European Economic Letters
ISSN 2323-5233
Vol 14, Issue 3 (2024)
http://eelet.org.uk

The Impact of Financial Technology on the Performance of Financial Markets

An Analytical and Econometric Study on the X-Stream INET Electronic Trading System in the Saudi Stock Exchange during the Period from 2012 to 2022

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Received: 27/04/2024 **Accepted: 28/06/2024** **Published: 30/07/2024**

Abstract:

This study aims to measure the impact of the application of financial technology represented by the electronic trading system on improving the performance of financial markets. In order to answer the problem of the study, the X-stream INET electronic trading system was chosen to measure the impact of its application on the performance of the Saudi Stock Market (Tadawul) during the period from 2012 to 2022.

The study sample consists of annual data in relation to the analytical study and monthly data in relation to the standard study, where the Wilcoxon statistical test was used to measure the impact of the X-stream INET electronic trading system on the performance of the Saudi capital market during the period from 2012 to 2019.

The study concluded that the application of the X-stream INET electronic trading system has contributed to improving the performance indicators of the Saudi capital market during the period from 2016 to 2022, compared to the period from 2012 to 2015.

Keywords: Financial Technology, Electronic Trading System, Financial Markets, Capital Market Performance Indicators, Wilcoxon Test**.**

JEL Classification Codes: O14, G1, G10.

1. Introduction:

The latest financial technology has brought about a revolution and radical changes in the global and Arab financial systems in the past few years, where the deep integration between finance and technology has stimulated change in traditional financial field, enhanced innovation in financial services, improved resource allocation efficiency, increased diversification of financial products, improved traditional financial operations and management patterns, and further digitization of the financial industry. Financial technology startups have succeeded in innovating and offering a variety of financial services, including payment services, settlement, clearing, trading, digital currencies, money transfers, as well as lending, crowdfunding, wealth management, and insurance services, which now threaten the future of traditional financial services. Therefore, financial system institutions, especially financial markets, are seeking to introduce some changes in their business models by expanding their adoption of technology, investing in their infrastructure, and perhaps entering into partnerships with startups to improve their competitive capabilities and increase reliance on modern technology in delivering financial services. One of the most important products of financial technology and its applications in financial markets is known as the electronic trading system.

Many financial markets have automated their trading systems to take advantage of financial technology innovations and improve their efficiency and performance indicators. Electronic trading systems have changed the way financial markets operate, increasing the number of executed transactions, improving market liquidity and transparency, and stimulating securities trading activity.

The Saudi financial market is one of the Arab financial markets that the supervisory authority always seeks to improve and develop. Therefore, the Saudi financial market is considered one of the first markets to implement electronic

trading system, and it continues to update, develop, and change it with more advanced systems to keep pace with market developments.

1.1. Study problem:

The X-stream INET electronic trading system is considered one of the latest electronic systems implemented by the Saudi stock market in 2015, and the Kingdom of Saudi Arabia is one of four global markets that use this system, which is considered one of the latest trading systems in the global market due to its features and advantages that make it provide the best financial services and solutions to the market. The Swedish company OMX is the designer and implementer of this system, and it is one of the best companies specialized in manufacturing and operating technologies in financial markets.

Through the foregoing, the outlines of the problematic aspects of our study are crystallized, which can be formulated in the following central question:

To what extent has financial technology, represented by the X-stream INET electronic trading system, contributed to improving the performance of the Saudi financial market during the period from 2012 to 2022?

1.2. Study hypotheses:

To answer this question, the following hypothesis was proposed:

Financial technology represented by the X-stream INET electronic trading system contributed to improving the performance of the Saudi financial market during the period from 2012 to 2022.

1.3. Study importance:

The importance of studying stems from the importance of financial markets as one of the most important foundations of the financial sector and a central component of the investment process. It plays a strategic and important role in the economic development process, particularly from a financial perspective, by mobilizing financial resources through its means and mechanisms to facilitate their transfer from surplus to deficit holders. In addition, it creates investment channels for capital owners to invest in, and it also works to provide all necessary information related to investments. To achieve these goals, markets must keep pace with financial developments, and financial technology is considered one of the most important developments in recent years, as it has revolutionized the world of financial services with a huge amount of technological innovations that have changed the way business is conducted, money is transferred, and daily transactions are made. It has also changed the way investors participate in financial markets. Therefore, the sustainability of financial markets, financial systems, and economies as a whole is contingent on their ability to keep up with these developments and innovations.

1.4. Study objectives:

Our study aims to:

- Introduce financial technology, electronic trading systems, and financial market performance indicators;
- Assess the impact of implementing financial technology represented by electronic trading systems on improving the performance of the Saudi financial market;
- Provide recommendations to benefit from the advantages of financial technology represented by electronic trading systems and to avoid its risks.

1.5. Study Structure:

This study, in addition to the introduction, was divided into two parts: first Literature Review about the extent to which financial technology contributes to improving the performance of financial markets, and second the applied study, which included an analytical and measurement study on the impact of applying financial technology on the performance of the Saudi capital market, in addition to a conclusion and recommendations.

2. Literature Review:

Several previous studies have addressed the impact of electronic trading systems or financial technology on the performance of financial markets in an intensive and diverse manner. These studies have indicated that the shift to electronic trading has significantly contributed to improving the performance of financial markets by increasing the speed of transaction execution and reducing transaction costs. They have also highlighted the role of financial technology in enhancing transparency and providing a wider range of information to investors, leading to improved ability to make informed investment decisions. However, some studies have shown that these improvements may be accompanied by new challenges, such as increased exposure to technological and security risks and the emergence of new trading practices that may affect market stability. In general, the literature emphasizes that financial technology offers significant opportunities to improve the performance of financial markets, but it requires careful risk management to ensure the realization of the desired benefits. We will present these studies and arrange them from oldest to most recent.

