verification of signed acknowledgements provided by intermediate nodes, are tasks assigned to full-node participants or miners in a blockchain network. To ensure censorship resistance and safeguard sensitive information, encryption methods are employed to protect data from unauthorized interference (Ioannou and Demirel, 2021). Smart contracts are programmable protocols that can

automatically execute, update, and verify transactions, making them more efficient and transparent than traditional contracts (Alsalim and Ucan, 2023). Unlike traditional contracts, smart contracts can initiate and continue processes without delays caused by delivery issues, thanks to their ability to update automatically in just a few seconds. Smart contracts can reduce the need for paper-based documentation, thereby enhancing transparency while ensuring immutability (Alsalim and Ucan, 2023).

According to Gausdal et al. (2018), the adoption of blockchain can bring several benefits, such as increased efficiency, cost reduction, establishment of trust-free processes, and accountability. The anti-double spending feature of blockchain ensures that assets cannot be transferred more than once, which enhances security (Antonopoulos, 2017; Antonopoulos and Wood, 2018). However, the reliance on Supply Chain Finance (SCF) on paper-based documentation has led to inefficiencies and increased costs (ADB, 2019). Manual checking and sequential input of paper documents are prone to errors and cause delays in invoice reconciliation and payments (Chang, Chen, and Wu, 2019; Chen et al., 2020; More and Basu, 2013). The complexity of inter-organizational supply chain collaboration and intra-firm cross-functional coordination also contributes to increased costs (Ioannou and Demirel, 2021).

Decentralization, distributed consensus mechanisms and cryptography make it possible to conduct trust-free economic transactions using blockchain technology (Swan, 2015). Financial institutions were the earliest adopters of blockchain technology, recognizing its potential to improve escrow transactions and securities settlement (Swan, 2015). Blockchain research has also explored various issues related to its design, features, and applications in different contexts, including startup financing, supply chains, taxation and auditing, e-residency, energy distribution, and the Internet of things (Ahluwalia et al., 2020; Kamble et al., 2019; Hyvärinen et al., 2017; Schmitz and Leoni, 2019; Sullivan and Burger, 2017; Hou et al., 2020). Chang et al. (2020) examined how the transition to the blockchain can be accomplished through case studies, presenting a comprehensive classification of blockchain applications in different sectors such as trade, business services, IoT, and medical. Their research shed light on the potential future applications of blockchain finance and provided an illustrative example of other finance-related capabilities

III. Trade Finance and Blockchain

Contrary to the legacy model of letters of credit that relies on trusted third party, blockchain technology employs a decentralized ledger system (Zheng et al., 2017). This means that a single, centrally managed database is replaced by several local databases, where each transaction is visible to every node in the network. Moreover, the transparency and longevity of the blockchain are maintained since once a new block is generated, it must receive approval from most nodes through a distributed consensus mechanism. The validated block is then added to the chain, and trade finance transactions are recorded sequentially and permanently (Zheng et al., 2017). The process of letters of credit through blockchain has eleven primary stages starting when both the buyer and seller sign a trade agreement and concluding when the necessary documents for the buyer to access the goods are gathered (Khalil, Kerbache and Omri, 2021). Bogucharskov et al. (2018) describe in their work the fundamental mechanism of blockchain-based L/C that when a buyer of services intends to open a digital letter of credit, they must complete an application form that includes information about the seller, contract terms such as duration, amount, and other relevant details. Subsequently, the issuing bank reviews the application and grants approval, after which they confirm the application and establish a digital letter of credit. Afterwards, the details are incorporated into the block, which can be viewed by all participants, including the negotiating bank. Following the shipment of goods, the seller-exporter provides the bank with relevant documents (such as an invoice), and the bank proceeds to transfer the corresponding funds to the client while executing the digital letter of credit (Bogucharskov et al., 2018).

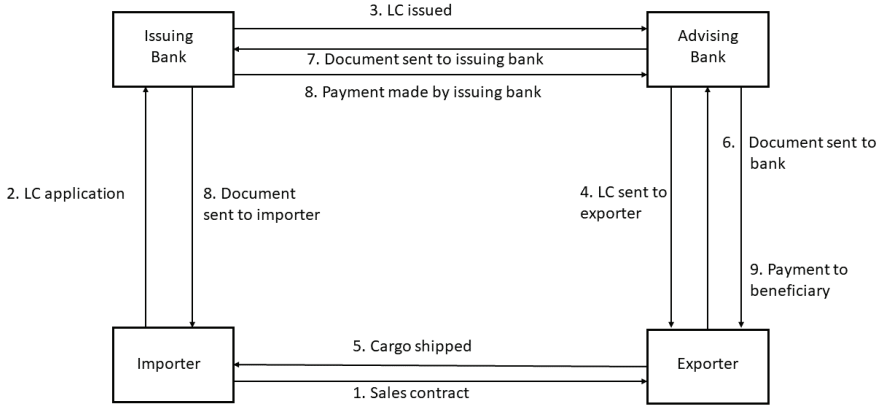


Figure 2. Traditional Letter of Credit mechanism (Source: ICC, 2022)

Blockchain-based L/C process is characterized by the electronic notification of the buyer's bank upon the buyer's request, followed by the

electronic tracing of the request throughout all subsequent steps (Alsalim and Ucan, 2023). Once the L/C is issued and advised to the advising bank, the seller is electronically notified and can also track the L/C. The same holds for the seller's and buyer's banks, as the tracing of the L/C process using digital signatures relies on public and private encryption keys known only to authorized parties, with the sharing of information controlled by the parties' respective levels of authority. Blockchain-based smart contracts allow for the automatic notification of status changes, such as the arrival of goods or the presentation of documents, which triggers specific business activities without human intervention (Chang et al., 2020). Digitization of trade documents is also facilitated by the use of cryptographic algorithms on the blockchain, providing integrity and preventing counterfeiting (Chang et al., 2020). According to Frankenfield (2021), a smart contract is a digital contract in which the buyer and seller determine the terms of the agreement, which are then encoded and distributed through a decentralized blockchain network. When combined with blockchain technology, smart contracts provide security, auditability, and transparency for all trade finance stakeholders, including banks, importers, exporters, and insurers (Chang et al., 2020).

