

Investigating the effects of Information and Communication Technology (ICT) on capital market uncertainty by considering its impact on the textile industry: a case study for Iran

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ABSTRACT – REZUMAT

Investigating the effects of Information and Communication Technology (ICT) on capital market uncertainty by considering its impact on the textile industry: a case study for Iran

Information and Communication Technology (ICT) plays a vital role in sharing information and greater participation in exchanges and trading of investors' shares. Because the use of information and communication technology in financial markets reduces marketing costs, it has a significant role. Therefore, the primary purpose of this research article is to investigate the impact of ICT on capital market uncertainty in Iran. In this study, the GARCH model has been used to estimate the capital market uncertainty index. The results of ARDL model estimation using quarterly data in the period 2011: 1 to 2020: 4 in the short and long term showed the effect of the ratio of online transactions to the total volume of transactions as an ICT indicator on capital market uncertainty in the short term. Long-term are different. In the short run, increasing the ratio of online transactions to the total volume of transactions has increased capital market uncertainty. It has reduced capital market uncertainty in the long run. Other model results showed that inflation, economic growth, and exchange rate significantly affect the performance uncertainty of the total stock exchange index as an indicator of capital market uncertainty. And it takes about 7.5 seasons on average to completely offset the imbalance in capital market uncertainty.

Keywords: financial time-series, Information and Communication Technology (ICT), computational financial mathematics, capital market Uncertainty, asset pricing models, vector autoregression model with distributed intervals (ARDL), ICT indicator, online trading system, developing countries, stock exchange index

Investigarea efectelor tehnologiei informației și comunicațiilor (TIC) asupra incertitudinii pieței de capital, luând în considerare impactul acesteia asupra industriei textile: un studiu de caz pentru Iran

Tehnologia informației și comunicațiilor (TIC) joacă un rol vital în schimbul de informații și facilitează o participare mai mare la schimburile și tranzacționarea acțiunilor investitorilor. Deoarece utilizarea tehnologiei informației și comunicațiilor pe piețele financiare reduce costurile de marketing, are un rol semnificativ. Prin urmare, scopul principal al acestui articol de cercetare este de a investiga impactul TIC asupra incertitudinii pieței de capital din Iran. În acest studiu, modelul GARCH a fost utilizat pentru a estima indicele de incertitudine al pieței de capital. Rezultatele estimării modelului ARDL folosind date trimestriale în perioada 2011: 1 până în 2020: 4 pe termen scurt și lung au evidențiat efectul raportului tranzacțiilor online față de volumul total al tranzacțiilor ca indicator TIC asupra incertitudinii pieței de capital pe termen scurt. Pe termen lung rezultatele sunt diferite. Pe termen scurt, creșterea raportului dintre tranzacțiile online și volumul total de tranzacții a crescut incertitudinea pieței de capital. Însă a redus incertitudinea pieței de capital pe termen lung. Alte rezultate ale modelului au arătat că inflația, creșterea economică și cursul de schimb afectează în mod semnificativ incertitudinea privind performanța totală a indicelui bursier ca indicator al incertitudinii pieței de capital. Și este nevoie de aproximativ 7,5 sezoane în medie pentru a compensa complet dezechilibrul în ceea ce privește incertitudinea pieței de capital.

Cuvinte cheie: serii temporale financiare, Tehnologia Informației și Comunicațiilor (TIC), matematică financiară computațională, incertitudinea pieței de capital, modele de stabilire a prețurilor activelor, model de autoregresie vectorială cu intervale distribuite (ARDL), indicator TIC, sistem de tranzacționare online, tari în curs de dezvoltare, indice bursier

INTRODUCTION

Following the spread of the coronavirus at the beginning of 2020, the social and economic situation of the world has entered a crisis at an incredible speed [1–3]. According to the forecasts of the International Monetary Fund, world economic growth is expected to be 4.9%, which is 7.6% lower than the previous

year's forecast. It is expected that 170 countries will face a decrease in per capita income [4]. In 2020 and 2021, most countries' economies were affected by the Coronavirus pandemic (COVID-19). As a result, economic activity contracted sharply in the first half of 2020 due to containment measures and increased risk aversion, and the setback continued. However, unlike the COVID-19 pandemic, the root causes of

one of the most intense extreme financial events of the last centuries, such as the GFC of 2007–2008 (global financial crisis), were more profound and more severe implications, both macroeconomic and microeconomic [5]. COVID-19 changed the context for Information and Communication Technology (ICT) use globally [6]. Information and Communication Technology has undoubtedly led to far-reaching changes in all social and economic spheres of humanity. Its impact on human societies is such that today's world rapidly becoming an information society [7]. ICT is a set of tools and methods computers, and communication networks use to produce, publish, store, organize, exchange, access, retrieve and disseminate information [8, 9]. ICT includes two aspects of hardware and software, each of which includes a variety of appropriate methods, tools, and standards [10]. In general, ICT, through the growth of productivity of all factors in the productive sectors of ICT, capital deepening, and productivity growth of all aspects through the reorganization and application of ICT, can influence economic growth [11].

In recent years, the environment has fundamentally changed in various social, cultural, and economic fields [12, 13]. According to most researchers, these fundamental changes result in ICT [14–16]. Today, the national economy has given way to the world economy. In this area, countries will be prosperous if they do not limit job opportunities only to their geographical framework and have an expansive worldwide workspace in mind [17]. One of the essential facilities provided by ICT is its effect on the production process of products and services that a new business offers [10, 18]. For example, ICT can help produce products with a broader range of information or add a new service to a product [19, 20]. Depending on the progress of a business's flow, ICT can help create, change or destroy activities and connections in the value chain of a business, or it can reorganize the current business process [21]. The availability and quality of ICT infrastructure determine the efficiency and feasibility of using these tools for business. ICT can provide an effective tool to support economic activity [22, 23]. ICT, especially mobile phones, computers, and the Internet, has become essential for business development and increasing competition [24]. The high penetration rate of mobile phones in developing countries and the cost-effectiveness of Internet services have provided unique opportunities for different people to take advantage of these technologies and start or expand new businesses [25].

Many economists attribute the slow economic growth of financial markets in developing countries to the inefficiency and underdevelopment of the ICT sector and recommend systematic reforms to achieve faster economic growth [26, 27]. After various studies on the developments in the ICT industry, attention was turned to the capital markets and the interaction between ICT and the stock market [28–30]. These studies showed that capital markets, which are very important in the economy of any country and have

been mentioned as one of the tools to control the economy, are affected by ICT tools, and gradually and with the strength of this industry, the ICT industry enters the market Capital has been smooth and welcomed by many investors [28, 31, 32]. In this regard, Cheng et al. [33] found that ICT development has increased economic growth and financial development by increasing the number of people using the Internet and securing Internet platforms. In their research, Brown et al. [34] found that the trading volume and frequency of capital market transactions decreased by about 5% on days when mobile Internet systems were slowing down. In other words, ICT has played an influential role in online transactions. Bahraini and Qafas [35], in their study on the impact of ICT on the economic growth of selected developing countries in the Middle East and North Africa (MENA) and sub-Saharan Africa (SSA), found that except for landlines, Other information and communication technologies such as mobile phones, Internet use, and bandwidth acceptance are the main drivers of economic growth in the developing countries MENA and SSA in the recent period 2007–2016. In addition, their findings confirm the superiority of MENA countries over SSA countries in terms of Internet use and bandwidth acceptance. Therefore, a group of researchers found that internal factors, including structural, financial, marketing, and managerial variables, and external factors, including economic, political, and cultural variables affect the stock price index in the stock market [36–40]. Sepehrdoost and Sadri [41] showed that tools and equipment related to information technology had a positive effect on the growth of the capital market of the Iranian Stock Exchange. Therefore, one of the primary and vital functions of ICT is the wide impact that it can have on financial markets [31]. Other research study used Capital Adequacy, Asset Quality, Management, Earnings, Liquidity, and Sensitivity or CAMELS rating system in the context of information reliability in the financial field [42].

Studies show that the introduction and improvement of ICT tools have led to increased trading volume and speed and better dissemination of information on the stock exchanges [30, 43, 44]. The importance of this industry has caused attention to be paid to the ICT industry and its developments in the stock market. In the capital market, the primary basis of transactions is the existence of relevant information, which is why communication is considered the most expensive asset in the capital market [45, 46]. Usually, when new information about the situation of companies in the market is published, this information is analyzed by analysts, investors, and other users. Based on this, a decision is made to buy or sell stocks [47, 48]. This information and how to react to it affect users' behaviour, especially actual and potential shareholders, and increases or decreases the price and volume of stock exchanges. Because how people respond to new information shapes price fluctuations. Therefore, in the case of confidential and heterogeneous dissemination of information, we will see different reactions from investors in the capital market,

leading to incorrect and misleading analyses of the current market situation.

Regardless of the various definitions and the wide range of ICT applications in different parts of human life, it is essential to state that the development of ICT is necessary for the growth and development of countries' economies for several reasons. First, this technology increases the speed of information transfer, and thus information is disseminated to more people. Second, ICT reduces the cost of production because access to the knowledge produced is possible at the lowest cost. Also, reducing transaction costs reduces the degree of inefficiency and uncertainty. Third, ICT overcomes time and space constraints, resulting in increased information transfer between buyers and sellers, and the production process transcends national boundaries. This technology enables everyone to recognize their superiority over others in a market economy, which leads to a broader market and increased access to the global supply of goods. Fourth, it makes the market more transparent and increases demand. The importance and necessity of ICT are such that in the present age, having the comparative advantage of natural resources and reserves specific to developing countries has lost its value compared to the competitive advantage of technology specific to developed countries. Therefore, investing in this sector, while the high added value will follow, significantly improves processes [49].

