The International Open Access Journal of RESISTIVE ECONOMICS (OAJRE)

Volume 12, Issue 1, 2024

ORIGINAL RESEARCH PAPER Pages: 1-44

Presenting a model of the status of the cryptocurrencies and its relationship with macro variables in Iran's economy: A Dynamic stochastic general equilibrium (DSGE)

Reza Akbarian[1*] , Farhad Zand[2] , Ahmad Sadraei Javaheri[3] , Hojat Parsa[4]

1. Associate Professor of Economics, Faculty of Economics, Kharazmi University,iran. (Corresponding Author)
rakbarian@khu.ac.ir

2. Phd Student of Monetary Economy,Department of Economy Shiraz University,Iran

3. Associate Professor of Economics, Department of Economics, Faculty of Social Sciences, Management and Economics, Shiraz University, Iran.

4.Associate Professor , Department of Economis, Business And Economics School, Persian Gulf University,Iran.

ABSTRACT

Many people around the world have been eager to work with this new currency since 2013 as crypt currencies took off, yet most people have limited information about this new technology. These days, the importance of crypt currency is so much that even recently the first university course has been launched as crypto currency. This new course is taught at the University of Nicosia, the largest university in Cyprus. Nowadays, the category of crypto currencies is very important for governments, and identifying the impact of crypto currencies fluctuations on macroeconomic variables such as consumption, production, unemployment, and monetary policies is an important issue for central banks and, accordingly, governments. The results of studies conducted in the field of crypt currencies and monetary shocks and their impact on macroeconomic variables show that many studies that used stochastic dynamic general equilibrium models analyzed the role of government money in the economy, in this regard, our research presents new perspectives and new evidence on the underlying mechanisms of crypt currency spillover effects in the economy. This research can also be a guide for investors and policy makers who are working in the central bank, and how researchers should act against the crypto currency ecosystem in the future. The results of this section indicate that the central bank's reaction to the growth rate of the total index of the real sector of the economy against the reaction to the deviation of the total index from its long-term equilibrium level can be more effective in reducing the real effects of the shocks of the real sector of the economy on macroeconomic variables, because the central bank controls the status of asset yield in other parallel markets such as currency, price levels, deposits and loans, and Therefore, reacting to the emotional dynamics of the market return against reacting to the level of the market index more guarantees the stability of the macro economy.

KEYWORDS: Deposits, loans, stochastic dynamic general equilibrium, central bank, money supply

How to Cite This Article: Heydari Ardi, T; Fattahi, M. ; Eghbal, M.R(2024).“ Designing a Digital Marketing Model for the Internationalization of Small and Medium-Sized Dairy Enterprises”. *The Open Access Journal of Resisitive Economics*, 12(1): 1-44.

Introduction

The concept of virtual currency[1], B-money[2], was first proposed by Wei Dai, who is an expert in the field of information technology, in 1998 [1]. Now, more than 1,000 virtual currencies have been launched, and currencies such as Allah Coin for the Islamic market, Litecoin[3] (with less restrictions than Bitcoin) or Mint Cheat (which were produced under the supervision of the Canadian government) show the willingness of governments and users to use this type of currency [2].

In recent years, technological innovations such as robotics, artificial intelligence, cloud technology and mobile economy have spread in different societies at a high speed, and now it has become a key element of commercial and social economy [3]. Therefore, it is of great importance to understand the effect of the advancement of technologies on the economy, business, people's way of life, etc., to adapt to new conditions [4]. One of the innovations in the field of technology is the emergence of cryptocurrencies in 2009 and in the framework of the block chain, which has greatly affected the financial and economic fields in recent years [5]. The effect of the emergence of cryptocurrencies in the monetary and economic spheres can be examined from both micro and macro perspectives. Our approach in this article is the macroeconomic dimension, which is a top-down approach[4], and the branches of economics [6].

This study seeks to answer the question, "How can the impact of Bitcoin price on important macroeconomic indicators be investigated in a dynamic stochastic general equilibrium model framework and expand the model to evaluate the economic consequences of Bitcoin on Iran's economy regardless of the background and conditions of production of these virtual currencies?". Most studies have analyzed cryptocurrency empirically. For example, Bloomberg et al. (2017) [7] used a non-causal auto-regression (AR) model to detect the existence of a bubble in the Bitcoin/dollar exchange rate. Bloomberg et al. (2017) [8] measured the volatility of Bitcoin exchange rate against six major currencies. Recently, Bodenstein et al. (2011) [9] analyzed and predicted cryptocurrency volatility, while Boehme et al. (2015) [10] predicted the full distribution of cryptocurrency. Catania et al. (2018) [11] and Catania et al. (2019) [12] have

[1] Virtual currency ensures security by using encryption technology such as public key cryptography and hash functions. Executed transactions are grouped in units called blocks, which are compiled into records known as blockchains.

[2] First revealed in 1998 by computer scientist Wei Dai, b-money was intended to be an anonymous, distributed electronic cash system.

[3] Litecoin is a decentralized peer-to-peer cryptocurrency and open-source software project released under the MIT/X11 license. Inspired by Bitcoin, Litecoin was among the earliest altcoins, starting in October 2011. In technical details, the Litecoin main chain shares a slightly modified Bitcoin codebase.

[4] What is the top-down approach to management? In the top-down approach to management, a team or project manager makes decisions, which then filter down through a hierarchical structure. Managers gather knowledge, analyze it, and draw actionable conclusions.

investigated the structure of relationships between cryptocurrency and the macroeconomics, similar to financial time series. We try to fill this gap and present a dynamic stochastic general equilibrium modeling (abbreviated as DSGE, or DGE, or sometimes SDGE)[1] for the Iranian economy, where cryptocurrency is considered as an alternative to the national currency. This assumption is consistent with the opinion of Cheah et al. (2018) [13] who have introduced crypto currency as a private digital currency.