However, it is important to note that each blockchain platform has its unique design and adding new parties to the network will require their approval and adoption of the same protocols within that platform, as not mentioned in previous literature. Alsalim and Ucan (2023) stated that blockchain applications, such as the IBM Hyperledger environment, can operate as a plug-and-play package or module.

Blockchain technology offers a unique opportunity to bridge gaps in trade finance by altering its structural foundation, where adopting a decentralized and secure information-sharing system among relevant parties could help reduce friction and maintain the efficiency of intermediated trade (DICAPRIO and JESSEL, 2018). Likewise, Alsalim and Ucan (2023) argue that the complexity of economic transactions often leads to trade disputes and suggest that smart contracts can mitigate these issues by streamlining operations and reducing human error. They propose that a blockchain-based trade system could provide a better customer experience compared to current procedures. Therefore, numerous researchers have been conducted to examine the potential role of blockchain technology in banking and its applications within the financial sector, particularly for letters of credit.

Sukand et al. (2017) found that digital solutions for trade finance payments represent a win-win scenario for both banks and corporates by enhancing

banks' internal efficiency and service costs of trade finance provision. Recently, the findings of Khalil, Kerbache and Omri (2021) reveal that blockchain generates significant increase in the efficiency of the L/C process by up to 94%. Specifically, the authors indicate that the blockchain-based letter of credit enhances productivity and reduces processing costs and time through eliminate the long circulation of L/C documents among parties and decreasing the excessive number of employees for processing documents. In addition, while the processing time for L/C is from 15 to 30 days, the average process under blockchain-based L/C will be reduced to 1 to 4 days due to the transformation of complete paper process to a digital process (Khalil, Kerbache and Omri, 2021). Besides saving time, moving away from a single centralized system to a collaborative network that is distributed, where allows for the easy transfer of value within a transparent ecosystem and facilitates the automation of processes (Chang et al., 2020). Consequently, this paradigm shift has the potential to prevent trade frictions and significantly speed up document transfers from days to minutes. A shared single source of truth among relevant parties can reduce costs linked to errors caused by repetitive verification, leading to shorter financing times. As a result, fewer errors in information transfer can lower additional costs associated with riskier trades (DICAPRIO and JESSEL, 2018). Furthermore, the use of blockchain platform for LCs can reduce transaction and associated costs, including those linked to searching, bargaining, and policing (Chang et al., 2020).

Technology offers a reliable and tamper-proof record of the trade asset's history, validates its authenticity, and reduces the expenses associated with ensuring compliance Belin (2019). Furthermore, Moyano and Ross (2017) suggest that the adoption of this technology can enhance national regulators' capability to track and audit financial records related to trade, where these records can serve as a trusted and single source of truth during the case of disputes. In this regard, blockchain is considered by Kowalski, Lee and Chan (2021) as an effective solution for persistent trust concerns between trading partners involved in trade finance. The recent study of blockchain Alsalim and Ucan (2023) highlights the immutability of the blockchain-based distributed ledger which decreases the risks and costs involved in transmitting LCs and Bills of Lading (BoL) by providing a secure and regulated way to share information and services. Likewise, Osés et al. (2020) claim that the use of a distributed database with immutable registration of essential parameters could greatly reduce document inconsistencies and asymmetry issues, common causes of delays and extra expenses, providing increased efficiency throughout the life cycle of LC, including issuance, securitization, execution, clearing, and settlement of securities. The characteristics of blockchain technology

that can enhance profitability include a shared and trustworthy layer of information, the automation of processes, the use of oracles, and the implementation of single or multiple signatures, which ultimately eliminates the need for confirmation steps since all parties involved can rely on the accuracy and consistency of the information (DICAPRIO and JESSEL, 2018).

KYC/AML requirements, which are related to regulatory compliance, and the high costs associated with document processing are closely linked to verification problems, according to (Osés et al., 2020). In this respect, DICAPRIO and JESSEL (2018) indicate that 29% of trade finance rejections resulting from KYC concerns and regulatory compliance expenses and intricacies significantly contribute to transaction costs, although the implementation of digital solutions in trade finance has not been able to address regulatory issues, the authors point out that enterprise blockchains can alleviate regulatory compliance uncertainty by enabling live information sharing through a regulator node, requiring KYC checks by third parties, and providing retrospective analysis for effective regulation. The key features of blockchain that facilitate regulatory compliance are notary functionality, regulator nodes, attestations, and audit trails. The authors add that unlike existing RegTech solutions that focus only on KYC simplification, blockchain allows regulators to have direct insight into transactions, thus reducing the reporting burden by incorporating it into the transaction itself. Blockchain has to the potential to reengineer business and trading processes in terms of decreasing effort and enhancing the ability to track products from their origin to their destination (Chang et al., 2020; Kshetri 2018).

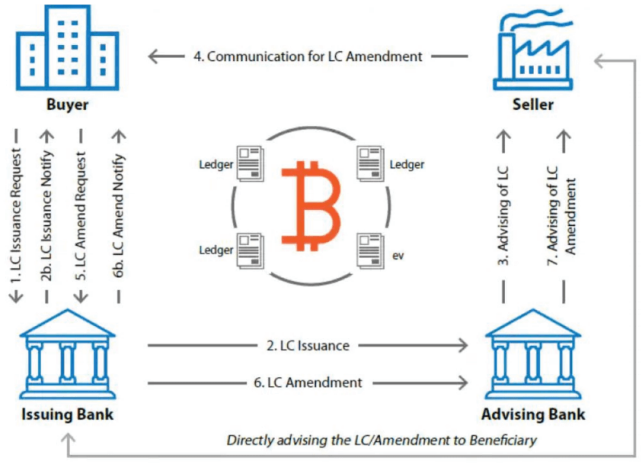


Figure 3. Process of Blockchain-based LCs (Source: Infosys BPM)

The empirical investigations by Beck (2003) and Svaleryd &Vlachos

(2005) conclude that the advanced financial industry facilitates external financing access for firms and tackles the dilemma of liquidity constraints. In addition to blockchain's advantages of mitigating risks, speeding up transactions and increasing transparency, unlocking capital and financing are representing the alternative key to narrowing the trade finance gap, particularly for SMEs (Truby, Dahdal and Caudevilla, 2022; WEF, 2018). Given that expensive processing costs for LC, which are partially due to inefficient document verification procedures, raise the transaction costs for SMEs, these costs can be reduced through the adoption of blockchain-based letters of credit, as previously described (Osés et al., 2020). The authors argue that despite the level of risk associated with a firm being indicative of an information asymmetry issue, the implementation of blockchain would enable SMEs with a strong history to efficiently communicate their creditworthiness to unfamiliar banks. From the same perspective, DICAPRIO and JESSEL (2018) suggest that Storing transactions on a blockchain creates a wealth of metadata that financial institutions can use to assess the performance risk of SMEs accurately and efficiently.