In situations where access to information is costly, investors are forced to formulate their analysis of the company's future profitability, cash flows, etc., through subjective estimates. As a result, people in a better position than others in terms of information will be able to make better estimates because of this information position. It will affect market supply and demand and lead to fluctuations in stock prices. Many empirical studies have shown that active financial markets in the face of information asymmetry can induce trade fluctuations and help them expand. In this regard, the main purpose of this article is to investigate the impact of ICT on stock market uncertainty in Iran in the period 2011–2020 using seasonal data. In this regard, it is hypothesized that the ratio of online transactions to the total volume of transactions and the number of published announcements significantly impact capital market uncertainty in Iran. The remaining sections are organized as follows: 2nd section is the Literature review and hypothesis, followed by the data and methods in 3rd section. The findings and discussion are presented in 4th section and 5th section concludes the research.

LITERATURE REVIEW

Information and Communications Technology

Life in the present age, although it has created new needs, questions and problems, has also presented him with solutions and ways of answering questions and satisfying human needs. Although direct communication and the use of traditional methods of infor-

mation are a vital necessity today, they alone do not meet the growing thirst of today's complex societies. Humans are thirsty to know, analyze, and process information and news, but the erratic spread of knowledge prevents them from making informed choices. For this reason, communications and communication tools have entered the arena to remove existing barriers [50, 51]. In the present age, ICT has overshadowed all aspects of human life, including a change in all production and distribution methods to education, exchanges, and human relations [52, 53]. The importance of communication as the cornerstone of human societies and the basis for the interaction of cultures and ideas is such that it has changed even the security borders of countries [51].

Information technology was probably coined in the late 1970s to refer to computer technology to work with information [54, 55]. Regardless of the various definitions and the wide range of ICT applications in different parts of human life, it is essential to state that the development of ICT is necessary for the growth and development of countries' economies for several reasons [56, 57]. First, this technology increases the speed of information transfer, and thus information is disseminated to more people [58, 59]. Second, ICT reduces the cost of production because access to the knowledge produced is possible at the lowest price. Also, reducing transaction costs minimizes the degree of inefficiency and uncertainty [53]. Third, ICT overcomes time and space constraints, resulting in increased information transfer between buyers and sellers, and the production process transcends national boundaries. This technology enables everyone to recognize their superiority over others in a market economy, which leads to a wider market and increased access to the global supply of goods [20, 21]. Fourth, it makes the market more transparent and increases demand [10, 60]. The importance and necessity of ICT are such that in the present age, having the comparative advantage of natural resources and reserves specific to developing countries has lost its value compared to the competitive advantage of technology specific to developed countries [21, 61]. Therefore, investing in this sector and the high-added value will significantly improve processes [21].

Adebisi and Babatunde [62] investigated the implementation of green information and communication technology in the textile industry using a multi-criteria approach for the most preferred ICT alternative in the textile industry. The criteria they considered were green ICT implementation cost (IC), operation and maintenance cost (OMC), environmental impact (EI), improved system performance and utilization (ISPU), supply chain management (SCM), and job opportunities. (EO). Their results show that the most preferred ICT alternative is power management, with an overall coefficient of 0.60, and the least preferred is software optimization, with a coefficient of 0.23. This allows for a clean industrial process in the textile industry and also promotes sustainable cities and communities through responsible consumption and

production, as highlighted in Sustainable Development Goals (SDG) 11 and 12. In their research, Vankevich et al. [63] studied ICT skills in Belarus for the textile industry. They state that investment in ICT skills training is needed to improve the situation. Avadanei et al. in their research [64] reviewed new ICT tools for the sustainable textile and apparel industry. They state that the textile and clothing industry of the European Union needs a flexible workforce that can respond to the development and globalization of the market and the need for sustainable design and manufacturing to meet the sustainable global demand for innovative products. Suitable for training employees, preparing them to face the importance of these new challenges, improving their knowledge, and developing new skills and competencies for this new type of business.

The effect of ICT on economic growth and development can be examined from both supply and demand sides. On the supply side, the growth of ICT and its skills leads to increased productivity of ICT agents in economic activities. The demand side leads to increased demand for new products and services. ICT has undoubtedly led to extensive changes in all social and economic areas of humanity. Its impact on human societies is such that today's world is rapidly becoming an information society. A community in which knowledge and the level of access and practical use of knowledge have a pivotal and decisive role. The scope of its application and effects in various aspects of human societies' present and future life have become essential topics worldwide. It has attracted the attention of many countries. Still, in the definition of ICT, it can be said that it is the collection, organization, storage, and dissemination of information, including audio, video, text, or number, done using computer tools and telecommunications [65].

Capital market uncertainty

The capital market is one of the important financial markets in every country, which equips and allocates financial resources to the economy [66, 67]. The capital market gives a large part of the country's financial resources, and how financial resources are allocated directly affects the performance of the real sector of the economy [68, 69]. On the other hand, considering the variety and dispersion of information in the field of accounting and financial affairs and the extent of information in this field, to choose the best information needed by each user to make a decision, a system is needed that intelligently features and can also analyze the information. Anticipate the need [70]. Forecasting is a crucial element for managerial decision-making because most decisions at all levels of the organization directly or indirectly depend on some form of future forecasting [71]. The purpose of forecasting is to reduce risk in decision-making, nowadays, many forecasts in accounting and finance are done by intelligent and expert systems, and the essential application of intelligent systems in accounting, management, and economics is the prediction of these variables [72]. Traders in financial markets, such as the stock market, use technical analysis

tools to make the right decision about buying or selling stocks [73]. Uncertainty is a space in which the decisions of economic actors, including households, businesses, and the public sector in various fields, are accompanied by uncertainty [74, 75]. The unpredictable nature of shocks and unawareness of the market structure cause one to remain confident under any circumstances. Several definitions of uncertainty can be presented [76, 77]. Therefore, the continuation of the process of growth and development in the economy, first of all, requires attention to the factors that create them [78–80]. Many countries, especially developing countries, work hard to develop and adopt economic policies to ensure full employment and sustainable economic growth through investment [81, 82]. By encouraging investment and granting special privileges, such countries seek to create a favourable environment for investment and attract foreign and domestic investment [82, 83].

The government's economic and sometimes non-economic policies are among the most important causes of economic uncertainty [84, 85]. These policies, along with changes in resources, preferences, and technology, obscure the outcome of the decisions of economic agents [86]. Accordingly, identifying the effects of uncertainty on the real activities of the economy is of particular importance. Uncertainty is a situation in which either possible events that occur in the future are unknown or, if these events are known and known, the probabilities of these events are not available and when either or both of these events occur. Decisions about the future are complex and difficult; hence the atmosphere of uncertainty prevails over decisions [87–89]. Economic decisions, including investment demand, are largely based on information from decision-makers about how variables move, but when these changes are unstable and irregular, they create uncertain conditions under which economic decisions will have more risks and costs [90, 91]. Instability and uncertainty in these variables cause distrust in the economic environment, so investors do not easily make investment decisions. Hence, investment is one of the most volatile macroeconomic variables [92–94]. A high degree of economic uncertainty can increase opportunity costs for the investor [95, 96]. These costs include delaying and waiting for new information before making an investment decision, which results in a favourable investment reduction [93, 97].

Therefore, the impact of macroeconomic uncertainties on investment is of particular importance, and extensive studies in economics today are devoted to the issue of uncertainty. Despite much debate, the effects of uncertainty on investment are still theoretically weak, and the results are inconsistent. Therefore, knowing how and to what extent these uncertainties affect investment can provide appropriate recommendations and help policymakers achieve the desired economic goals.

Various theories have been proposed to explain investment theories. The most important are internal investment theory, investment acceleration theory,

neoclassical investment theory, and the Tobin theory, which are called traditional investment theories [98]. The general feature of these theories called traditional investment theories, is that they are interrelated with past and present variables, such as sales, profits, prices, interest rates, and capital stock; this means that rationalizing the role of prices in determining the desired long-term capital stock, and also with the help of a hypothesis of static maximization, they find the optimal way to reach the desired level of capital stock in terms of confidence. In other words, profit-maximizing firms determine the optimal investment amount in terms of complete and risk-free information in these theories. In practice, however, it is difficult for firms to determine the optimal amount of investment, and they are usually, in fact, higher or lower than the optimal amount. This could be due to a lack of complete information [99, 100].

Traditional models often ignore three essential features of investment costs; first, these costs are largely irreversible, and the prices are not recoverable after the investment is made [101]. This means that investments are costs incurred and cannot be repaid. Second, there is always certainty about future investment returns [94]. The best thing to do here is to evaluate each investment opportunity's return probabilities [82]. Third, the investment can be delayed until you receive new information on prices, costs, and other market conditions [100]. This ability to defer irreversible investment costs influences investment decisions; in other words, these characteristics cause the investment to react to different types of risks, such as uncertainty, future prices and costs of production, interest rates, cash flow, and the time of investment [48,99]. These three cases show the profound impact of uncertainty issues on investment and make investors sensitive to the uncertainties of macroeconomic variables. According to the contents of this study, we consider two hypotheses:

H1: The ratio of online transactions to the total volume of transactions significantly affects capital market uncertainty in Iran.