In principle, knowing the effects of cryptocurrency on macroeconomic variables can play a significant role in the expansion of this new and emerging branch of science, which has been studied since the invention of this cryptocurrency by its mysterious creator Satoshi Nakamoto and its popularity and importance and wide use by people, and considering that in 2022, about 40% of the total digital currency market is owned by Bitcoin. Therefore, in this study, we consider Bitcoin as a representative of cryptocurrencies, which plays a leadership role in issues related to cryptocurrencies. According to the results of estimates, the annual amount of cryptocurrency mining in the world is 15 billion dollars and in Iran, it is 1.1 billion dollars (under current unofficial conditions). Currently, out of about 324,000 mined coins in the world, 19,500 bitcoins are mined unofficially in Iran, and this issue makes it important and valuable to examine the aspects and opportunities of this new technology.

Perhaps there is no escaping the use of cryptocurrencies, considering the development of virtual space and its functions in human life, and it is necessary for economic policy makers to adopt a clear approach to cryptocurrencies in setting and formulating policies for virtual and real economic communication.

our research presents new perspectives and new evidence on the underlying mechanisms of cryptocurrency spillover effects in the economy. This research can also be a guide for investors and policy makers who are working in the central bank, and how researchers should act against the cryptocurrency ecosystem in the future.

Basically, the main motivation of this research is our better understanding of the structure of cryptocurrencies and its effects on Iran's macroeconomics, despite its increasing popularity in the face of severe warnings from policymakers. The use of cryptocurrencies to reduce the negative effects of sanctions seems to be a logical solution in the conditions of sanctions and despite the problems of using common currencies that have arisen for Iran by the international community. Therefore, as an undeniable fact, it seems inevitable to know the effects of cryptocurrencies on the macro economy in Iran and to examine monetary shocks due to the presence of cryptocurrencies.

Therefore, in the study, we examine two separate demand shocks of national currency and cryptocurrency respectively. On the other hand, the category of examining the effects of monetary shocks in Iran's economy has received much attention in recent studies and has resulted in important results, but this article examines these shocks despite the fact that cryptocurrencies are a new category in the economy and examines their effects and consequences on the macroeconomic variables of Iran.

2. Research background

[1] Dynamic stochastic general equilibrium modeling (abbreviated as DSGE, or DGE, or sometimes SDGE) is a macroeconomic method which is often employed by monetary and fiscal authorities for policy analysis, explaining historical time-series data, as well as future forecasting purposes.

Yao et al. (2022) in an article entitled " Bitcoin, gold and the dollar: A GARCH volatility analysis" conclude that the financial asset capabilities of Bitcoin, which have been investigated using GARCH models, show that the initial model has many similarities with gold and the dollar. It shows that it shows the capabilities and benefits of economic coverage as a medium of exchange. The asymmetric GARCH model showed that Bitcoin may be useful in risk management and ideal in predicting negative shocks to the market for risk-averse investors[1]. In general, Bitcoin has a good place in the financial markets and in portfolio management, because it can be classified in terms of benefiting from the advantage of storage and liquidity something between gold and the US dollar [14].

Fernandez et al. (2016) in the article titled "Bitcoin's Dysfunction" state that despite the recent popularity of Bitcoin in the media and investment circles, there is still a lack of understanding and skepticism about this cryptocurrency. It has conducted strong tests to check the efficiency of Bitcoin in the market, and it has come to the conclusion that Bitcoin has significantly inefficient returns in the market, but when we examine the second period of returns for Bitcoin, the rate of return (RoR)[2] increases. slow, and it seems that the Bitcoin market is moving towards an efficient market [15].

Fry (2018) in an article entitled "Bitcoin, Gold and the Dollar - A Replication and Extension" analyzes the relationship between Bitcoin, gold and the US dollar and states that Bitcoin can be classified as an asset between Gold and US dollars. Using econometric models to replicate the findings, this article shows that exact replication is not possible, and alternative statistical methods provide more reliable and at the same time very different results. According to the findings from the main sample and a long sample period, Bitcoin shows other distinctive characteristics of return, volatility and correlation compared to other assets such as gold and the US dollar [16].

Gandal et al. (2018) in an article entitled "Developments, Bankruptcies and Market Giants: The Story of Bitcoin and Crypto Markets" state that recently the topic of Bitcoin and cryptocurrency has gained a lot of popularity among economists and academics. Also, it states that there are two types of views towards cryptocurrencies, including commodity and monetary views. Each of these two views and how to deal with them can increase the possibility of development or increase the risk of failure. Also, it causes the creation of market giants or big bankrupts [17].

Giudici et al. (2019) in an article entitled "Investigating the dynamic relationships between cryptocurrencies and other financial assets" in time and frequency domain investigated the relationship between three famous cryptocurrencies (Bitcoin, Ripple[3], and Ethereum[4]) and found other types of financial assets and evidence. from the relative isolation of these assets from financial and economic assets. According to the results, cryptocurrencies may offer various

[1] A risk averse investor tends to avoid relatively higher risk investments such as stocks, options, and futures. They prefer to stick with investments with guaranteed returns and lower-to-no risk. These investments include, for example, government bonds and Treasury bills.

[2] A rate of return (RoR) is the net gain or loss of an investment over a specified time period, expressed as a percentage of the investment's initial cost. When calculating the rate of return, you are determining the percentage change from the beginning of the period until the end.

[3] Ripple is a real-time gross settlement system, currency exchange and remittance network that is open to financial institutions worldwide and was created by Ripple Labs Inc., a US-based technology company.