Since 2016, there has been a significant increase in research, initiatives, and conversations surrounding the use of blockchain technology to digitize trade finance (Ioannou and Demirel, 2021). Furthermore, Dahdal, Truby and Botosh (2020) refer that the adoption of blockchain technology to streamline trade finance procedures is part of a larger global initiative by organizations such as the WTO, UNCTAD, ICC, and WCO to advance the eTrade agenda. In 2019, survey results from the University of Cambridge showed that blockchain adoption is being considered by business users as a cost-saving technology (Rauchs et al., 2019). The emerging perspectives towards blockchain applications in finance suggest that this technology is more likely to gain popularity initially in areas where there is minimal automation and high inefficiencies due to a reliance on manual processes such as trade finance (World Bank, 2017). Recently and during the Covid-19 pandemic, ICC Global Survey on Trade Finance (2020) shows that most companies have seen a positive impact on their plans and actions related to blockchain due to the pandemic.

The first global blockchain-based LC was on 6 September 2016 from Barclays bank in cooperation with blockchain start-up called Wave, where the products were butter and cheese between Ornua and Seychelles Trading Company. Barclays observed a substantial decrease in the time taken to process trade finance, specifically, it was accomplished in four hours), while implementation of a blockchain-based LC eliminates the need for paper-based transactions, allowing traders to reap the rewards

of adopting this technology (Chang et al., 2020). Moreover, several cases were conducted afterwards through blockchain-based LC have listed by Chang et al. (2020). For instance, On 6 July 2017, the Japanese company Marubeni and Sompo demonstrated the effectiveness of using blockchain technology to replace L/Cs and other trade documents. Their trade deal was conducted via IBM's Hyperledger Fabric platform, reducing the transaction time from weeks to just two hours. In 2018, HSBC conducted its first blockchain-based LC with the U.S. agricultural group Cargill, using a consortium chain for soybean shipments, and facilitating transactions between the R3 counterparty and the Dutch bank ING. The Spanish bank Banco Bilbao Vizcaya Argentaria also used blockchain technology in 2018 to reduce transaction time from 10 days to less than three hours for the export of frozen tuna from Mexico. Furthermore, Eberhardt and Tai (2017) state that, IBM and Maersk by using blockchain L/C reduced document transmission time from days to just a few hours, eliminating the need for repeated confirmation or manual checks that are typical in trade logistics/ payment contexts. Additionally, IBM and Maersk were able to significantly reduce document transfer costs to just 15% of the total cost for container tracking. Similarly, the authors indicate that in September 2017, Hyundai Merchant Marine used blockchain technology to track refrigerated containers from Busan to Chengdu in China.

Chang et al. (2020) conclude based on the previous cases that the blockchain allows trading parties, such as carriers, exporters, importers, and banks, to utilize shared distributed ledgers for trade finance, while digitized trade documents can be automatically executed through smart contracts using preset codes. Additionally, event-driven mechanisms assist in the flow of crucial information between parties, reducing trade friction and the cumbersome transfer of goods and documents, resulting in nearly real-time monitoring of workflow status. Li.kewise, Alsalim and Ucan, (2023) point out that the proposed system's trialability is considered satisfactory, as demonstrated by the successful testing and implementation of blockchain technology in the global shipping and international trade sectors. It is noteworthy to mention that the blockchain-based letter of credit is conducted through Contour blockchain platform (Khalil, Kerbache and Omri, 2021). Contour was established in 2017 as a cooperative venture between eight banks and R3, with the aim of creating a global blockchain-based network and application for digitizing the $18 trillion trade finance industry. In January 2020, Contour was commercially launched, and it now includes the following members: ING, Citi, CTBC, Standard Chartered, RBS, SEB, BNP Paribas, HSBC, and Bangkok. The platform has been used in trials by more than 50 banks and corporations, with simulations of multiple digital Letter of Credit

transactions across 27 countries on six continents (Contour, 2020).

Although the previous case studies highlight the crucial role of blockchain to improve the global trade finance industry, there are technical obstacles and legal constraints that might delay the widespread adoption of blockchain-based letters of credit (Chang et al., 2020). Some regulatory frameworks require the presence of paper documents instead of digital or electronic documents, whereas transforming the document from paper to digital doesn't imply comprehensive digitalization for the process (Khalil, Kerbache and Omri, 2021). The World Bank (2017) notes that the infrastructure of the financial sector may face a significant challenge in terms of the high expenses associated with moving their long-standing IT systems, operational processes, and regulations to blockchain-based infrastructure. However, major central banks such as the Fed, Bank of England, FCA, European Central Bank and RBI are setting essential regulatory provisions and practices about using blockchain technology that must be followed by financial market participants (Bhogal and Trivedi, 2019). According to Ruslan (2022), it is important that more financial institutions have to engage with blockchain-based LC services to adopt this efficient approach within international trade.

4. Empirical strategy

This research attempts to test the hypothesis that transaction costs factors have negative effects on the extent of trade finance in Kuwait, particularly about the documentary letters of credit. In addition, the research aims to build an economic impact of the potential role of utilizing blockchain technology on letters of credit and measure the estimated gains of eliminating inefficiency patterns in trade finance by Blockchain-based Letters of Credit. The research's objectives will be conducted by applying several datasets on multiple analytical approaches.

I. Data

The empirical analysis of the research will employ multiple annual time series datasets from different sources. The sample period of datasets covers 19 years from 2001 to 2019. The type of the examined data is divided into two categories: 1) Trade finance and Macroeconomic, and 2) Transaction costs.