)**Market Policies Group (Bank of Japan)**(**2001** ، Focused on recent developments in electronic trading systems and their impact on Japanese government securities and foreign exchange markets, taking into account a recent study conducted by central banks of the G10 titled "Reflections of Electronic Trading in Financial Markets, January 2001.

Electronic trading in Japan represents a large percentage (about 90%) of all foreign exchange transactions among traders. In contrast, electronic trading has not yet captured a large share of either foreign exchange transactions between traders and clients or transactions in government securities (neither in interdealer trading nor between dealers and clients), although electronic trading has the potential to enhance operational efficiency and price discovery. Therefore, it is important for enhancing market liquidity, automating operational processes, and ensuring competitiveness in electronic trading services to reap the full benefits.

In same vain **)Masoud(2013** ،aimed to shed light on the impact of adopting an electronic trading system on the performance of the Amman Stock Exchange, represented by the traded value and market capitalization. To address the study's problem, the differences between the two samples were analyzed: the study variables before the system's introduction, and the other after its introduction, to determine if there is a significant difference in the exchange's trading volume before and after the introduction of the electronic trading system, and whether there is a significant difference in the market value of the listed securities before and after the system's introduction.

The study found that using the electronic trading system as an alternative to the manual trading system contributed to increasing the trading volume and market value of the Amman Stock Exchange, as the system facilitated control over trading operations and real-time information dissemination for both local and foreign investors, thus contributing to increasing market depth and liquidity.

- The results indicate that African stock exchanges cannot simply improve the performance of their financial markets by transitioning to electronic trading platforms.

)Heba Mahdi Saleh(2020 ،This study discuss determine the impact of the electronic trading system and central depository on the performance of the Iraqi financial market during the period from 2008 to 2018 after the conversion of the market system from manual trading to electronic trading in 2009.

To answer the problem of the study, performance indicators of financial markets were compared, represented by: number of traded stocks, value of traded stocks, number of contracts, number of listed companies, market capitalization, stock turnover rate in 2008, which is the last year manual trading system was used, with the period from 2009 to 2018, which is the period of electronic trading system implementation.

The study found that using an electronic trading system as an alternative to manual trading system provided brokers with greater flexibility and different information, making it easier for them to know executed and unexecuted transactions, analyze the trading companies' stocks faster, and achieve transparency and security for market participants and investors, contributing to increasing the efficiency and speed of securities trading.

The Iraqi Depository Center settles all operations as soon as they are registered, increasing the deposit indicators and their interaction according to the center's activity.

)Hassan Taher Sharif(2019 ،This study aimed to highlight the role of using the electronic trading system in activating the performance of the Khartoum Stock Exchange during the period 2007-2016 through studying the performance indicators of financial markets.

To answer the problem of the study, indicators of financial market performance were measured, including market capitalization, trading volume, number of listed companies, and stock turnover rate, before the implementation of the electronic trading system (2007-2011), and compared to the period after the implementation of the electronic trading system (2012-2016).

This study found that the use of electronic trading system has improved trading indicators in the Khartoum financial market, leading to increased transparency, accuracy, and credibility of information entering the market.

(Gbenga Adamolekun, 2023) This study examines the impact of replacing manual trading systems with electronic trading systems on improving the performance of African financial markets using Bayesian estimations.

To answer the study's problem, data was collected on 18 African financial markets: Algeria, Angola, Botswana, Côte d'Ivoire, Egypt, Ghana, Kenya, Libya, Mauritius, Morocco, Namibia, Nigeria, South Africa, Sudan, Tanzania, Tunisia, Zambia, and Zimbabwe for the period 1980 to 2020.

- ✓ The study concluded:

- The transition to electronic trading systems led to a reduction in trading activity in the financial markets under study, as the turnover rate decreased after the implementation of electronic trading systems, while the number of listed companies increased with the increase in listing.
- The results indicate that African stock exchanges cannot improve the performance of their financial markets simply by moving to electronic trading platforms.

3. The applied study on the impact of the X-stream INET electronic trading system on improving the performance of the Saudi financial market (Tadawul).

We will provide an overview of the Saudi financial market (Tadawul), then we will discuss the electronic trading system X-stream INET, and finally the empirical study.

3.1. Overview of the Saudi Stock Market (Tadawul): The Saudi financial market has witnessed important milestones in its history, as follows (Capital Market Authority, 2021, pp. 2-3):

- Formation of a ministerial committee in coordination with the Saudi Arabian Monetary Authority to regulate the market in 1984;

- Establishment of the Capital Market Authority as a supervisory and regulatory body for the financial market in 2003;

- Actual establishment of the Saudi financial market (Tadawul) as a public joint-stock company in 2007, as the sole licensed organization to operate as a securities market in the Kingdom of Saudi Arabia;

- Transformation of the Saudi Stock Exchange (Tadawul) into a holding company named Saudi Tadawul Group. It is a wholly owned subsidiary of Saudi Tadawul Group formed in March 2021, with its headquarters located in Riyadh, Kingdom of Saudi Arabia.

The company's capital is set at one billion two hundred million (1,200,000,000) Saudi Riyals, divided into one hundred and twenty million (120,000,000) shares, all of equal value, with a nominal value of ten (10) Riyals each, all of which are cash shares subscribed to by the Public Investment Fund.