[4] Ethereum is a decentralized blockchain with smart contract functionality. Ether is the native cryptocurrency of the platform. Among cryptocurrencies, ether is second only to bitcoin in market capitalization. It is open-source software. Ethereum was conceived in 2013 by programmer Vitalik Buterin.

benefits to investors with short investment horizons. Time variation indicates external economic and financial shocks [18].

Grinis et al. (2021) in an article entitled "Is there a relationship between cryptocurrencies and stock market indices?" used ARFIMA techniques to investigate the stochastic properties of six major cryptocurrencies and their bilateral relationships with six stock market indices, according to univariate analysis, it was observed that the null hypothesis of unit root cannot be rejected for Bitcoin and Ethereum. The order of integration is significantly higher than 1 for Litecoin, Ripple, and Stellar. Evidence was found for Tether that means mean reversion. The results are more homogeneous for the stock market indices, and the unit root cannot be rejected in any of these sets, with the exception of the VIX, where mean reversion is obtained. Regarding the bivariate results in cryptocurrencies and the cointegration test, there is evidence of non-cointegration among the six cryptocurrencies. In this regard, by testing the coherence between cryptocurrencies and stock market indices, evidence was found of non-integration, which indicates the separation of cryptocurrencies from the main financial and economic assets. According to the findings of this study, cryptocurrencies play a significant role in investors' securities, because cryptocurrencies act as a diversification option for investors and confirm that cryptocurrency is a new class of investment assets [19].

Koutmos et al. (2021) in an article entitled " Non-linear causal linkages of EPU and gold with major cryptocurrencies during bull and bear (Bulish and Bearish) Markets[1]" investigate whether "the Uncertainty Initiative Index "Does economic policy (EPU) and gold holdings affect the returns of high-cap cryptocurrencies in a non-linear way?" Estimates are related to both prosperous and tense periods in digital currency markets. According to the econometric results, the returns of almost half of the examined cryptocurrencies are strongly correlated with the EPU index in bull (strong demand) markets. While even more cryptocurrencies are associated with this index in bear markets. According to the same findings regarding the impact of gold in bear (high supply) markets, it has a greater impact due to its hedging capabilities. There is also evidence that variance causality is significant in all markets [20].

Saadat Mehr et al (2018), during a study, have compared the effect of monetary and financial policies on macro variables of Iran's economy. Changes in money volume have been investigated as a representative of monetary policies and changes in government expenditures as a representative of financial policies on Iran's economy. This work has been done in the framework of a New Keynesian Dynamic Stochastic General Equilibrium (DSGE) model using time series data from 1357-1994. The general balance of the economy consists of 15 equations obtained from the process of optimizing the behavior of households and companies along with the policy rules of the government and the central bank. The parameters of the model have been estimated using the Bayesian method and calibration. According to the results, the shock of increasing the amount of money causes an increase in production, investment and employment along with an increase in inflation. Also, the shock increases government spending, production, employment, and inflation, but decreases private investment. According to the results, the intensity of the impact of the government expenditure shock and its durability is greater than the money volume shock [21].

[1] In the investing world, the terms "bull" and "bear" are frequently used to refer to market conditions.

Kazerouni et al. (2018), during a study investigated the effect of monetary impulses on employment under foreign exchange regimes in Iran during the quarterly data of the period 2015-2016 using the dynamic stochastic general- equilibrium model (DSGE) of new Keynesian considering the importance of the structure of Iran's economy in transferring the effects of economic policies, it has been tried to add the oil sector of the country's economy to the model in order to provide a model closer to Iran's economic structure, in addition to considering the main elements of standard models such as households, firms government, monetary authority and foreign sector. In this study, first, using the technical method and using the Markov-switching method, the free market exchange rate statistics were used to identify currency regimes in Iran, and the first regime: an unstable currency regime with high volatility and the second regime: a stable currency regime with Low turbulence is extracted. In the following, by determining the input values and parameters of the model in the DSGE model using the calibration method, the results of the simulation of the model variables indicate that the effect of monetary stimulus on employment under foreign exchange regimes in Iran is different, so that the effect of one unit of monetary impulse on employment under an unstable currency regime will decrease employment, but the effect of one unit of monetary impulse on employment under a stable currency regime will increase employment in the short term; therefore, economic policy makers should also consider the currency regimes of the country when increasing the amount of money to influence the employment variable [22].

Research method

This section deals with the method used in this study. It should be noted that this part of the research will have changes during the completion of the article according to the requirements of the article. This model has been written based on the article of Assimakopoulos et al. (2019) as well as Komhoff et al. (2010) and McCallum (2006) and probably changes will be made in the model due to the requirements of the Iranian economy.

The structure of dynamic stochastic general equilibrium modeling (DSGE) is made like other general equilibrium models with the aim of describing the behavior of the whole economy and applying the analysis of micro-decision interactions at different levels. The decisions included in most of the DSGE models are stochastic in relation to the macro quantities studied in economics. Due to the existence of sanctions and the lack of clear and correct information on the amount of sales of crude oil and other export items and petroleum products and unnecessary complications, the economics thesis is considered closed, but it can be considered as an extension of the work of economics if the correct information is available.