The data of the response variable in this investigation is the ratio of Documentary Letters of Credit to Total Imports in Kuwait. The variable of LCs to Imports ratio was obtained from the Central Bank of Kuwait through dividing the sum value of Documentary Letters of Credit issued in Kuwait by the Total value of Imports. The independent variables in this

model are divided into two components: macroeconomic variables and transaction cost variables. The applied model is described by the following expression:

$$LCs/Imports = f(GDP, Exchangerate, TradeBalance, Oilrent, EconomicFreedom, Tradingscore) \quad (1)$$

The macroeconomic variables are used in the estimation model as control variables. Macroeconomic variables include the Real Gross Domestic Product (GDP) of Kuwait, where it's obtained from the World Bank Data, and it's measured by current $US dollar. The second variable is the annual Exchange rate of USD against KWD where it's gathered from the Central Bank of Kuwait. The third variable is the balance of trade which represents the monetary value difference between exports and imports, and it's obtained from the CBK as well. The fourth and last macroeconomic variable is Oil rent which's obtained from the World Bank and captures the economic dependency on oil as a percentage of the total GDP.

Transaction costs variables are the variables of this research's interest, and they include the overall score for economic freedom indices and the score of trading across borders. The variable of the overall score for Economic Freedom indicators in Kuwait is an index score (0-100 scale) obtained from the Heritage Foundation. This score is an overall indicator for the following measurements: government size, the rule of law, open markets and regulatory efficiency. The second variable of the transaction costs category is the score of Trading Across Borders (0-100 scale) which's obtained from Doing Business indicator by the World Bank and it's measuring the relevant time and costs with the process of exporting and importing goods.

II. Methodology

The empirical strategy for this research will follow multiple econometric techniques in order to obtain valid outcomes and reach an objective analysis. Firstly, observe the summary of the descriptive statistics for all variables that have used in this research. Descriptive statistics explains several features of these variables during the sample period from 2001 to 2019 and identifies average, median, maximum and minimum values of the employed datasets. Secondly, transforming the raw time series data into the natural log to become much more symmetric and less skewed. Thirdly, Augmented Dickey–Fuller test (ADF) will be conducted, which's a unit root test to avoid spurious regression through testing the stationary of the time series variables and to show the signs of non-stationary either in level or 1st difference or 2nd difference. Fourthly, the Cointegration test will be applied after ADF test to estimate the long-run relationship between variables to run ordinary least squares regression later. The fifth technique

will be the Ordinary Least Squares (OLS) is the best estimator for linear relations among the dependent variable x and independent variables y and it estimates the best possible linear relationship between the dependent and independent variables.

The main purpose of the OLS regression model is to measure the association and elasticity changes between dependent and independent variables in our empirical study. The initial estimation model will be as the following:

$$LC\_M_t = B_0 + B_1 GDP_t + B_2 EXR_t + B_3 BOT_t + B_4 Oil_t + B_5 FREE_t + B_6 TSC_t + \varepsilon_t \quad \textbf{(2)}$$

Where B_0 is the intercept; coefficients of B_1, B_2, B_3, B_4, B_5 and B_6 are the slope of the model's coefficients; the variable "LC_M" indicates LCs to Imports ratio; the variable "GDP" represents the real Gross Domestic Product; the variable "EXR" denotes the exchange rate; the variable"BOT" is the balance of trade; the variable "Oil" measures the oil rent as a percentage of the total GDP; the variable "$FREE$" is the overall economic freedom index; the variable "TSC" indicates the score of trading across borders; and ε refers to the error term.

The last approach will be Granger causality test to forecast the future values of a time series using prior values of the other time series and to estimate the causality among the dependent variable and independent variables.

The reliability of the model's outputs will be examined through diagnostic tests such as autocorrelation (Durbin-Watson and Lagrange Multiplier) and heteroscedasticity tests (Breusch-Pagan-Godfrey, Glejser, Harvey, ARCH and White). The normality of the model will be examined using the Jarque-Bera test. The inclusion of the LM test is crucial due to the small sample size, as it is known to be more powerful in detecting higher orders of serial correlation. In contrast, the DW test is more suitable for larger samples and it might yield inconclusive results in smaller samples, according to previous studies (Breusch and Pagan, 1980; Mizon and Hendry, 1980; Kiviet, 1986; Hole, 2006; Asteriou and Hall, 2007). Moreover, the stability of the model will be evaluated by cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive

residuals (CUSUMSQ).

Eviews11 statistical software is used to conduct all econometric approaches.

5. Results

I. Descriptive Statistics

The summary of variables shows different features about the applied variables during the sample period (see Table.2). The average (mean) of LCs-to-Imports ratio was 35.8% from 2001 to 2019, which implies that 35.8% of imported goods in Kuwait were financed by letters of credit during the mentioned period. The highest LCs-to-Imports ratio was in 2008 by 55%, while the lowest ratio was 16.8% in 2017. There was gradual decrease in the LCs-to-Imports ratio throughout the selected 19 years, where the percentage rate from 2001 to 2019 was -55%.

On the other hand, transaction costs' variables display different patterns. The index of overall economic freedom was 64.67 on average, where the highest score was in 2001 and the lowest was in 2019. Likewise, the average score for trading across borders was 60.2, while the highest in 2013 and the lowest in 2015 and 2016. The percentage change for the economic freedom index and trading across borders was 10.8% and 16.7%, respectively. Generally, the data of trade finance and transaction costs reveal that there was remarkable drop in financing imports and the overall economic performance and foreign trade activities from 2001 to 2019. Similarly, these primary results indicate an increase in restrictions during the selected period on trade finance activities, economic freedom and trading across borders.