H2: The number of published announcements significantly affects capital market uncertainty in Iran.

RESEARCH METHODOLOGY

Data

Considering that the method used in this dissertation is data processing using data published by institutions such as the Statistics Center of Iran, the Central Bank of the Islamic Republic of Iran, the stock exchange site, the main stock deposit site, the comprehensive information system of publishers, The site of the Ministry of Economy and Finance and the Tehran Stock Exchange Technology Management Company is referred to certain individuals or groups are not parties to the question. No questionnaire is used, so the statistical community is not discussed in this study, but time and place. The online trading system was implemented and available in Iran in

January 2010. For this reason, statistical data related to Iran have been used quarterly from 2011 to 2020. Excel software has been used to prepare the necessary variables for use in the model related to the hypothesis. For this purpose, the information collected in the worksheets created in this software environment was entered. Then the necessary calculations (for example, the ratio of online or online transactions to the total volume of transactions) were performed to obtain the variables of this study. Necessary for use in this research model entered version 10 of Eviews software. First, the uncertainty of the total return index of the stock market was calculated, and then the model was estimated by the ARDL method.

Model

Model 1 has been used to test the research hypotheses using theoretical foundations and experimental studies.

$$FD_t = C + \beta_1 LRGDP_t + \beta_2 INF_t + \beta_3 FREERATE_t + \beta_4 GOV_t + \beta_5 FIN_t + U_t \quad (1)$$

where:

FD is Stock Market Index Returns Uncertainty As a capital market uncertainty index, first extract the stock market index returns from the Tehran Stock Exchange site and then use the GARCH model to estimate the return of the stock market index.

GOV is the ratio of online or offline trades to the total volume of trades. The indicators of the number of users of online transactions, the number of published announcements, the ratio of capital market participants to capital market users, and the ratio of online or online transactions to the total volume of transactions were used as ICT indicators in the model. However, due to inappropriate econometric results (inappropriate results in terms of economic theory and semantics) due to the use of indicators of the number of users of online transactions and the ratio of capital market participants to capital market users, these indicators were removed from the models. The data required for this study for the relevant period through the Statistics Center of Iran, the Central Bank of the Islamic Republic of Iran, information stored in the library of the Tehran Stock Exchange Organization and the websites of the Stock Exchange Organization, the comprehensive information system of publishers, website of the Ministry Economy and Finance and Technology Management Company of Tehran Stock Exchange have been collected.

FIN is the number of notifications published. The number of announcements and advertisements posted to inform the visitors on the site of the comprehensive information system of publishers.

GDP is the GDP is a measure of economic growth the economy. Gross domestic product is the sum of the final value of goods and services produced in a country, usually one year. It is used to measure this variable through the logarithm of GDP in each chapter.

INFLATION is the Inflation Rate (Percent). **FREE RATE** is the unofficial exchange rate.

The exchange rate is a foreign currency equivalent to a domestic currency. In other words, the exchange rate is the price of buying and selling a foreign currency in the country's currency. U is the equation error, and t is the time representation.

EMPIRICAL RESULTS

Table 1 presents some of the concepts of descriptive statistics of variables, including mean, median, minimum and maximum observations, standard deviation, skewness, and elongation. The essential central indicator is the average, which indicates the distribution's equilibrium point and centre of gravity and is an excellent indicator to indicate the centrality of the data. The middle is another central indicator that shows the state of society. An important point that can be inferred from comparing the mean and the median is the issue of the normality of the data. One of the essential parameters of data dispersion is the standard deviation. A vital point to be inferred from the standard deviation of a variable is to include the variable in the regression model. As seen in table 1, the standard deviation of the variables is not zero, so the studied variables can be entered into the model. The degree of asymmetry of the frequency curve is called skewness. If the skewness coefficient is zero, society is perfectly symmetrical. If the skewness coefficient is positive, there is skewness to the right, and if it is negative, there is skewing to the left. The

curve's elongation amount compared to the standard curve is called elongation with elongation. If the elongation is about zero, the frequency curve is balanced and standard in terms of elongation. If this value is positive, the curve is prominent, and if it is negative, the curve is broad. In this study, the elongation of all variables is positive. The skewness is normal to the third torque. Skewness is a measure of the existence or asymmetry of the distribution. For a perfectly symmetric distribution, it is zero; for an asymmetric distribution, it is positively skewed for higher values; and for an asymmetric distribution, it is negatively stretched for smaller values.

Examining the trend of variables

Investigating the trend of the return index of the Tehran Stock Exchange (Dx) as a capital market index (FD)

The return trend of the total stock index as a capital market index shows that: during the period studied in the present study, the highest rate of return on the capital market index is related to the first quarter of 2020, and the lowest rate of return is associated with the winter of 2014 (figure 1).

To better examine this issue, we must first examine some of the drivers of liquidity absorption in the second half of 2019, particularly in 2020. One of the biggest economic problems of governments is the issue of liquidity growth, which causes inflation and

Table 1

DESCRIPTIVE STATISTICS							
Variables	Mean	Median	Std. Deviation	Skewness	kurtosis	Minimum	Maximum
FD	0.089115	0.00834	0.344293	5.829267	35.94767	3.810007	2.182516
LRFD	9.559013	9.544489	0.173883	-0.08054	2.666686	9.186622	9.951641
INF	21.5525	21	11.32687	0.306265	1.804615	6.9	42.7
FREERATE	66937.51	35389.7	68005.91	1.681351	4.812919	11531.5	272626
FIN	5991.15	4940.5	2897.525	0.73499	2.419832	2291	13305
GOV	0.8565	0.9	0.092807	-0.7362	2.26387	0.65	0.96

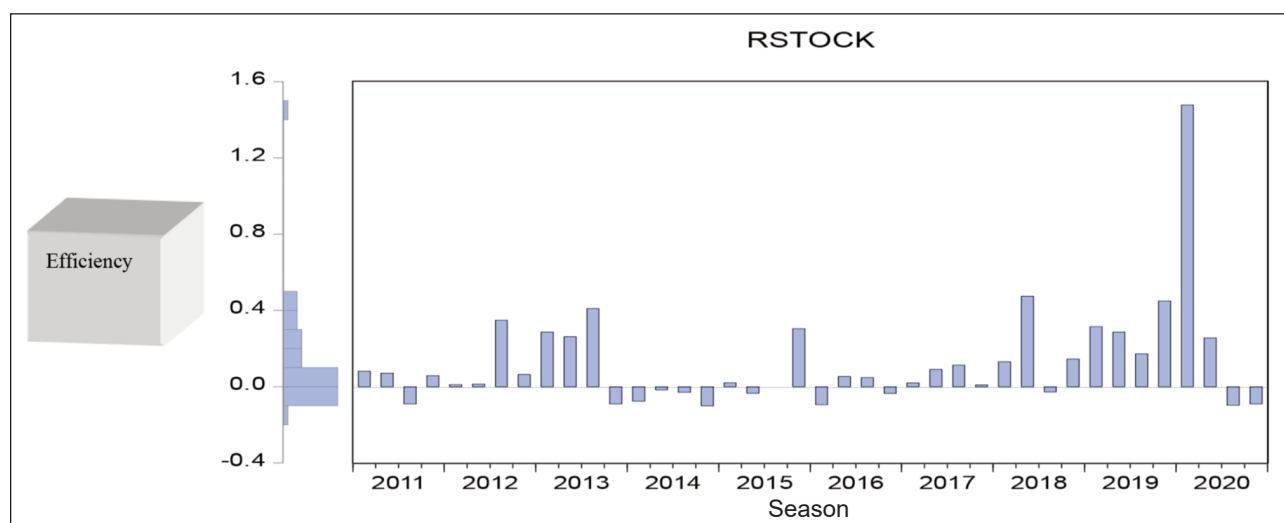


Fig. 1. Return on the total stock index as an indicator of capital market uncertainty

consequently increases commodity prices. Therefore, a mechanism to control liquidity and attract market liquidity is one of the demands of governments. It means that holding money reduces its value, and the desire to turn it into capital goods among investors flourishes. Without a practical and accurate solution, this desire creates speculation in investment markets such as currency, gold, cars, and housing.

On the other hand, the budget deficit and the lack of funding through oil exports due to sanctions doubled the attractiveness of the stock market for the government to cover the budget deficit by divesting its shares in large companies. Government financial and propaganda support for the stock market caused the stock market to turn green, the economic downturn due to the outbreak of coronary heart disease, and business owner's efforts to earn alternative income and compensate for losses. On the other hand, lower bank interest rates caused many capitalists. Due to the attractiveness of the stock market, they should transfer capital from banks to the stock exchange. Other factors that make the stock market attractive to the general public include the ease of access to mobile phone transactions, which is possible even in the most remote areas. The cessation of imports of many goods due to sanctions resulted in the success of domestic goods and the resulting profitability of domestic manufacturing companies due to the growth of demand. Sell at a reasonable and anticipated price by designing and selling ETF funds to support specific shares.

On the other hand, the increasing growth of companies' capital increase this year, which is done to improve financial structures, created increasing attractiveness for its inclusion symbols. To finance the government, the initial public offerings became more intense, and the dream profits that its shareholders received in a short time became an attempt to buy them. It became a daily competition. They

were worried about losing attractive daily profits, which added to the excitement of the everyday shopping queue and made the queues heavier.