Households

The representative household maximizes the expected utility value as follows:

$$\max_{\{C_t, H_t, B_t, M_t^g, M_t^c\}} E \sum_{t=0}^{\infty} \beta^t A_t \left[u\left(C_t, \frac{\frac{M_t^g}{P_t}}{E_t^g}, \frac{\chi_t \frac{M_t^c}{P_t}}{E_t^c} \right) - \eta H_t \right] \quad (1)$$

Where, $0<\beta<1$ and $\eta>0$. The budget limit in each period is given by:

$$M_{t-1}^g + \chi_{t-1} M_{t-1}^c + T_t + B_{t-1} + W_t H_t + D_t = P_t C_t + \frac{B_t}{R_t} + M_t^g + \chi_t M_t^c \quad (2)$$

The variable $\frac{M_t^g}{P_t}$ indicates the actual balance of government money, while $\frac{M_t^c}{P_t}$ indicates the actual balance of the cryptocurrency. In addition, $\chi_t$indicates the nominal exchange rate between government money and cryptocurrency in both equations (1) and (2) cryptocurrency is entered as a substitute currency with respect to government money. Our assumption is linear, by defining cryptocurrency as a Private Digital Currency by Gans and Halaburda (2019), holding cryptocurrency benefits the representative household, the household of the representative buys the cryptocurrency $M_{t-1}^c = \frac{M_{t-1}^g}{\chi_{t-1}}$, at t-1 and holds government money and cryptocurrency at time t as $M_t^c = \frac{M_t^g}{\chi_t}$.

In this respect, there is a difference between our modeling and standard open economy stochastic dynamic general equilibrium models with different currencies. The currency conversion rate is used to convert the interest rate received in holding foreign bonds by the representative household in these models. But in the model of the present study, the exchange rate allows the conversion of two types of money (for example, government money and cryptocurrency) that are used in the same economy.

In equations (1) and (2), Ct and Ht respectively represent household consumption and labor supply during the shock period At.

$E_t^g$and E_t^cfollow autoregression processes:

$$\ln(A_t) = \rho^a \ln(A_{t-1}) + \varepsilon_t^a \quad (3)$$

$$\ln(E_t^g) = \rho^{eg} \ln(E_{t-1}^g) + \varepsilon_t^{eg} \quad (4)$$

$$\ln(E_t^c) = \rho^{ec} \ln(E_{t-1}^c) + \varepsilon_t^{ec} \quad (5)$$

Where, $0 < \rho^a, \rho^{eg}, \rho^{ec} < 1$and zero mean, uncorrelated series of innovations $\varepsilon_t^a, \varepsilon_t^{eg}$ and ε_t^{ec}, usually with standard deviation σ^a, σ^{eg} and $\sigma^{ec}$are distributed. As we will show below, a shock At, in equilibrium, means a disturbance in the IS curve of the model, where $E_t^g$and E_t^crepresent a disturbance in the government money and cryptocurrency demand curves.

In the budget constraint, household financial resources consist of Tt, the nominal lump sum transfer received from the monetary authority at the beginning of period t, and Bt-1, the amount of nominal bonds maturing during period t. The financial resources of the family also include income from wages or the supply of labor services, WtHt, where Wt represents the nominal wage, Dt, the amount received from enterprises producing intermediate goods. Household expenditure consists of funds consisting of consumption, Ct, of final goods, purchased at nominal prices, Pt. Newly issued bonds with a value of $\frac{B_t}{R_t}$, where Rt represents the gross nominal interest rate. In the following cases, to facilitate the real balance of government money and cryptocurrency for the household, respectively, $m_t^g = \frac{M_t^g}{P_t}$ and $m_t^c = \frac{M_t^c}{P_t}$. Furthermore, we show the growth of the inflation rate during the period t with $\pi_t = \frac{P_t}{P_{t-1}}$. In this thesis, despite the homogenous consideration of the households by the basic article, if the results of the thesis do not have a significant problem, the heterogeneous household will be considered.

Entrepreneurs

We assume that there is a chain of entrepreneurs indexed by n such that n ϵ [0; 1], which produce cryptocurrency. Every representative entrepreneur operates under a perfectly competitive market. Like Sockin and Xiong (2018), we introduce the cryptocurrency production cost given by the function $\kappa^{-\varphi t} Q^c$, where Q^c is the amount of tokens that an entrepreneur produces. κ is a fraction that represents the ratio of the production of a token unit to fixed costs such as participation costs that may be financial or mental, and can represent the cost of setting up a wallet and installation, or providing the necessary software to participate in the platform. Furthermore:

$$\phi_t = \xi_t + \nu_t \quad (6)$$

T The productivity of the entrepreneur depends on the productivity of other entrepreneurs through the common factor, which is ξt.

As well as for the specific programming skills of the entrepreneur, we assume that ξt and νt represent the common and specific shocks to the following production costs, which follow an autoregressive process.he productivity of the entrepreneur depends on the productivity of other entrepreneurs through the common component, which is ξt, and also on the specific programming skills of the entrepreneur. which follows an autoregressive process.

$$\ln(\xi_t) = \rho^{\xi} \ln(\xi_{t-1}) + \varepsilon_t^{\xi} \quad (7)$$

$$\ln(v_t) = \rho^{v} \ln(v_{t-1}) + \varepsilon_t^{v} \quad (8)$$

Where $0 < \rho^{\xi}, \rho^{v} < 1$, and serial uncorrelated innovations with zero mean, ε^{v}, are normally distributed with standard deviation $\sigma^{\xi}$and σ^{υ}. Entrepreneurs also earn a portion of $(1-\rho) \in (0,1)$ from selling cryptocurrency products to households at a price of $\frac{P_t}{\chi^t}$. Therefore, entrepreneurs maximize their profits. According to Q_t^c:

$$\prod_t = \max_{\{Q_t^c\}} \quad (9)$$

Firms

We assume that there exists a chain of monopolistically competitive firms, which we denote by i ∈ [0, 1] such that t = 0, 1, 2, ..., , and also there are different sets of intermediate goods, and only one final good is produced by combining them in a perfectly competitive market. In each period t, Yt (i) is the output of the firm representing firms producing the final good, which buys from Pt (i) any intermediate good at the nominal price P to produce Yt (i) (an amount of the final good based on a function of constant returns to scale with a fixed-to-scale technology), according to Eq

$$Y_t = \left[\int_0^1 Y_t(i)^{\frac{(\theta-1)}{\theta}} di\right]^{\frac{\theta}{(\theta-1)}} \quad (10)$$