	Mean	Median	Maximum	Minimum	Observations

LCs-to-Imports ratio	35.803	33.626	55.024	16.800	19
GDP	108.400	114.603	174.161	34.888	19
Exchange rate	0.29204	0.29200	0.30653	0.26853	19
Trade Balance	11074.74	9806.90	24419.60	1930.50	19
Oil rent	46.169	47.904	58.186	32.520	19
Overall Economic Freedom	64.67	64.90	68.20	60.80	19
Trading across borders score	60.20	60.67	68.02	48.824	19

Table 2. Descriptive statistics

II. Data Transformation

As mentioned above in the methodology section, the time series datasets have to be turned into the natural log transformation to reduce skewness in the model and gain interpretable outcomes. Therefore, the estimation model is extended as follows:

$$Log(LC\_M)_t = B_0 + B_1 Log(GDP)_t + B_2 Log(EXR)_t + B_3 Log(BOT)_t + B_4 Log(Oil)_t + B_5 Log(FREE)_t + B_6 Log(TSC)_t + \varepsilon_t \quad (3)$$

III. Augmented Dickey–Fuller test (ADF)

The outcomes of ADF test indicate that all the seven applied variables are stationary at the first difference in constant and trend, as reported below in Table.3 .

As a result of the unit root test, we extend the model (3) as follows:

$$\Delta Log(LC\_M)_t = B_0 + B_1 \Delta Log(GDP)_t + B_2 \Delta Log(EXR)_t + B_3 \Delta Log(BOT)_t + B_4 \Delta Log(Oil)_t + B_5 \Delta Log(FREE)_t + B_6 \Delta Log(TSC)_t + \varepsilon_t \quad (4)$$

Where Δ refers to the first difference.

Table 3. ADF unit root test outcomes

Series	Level Constant	Level Constant and Trend	1st Difference Constant	1st Difference Constant and Trend
LCs-to-Imports ratio	-0.1560 (0.9291)	-1.9493 (0.5902)	-3.4285 (0.0236)**	-3.4432 (0.0769)*
GDP	-1.7944 (0.3716)	-1.0444 (0.9124)	-3.1348 (0.0418)**	-4.1583 (0.0259)**
Exchange rate	-1.7569 (0.3888)	-1.5757 (0.7641)	-4.6619 (0.0020)***	-4.6245 (0.0099)***
Trade Balance	-2.4515 (0.1428)	-1.2706 (0.8639)	-3.0040 (0.0535)*	-3.8147 (0.0458)**
Oil rent	-2.2904 (0.1846)	-2.3029 (0.4127)	-4.0100 (0.0073)***	-3.8778 (0.0358)**
Overall Economic Freedom	-2.0358 (0.2704)	-3.0343 (0.1491)	-5.5664 (0.0003)***	-5.3724 (0.0023)***
Trading across borders score	-1.1281 (0.6820)	-1.6713 (0.7239)	-4.0886 (0.0063)***	-4.1280 (0.0227)**

Note: *, **, *** represent 10%, 5% and 1% of significance, respectively.

IV. Johansen Cointegration test

Since all variables are stationary at the 1st difference, Johansen Cointegration test is applied to find out multiple cointegration vectors. Table.4 and Table.5 indicate that in Johansen test (Trace) there are three cointegrating equations at 5% significance level, while in Johansen test (Maximum Eigenvalue) there is one cointegrating equation at 5% significance level. These outcomes imply that we reject the null hypothesis, and the series are cointegrated and move together in a long-run relationship.

Table 4. Trace cointegration test result

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.952976	162.1513	125.6154	0.0001
At most 1 *	0.855653	107.1236	95.75366	0.0066
At most 2 *	0.768302	72.28398	69.81889	0.0314
At most 3	0.680374	45.96219	47.85613	0.0745
At most 4	0.446874	25.43130	29.79707	0.1466
At most 5	0.400328	14.77223	15.49471	0.0640
At most 6 *	0.266045	5.567529	3.841466	0.0183

Table 5. Maximum Eigenvalue cointegration test result

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.952976	55.02765	46.23142	0.0045
At most 1	0.855653	34.83963	40.07757	0.1730
At most 2	0.768302	26.32179	33.87687	0.3015
At most 3	0.680374	20.53089	27.58434	0.3056
At most 4	0.446874	10.65907	21.13162	0.6812
At most 5	0.400328	9.204704	14.26460	0.2695
At most 6 *	0.266045	5.567529	3.841466	0.0183

V. Ordinary Least Squares (OLS)

The estimated results of OLS regression model are shown in Table.6. The coefficients in the estimated model present the relationship and percentage change between the dependent variable (LCs-to-Imports ratio) and independent variables (GDP, Exchange rate, Trade Balance, Oil rent, Overall Economic Freedom and Trading across borders score). The probability values denote the significance level among the dependent variable and independent variables at 1%, 5% and 10% significance level. The model is attributed to high robustness estimation as it's indicated through R^2 result of 84%.

The results of the regression model show that most of the variables are statistically significant at 1%, except GDP is insignificant at any level. Regarding macroeconomic variables and their relationship with the LCs-to-Imports ratio, the model points out the majority have negative effects, except Trade Balance. Despite that GDP is statistically insignificant, the results indicate that if GDP decreases by 1% then the LCs-to-Imports ratio will be decreased by 0.63%. The Exchange rate of USD against KWD has the greatest impact within the model, where it reveals that a 1% decline in the Exchange rate will lead LCs-to-Imports ratio to be reduced by 5%. However, the model indicates that any 1% rise in Trade Balance is lowering LCs-to-Imports ratio by 0.8%. Furthermore, model's findings show that

any 1% decline in Oil rent will trigger 1.64% decrease in LCs-to-Imports ratio.

In terms of transaction costs estimated variables, which are variables of the research interest, the model confirms that all of them have negative implications. The outcomes of the model indicate clearly that a 1% drop in the index of Overall Economic Freedom is associated with 2.09% reduction in the ratio of LCs-to-Imports. Likewise, the results refer that any 1% decrease in the score of Trading across borders would depreciate LCs-to-Imports ratio by 1.04%.

Dependent Variable: LCs-to-Imports ratio			
Variable	**Coefficient**	**t-Statistic**	**Prob.**
Intercept	-0.086744	-3.731299	0.0029***
GDP	-0.637343	-1.718946	0.1113
Exchange rate	-5.010224	-3.716126	0.0029***
Trade Balance	0.798943	4.216251	0.0012***
Oil rent	-1.646165	-5.595943	0.0001***
Overall Economic Freedom	-2.086244	-3.798178	0.0025***
Trading across borders score	-1.038699	-3.608018	0.0036***
R^2	0.840725		
Durbin-Watson statistic	1.398276		

Table 6. OLS regression outputs

Note: *, **, *** represent 10%, 5% and 1% significance level, respectively.