Examining the trend of real GDP logarithm (LRGDP) as an indicator of economic growth

First, the GDP variable at this year's price was extracted from the Central Bank's website to calculate the economic growth index. To convert current GDP data into real figures, this variable was divided into CPI data for each period, which is quarterly extracted from the website of the Statistics Center of Iran, which results in real GDP. The data were then logarithmized for use in the model. The data trend of this variable is shown in the figure 2.

The highest economic growth rate is related to the second quarter (summer) of 2020 because in this period, in addition to removing a few obstacles to sanctions, such as the release of some money blocked state-owned banks and facilitating exports, while increasing global demand. In the field of oil and gas, due to the discovery of the coronavirus vaccine in the world and the return of factories to the production line, the volume and selling price of oil and gas products increased, which has led to an increase in real production. The lowest rate of economic growth was in the fourth quarter of 2011.

Examining the inflation rate trend

The highest amount of inflation data is related to the second quarter of 2019, which occurred due to the policies of the Central Bank to increase the volume of liquidity. The lowest inflation rate during the period under review is related to Chapter 4 of 2016, which occurred due to the government's contractionary policies using open market operations and bond issuance. In 2016 and 2017, the government and the central bank performed the best performance in controlling the inflation rate during the study period (figure 3).

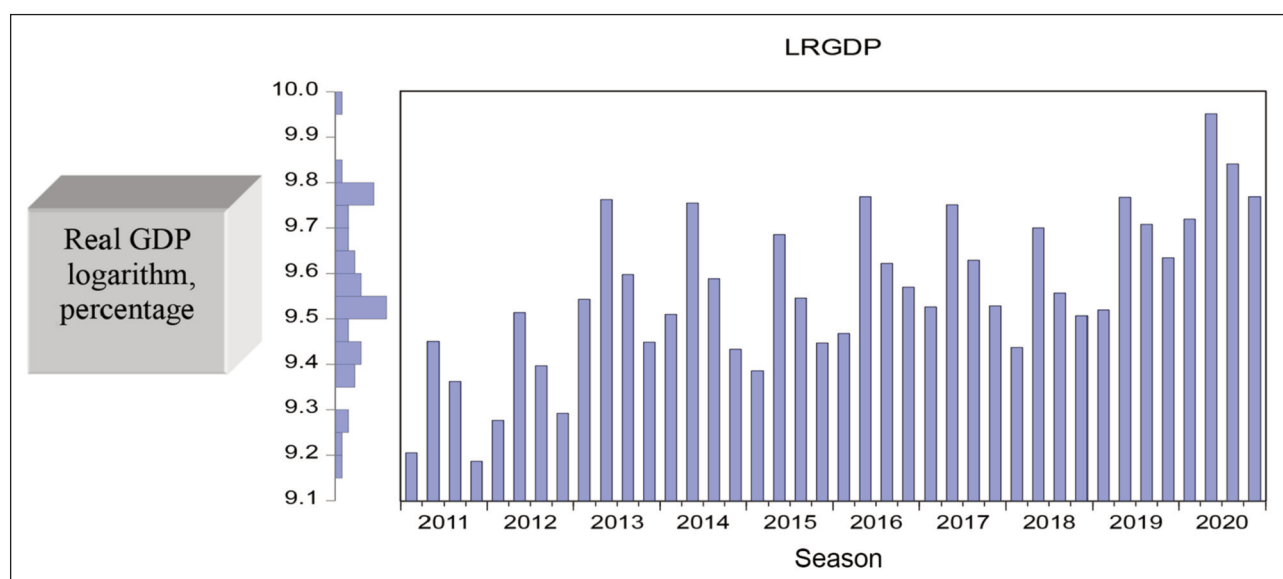


Fig. 2. The logarithm trend of real GDP as an indicator of economic growth
 (Source: Research calculations based on data from the Statistics Center of Iran and the Central Bank and researcher calculations and author's computations)

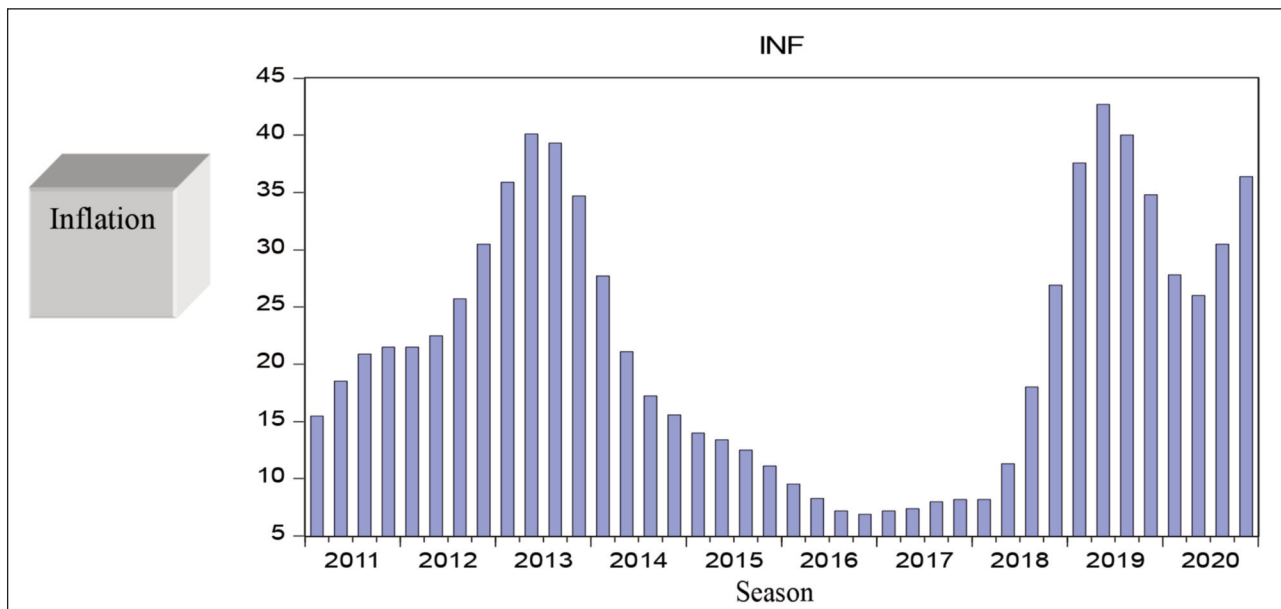


Fig. 3. Inflation rate trend
 (Source: Statistics and Data Center of the Ministry of Economy and Finance and researcher calculations and Author's computations)

Checking the trend of the free exchange rate (unofficial) (FREERATE)

An examination of the free exchange rate trend shows the national currency's highest exchange rate or devaluation in the third quarter of 2020 and the lowest in the first quarter of 2011 (figure 4).

The ratio of online or total transactions to total transactions (GOV) as an indicator of ICT

This index is the ratio of the number of online transactions that users and capital market participants have registered in their trading platform during the study period. Its data has been extracted through the

Tehran Stock Exchange and Securities Organization data centre to the total transactions. (Calculated by trading worksheets + total online sales). Increasing the face of this deduction means increasing the volume of online or offline transactions relative to the denominator of the deduction, which includes the total number of transactions. This means that trading platforms are expanding and improving their mechanism. Users and traders are positioned as good indicators as a variable of the quality of the ICT status to examine its effects on the capital market (figure 5). Due to the improvement of the structure of Internet technology and efforts to make public use of this