Where, θ>1, the company producing the final product maximizes its profit by the equation:

$$Y_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\theta} = Y_t \quad (11)$$

This shows that θ measures the constant price elasticity of demand. For each intermediate product, competition causes the firm producing the final product to obtain zero profit in equilibrium, in which case zero profit is obtained from the following equation.

$$Pt = \left[\int_0^1 \left(P_i(i)\right)^{1-\theta} di\right]^{\frac{1}{1-\theta}} \quad (12)$$

In each period t = 0, 1, 2, ..., the representative firm producing the intermediate goods Ht (i) hires one unit of labor from the representative household, which is Yt (i) of the intermediate goods with technology The line given in equation 13 that produces the total productivity shock Zt has an autoregressive process as shown in equation 14.

$$Y_t(i) = Z_t H_t(i) \quad (13)$$

$$\ln(Z_t) = \rho^z \ln(Z_{t-1}) + \varepsilon_t^z \quad (14)$$

Where, $0 < \rho^Z < 1$ has non-zero mean, ε_t^z is not serially correlated, and has a standard normal distribution with standard deviation σ^Z. In the balance of this shock, the supply side acts as a shock to the Phillips curve, since an intermediate product is incompletely substituted for another intermediate product, in the production of the final product, the company that produces the intermediate product represents its product in a market. Monopolistic competition sells, in this case, the firm is considered as a firm that determines the price, but it must take into account the demand of the representative firm that produces the intermediate goods in determining its price, similar to Rotenberg (1982), the firm that produces the intermediate goods with a quadratic function to adjust the nominal price, which is measured with the final product, and its equation is as equation 15.

$$\frac{\phi}{2}\left[\frac{P_t(i)}{\pi P_{t-1}(i)} - 1\right]^2 Y_i \quad (15)$$

Where, $\phi > 0$ and π measure the growth rate of nominal inflation, this price adjustment cost makes the problem of the firm producing the intermediate good dynamic, which means it chooses $P_t(i)$for all periods. t = 0, 1, 2, ... to maximize its total market value. At the end of each period, the firm distributes its profit to the representative's household in the form of a nominal $D_t(i)$payment.

Monetary policy of the central bank

In many countries of the world, the popularization of the interest rate as a monetary policy tool indicates the effectiveness of this tool in countries that have appropriate institutions and markets for this tool; But this choice cannot be extended simply to all countries. For example, in Iran, it is practically impossible to use price instruments in the short term due to such things as the underdevelopment of markets and financial documents, the lack of variety of financial tradable documents compatible with the law of usury-free banking operations, the lack of deep markets to discover the rate of return, The risk price of

documents and the lack of transparency in the pricing in the banking sector. Of course, there are other problems that have caused the ineffectiveness of the interest rate as a policy tool, and that is that when the central bank can quickly affect the interest rate in the market, then it will be able to use the rules based on the interest rate, and it will also be able to quickly change the interest rate with open market operations with the transformation and transformation in the economy and as a result of changing the parameters in this monetary rule. But the obstacle that exists now is that there is no ability to quickly change the interest rate.

Therefore, these variables will have a higher efficiency in countries with emerging and developing markets such as Iran, considering the above limitations on the one hand and, on the other hand, due to the high power of the central bank in controlling monetary aggregates such as the growth rate of the monetary base and the volume of money. Therefore, it is better for the central bank to use monetary aggregates as a monetary policy tool. Based on this, the McCallum rule, which uses the monetary base as a policy tool, seems to be a suitable choice for the Central Bank of Iran.

McCallum's rule[1] is another simple rule that improves economic performance. The McCallum rule requires central banks to target the nominal GDP growth rate using the monetary base as a policy tool:

$$\Delta B_t = \Delta X_t^* - \Delta VB_t + \lambda\,(\Delta X_{t-1}^* - \Delta X_{t-1}) \qquad (16)$$

Where, all variables are logarithmic. ΔB is monetary base growth rate, ΔVB is money circulation velocity growth, ΔX is nominal income growth, $\Delta X^*$is target nominal income growth rate and λ monetary reaction factor.

The growth of the monetary base is determined by the three terms on the right side of this equation.

The first term sets the monetary base growth rate equal to the desired inflation rate plus the potential or desired real GDP growth rate. Since the levels of production and employment in long-term time periods are independent of the average growth rate of nominal variables, McCallum emphasizes real production. The second term of this relationship is the rate of growth of the speed of monetary base circulation, which shows the effect of technological changes on the speed of monetary base circulation, considering which, the McCallum rule predicts the average growth rate of the speed of monetary base circulation in the future. This sentence helps to prevent price level changes due to a permanent shock to money demand. Assuming that the monetary policy is neutral in the long term and the growth rate of money circulation is in its stable state, and the nominal GDP growth rate is equal to its target rate, according to the McCallum rule, inflation must remain at its desired level. The last term on the right side of this relationship is the most important component for stabilizing the production and price levels, which advises the monetary authority to adjust the monetary base growth when the nominal GDP growth rate is different from its target. When the nominal GDP growth rate is lower than the target rate, the monetary authority should temporarily increase the monetary base growth and vice versa.