VI. Granger causality test

The Granger causality test results are presented in Table.7. The null hypothesis being that the LCs-to-Imports ratio does not cause or lead the relevant time series variables, and vice versa. While the OLS regression model outcomes in Table.6 exhibit a statistically significant relationship between the dependent variable and most of the independent variables, the results from the Granger causality test indicate that the explanatory variables don't influence the direction of the LCs-to-Imports ratio. Nevertheless, the findings suggest a causal relationship between the LCs-to-Imports ratio and the transaction costs variables.

This implies that the LCs-to-Imports ratio has the ability to impact the Overall Economic Freedom index and the Trading across borders score, with the former variable serving as a predictive measure for the latter variables and assisting in identifying their direction. Therefore, the results imply that an increase in the LCs-to-Imports ratio would mitigate the adverse effects of the transaction costs variables.

Direction of Causality	Number of lags	*F* value	Prob.**	Decision
GDP ⟶ LCs-to-Imports	1	1.54401	0.2319	Accept
LCs-to-Imports ⟶ GDP	1	0.01011	0.9212	Accept
Exchange rate ⟶ LCs-to-Imports	1	0.83243	0.3751	Accept
LCs-to-Imports ⟶ Exchange rate	1	1.41921	0.2509	Accept
Trade Balance ⟶ LCs-to-Imports	1	0.61918	0.4429	Accept
LCs-to-Imports ⟶ Trade Balance	1	0.00041	0.9842	Accept
Oil rent ⟶ LCs-to-Imports	1	1.40602	0.2530	Accept
LCs-to-Imports ⟶ Oil rent	1	0.39863	0.5367	Accept
Economic Freedom ⟶ LCs-to-Imports	1	1.58627	0.2259	Accept
LCs-to-Imports ⟶ Economic Freedom	1	6.65173	0.0202	**Reject**
Trading score ⟶ LCs-to-Imports	1	0.00731	0.9329	Accept
LCs-to-Imports ⟶ Trading score	1	3.44324	0.0820	**Reject**

Table 7. Results of Granger causality test

VII. Diagnostic tests

The diagnostic tests are conducted on the estimated model to identify the lack of spurious outcomes produced by the model and to examine the robustness of the results.

Since the reported value of Durbin-Watson test in Table 6. lies within the indecision zone and provides an inconclusive result, as described by Asteriou and Hall (2007), Lagrange Multiplier (LM) test is utilized to detect the autocorrelation. The result of the LM test in Table.8 shows that the hypothesis of no serial correlation is accepted. Therefore, the result confirms the reliability of the applied estimation model and indicates that the serial correlation does not exist.

Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	1.109442	**Prob.**	0.3671

Table 8. Result of Serial correlation LM test

The presence of heteroscedasticity is examined through various heteroscedasticity tests, and the results are presented in Table 9. The p-values associated with these tests indicate that all of them provide evidence in support of the null hypothesis of homoscedasticity. This implies that the estimated model can be considered reliable and is not affected by heteroscedasticity. Moreover, the result of the normality test in Table 10. confirms the normality in the estimated regression model, further enhancing the reliability and robustness of the findings.

Null hypothesis: Homoskedasticity			
Test: Breusch-Pagan-Godfrey			
F-statistic	1.082383	Prob.	0.4251
Obs*R-squared	6.671875	Prob.	0.3523
Test: Glejser			
F-statistic	1.206728	**Prob.**	0.3668
Obs*R-squared	7.149917	**Prob.**	0.3072
Test: Harvey			
F-statistic	0.700129	**Prob.**	0.6553
Obs*R-squared	4.926596	**Prob.**	0.553
Test: ARCH			
F-statistic	9.40E-05	Prob.	0.9924
Obs*R-squared	0.000106	Prob.	0.9918
Test: White			
F-statistic	1.594512	Prob.	0.2313
Obs*R-squared	8.428328	**Prob.**	0.2084

Table 9. Heteroscedasticity tests

Normality test (Jarque-Bera test)			
Jarque-Bera	0.632388	**Prob.**	0.728918

Table 10. Normality test

VIII. Model stability

The cumulative sum plot of recursive residual (CUSUM) and the cumulative sum of squares plot of recursive residual (CUSUM sq) for the model are shown in Figure.4 and Figure.5, respectively. The purpose of CUSUM and CUSUM sq is to determine the stability of the model parameters. The outcomes confirm the stability of the model parameters and ensure that the values of the coefficients lie inside the critical bound values.

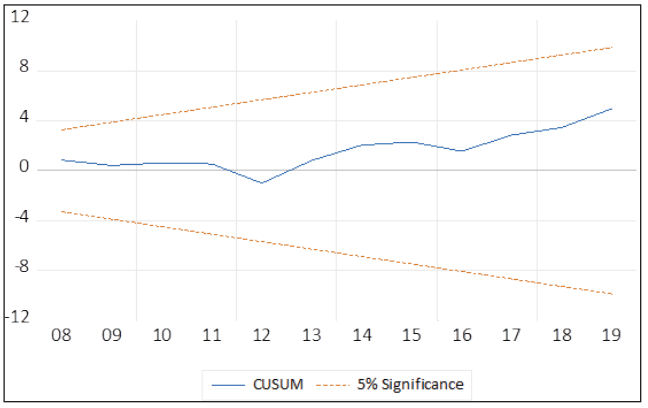


Figure 4. CUSUM test

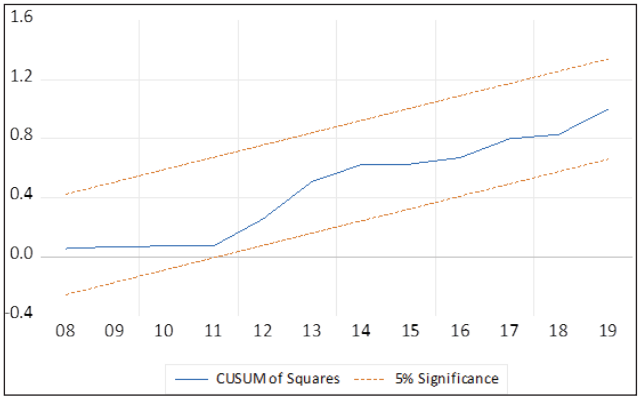


Figure 5. CUSUM sq test

6. Discussion

The outcomes of the examined model above have confirmed the existence of the long-run relationships among LCs-to-Imports ratio and macroeconomic and transaction costs variables. The general view of coefficients' signs of the OLS regression model reveals that the transaction costs factors have significant negative implications on the extent of letters of credit in Kuwait, which implies that economic constraints and trade barriers are affecting trade finance facilities.