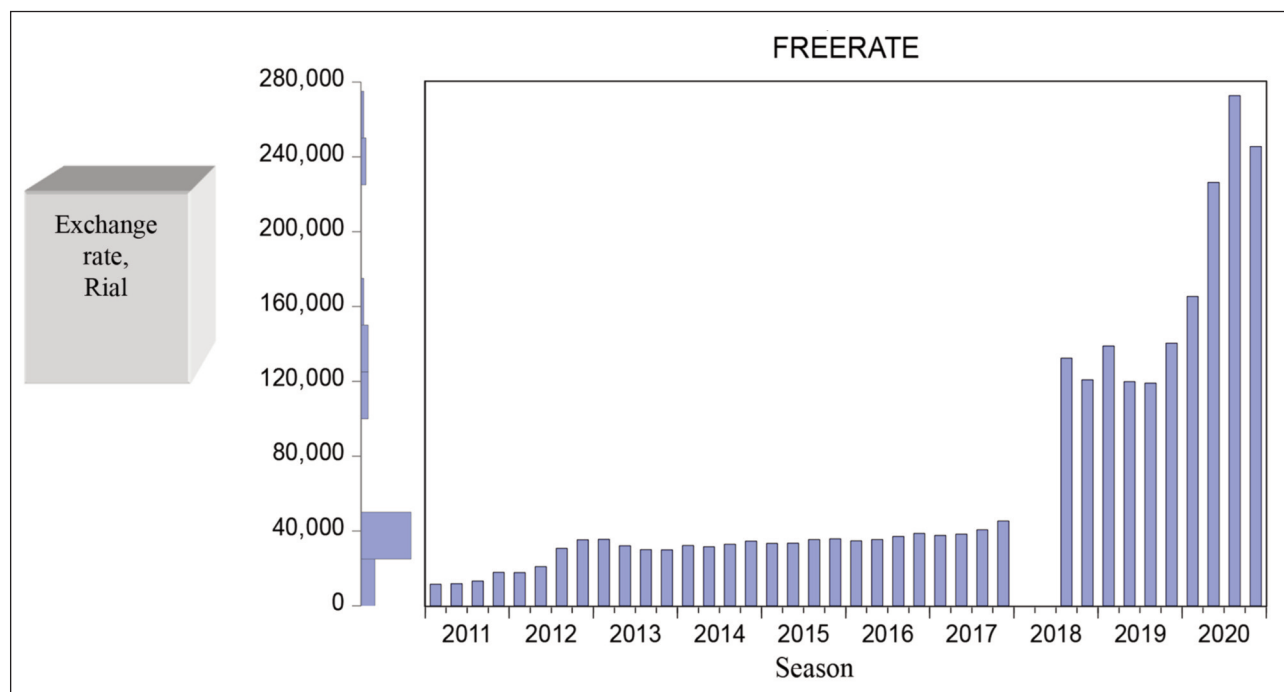


Fig. 4. Free (Informal) Exchange Rate Trend

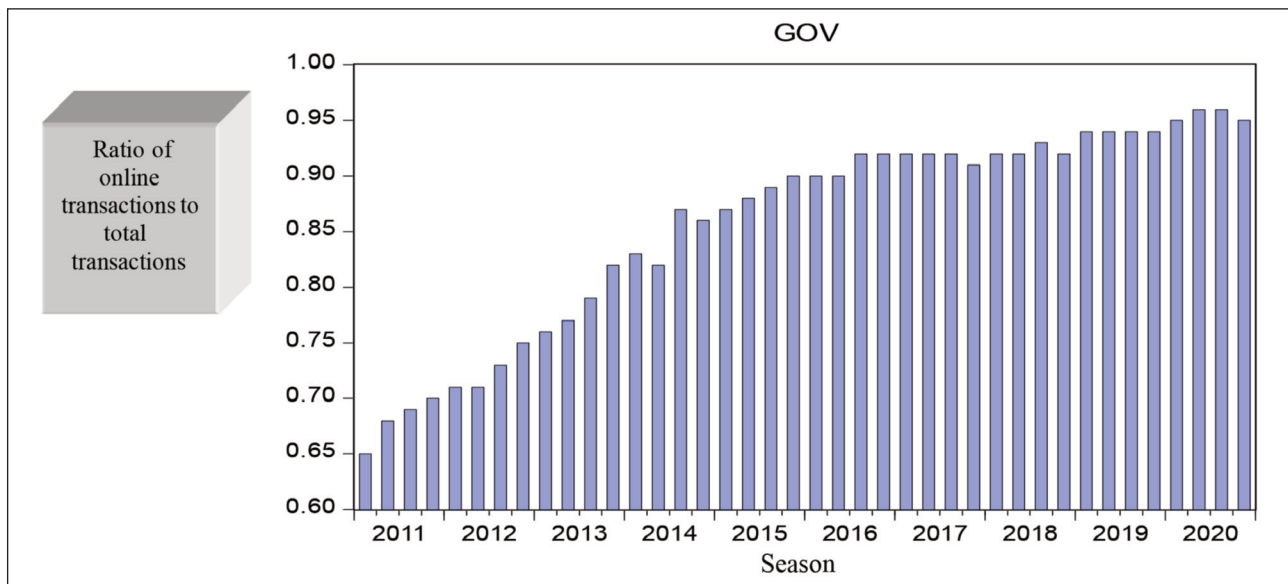


Fig. 5. The trend of the ratio of online transactions to total transactions
(Source: Tehran Stock Exchange (WWW.TSETMC.COM) and author's computations)

powerful tool in various fields, significantly improving the quality of trading platforms and easier and more access to this essential infrastructure that is required for online or offline trading, during the period The trend of online trading in relation to the total trading is still increasing, which is a factor for the upward slope of figure 5.

Check the trend of the number of published announcements (FIN)

The number of published announcements is related to the change in the status of trading symbols, capital increase and distribution of profits, and quarterly, six-month, nine-month, and annual financial statements of listed companies, as well as the disclosure of information from groups A and B. Published by the Exchange and Securities Organization (figure 6):.

The highest number of announcements was published in the second quarter of 2020, and the lowest number of reports was published in the fourth quarter of 2011.

The essential central indicator is the average, which indicates the distribution's equilibrium point and centre of gravity and is an excellent indicator to indicate the centrality of the data. The middle is another central indicator that shows the state of society. An important point that can be inferred from comparing the mean and the mean is the issue of the normality of the data. One of the essential parameters of data dispersion is the standard deviation. A vital point inferred from the standard deviation is to include the variable in the regression model. The results showed that the standard deviation of the variables is not zero, so the studied variables can be entered into the

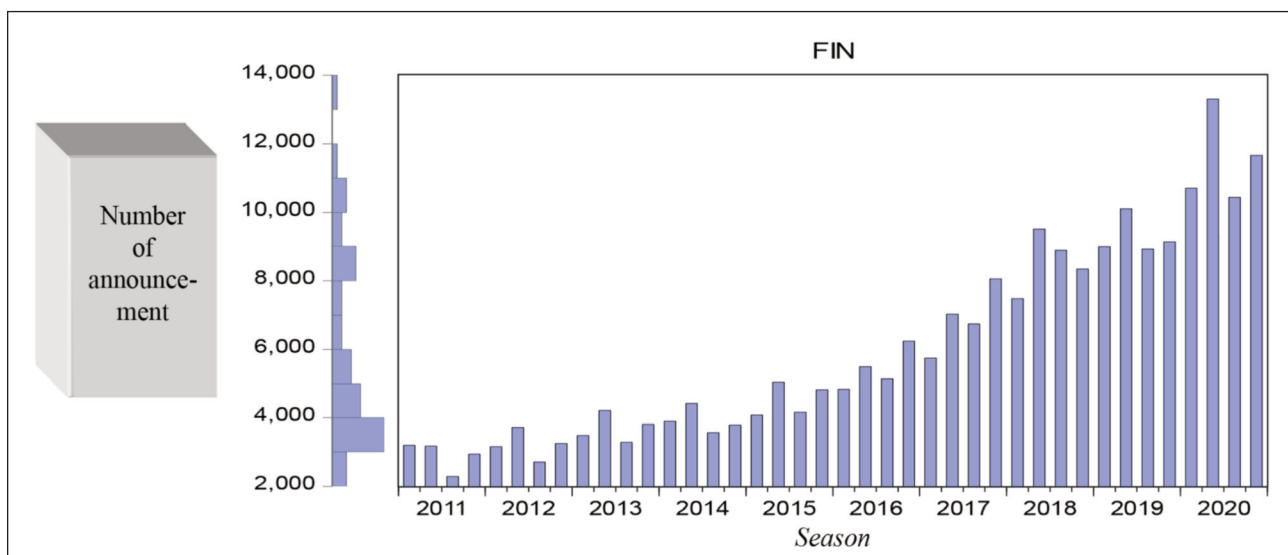


Fig. 6. The trend of the number of announcements published through the CODAL system and Tehran Stock Exchange Technology Management Company
Source: CODAL system (WWW.CODAL.IR) and Author's computations

model. The degree of asymmetry of the frequency curve is called skewness. If the skewness coefficient is zero, society is perfectly symmetrical. If the skewness coefficient is positive, there is skewness to the right, and if it is negative, there is skewness to the left. The curve's elongation amount compared to the standard curve is called elongation with elongation. If the elongation is about zero, the frequency curve is balanced and normal in terms of elongation. If this value is positive, the curve is prominent, and if it is negative, the curve is wide. In this study, the elongation of all variables is positive. The national currency's highest exchange rate or devaluation was in the third quarter of 2020, and the lowest was in the first quarter of 2011. The highest number of announcements was published in the second quarter of 2020, and the lowest number of reports was published in the fourth quarter of 2011. During the study period, the trend of online trading in relation to total trading continued to increase, which is a factor for the upward slope of figure 6. The highest inflation data relates to the second quarter of 2019 due to the central bank's policies to increase liquidity.

The lowest inflation rate during the study period is related to Chapter 4 of 2016, which occurred due to the government's contractionary policies using open market operations and bond issuance. The highest economic growth rate is related to the second quarter (summer) of 2020 because in this period, in addition to removing a few obstacles to sanctions, such as the release of some money blocked state-owned banks and facilitating exports, while increasing global demand. In the field of oil and gas, due to the discovery of the coronavirus vaccine in the world and the return of factories to the production line, the volume and selling price of oil and gas products increased, which has led to an increase in real production. The lowest rate of economic growth was in the fourth quarter of 2011. During the period studied in the present study, the highest rate of return on the capital market index is related to the first quarter of 2020, and the lowest rate of return is associated with the winter of 2014.

Stationary variable

One of the most appropriate tests for seasonal data is the HEGY test, proposed by Parasite, Granger, and Yu as a method that replaces the generalized Dickey-Fuller unit (ADF) test in seasonal data. The results of the HEGY test are given in table 2.

The results of the unit root test in the period 2011: 1 to 2020: 4 in table 3 show that the volatility variables of the return of the total stock index as an index of capital market uncertainty (FD) and the logarithm of real GDP (LRGDP) as an indicator of economic growth with a one-time difference and inflation rate (INF) variables, number of published announcements (FIN) and the ratio of online or offline trades to total trades as an ICT index (GOV) and non-exchange rate Are official (FREERATE) at the Stationary level (I0).