McCallum showed that if a rule like this is used (for example with λ=0.5), the performance of the US economy is likely to be better than the actual performance. Especially in the 1930s and 1970s, which were two of the worst monetary policy mistakes in the history of the Federal Reserve (Giudici et al., 2019). The first feature of McCallum's rule is that it associates nominal GDP as the target variable with monetary aggregates such as M_1 and M_2 instead of real GDP. Because these variables are unrealistic guides, and

[1] McCallum's rule targets nominal GDP (the dollar value of output in the economy) by setting the growth rate of the money supply (more precisely, the monetary base, which consists of bank reserves plus currency in circulation).

they are also correlated with real GDP and inflation. In addition, nominal GDP has two other characteristics that make it a suitable guide for policy making. First, under nominal GDP targeting, monetary policy neutralizes disturbances to aggregate demand. Secondly, nominal GDP targeting helps the policy maker to balance the goals of production growth and inflation stabilization in the face of supply side shocks. In addition to the above, due to the lack of forecasting power or the central bank's lack of power to separate nominal GDP growth into real and inflation, nominal GDP is preferable to real GDP as a monetary policy target.

The second feature of McCallum's rule is to specify a fixed target growth rate for nominal income instead of a target rate that changes over the course of the business cycle. In this way, the rule of minimum policy surprises, as a source, eliminates the undesirable fluctuations caused by the central bank following an optimal policy decision.

The third feature of McCallum's rule is the use of the monetary base instead of the interest rate as a monetary policy tool. McCallum believes that if the nominal interest rate is used as a measure to follow the monetary policy, the easing or tightening of the monetary situation leads to ambiguity. For this reason, since the central bank is able to fully control the monetary base, this rule can be used in a favorable way (Giudici et al., 2019).

A technical point in the McCallum rule related to empirical application is that it is suggested to use the average nominal GDP growth over the past 4 seasons instead of the last season in the last sentence of the McCallum rule (McCallum, 2006). This is similar to using the four seasons of inflation in Taylor's rule. McCallum's rule, which mentions the last 4 seasons of nominal GDP growth, is known as the improved McCallum's rule.

The McCallum rule is less popular than the Taylor rule because central banks emphasize interest rates in their policy decisions rather than the growth rate of the monetary base (Giudici et al., 2019). New Keynesian models, based on Taylor's rule, have taken into account that central banks pursue a target interest rate instead of monetary aggregates.

In the model of the present study, it is assumed that the household maximizes its desirable representative by considering the fact that it keeps some cryptocurrency. In addition, entrepreneurs are involved in the theoretical model that determines the amount of cryptocurrency supply in the economy. Iran's monthly data will be used for estimation and the results will be compared with the latest economic models without cryptocurrency. Also, the effects of monetary policy shocks, technology and trends on the real balances of government money and cryptocurrency will be investigated. Also, the reactions of the main macroeconomic variables to productivity shocks in cryptocurrency production will be evaluated.

Government

The modeling of the interaction of monetary and financial policy has been done in different ways, depending on whether the financial dominance is dominant in the economy or not.

1- Absence of financial authority: financial and monetary authority are modeled separately and each of them seeks to fulfill their mission from the point of view of their duties.

2- The presence of financial dominance: the financial and monetary authority enter the model as a unit, and the financial authority has a decisive role in monetary policy, and the central bank does not have the independence to carry out its inherent missions. For example, Tavaklian (2012) and Jalali Naini (2015) stated that due to the existence of financial dominance in the Iranian economy and the central bank not being independent to fulfill its goals and missions, the definition of the loss function in which the central bank seeks to stabilize the gap between production and inflation is not meaningful; Therefore, the government sector and the central

bank are brought together. Despite the fact that the second approach is an accepted approach in studies with financial dominance, in a number of studies, such as Kumhoff et al. (2010), the possibility of modeling monetary and financial rules has been proposed separately in the presence of financial dominance. Also, it has been stated that in developing countries dominated by finance, if the central bank includes financial variables (government spending or government debt) in its policy rule, it will help to improve welfare (Kumhoff et al., 2010: 88). Gastiger (2011) has also examined the issue of financial dominance along with the existence of an independent central bank. Jalali Naini (2014) has also pointed out the possibility of modeling the behavior of the government and the monetary authority despite financial domination separately. In this study, the behavior of the government and the central bank have been modeled separately according to these studies.

We assume that the government finances its expenditure $G_t$in each period through a) tax revenues $T_t$and oil revenue Or_tsale of bonds to the private sector $[B_t - (1 + i_{t-1})B_{t-1}]$and borrowing from the central bank $(M_t - M_{t-1})$. The Government budget restriction will be nominal in the form of relation (17). In connection with the presence of oil revenues in the government budget in a closed economy, if $(M_t - M_{t-1})$represents the monetary base, in this case, the oil income itself is integrated in the monetary base, and there is no need for the presence of oil income. But if $(M_t - M_{t-1})$ is not an indicator of the monetary base, oil revenues should be included separately in the government budget. In this study, following Samimi et al. (2017), $(M_t - M_{t-1})$ is given as the debt of the government and banks to the central bank instead of the monetary base, and oil revenues are also reflected in the government budget.

$$(1 + i_{t-1})B_{t-1} + M_{t-1} + G_t = B_t + M_t + T_t + Or_t \quad (17)$$

In equation (17), $[(1 + i_{t-1})B_{t-1} + M_{t-1}]$ is defined as accumulated debt.