According to the OLS regression model, macroeconomic variables are influencing LCs-to-Imports ratio by more than 6.5%. Although GDP is statistically insignificant in the model, it negatively affected the extent of LCs by 0.63%. This implies that when the economy shrinks it will reduce trade and financial transactions, consequently. The outcomes indicate that the Exchange rate of USD against KWD demonstrates a notable impact within the model, accounting for 5%. This finding carries various monetary implications within the given context. For instance, the variations observed in the USD during the period when KWD was pegged to it (2003-2007) and following the financial crisis of 2008 have influenced the general price level and consequently influenced the costs associated with trading and financing activities. Otherwise, the result of the Trade Balance has an inverse relationship with LCs-to-Imports ratio, where when the former increases the latter tends to decrease by 0.8%. This phenomenon could be attributed to the nexus between trade surplus and inflation, which in turn triggers a raise in trade finance costs afterwards. Furthermore, Oil rent represents critical element in the model, where it decreases trade finance transactions by 1.64%. The importance of oil in the case of Kuwait is represented by the massive dependency of the Kuwaiti's economy on oil as an engine for growth, where Oil rent on average counts 46% of the total economy within the sample period.

Alternatively, the results of transaction costs variables brought considerable reasons about their effects on trade finance transactions in Kuwait. The regression model's outcomes point out that weakening Economic Freedom index and Trading Across Borders are contributing on average into more than 3% annual reduction in LCs-to-Imports ratio. In terms of Overall Economic Freedom index variable, it has significantly the largest negative impact on the share of imports financed by letters of credit in Kuwait by 2.086%. This interpretation of this result refers that any additional constraints in trade and finance activities would restrict economic performance by enterprises and minimize the ability to trade and doing business, and as a result, it's negatively reflecting on the ratio of LCs-to-Imports. Comparably, the outcome of Trade Across Borders variable has recorded significant negative associations with trade finance provisions for importing goods by 1.038%. This result implies that any trade and financial restrictions will trigger a fall in trade finance provisions for importers by more than 1%. Overall, the model accepts the hypothesis that transaction costs factors are causing a remarkable reduction in trade finance activities and it's adding more obstacles for enterprises and for importers in specific. Meanwhile, Granger causality test refers that LCs-to-Imports is affecting Overall Economic Freedom index and the score of Trading Across Borders, where these results imply that any increase in the share of financed imports by LCs will lead into improving the indicators of economic freedom and foreign trade, and vice versa.

The Potential Role of Blockchain-based Letters of Credit

Hence, as transaction costs represent an important factor in the provision of letters of credit in the case of Kuwait, the need to mitigate these costs is required in this context. In light of the potential role of the blockchain technology to eliminate and reduce the relevant transaction/friction costs with letters of credit, it seems clear that adopting Blockchain-based-LCs would improve trade finance

instruments in the financial sector in Kuwait and facilitate credit's accessibility for importers through removing transaction costs obstacles.

Given that the transaction costs are negatively influenced LCs-to-Imports ratio in Kuwait by 3.1 per cent, Table.11 provides our magnitude assumptions for Blockchain-based Letters of Credit potentiality to eliminate the transaction costs and its reflections on financing imports by LCs. The assumptions about the potential role of blockchain to mitigate transaction costs are divided into three scenarios: full reduction of 100%, 50% reduction and 25% reduction. These assumptions imply that adopting blockchain for LCs operations in Kuwait would clawback and increase LCs-to-Imports ratio by 3.1%, 1.6% and 0.8%, respectively based on the reduction scenario.

Highest Scenario (Full reduction 100%)	Moderate Scenario (50% reduction)	Lowest Scenario (25% reduction)
3.1%	**1.6%**	**0.8%**

Table 11. Reduction scenarios for transaction costs by Blockchain-based LCs

Back to the estimation model results for the transaction costs variables, adopting Blockchain-based Letters of Credit could increase LCs-to-Imports ratio by 2.086% by raising the index of overall economic freedom in Kuwait, which's through improving the trade and financial efficiency and eliminating complicated procedures. Similarly, 1.038% could be added to LCs-to-Imports ratio if blockchain is used within the trade finance industry to increase the score of trading across borders in Kuwait by reducing the associated time, cost and compliance procedure of exchanging goods.

7. Conclusion

This research attempts to identify the potential role of adopting blockchain technology for the issuance procedure of letters of credit in Kuwait and build economic estimation for eliminating the transaction costs in the trade finance sector. This empirical investigation has found several positive outcomes in this matter, through using a sample of annual time series data from 2001 to 2019 of Kuwait for LCs-to-Imports ratio as the dependent variable in this research and macroeconomic variables with transaction costs variables, as independent variables.

The estimated outcomes through Johansen cointegration test and Ordinary Least Squares regression illustrate that all the applied independent variables within the model have long-run relationships and they were statistically significant with the LCs-to-Imports ratio, except GDP as a macroeconomic control variable. The variables of the transaction costs are the focus of this research and they show strong effective role, by reflecting negatively on LCs transactions in Kuwait. Implementing Blockchain-based Letters of Credit to eliminate the frictional costs will be associated with a considerable increase in the ratio of LCs to imports in Kuwait and would enhance trade finance provisions and international trade activities. The results reveal that the magnitude assumptions to increase LCs-to-Imports ratio is from 3.1% to 0.8% at least through implementing blockchain technology on the trade finance infrastructure.