Among the tasks of the Saudi financial market (Tadawul) are (Capital Market Authority, 2023):

- Tadawul Saudi Company is responsible for listing and trading securities for local and international investors through electronic trading systems, as it is the securities market concerned with trading activities and the official source of all market-related information in the Kingdom;

- It plays a pivotal role in achieving the strategic growth plans of the group;

- It carries out the deposit and registration process for securities;

- Executes clearing operations between the parties involved in the executed transactions;

- Provides market participants with attractive and diverse investment opportunities;

- Monitors the processes of ownership transfer and settlement between the trading parties.

"Saudi Stock Exchange" ranks ninth as the largest financial market among the 67 member financial markets of the International Federation of Stock Exchanges. It is also classified as the largest financial market in the Gulf Cooperation Council countries, and the third largest financial market among its counterparts in emerging markets. It is a member of both the International Organization of Securities Commissions and the Arab Federation of Exchanges, representing 77.66% of the total market capitalization of financial markets in the Middle East and North Africa. The Financial Market Law, issued by Royal Decree No. (M/30) in June 2003, outlines the legal framework, objectives, and responsibilities of the stock market and the securities depository center.

3.2. **Electronic Trading System in the Saudi Stock Market**: The Saudi stock market is considered one of the oldest financial markets to implement an electronic trading system. The process of stock trading was mechanized through a contract between the Saudi Arabian Monetary Agency and a local company to develop and update the manual trading systems previously used by the market. The electronic trading system, known as ESIS (Equity Services and Information), was implemented, providing multiple advantages to the Saudi stock market by integrating trading, settlement, clearing, and deposit systems into one, resulting in a reduction of the settlement period to one day (Capital Market Authority, 2021, p. 108).

With the evolution in the Saudi stock market in terms of the increasing number of listed companies, the increase in the number of market participants, the system has been updated since its implementation 9 times (Al-Suhaibani, 2007, p. 05). However, it has not been able to keep up with the significant developments in the market, especially with the evolution of electronic systems in global financial markets. As a result, it was replaced in 2001 by a new trading system called "Tadawul," and the Capital Market Authority, established in 2003, is the regulatory authority for the market. The electronic trading system (Tadawul) is characterized by many features, including executing no less than 2 million transactions per day, electronic disclosure of financial information and data for listed companies, providing a fast and efficient trading platform, and providing deposit and registration services for securities, etc.

The Saudi stock market in 2014 collaborated with NASDAQ to work on a comprehensive development project with the aim of replacing the trading system with the X-stream INET system. The new trading system was launched in September 2015 and is one of the latest electronic trading systems developed by NASDAQ, currently implemented in over 25 financial markets worldwide. It is regularly updated in collaboration with the global supplier company, representing a new leap in the market's journey of updates and development since its inception (Al-Sahan, 2015).

We can mention some features of the X-stream INET electronic trading system as follows (Al-Sahan, 2015):

- It is characterized by its effectiveness and speed in executing orders accurately and securely, in trading stocks, bonds, sukuk, and index funds;

- The system allows for the execution of more than 720,000 transactions in a single session, as well as the trading of many new financial instruments with greater speed and ease;

- It allows for the existence of several markets operating in a single trading field in an integrated manner, including stock and bond markets, tradable financial instruments, and investment funds, as well as other trading markets and systems that can be added in the future;

- It is a highly reliable and powerful trading platform;

- Capable of accommodating any new mechanisms introduced by the market, such as margin trading systems or index funds, due to its complete speed and flexibility in dealing with them and the continuous innovation and development operations sought by the market for the purpose of updating and development, in line with the best standards and systems used in global markets.

3.3. An analytical study of the impact of the X-stream INET electronic trading system on the performance of the Saudi stock market during the period from 2012 to 2022.

The study includes two variables: a dependent variable represented by the electronic trading system, and independent variables represented by market size variables and market liquidity indicators. This was done in the Saudi financial market (Tadawul). The data was obtained from the annual reports of the Saudi financial market (Tadawul), the Saudi Monetary Fund, and the Arab Monetary Fund, which are annual data.

3.3.1. Analytical study steps on the impact of the X-stream INET electronic trading system on the performance of the Saudi financial market during the period from 2012 to 2022.

The study period has been divided into two main periods:

- From 2012 to 2015, which is the pre-implementation stage of the X-stream INET electronic trading system.

- From 2015 to 2022, which is the stage of implementing the X-stream INET electronic trading system.

- The performance of the Saudi stock market will be judged starting from 2016 because the X-stream INET system was implemented in September 2015.

We will measure the market performance through the following indicators:

- Market size index by applying two indicators: market capitalization index, number of listed companies index.

- Market liquidity index by applying the following indicators: trading volume index, number of executed transactions index, number of participants in the trading system.

3.3.2 Measuring the performance of the Saudi stock market trading before and after the implementation of the X-stream INET system during the period from 2012 to 2022

We will analyze the performance of the Saudi stock market according to the following indicators

I) The performance of the main stock market index TASI evolved during the period from 2012 to 2022.

represented in the following table and Figure

Table 01: Represents the performance evolution of the main market index TASI during the period from 2012 to 2022

Unit: point

Years	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
TASSI Index	6801,2	8535,6	8333,3	6911,76	7210,43	7226,32	7826,7	8389,2	8689,5	11281,7	10478
Growth rate	-	26	-2	-17	4	0,2	8	7	4	30	-7

Source: Reports and publications of the Tadawul Market and the Saudi Monetary Fund