Government budget restriction in real terms? It comes out as equation (18):

$$\frac{(1 + i_{t-1})B_{t-1}}{P_{t-1}(1 + \pi_t)} + \frac{M_{t-1}}{P_{t-1}(1 + \pi_t)} + \frac{G_t}{P_t} = \frac{M_t}{P_t} + t_t + or_t \quad (18)$$

Finally, the government budget constraint will be simplified in real terms in the form of equation

$$g_t = m_t + b_t + or_t + t_t - \frac{(1 + i_{t-1})b_{t-1}}{(1 + \pi_t)} - \frac{m_{t-1}}{(1 + \pi_t)} \quad (19)$$

In equation (19), government expenditures are assumed to follow a first-order autoregression process, and oil income is considered exogenous due to the recent sanctions and the impossibility of using an autoregression process:

$$g_t = \rho_g g_{t-1} + \varepsilon_g \qquad or_t = \text{External} \quad (20)$$

Government financial rule

In determining the government's financial rule, the goal is to examine the government's behavior in dealing with its accumulated debt. In other words, in modeling the government's behavior, it is important to examine the issue of how the government behaves in the face of its accumulated debt. In this context, the government determines spending or taxes or tax rates according to the amount of accumulated debt. This approach is used in Kumhoff et al. (2010). Among the most important financial rules in this field, the following two rules (21) and (22) can be mentioned:

$$\tau_t = \tau^* + q_\tau(s^B_{t-1}) \quad (21)$$

$$T_t = T^* + q_T(s^B_{t-1}) \quad (22)$$

In equation (21) and (22), $\tau_t$is the tax rate and $T_t$is the tax and $(s^B_{t-1})$is the accumulated debt of the government. $q_\tau$and $q_T$is the reaction coefficient of tax rate or tax to accumulated debt. If the government, faced with the accumulated debt, increases the amount of tax or tax rate to such an extent, that the accumulated debt of the government is completely settled, in this case, passive fiscal policy and monetary policy are dominant. But if the changes in the tax rate and amount of tax are not equal to the amount of changes in the accumulated debt, financial dominance is established.

The accumulated debt of the government can be defined in real terms as equation (23) (Kumhoff et al., 2008: 69).

$$gd_{t-1} = (M_{t-1} + (1 + i_{t-1})B_{t-1})/P_{t-1} \quad (23)$$

In this study, tax changes have been used to examine the modeling of financial dominance.

$$T_t = \eta_0 + \eta_1 gd_{t-1} \quad , \quad \eta_1 > 0 \quad (24)$$

Where, $\eta_1$indicates the government's response to the increase in accumulated debt.

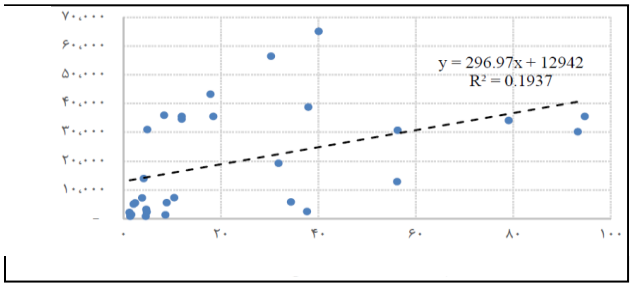
Analysis

The total value of the exchange of cryptocurrency to GDP is one of the indicators of the liquidity ratio (the ability to buy and sell easily with the existence of cryptocurrency) of the existence of cryptocurrency in the economy. As this ratio becomes larger, the position of cryptocurrency in the national economy is more important, and it shows the market's greater liquidity.

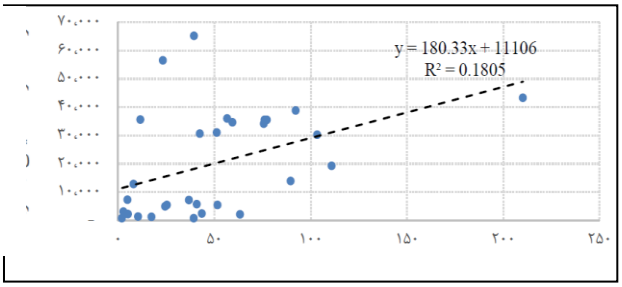
The value of transactions in the real sector of Iran's economy is at a low level compared to the average of countries in the region and the world, and there is a possibility of increasing the liquidity ratio of the real sector of the economy to have a greater effect on the macro economy. According to Graph (1), it seems that, on average, as the ratio of the total value of cryptocurrency to GDP increases, the average real per capita income among countries increases to higher levels, and according to Graph (1), the average inflation rate among countries ((developing countries including India, Indonesia, Brazil and Iran) is at lower levels.

Also, one of the variables showing the development of the real sector of the economy is the number of listed companies at stock exchange. Deregulation by removing or simplifying the special and sometimes strict regulations governing government companies and generalizing current business laws to companies, leads to the increase of companies and as a result the increase of accounting and auditing standards in economic enterprises. In other words, based on the functions of the real sector of the economy, with the increase in the number of accepted companies, it can be expected that the transparency of financial reporting standards in the economy will increase and eventually the relevant standards will be expanded. On the other hand, after offering their shares in the presence of cryptocurrency, accepted companies put various methods of financing such as increasing capital, issuing partnership bonds and finding new shareholders and partners on the agenda, the final result of which is increasing the market size and expanding ownership. shareholders and also creating suitable opportunities for portfolio diversification and better risk management. Graphs (2) and (3) show, on average, a direct

relationship between listed companies with real per capita income and a negative relationship between market expansion and inflation among the countries under study.