This estimate is only used to calculate the uncertainty and therefore does not need to be interpreted. By estimating the GARCH model (1), RESID can be estimated using the return variable of the total index of the Tehran Stock Exchange. To calculate the uncertainty, it is enough to multiply the residues of the above equation or the so-called RESID by two. In the next step, the main research model is estimated. Regression equation (1) by ARDL method and with default settings of Ives software (in Ordinary mode and according to the number of data in the studied time series, considering that the number of data is less than 80 by Schwartz-Bayesian method) has been estimated (table 4).

The results of the short-term model estimation in table 4 show that: the uncertainty of the return of the total stock exchange index as an index of capital market uncertainty in previous seasons has had a negative and significant effect on capital market uncertainty in the current season. In other words, with a one percent increase in the uncertainty of the return of the total stock index in the previous quarter, assuming other conditions are stable, the uncertainty of the capital market in the current season has decreased by 1.620977 percent. This indicates a lack of transfer of uncertainty between the seasons.

Table 2

RESULTS OF STATIONARY OF THE VARIABLE TEST USING THE HEGY TEST					
Result	Hypothesis zero	In level of			Variable
		$F_{\pi_3 \cap \pi_4}$	t_{π_2}	t_{π_1}	
Stationary with one-time differentiation – I(1)	Hypothesis 1. Existence of unit root or non-seasonal unit root at zero frequency Hypothesis 2. Existence of seasonal unit root at six-month frequency. Hypothesis 3. Existence of seasonal unit root in annual frequency	3.65	-2.73	-3.14	FD
Stationary with one-time differentiation Stationary – I(1)		7.32	-1.86	-2.24	LRGDP
Stationary – I(0)		8.78	-1.79	-1.16	INF
Stationary – I(0)		0.07	-2.87	-2.25	GOV
Stationary – I(0)		15.39	-1.53	-2.46	FREERATE
I(0)Stationary		10.76	-2.23	-2.95	FIN

Table 3

RESULTS OF ESTIMATING THE UNCERTAINTY OF RETURN ON THE TOTAL STOCK EXCHANGE INDEX AS AN INDEX OF CAPITAL MARKET UNCERTAINTY				
Dependent Variable: RSTOCK Method: ML ARCH – Normal distribution (BFGS / Marquardt steps) Coefficient covariance computed using the outer product of gradients Presample variance: backcast (parameter = 0.7) GARCH = C(1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Variance equation				
C	0.022246	0.006762	3.289914	0.0010***
RESID(-1)^2	1.425018	0.432289	3.296446	0.0010***
GARCH(-1)	-0.033407	0.044931	-0.743508	0.4572*
R-squared	-0.230744	Mean dependent var		0.129258
Adjusted R-squared	-0.199976	S.D. dependent var		0.272514
S.E. of regression	0.298521	Akaike info criterion		-0.073886
Sum squared resid	3.5646	Schwarz criterion		0.05278
Log-likelihood	4.477723	Hannan-Quinn criteria.		-0.028088
Durbin-Watson stat	1.151736			

Note: * 10% error level; ** 5% error level; *** 1% error level.

Table 4

RESULTS OF MODEL ESTIMATION IN SHORT-TERM ARDL (3,2, 0, 3, 0, 0)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
FD(-1)	-1.620977	0.129941	-12.47471	0.0000***
INF	-0.140687	0.021635	-6.502782	0.0000***
LRGDP	0.945229	0.226555	4.172179	0.0006***
FREERATE	4.43E-05	4.86E-06	9.120681	0.0000***
GOV	1.912389	0.791275	2.416845	0.0265***
FIN	-8.90E-05	3.85E-05	-2.313415	0.0327***
C	-10.35073	1.942586	-5.328324	0.0000***
R-squared	0.951579	Durbin-Watson stat		2.14146
Adjusted R-squared	0.916608	Prob(F-statistic)		0.0000

Note: * 10% error level; ** 5% error level; *** 1% error level.

Suppose there is an increase in uncertainty in a particular season. In that case, the resulting excitement is discharged in the same season. There is no reason for the cycle of uncertainty to continue into subsequent seasons by changing the circumstances. Market participants are smart and make the necessary adjustments to their investment portfolio in the same season under uncertain conditions. Inflation has a negative and significant effect on the uncertainty of the return of the entire stock exchange index as an indicator of capital market uncertainty. Therefore, the hypothesis about the considerable impact of inflation on capital market uncertainty can not be rejected. With a one percent increase in the average inflation rate, assuming other conditions remain constant, capital market uncertainty has decreased by 0.140687 percent. In inflationary conditions, the average nominal profit of companies increases due to the devaluation of money. This increase is due to compensate for the decrease in

real profits. Therefore, with the rise in the inflation rate, companies' dividends will increase, and consequently, the stock price will increase. Also, with growing inflation, the investor is less inclined to hold money due to its high risk. Therefore, they are looking to reduce the liquidity in their portfolio. For this purpose, one of the options is to buy stocks that can act as a shield against inflation.

As a result, the demand for investing in the stock market increases. Increasing the need to buy stocks increases the stock price, consequently increasing the value of transactions and increasing the volume of transactions. Investment in companies can increase. Therefore, companies issue shares to provide the necessary financial resources for future investments. Thus, with the inflation rate increase, companies' shares will also improve. According to what was said, inflation raises the stock market activity index (trading value, trading volume, the number of shares, and stock returns). Also, the liquidity index (ratio of

exchange value to total current value of the stock market, ratio of the number of exchanged shares to the total issued shares of the stock market) can increase. Therefore, the effect of inflation on stock market activity, return, and liquidity indicators is positive in the short run. Since stock market activity and liquidity indicate stock market performance, it can be concluded that the effect of inflation on stock market performance in the short term in Iran is positive. As a result, capital market uncertainty decreases [102].

Fama sought to explain the negative relationship between inflation and stock returns. He showed that the negative relationship between actual stock returns and inflation is due to chain effects. His explanation was contrary to the original Phillips curve, meaning a negative correlation between inflation and economic activity. Increasing persistent inflation reduces actual future activities because steady inflation reflects changes in real future activities and, as a result, decreases stock returns. The negative correlation between actual stock returns and inflation is called the chain effect due to the connection between these two relationships. In general, the real sector of the economy indicates that the relationship between stock returns and the growth rate of actual activities is positive. Fama believed that a positive relationship between stock returns and actual activity due to the real sector is combined with a negative relationship between inflation and actual activity due to the financial industry. A negative relationship between actual stock returns and inflation is inferred. In other words, with rising inflation, stock returns will decrease, and capital market uncertainty will increase.

Economic growth has a positive and significant effect on the performance uncertainty of the total stock index as an indicator of capital market uncertainty. Therefore, the hypothesis about the considerable impact of economic growth on capital market uncertainty can not be rejected. With an average increase of one percent in economic development, assuming other conditions are stable, capital market uncertainty has increased by 0.945229 percent. As economic growth increases, so do the welfare of society and the willingness to invest. As a result, corporate profits increase, their financial statements improve, corporate stocks become more valuable, corporate stock returns increase, and capital market uncertainty decreases. But in the Iranian economy, economic growth has increased capital market uncertainty. Thus, economic growth leads to the demand for financial services and financial market development. The exchange rate has a positive and significant effect on the performance uncertainty of the total index of the stock exchange as an indicator of capital market uncertainty. Therefore, the hypothesis about the considerable impact of exchange rates on capital market uncertainty can not be rejected. Capital market uncertainty increases by increasing the unit exchange rate on average, assuming other conditions are constant. The ratio of online transactions to the total volume of transactions as an ICT index has a positive and significant effect on the return uncer-

tainty of the total stock exchange index as an indicator of capital market uncertainty. Therefore, the hypothesis of the considerable impact of ICT on capital market uncertainty can not be rejected. With increasing one unit in the ratio of online transactions to the total volume of transactions as an average of ICT, assuming that other conditions are constant, capital market uncertainty has increased by 1.912389% in the short term. The effect of the ratio of online or online transactions to the total volume of transactions on capital market uncertainty in the long and short time is different. Since some capital market participants in Iran do not have stock exchange literacy, they are affected by the actions of other shareholders, especially significant shareholders, and imitate their behaviour. This factor increases the excitement in the market and increases the uncertainty in the capital market in the short run. Increasing trading volume in the long run increases market confidence, increases market profitability expectations, and reduces capital market uncertainty.

The number of announcements and advertisements issued as an ICT index has a negative and significant effect on the uncertainty of the return of the entire stock exchange index as an indicator of capital market uncertainty. Therefore, the hypothesis of the considerable impact of ICT on capital market uncertainty can not be rejected. With the increase of one unit in the number of announcements and advertisements published as an ICT indicator, on average, assuming that other conditions are constant, the uncertainty of the capital market has decreased. Whenever users in designated trading systems and platforms provide more accurate and timely information as a result of decisions made about the market as a whole (such as trading time, fluctuations, fluctuations, etc.) or specific stocks (reopen or stop Being a symbol, the decisions of the assembly regarding the increase of capital and distribution of profits, etc.) should be informed faster and more accurate and timely information should be provided in this regard, the decisions of the shareholders will be adjusted at a more appropriate speed. This will reduce the risk and consequently the uncertainty of the capital market (figures 7 and 8).