European Economic Letters
ISSN 2323-5233
Vol 14, Issue 3 (2024)
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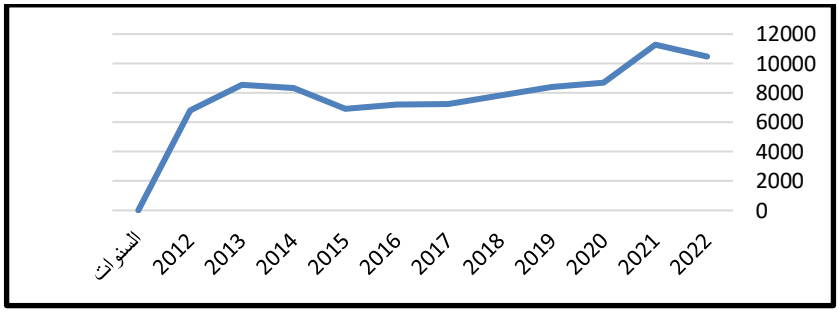
Figure 01: Shows the performance evolution of the main market index TASI during the period from 2012 to 2022



Source: Outputs of Excel 2016 program

We notice through the table and figure (1) that the main market index TASI during the period from 2012 to 2022 is in continuous development, where it reached 6801.2 points in 2012, then decreased in 2014 and 2015 by (2%) and (17%) respectively, due to 27% of the listed companies in the market recording significant losses, in addition to the decrease in oil prices during the fourth quarter of 2014. It improved after that from 2016 to 2021, due to the implementation of the X-stream INET trading system, through the improvement of all liquidity, volume, and trading indicators in the Saudi financial market (we will detail this in this study), in addition to the noticeable improvement in the activity of the Saudi Capital Market Authority, especially its efforts in achieving the goals of Saudi Vision 2030 for the development of the financial sector, which began implementation since 2017. However, in 2022, the index decreased by (7%), and most analysts attribute this to the panic and fear of investors from:

- Several decisions have been issued by "OPEC Plus" in conjunction with the events in the global oil market, the latest of which is a reduction in crude oil production by two million barrels per day starting from November 2022;
-The Russian-Ukrainian crisis and the resulting uncertainty in the oil markets and the global economy.

II) The market capitalization index in the Saudi stock market traded during the period from 2012 to 2022.

The following table includes the development of the market value index (stock capitalization) in the Saudi financial market trading during the period from 2012 to 2022.

Table 02: represents Evolution of the market capitalization index in the Saudi financial market during the period from 2012 to 2022

Unit: One billion Saudi riyals

Years	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Market value	1400.3	1753	1813	1579	1682	1689	1860	9025.4	9101.81	10.009.15	9.878.10
GDP	2,759,906	2,799,927	2,836,314	2,453,512	2,418,508	2,582,198	3,174,689	3,144,618	2,753,517	3,257,197	4,155,559
the market value index	0.05	0.062	0.063	0.064	0.069	0.065	0.058	0.287	0.33	0.307	23.77
Growth Rate		0.23	0.02	0.006	0.08	-0.05	-0.1	3.89	0.15	-0.09	78.23

Source: Reports and publications of the Tadawul Market and the Saudi Monetary Fund

We notice that the market value index (market capitalization index)has been continuously evolving from 2012 to 2016, to decrease in 2017 and 2018 by (0.05%) and (0.10%) respectively, then to rise again between 2019 and 2020 by (3.89%) and (0.15%). It decreased in 2021 due to the negative effects of the COVID-19 pandemic, then rose in 2022 to achieve an increase of (78.23%), indicating greater liquidity in the Saudi stock market and a superior ability to mobilize capital and increase market size, mainly attributed to the X-stream INET electronic trading system.

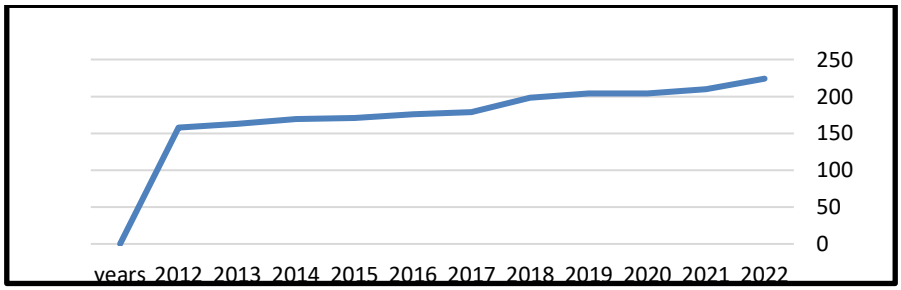
III) The number of companies listed on the Saudi stock market Tadawul evolved during the period from 2012 to 2022:

represented in the following table and Figure

years	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Number of companies	158	163	169	171	176	179	198	204	204	210	224

Source: Reports and publications of the Tadawul Market and the Saudi Monetary Fund

Figure 03: Shows the Evolution of the number of companies listed in the Saudi capital market during the period from 2012 to 2022.



Source: Outputs of Excel 2016 program

We notice from the table and figure (03) that the number of listed companies during the period from 2012 to 2015 was growing at a slow pace, increasing by about 5 to 7 companies each year. However, during the period from 2015 to 2020, the number of listed companies began to grow at a high rate, reaching 179 companies in 2017, increasing to 198 companies in 2019, and reaching 204 companies in 2020, and 224 companies in 2021. This confirms the attractiveness of the Saudi market, as well as the excellent services provided by the X-stream INET electronic trading system, which has encouraged many companies to enter the stock market.

The increase in the number of companies from year to year reflects the development and growth in the Saudi stock market, and generates active movement and activity for securities, qualifying the market to increase securities trading indicators.