Broadly, these outcomes should be considered in order to attain the objectives of the national strategic plan "New Kuwait 2035 Vision" towards economic diversification and implement CBK's vision to digitalize financial services. This research recommends the importance and the need to utilize blockchain within trade finance transactions in the near future to increase efficiency within the financial and trade sectors and clawback the losses that might be gained from the transaction costs, in order to close the trade finance gap

and provide financial accessibility for local enterprises. The banking sector and regulatory authorities in Kuwait are recommended to follow advanced and regional economies' efforts to conduct a legal review and technical attempts to explore the possibility of digitalizing trade finance activities through blockchain technology.

8. Limitations and Further Research of the Study

This study investigates and measures the potential benefits of adopting blockchain-based LCs at the country-level from an economic perspective. The study's scope is constrained by the lack of detailed sectoral data on banks in Kuwait, which impedes the analysis of the implications of blockchain technology implementation on trade finance instruments at the firm-level. Specifically, the absence of certain data, such as transaction costs and the associated costs of current trade finance procedures, hinders a comprehensive evaluation of the potential financial and administrative advantages of utilizing blockchain within the banking sector in Kuwait.

Additionally, the study is constrained by the limited time span of available data on transaction costs indicators, which restricts the sample size and limits the expansion of the estimated model to cover further periods. Furthermore, the study primarily focuses on the general economic impacts of blockchain-based LCs, rather than delving into regulatory frameworks or evaluating the technological capabilities within the local financial infrastructure.

The identified limitations present valuable insights and recommendations for future research in this area. To address the gaps in sectoral-level analysis, it is suggested to collect statistical data from local commercial banks regarding the operational costs involved in processing LCs, the trade finance workforce and the average time taken for procedures. By obtaining such data, a comprehensive evaluation and cost-benefit analysis can be conducted to assess

the potential tendency of the local banking sector towards adopting blockchain technology in trade finance activities.

Furthermore, the legal perspective should be considered when applying blockchain to trade finance operations, taking into account existing financial legislations and regulations. Additionally, the technological capabilities of the local financial industry and the associated risks of implementing blockchain technology require further investigation from a technical perspective.

Generally, these suggestions for future research identify and mitigate potential risks and challenges of adopting blockchain technology in trade finance within the context of Kuwait's banking sector.

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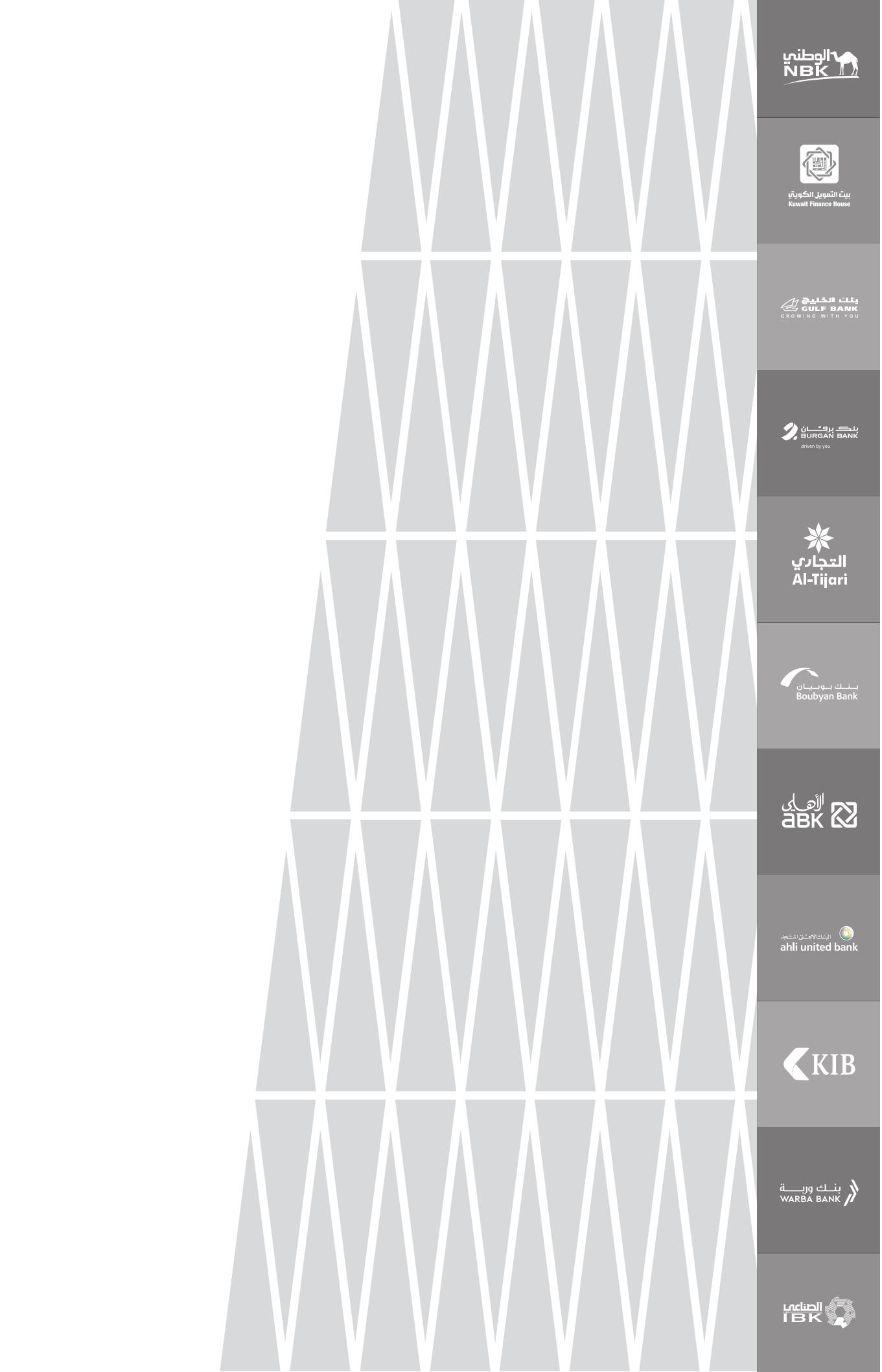
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