Then, to further ensure the accuracy of the estimation method and the estimation parameters in the main research model, the following tests (including normality test, heterogeneity test, model specification test, and autocorrelation test). It was done according to the classical assumptions, summarized in tables 5 and 6.

To investigate the existence of long-term relationships, the shore test method has been used in the combined study of the IPS method. Testing the shores can overcome the limitations of other methods used in previous studies (tables 7, 8 and 9).

Therefore, according to the test results and confirmation of the absence of problems such as structural failure, variance heterogeneity, and autocorrelation, the short-term model is approved in the same way as in the form of Schwartz and Ordinary. Also, the

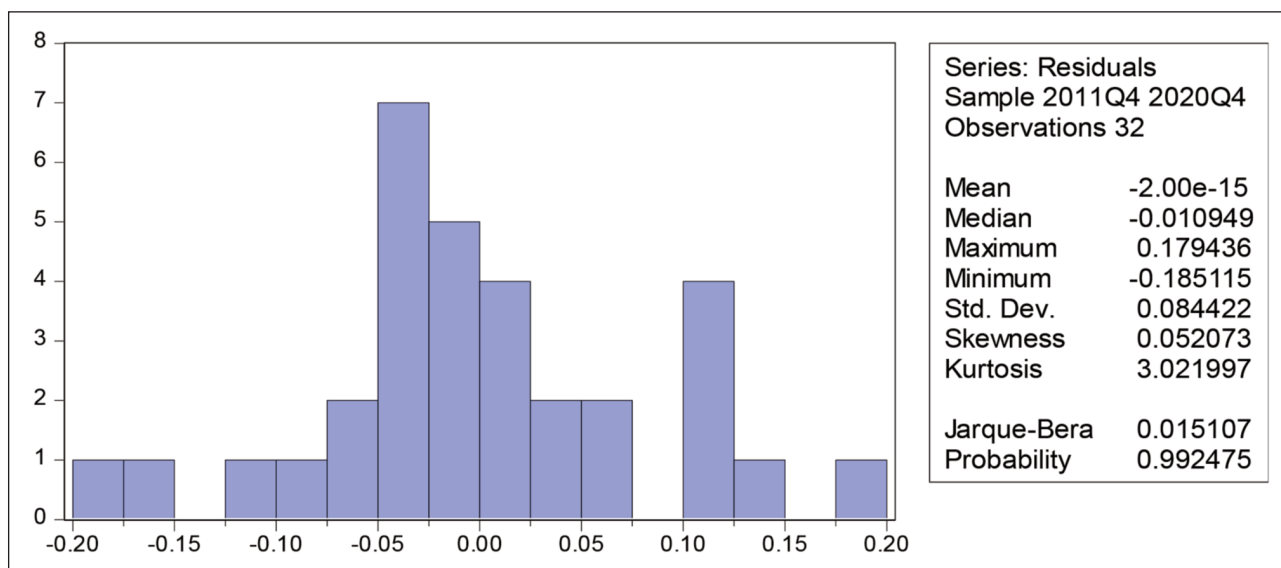


Fig. 7. Test for normality of estimation errors

Table 5

RESULTS OF THE BRUCH-GODFREY AUTOCORRELATION TEST				
F-statistic	1.680598	Prob. F(2,16)	0.2175	
Obs*R-squared	5.555352	Prob. Chi-Square(2)	0.0622	
Test Equation: Dependent Variable: RESID Method: ARDL Sample: 2011Q4 2020Q4 Presample and interior missing value lagged residuals set to zero.				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
FD(-1)	0.014052	0.131561	0.106807	0.9163*
FD(-2)	0.059459	0.169246	0.351317	0.7299*
FD(-3)	0.074335	0.197353	0.376659	0.7114*
INF	-0.00765	0.022622	-0.33794	0.7398*
INF(-1)	0.013833	0.040452	0.341959	0.7368*
INF(-2)	-0.0071	0.022386	-0.31726	0.7551*
LRGDP	0.056607	0.223598	0.253165	0.8034*
FREERATE	5.000007	4.760006	0.105045	0.9176*
FREERATE(-1)	-3.58001	5.300006	-0.06743	0.9471*
FREERATE(-2)	-1.53001	4.600006	-0.33215	0.7441*
FREERATE(-3)	7.050007	4.360006	0.161859	0.8734*
GOV	-0.11161	0.768837	-0.14516	0.8864*
FIN	5.030006	3.760005	0.133953	0.8951*
C	-0.43315	1.902482	-0.22768	0.8228*
RESID(-1)	-0.13708	0.27433	-0.49969	0.6241*
RESID(-2)	-0.45443	0.250878	-1.81134	0.0889*
R-squared	0.173605	Mean dependent var	-2.000015	
Adjusted R-squared	-0.60114	S.D. dependent var	0.084422	
S.E. of regression	0.106825	Akaike info criterion	-1.328399	
Sum squared resid	0.182585	Schwarz criterion	-0.595531	
Log-likelihood	37.25438	Hannan-Quinn criteria	-1.085474	
F-statistic	0.22408	Durbin-Watson stat	2.305332	
Prob(F-statistic)	0.997043			

Note: * 10% error level; ** 5% error level; *** 1% error level.

RESULTS OF CONDITIONAL VARIANCE HETEROGENEITY TEST				
Heteroskedasticity Test: ARCH				
F-statistic	1.294481	Prob. F(1,28)		0.2649
Obs*R-squared	1.325657	Prob. Chi-Square(1)		0.2496
Test Equation: Dependent Variable: RESID^2 Method: Least Squares Sample (adjusted): 2012Q1 2020Q4 Included observations: 30 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.00883	0.00227	3.899015	0.0006***
RESID^2(-1)	-0.2088	0.18352	-1.137753	0.2649*
R-squared	0.044189	Mean dependent var		0.007337
Adjusted R-squared	0.010052	S.D. dependent var		0.010161
S.E. of regression	0.01011	Akaike info criterion		-6.28622
Sum squared resid	0.002862	Schwarz criterion		-6.19281
Log-likelihood	96.29332	Hannan-Quinn criteria		-6.25634
F-statistic	1.294481	Durbin-Watson stat		1.8841
Prob(F-statistic)	0.264866			

Note: * 10% error level; ** 5% error level; *** 1% error level.

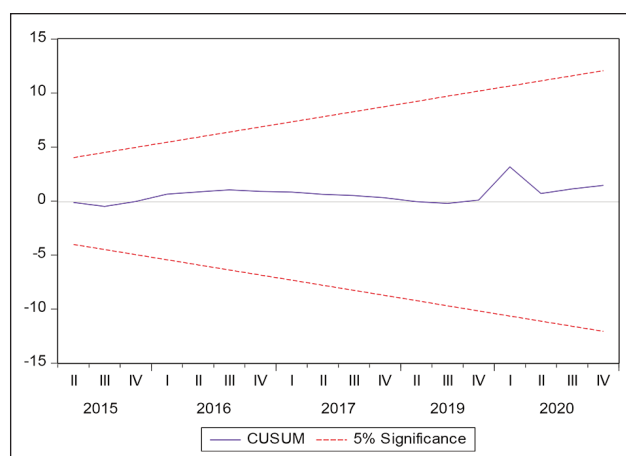


Fig. 8. Structural failure test by Qiosam method

Table 7

THE RESULTS OF THE CO-BAND BOUNDARY TEST TO EVALUATE THE EXISTENCE OF A LONG-RUN RELATIONSHIP		
ARDL Bounds Test Sample: 2011Q4 2020Q4 Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	15.73506	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.50%	2.96	4.18
1%	3.41	4.68

research model is estimated in the long run according to the confirmation of a long-term relationship. Table 10 shows the results of the long-term research model.

The results of long-term model estimation show that:

- The uncertainty of the return of the total stock market index as an index of capital market uncertainty in previous seasons has had a positive and significant effect on capital market uncertainty. This indicates a long-term transfer of uncertainty between seasons. Suppose there is an increase in tension in a particular season. In that case, the resulting excitement, in the long run, is not discharged in the same season. There is a possibility that the cycle of increasing uncertainty will continue into subsequent seasons in the long run.
- Inflation has a negative and significant effect on the yield uncertainty of the total stock index and securities as an indicator of capital market uncertainty. Therefore, the hypothesis about the considerable impact of inflation on capital market uncertainty cannot be rejected.
- Economic growth has a positive and significant effect on the uncertainty of the return of the entire stock exchange index as an indicator of capital market uncertainty. Therefore, the hypothesis about the considerable impact of economic growth on capital market uncertainty cannot be rejected. Considering that economic growth in Iran is strongly dependent on oil revenues and its derivatives; Also, the main volume of imports in the country is the import of intermediate goods for the production of final goods and, finally, their export; Sanctions and currency fluctuations have caused fluctuations in production and economic growth; Therefore, the

Table 8

THE RESULTS OF THE CO-BAND BOUNDARY TEST TO EVALUATE THE EXISTENCE OF A LONG-RUN RELATIONSHIP				
Dependent Variable: D(FD) Method: Least Squares Sample: 2011Q4 2020Q4				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FD(-1))	3.594883	0.5299	6.784084	0.0000***
D(FD(-2))	1.470378	0.361897	4.06297	0.0007***
D(INF)	-0.059516	0.014563	-4.086663	0.0006***
D(FREERATE)	2.650005	6.640006	3.992681	0.0008***
D(FREERATE(-1))	4.950005	8.800006	5.626161	0.0000***
D(FREERATE(-2))	3.260005	7.440006	4.383904	0.0003***
C	-3.32778	3.008499	-1.106126	0.2825*
INF	0.025254	0.0087	2.902651	0.0091***
LRGDP(-1)	0.110826	0.350331	0.316348	0.7552*
FREERATE(-1)	-3.110006	5.120006	-0.607518	0.5507*
GOV(-1)	2.140962	1.397969	1.53148	0.1421*
FIN(-1)	2.630005	6.880005	0.381884	0.7068*
FD(-1)	-6.103416	0.673261	-9.065453	0.0000***
R-squared	0.92243	Mean dependent var		-0.00309
Adjusted R-squared	0.87343	S.D. dependent var		0.524517
S.E. of regression	0.1866	Akaike info criterion		-0.22845
Sum squared resid	0.6616	Schwarz criterion		0.367002
Log-likelihood	16.6553	Hannan-Quinn criteria		-0.03108
F-statistic	18.8273	Durbin-Watson stat		1.298827

Note: * 10% error level; ** 5% error level; *** 1% error level.