IV) The evolution of trading volume in the Saudi stock market during the period from 2012 to 2022

represented in the following table and Figure:

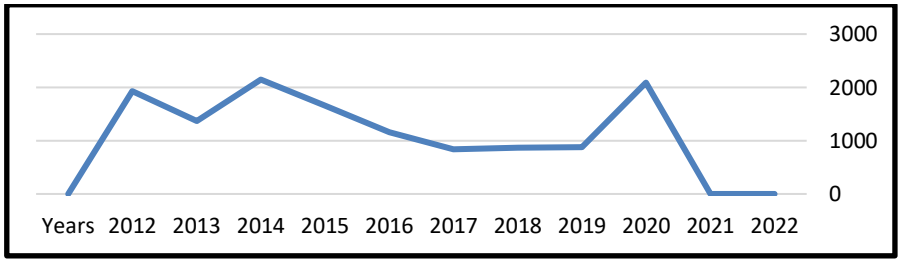
Table 04: Represents the evolution of trading volume in the Saudi financial market during the period from 2012 to 2022.

Unit: One billion Saudi riyals

Years	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
trading volume	1929,3	1369,7	2146,5	1660,6	1157	836,3	870,9	880,1	2087,8	2.235.900	1.708.040
Growth rate		-29	56,7	-22,6	-30,3	-27,7	-4,1	1,1	137,2	7,09	-23,6

Source: Reports and publications of the Tadawul Market and the Saudi Monetary Fund

Figure 04: Shows the evolution of trading volume in the Saudi financial market during the period from 2012 to 2022.



Source: Outputs of Excel 2016 program

Through the table and figure (04), we notice the following:

- The total value of stocks reached 1369.7 billion riyals in 2013, compared to 1929.3 billion riyals in 2012, a decrease of 29%. It then increased to 2146.5 billion riyals in 2014, and continued to decrease during the period from 2015 to 2017, then improved and rose in 2018 to reach about 870.9 billion riyals, an increase of 4.1%. It reached its peak in 2020 with an increase of 137% compared to 2019, then reached 2087799.5 million riyals in 2021, achieving a market share of 59% of the total trading value for the Arab financial markets.

- Despite the positive effects of implementing the electronic trading system, the trading volume during the years 2016 and 2017 witnessed a decrease. We can mention some reasons for this decline:

- External economic and financial factors, such as interest rate trends in the US and advanced countries, and the losses in global financial markets. The slowdown in the implementation of economic projects and the consequent decrease in economic growth have impacted the profits of listed companies in the Gulf stock markets in general, and the Saudi financial market in particular. Investors are now more interested in the financial results of companies and are selectively directing liquidity towards leading stocks, which have shown good profit growth, leading to a weakening of the liquidity levels that were previously driven by speculative trading activities.

- The fluctuation in global stock markets and its continuous impact on foreign investment in the Saudi stock market has resulted in the withdrawal of a significant portion of liquidity by foreign investors and a repositioning of their investment portfolios outside the market.

-The continued oil prices below $50 per barrel amid the imbalance between supply and demand for oil, as the performance of the Saudi stock market is closely and significantly linked to the movements of oil prices.

- Individual investors and speculators dominate a large part of the trading in the Gulf markets, especially the Saudi stock market, weakening the role of institutional investment and the absence of market makers to stabilize the markets, support prices, and stimulate liquidity.

V)The evolution of executed transactions* in the Saudi stock market Tadawul during the period from 2012 to 2022:

represented in the following table and Figure

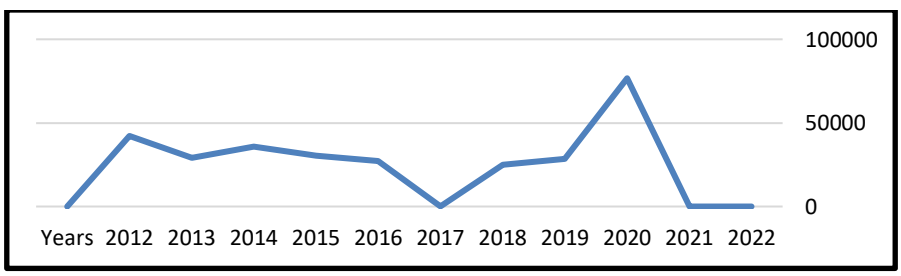
Table 05: Represents the evolution of executed transactions in the Saudi financial market during the period from 2012 to 2022

Unit : million transactions

Years	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
transactions executed	42105	28967,7	35761,1	30444,2	27273,7	21,9	25011,9	28395,8	76686,3	91.887.406	87.899.022
Growth rate		-31,2	23,5	-149	-10,4	-19,7	14,2	13,5	170,1	91,87	-4,32

Source: Reports and publications of the Tadawul Market and the Saudi Monetary Fund

Figure 05: Shows evolution of executed transactions in the Saudi capital market during the period from 2012 to 2022



Source: Outputs of Excel 2016 program

* We will also use the term Number of trades as an alternative to the term transactions executed

- Through the table and figure (05) we notice:

-The number of executed transactions reached 28 million transactions in 2013, representing a decrease of (31.2%) from the 42 million transactions executed in 2012. It then increased again in 2014 to reach 35 million executed transactions, with an increase rate of (23.5%). However, it decreased to 30 and 27 million transactions in 2015 and 2016 respectively, with a decrease rate of (14.9%) and (10.4%). Starting from 2018, there was an improvement, reaching its peak in 2020 with 76.7 million transactions, representing an increase of (170.1%) compared to 2019, which had 28.4 million executed transactions. This is mainly attributed to the X-stream INET electronic trading system, which allows the execution of over 720 thousand transactions in a single session. The improvement in the number of executed transactions is evident due to the electronic trading system, which has had a positive impact on increasing the number of investors and the interest of many companies to list on the market, reaching a peak in 2022 with 224 listed companies.

-In 2021, the market executed 91.87 million transactions, achieving an increase of 91.87%, but it decreased in 2022 to 87.89 million transactions, a decrease of 4.32%.

VI) The evolution of the number of investors registered in the X-stream INET trading system during the period from 2012 to 2022

represented in the following table and Figure

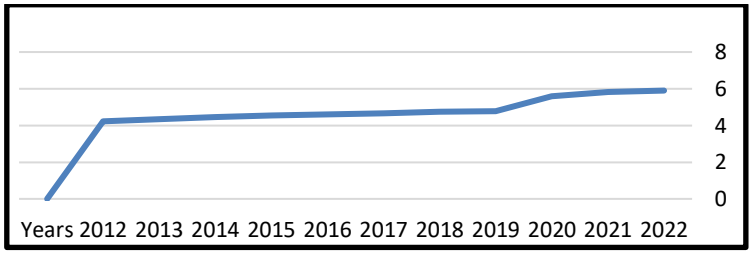
Table 06: Represents Number of registered investors in the X-stream INET trading system compared to the Tadawul trading system

Unit: 1 million investors

Years	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Number of investors	4,22	4,33	4,46	4,55	4,61	4,67	4,74	4,78	5,6	5,81	5,9
Growth rate		2,7	2,9	2,1	3,1	1,3	1,4	15,7	2	5,63	1,5

Source: Reports and publications of the Tadawul Market and the Saudi Monetary Fund

Figure 06: Shows Number of investors registered with the X-stream INET trading system compared to the Tadawul trading system.



Source: Outputs of Excel 2016 program

Through Table and Figure (06):

- The number of investors registered in the electronic trading system (Tadawul) reached 4.3 million investors in 2013, compared to 4.2 million investors in 2012, an increase of 2.7%. The number of registered investors then rose to 4.4 million in 2014, and in 2015 it reached 4.5 million investors with an increase of 2.1%. In 2016, when the actual activity of the X-stream INET system began, the number of registered investors reached 4.6 million, compared to 4.5 million in 2015, an increase of 1.3%. The market maintained almost the same increase in 2017 and 2018, but in 2020 the number of registered investors increased by 2.0% to reach 5.6 million investors, then 5.81 million investors in 2021, and 5.9 million investors in 2022, the highest number of subscribers since 2012.

➢ The increase in the number of investors registered in the electronic trading system X-stream INET is attributed to the numerous advantages and services it offers compared to the old trading system Tadawul, including:

- Flexibility in the variety of assets, financial instruments, and currencies;
- Significant reduction in errors and technical problems, with the ability to handle them faster and more efficiently than the previous trading system;
- Ease of depositing securities and executing settlements, speed and efficiency in stock trading;
- Speed of clearance and registration of ownership of securities, done instantly;
- Efficiency in order execution, and providing 24-hour support service.

3.4. A standard study of the impact of the X-stream INET electronic trading system on the performance of the Saudi financial market during the period from 2012 to 2022

3.4.1 Study Variables and Data Quality

Dependent variable: The X-stream INET electronic trading system, which was implemented in 2015.
Independent variables: They consist of:
- Value of traded stocks (trading volume);
- Number of executed transactions.

Where 48 monthly observations were adopted before the system's implementation, from 2012 to 2015, and 48 observations after the system's implementation, spanning from 2016 to 2019 (for both variables).
Data quality: Monthly data, with data sources being the annual reports of the Saudi financial market (trading).

3.4.2 Statistical Hypotheses for the Standard Study

✓ There is a significant difference between the average trading volume and the average number of executed transactions in the Saudi financial market before the introduction of the X-stream INET electronic trading system, and the average trading volume and the average number of executed transactions after the introduction of the X-stream INET electronic trading system during the period from 2012 to 2019;

Statistically, it translates as follows:
H_0: The average trading volume before the system's implementation is equal to the average trading volume after the system's implementation (i.e., there are no statistically significant differences in the average trading volume before and after the system's implementation).
H_1: The average trading volume before the system's implementation is not equal to the average trading volume after the system's implementation (i.e., there are statistically significant differences in the average trading volume before and after the system's implementation).
H_0: The average number of executed transactions before the system's implementation is equal to the average number of executed transactions after the system's implementation (i.e., there are no statistically significant differences in the average number of executed transactions before and after the system's implementation).
H_1: The average number of executed transactions before implementing the system is not equal to the average number of executed transactions after implementing the system (i.e., there are statistically significant differences between the average number of executed transactions before and after implementing the system).

3.4.3. Statistical Analysis Results

I) Normal Distribution Test:
Before conducting any statistical tests, it is necessary to verify the normal distribution of the data in order to determine the appropriate test for the sample. If the data follows a normal distribution, we use the t-test for unpaired samples, and if the data does not follow a normal distribution, we use the Wilcoxon test for paired samples. The results of the normal distribution test are as follows:

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Table 07: Represents Results of the normal distribution test for the study variables

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistiques	ddl	Sig.	Statistiques	ddl	Sig.
Trading volume before implementing the system	,171	48	,001	,903	48	**,001**
Trading volume after implementing the system	,168	48	,002	,906	48	**,001**
Number of executed transactions before implementing the system	,118	48	,093	,909	48	**,001**
Number of executed transactions after implementing the system	,063	48	,200*	,988	48	**,912**

*. Il s'agit de la borne inférieure de la vraie signification.

a. Correction de signification de Lilliefors

Source: SPSS 26 output

Table (7) includes the results of the normal distribution tests for Kolmogorov-Smirnov and Shapiro-Wilk for four sets of data (trading volume before implementing the electronic trading system, trading volume after implementing the electronic trading system, number of executed transactions before implementing the electronic trading system, and number of executed transactions after implementing the electronic trading system).