Table 9

SUMMARY OF THE RESULTS OF THE MODEL DIAGNOSTIC TESTS		
Summary of results	Test statistics (probability level)	Title of exam
The distribution of errors is very close to the normal pattern.	Jarque-Bera = 0.015107(0.992475)	Normality Test
There is no self-correlation based on the probability level of the F statistic greater than 0.05. If there is autocorrelation, it is necessary to estimate the pattern by the HAC (NEWKEY WEST) method so as not to create the problem of autocorrelation in estimating the parameters of the bias pattern.	F(2,16) = 1.680598 (0.2175)	(LM Test)
Given that the probability level is higher than 0.05 based on the estimated statistics of Chi-square and F, there is no problem with variance inhomogeneity. Therefore, the model must be estimated as ORDINARY. Suppose there is a conditional variance heterogeneity problem. In that case, it is necessary to estimate the model using the WHITE method so that the heterogeneity problem does not cause inefficiency and skew in the estimation parameters.	F(1,28) = 1.294481 (0.2649) Chi-Square(1) = 1.325657 (0.2496)	(ARCH)
There is no structural break. There is no structural break because it does not go beyond the boundary lines.	Graph	Structural Break
Compared with the one percent limit range (3.41–4.68) and the resulting F position above this set range, it can be concluded that the existence of a long-term relationship with 100% probability (100%) has been confirmed.	F(K=5) = 15.73506	(Bounds Test)

RESULTS OF LONG-TERM MODEL ESTIMATION USING ARDL METHOD (3, 2, 0, 3, 0, 0)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FD(-1))	3.681091	0.312586	11.77625	0.0000***
D(FD(-2))	1.294925	0.191674	6.755881	0.0000***
D(INF)	-0.14069	0.021635	-6.50278	0.0000***
D(INF)	0.116693	0.021187	5.507841	0.0000***
D(LRGDP)	0.945229	0.226555	4.172179	0.0006***
D(FREERATE)	0.000044	0.000005	9.120681	0.0000***
D(FREERATE(-1))	0.000026	0.000005	5.658064	0.0000***
D(FREERATE(-2))	0.000034	0.000004	7.658965	0.0000***
D(GOV)	1.912389	0.791275	2.416845	0.0265**
D(FIN)	-8.9E-05	0.000038	-2.31342	0.0327**
CointEq(-1)	-6.30207	0.395435	-15.937	0.0000***
Cointeq = FD - (0.0011*INF + 0.1500*LRGDP - 0.0000*FREERATE + 0.3035*GOV - 0.0000*FIN - 1.6424)				

Note: * 10% error level; ** 5% error level; *** 1% error level.

stock returns of companies have been volatile, which has caused traders confusion and hesitation in decision-making, as well as increased uncertainty in the capital market.

- Exchange rate has a negative and significant effect on the performance uncertainty of the total stock market index as an indicator of capital market uncertainty. Therefore, the hypothesis about the considerable impact of economic growth on capital market uncertainty cannot be rejected. The direct impact includes those listed companies that are exported and priced at world rates, such as refining, petrochemical, metal, mining, and other industries. The exporters are more profitable and more profitable, so usually, after the exchange rate rises, the value of the shares of these companies will also increase. This is true today for half of all listed companies. Therefore, as the return on the overall index increases, the severity of uncertainty in the market decreases.
- The ratio of online transactions to the total volume of transactions as an ICT index has a negative and significant effect on the uncertainty of the return of the total index of the stock exchange as an indicator of capital market uncertainty. Therefore, the hypothesis on the significant effect of ICT on capital market uncertainty cannot be rejected.
- The number of announcements and advertisements issued as an ICT index has a negative and significant effect on the uncertainty of the return of the entire stock exchange index as an indicator of capital market uncertainty. Therefore, the hypothesis of the considerable impact of ICT on capital market uncertainty cannot be rejected.
- Good model fit tests (including autocorrelation, heterogeneity, normality, etc.) show no autocorrelation, variance heterogeneity, or structural failure that causes the model estimates to be biased.
- The results of long-term model calculations show that in addition to the significance of the estimated

coefficients, according to the number of statistics < -1 CointEq $(-1) = -6.30$, the errors are moderated sinusoidally and divergently. The adjustment rate is equal to $1 - \text{CointEq}(-1) = 1 - (-6.30) = 7.30$. In other words, it takes about 7.5 seasons on average to completely neutralize the imbalance in capital market uncertainty.

CONCLUSION

This study investigates the impact of ICT on capital market uncertainty in Iran. For this purpose, the GARCH model has been used to estimate the yield uncertainty of the total stock exchange index as an index of capital market uncertainty. The vector autoregression model with distributed intervals (ARDL) has been used to estimate the model. The results of evaluating the model using quarterly data in the period 2011: 1 to 2020: 4 showed that in the short run, the return on the total index of the stock exchange as an indicator of capital market uncertainty has a negative and significant effect and in the long run a positive impact and has had a significant effect on capital market uncertainty. This indicates a lack of transfer of capital market uncertainty between the seasons in the short run. Suppose there is an increase in tension in one season. In that case, the resulting excitement is discharged in the same season. There is no reason for the cycle of increasing uncertainty to continue into subsequent seasons by changing the conditions. Market participants are smart and make the necessary adjustments to their investment portfolio in the same season under uncertain conditions. In the long run, the excitement resulting from the uncertainty of the return of the entire stock exchange index as an indicator of capital market uncertainty in the same season is not discharged, and there is a possibility of continuing the increasing cycle of uncertainty in subsequent seasons. Also, the effect of the ratio of online or online transactions to the total volume of transactions on capital

market uncertainty in the long and short term is different. Since some capital market participants in Iran do not have stock exchange literacy, they are affected by the actions of other shareholders, especially significant shareholders, and imitate their behaviour. This factor has led to increased excitement and uncertainty in the capital market in the short term. While increasing trading volume, in the long run, has increased market confidence, increased market profitability, and reduced capital market uncertainty. This study's results align with the investigations of Sepehrdoost et al. [41]. In this regard, Cheng et al. [33] explained that ICT development has increased economic growth and financial development in high-income countries by increasing the number of people using the Internet and secure Internet platforms [33]. Brown et al. [34] found that the trading volume and frequency of capital market transactions decreased by about 5% on days when mobile Internet systems were slow.

Therefore, ICT has an influential role in online transactions [34]. Sepehrdoost et al. [103], in a study, showed that tools and equipment related to ICT have a positive and significant effect on the growth of the capital market of the Iranian Stock Exchange. In this regard, the number of announcements and advertisements published as another indicator of ICT also has a significant effect on the performance uncertainty of the total index of the stock exchange as an indicator of capital market uncertainty. Whenever users in designated trading systems and platforms provide more accurate and timely information as a result of decisions made about the market as a whole (such as trading time, fluctuations, fluctuations, etc.) or specific stocks (reopen or stop Being a symbol, the decisions of the assembly regarding the increase of capital and distribution of profits, etc.) should be informed faster and more accurate and timely infor-

mation should be provided in this regard, the decisions of the shareholders will be adjusted at a more appropriate speed This will reduce the risk and consequently the uncertainty of the capital market. In this regard, Asongu and Moulin [104] stated that ICT is essential in information sharing and greater participation in exchanges and buying and selling investors' shares in financial markets. The use of ICT in financial markets will reduce marketing costs, increase the involvement of shareholders and investors, and reduce information asymmetry. This way, it can facilitate access to financial services among investors. Levine [105] also stated that ICT reduces information asymmetry and facilitates the investment process among investors.

Considering the impact of ICT on capital market uncertainty, it is suggested that efforts be made for transparency, ease of access, and updating and updating of information available to users in this area to prevent the severity of uncertainty and the degree of risk of transactions as much as possible. Preparation and development of codified programs in various fields such as communication, educational, cultural, and economic infrastructures to provide and use ICT infrastructure, optimal use of ICT human resources, increase productivity, and at the same time, support growth. The activity of small and medium companies in ICT is recommended. Also, developing countries should take appropriate policies to strengthen institutions active in ICT. Considering the significant effect of the exchange rate on capital market uncertainty, it is suggested to use more powerful tools such as call options and futures trading in the capital market of Iran's economy to prevent increased tension and money out of this area during severe market fluctuations. Currency is taken, and traders' portfolios are protected from damage.

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