- **For trading volume**: We notice that the p-value for the Shapiro-Wilk test is less than 0.05 for both trading volumes before implementing the system, which is (P=0.001), and also for trading volume after implementing the system, which is also (P=0.001);
- **For the Numbers of executed transactions**: We notice That the p-value for the Shapiro-Wilk test is less than 0.05 for the number of executed transactions before implementing the system, which is (P=0.001). As for the p-value for the Shapiro-Wilk test for the number of executed transactions after implementing the system, we notice that it is greater than 0.05 and equals (P=0.912).

➢ Since the p-value for most of the above variables is less than 0.05, they do not follow the normal distribution.

II) Descriptive characteristics of the study variables before and after applying the trading system:

Table 08: Represents Descriptive statistics for study variables

	N	Moyenne	Ecart	Minimum	Maximum
Trading volume before implementing the system	48	148,0442	52,41096	79,41	319,28
Trading volume after implementing the system	48	78,3806	23,36913	41,74	131,20
Number of executed transactions before implementing the	48	2,8840	,93953	1,50	5,61
Number of executed transactions after mplementing the	48	2,1370	,55731	,93	3,74

Source: SPSS 26 output

✓ **Trading volume before implementing the electronic trading system**

Through the above table (8), we note that the number of relied-upon views is estimated at 48 views, where the independent variable registered an average positive trading volume (Mean) of 148.04%, indicating positive growth in trading volume before the implementation of the trading system (2012-2015).

▪ As for the maximum value of stock prices before the implementation of the trading system, it reached 319.28% recorded in March 2015. Among the reasons for this:

- The Saudi stock market opened its doors to direct foreign investment in 2015, and during the past year, it eased restrictions on investors seeking a qualified foreign investor license, leading to an increase in their number to 60 investors.

- Four companies from the retail sectors: industrial investment, real estate development, and transportation, offered part of their shares for subscription.

▪ The minimum value for the independent variable of trading volume was 79.41%, recorded in July 2015. The reasons for this decrease can be mentioned as follows:

- The decline in stock values began with the decline in global oil prices during 2015. The losses of the Saudi financial market and other Arab financial markets have increased since the beginning of the decline in global oil markets, reaching around 320 billion dollars, equivalent to about 24% of their total market value, especially in oil-exporting Arab countries, where the continuous decline in oil prices has reflected on the liquidity contraction and the confidence of investors in the future prospects of these markets.

- In addition to the decline in oil prices, we also mention the slowdown in the global economic recovery and the decline in expectations for the performance of emerging economies, specifically the Chinese economy, along with the repercussions of the increase in US interest rates and concerns about the resurgence.

- In addition to the decline in oil prices, we also note the slowdown in the global economic recovery and the decline in the performance expectations of emerging economies, specifically the Chinese economy, along with the repercussions of the increase in US interest rates and concerns about a return to conventional monetary policies, which has had a negative impact on the performance of financial markets in emerging and developing economies, including Arab economies.
- Most Arab companies experienced a contraction in net profits according to available data for the first nine months, with noticeable and tangible declines in sectors such as petrochemical industries, real estate and construction companies, telecommunications, and hotel services, which has been reflected in the stock prices of these sectors throughout the year.

✓ **The number of executed transactions before the implementation of the electronic trading system**

From Table (8), we notice that the number of approved views is estimated at 48 views, with the independent variable of the number of executed transactions averaging a positive growth (Mean) of 2.8840%, indicating positive growth in the number of executed transactions before the implementation of the trading system (2012-2015).
- As for the maximum number of executed transactions before the implementation of the trading system, it reached 5.61% recorded in March 2016, mainly due to the positive effects of implementing the electronic trading system X-stream INET.
- The minimum number of executed transactions before the implementation of the trading system was 1.50% recorded in October 2013, where the number of executed transactions decreased by 31.20% compared to 2012.

- The degree of dispersion of values around their mean includes the standard deviation (0.93).

III) Wilcoxon Test

The Wilcoxon test, also known as the sign-rank test, is used to determine whether there is a difference or discrepancy between two related samples in terms of a specific dependent variable. It serves as a non-parametric alternative to the paired t-test for related samples (non-independent). These two samples include the same group of individuals who undergo pre-test and post-test measurements. In this case, each individual in the sample has two scores, one representing their score in the pre-test and the other representing their score in the post-test. The test conditions are as follows:

- The two samples are not independent, or the same sample underwent different measurements.

- The population does not have a normal distribution.

Therefore, the test of significance for ranks will be used (i.e., based on the ranks of observations or values).

It is worth noting that there are different tests for rank data of non-independent samples. For example, the sign test only focuses on the signs of differences between the data of the two samples. However, the Wilcoxon test is better because it considers both the signs and ranks of the differences between the data of the two samples.

Test hypotheses:

H_0: The mean of the variables before the system implementation is equal to the mean of the variables after the system implementation (i.e., there are no statistically significant differences between the means of the variables before and after the system implementation).

H_1: The mean of the variables before the system implementation is not equal to the mean of the variables after the system implementation (i.e., there are statistically significant differences between the means of the variables before and after the system implementation).

III) Wilcoxon Test Results:

Through the above table (8), we notice that the average trading volume before implementing the system was 148.0442 billion Saudi riyals, and after implementing the system it was 78.3806 billion Saudi riyals. Therefore, the average after implementing the system decreased from the average before implementing the system. Based on this, we reject the null hypothesis that there are no statistically significant differences between the average trading volume before and after implementing the system, and accept the alternative hypothesis.

The average number of executed transactions before implementing the system was 2.8840 million Saudi riyals, and after implementing the system it was 2.1370 million Saudi riyals. Therefore, the average after implementing the system decreased from the average before implementing the system. Based on this, we reject the null hypothesis that there are no statistically significant differences between the average number of executed transactions before and after implementing the system, and accept the alternative hypothesis.

✓ To ensure whether the obtained difference is substantial or not, we use the Wilcoxon test. The subsequent table shows the results of the Wilcoxon test.

Table 09: Represents results of the WILCOXON test

Tests statistiques[a]		
	Trading volume after implementing the system- Trading volume before implementing the system	Number of trades after implementing the system - Number of trades before implementing the system
Z	-5,959[b]	-4,523[b]
Sig. asymptotique (bilatérale)	,000	,000
a. Test de classement de Wilcoxon		
b. Basée sur les rangs positifs.		

Source: SPSS 26 output

We notice that the "Sig. asymptotic (two-tailed)" value for the Wilcoxon test, represented by the Z value (indicating the difference between the values before and after implementing the system) for the trading volume and executed transactions, is 0.000, which is less than 0.05. This indicates the presence of statistically significant differences between the average stock values before and after implementing the system. A decision is made to reject the null hypothesis and accept the alternative hypothesis, and thus the values after implementing the system were lower than the values before implementing the system.

European Economic Letters
ISSN 2323-5233
Vol 14, Issue 3 (2024)
http://eelet.org.uk

In light of the foregoing, the Wilcoxon test indicates a difference between the variables before and after the implementation of the X-stream INET electronic trading system. Therefore, the implementation of the latter led to statistically significant changes in trading volume and the number of executed transactions.

We notice that the "Sig. asymptotic (two-tailed)" value for the Wilcoxon test, represented by the Z value (indicating the difference between the values before and after implementing the system) for the trading volume and executed transactions, is 0.000, which is less than 0.05. This indicates the presence of statistically significant differences between the average stock values before and after implementing the system. A decision is made to reject the null hypothesis and accept the alternative hypothesis, and thus the values after implementing the system were lower than the values before implementing the system.

In light of the foregoing, the Wilcoxon test indicates a difference between the variables before and after the implementation of the X-stream INET electronic trading system. Therefore, the implementation of the latter led to statistically significant changes in trading volume and the number of executed transactions.

Table 10: Represents Ranks, signs, and how to determine them

		N	Rang moyen :	Somme des rangs
Trading volume before implementing the system- Trading volume after implementing the system	Rangs négatifs	47[a]	24,87	1169,00
	Rangs positifs	1[b]	7,00	7,00
	Ex aequo	0 [c]		
	Total	48		
Number of trades before implementing the system - Number of trades after implementing the system	Rangs négatifs	37[d]	27,81	1029,00
	Rangs positifs	11[e]	13,36	147,00
	Ex aequo	0[f]		
	Total	48		

a. Trading volume before implementing the system >Trading volume after
b. Trading volume before implementing the system <Trading volume after
c. Trading volume before implementing the system = Trading volume after
d. Number of trades before implementing the system > Number of trades after
e. Number of trades before implementing the system < Number of trades after
f. Number of trades before implementing the system = Number of trades after

Source: SPSS 26 output

- A decision is made based on the existence of statistically significant differences between the average trading volume and the number of executed trades before and after the system implementation, so we reject the null hypothesis and accept the alternative hypothesis.
- Through testing statistical hypotheses related to the statistical aspect and the results of the analytical study, we confirm the main hypothesis, thus financial technology represented by the electronic trading system contributes to improving the performance of the Saudi stock market during the period from 2012 to 2022.

4. Conclusion: The study reached the following results:
1. Financial technology represented by the electronic trading system contributes to achieving fairness in the market, increasing trading transparency, and speeding up the analysis of the financial conditions of listed companies, which is reflected in the expansion of the market size and its liquidity;
2. The electronic trading system X-stream INET contributed to increasing the attraction of listed companies and investors, with the number of subscribers to the electronic trading system reaching 5.59 million investors in 2022 due to several reasons including flexibility, transparency, ease of use, speed, and cost reduction;
3. The electronic trading system X-stream INET helped increase the number of buy and sell orders;
4. The electronic trading system X-stream INET contributed to increasing the number of executed trades, reaching a peak of 91.88 million executed trades in 2021, as the X-stream INET system is capable of executing over 720,000 trades in a single session;
5. The application of the electronic trading system had a positive impact on the performance of the Saudi stock market during the study period, due to the differences between the variables before and after the application of the electronic trading system X-stream INET (according to the Wilcoxon test).

5. Recommendations: Based on our study results, we recommend the following:

1. The necessity of continuous work and efforts to enhance the efficiency of the X-stream INET electronic trading system in the Saudi financial market through its continuous updating to keep pace with modern developments, especially in light of Saudi Vision 2030;

2. Enhancing the benefits and advantages offered by the X-stream INET electronic trading system by linking the market to other Arab financial markets, especially the neighboring ones, to encourage the transfer of capital;
3. Encouraging private companies not listed in the Saudi financial market to transform into joint-stock companies and be listed in the financial market, providing them with wide possibilities in providing liquidity and necessary funds for their future expansion, especially with the advantages provided by the X-stream INET electronic trading system;

4. Supporting financial technology innovations in the financial market, including identifying the necessary licenses for their practice by financial market institutions;

5. Improving technological solutions for monitoring brokers to enable automated monitoring of investors' trades in the financial market;

6. Collaborating internationally to combat cybercrimes, especially in connection with other global financial markets;
7. Continuously raising awareness to promote electronic financial culture;
8. The necessity of hedging against risks of electronic trading systems, such as the possibility of electronic trading systems being vulnerable to internet network disruptions, or cybercrime activities, by developing early warning centers to combat cyber financial crimes.

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