Graph 2- The relationship between the spread of cryptocurrency and real per capita income



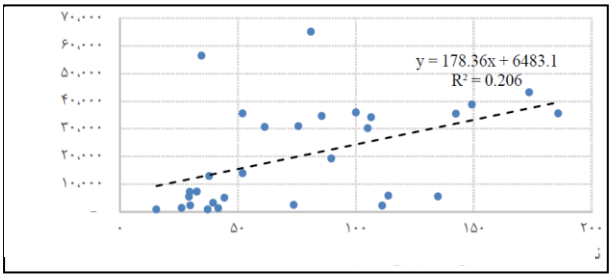
Graph 1 - The relationship between the liquidity ratio of cryptocurrency and real per capita income

% Real GDP per capita (dollar)
The number of listed companies at stock exchange

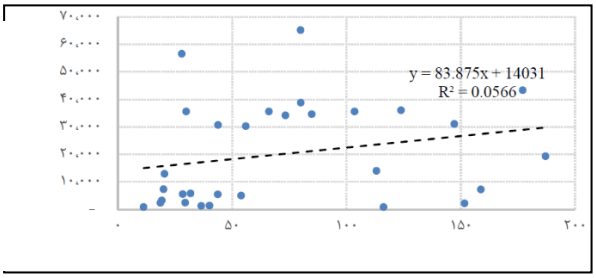
% Real GDP per capita (dollar)
The transaction value to GDP ratio

The ratio of the value of the exchanged shares to the average current market value is called the turnover ratio or the activity of the existence of cryptocurrency, and it indicates the speed of stock circulation in the market, and it shows the speed of conversion of other assets into shares and vice versa. The average (standard deviation) of this ratio in the United States, the world, the Middle East and Iran during the period under review is 177 (53), 20 (7), 19 (9), 19 (8) percent, respectively. This ratio shows the dynamism of the existence of cryptocurrency well. In general, graphs (3) and (8) show that on average, the circulation speed of more cryptocurrency has a positive correlation with the real per capita income, and it has a negative relationship with the inflation rate.

Financial markets, especially banks and their functions for short-term financing of economic enterprises and facilities for households, play an important role in the economy. According to Graphs (4) and (9), there is a positive relationship between bank financing and real per capita income and a negative relationship between bank financing and inflation rate. It seems that all the components of the financial markets are important for the performance of the real sector of the economy based on their characteristics, and one or more components of this financial structure cannot be removed or emphasized or diminished in a command manner.



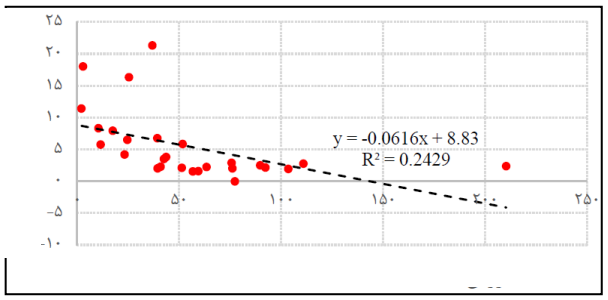
Graph 4- The relationship between the credit of the private sector from deposits and other institutions and real per capita income



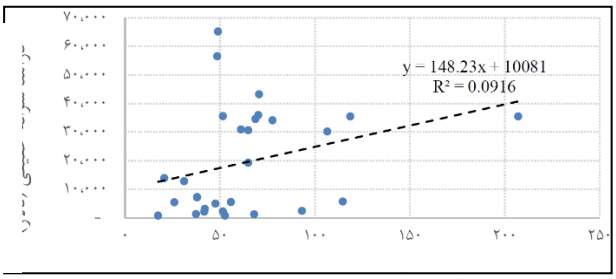
Graph 3- The relationship between the activity speed of cryptocurrency existence and real per capita income

% Real GDP per capita (dollar)
Ratio of private sector credits from deposits to GDP

% Real GDP per capita (dollar)
Stock market turnover ratio



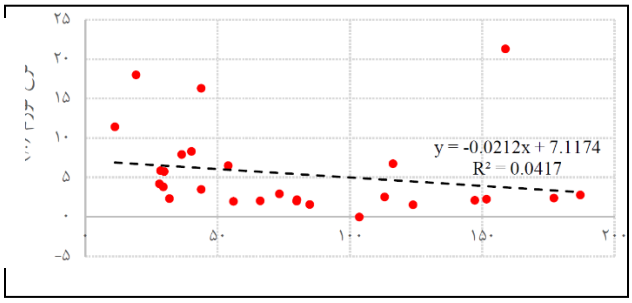
Graph 6- The relationship between the liquidity ratio of the existence of cryptocurrency and the inflation rate

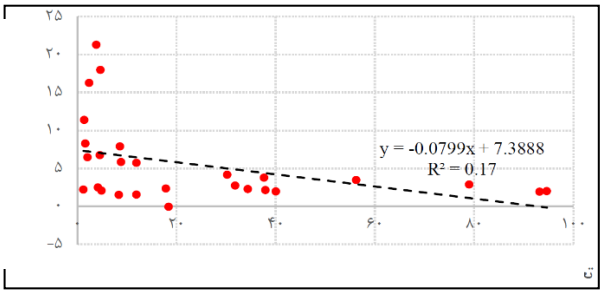


Graph 5 - the relationship between the expansion of the banking sector and real per capita income

Inflation ratio
The transaction value to GDP ratio

Real per capita income
Bank deposit–to-GDP ratio





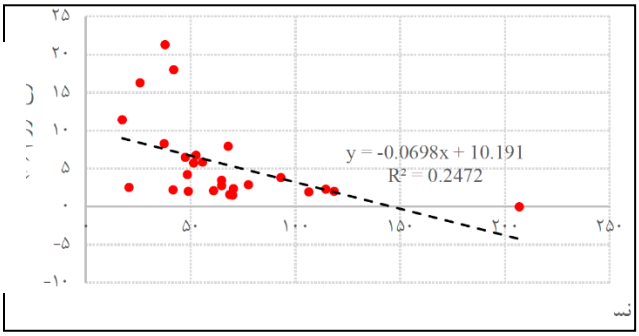
Graph 7- The relationship between the spread of

Diagram 8- The relationship between the activity speed of cryptocurrency and the inflation rate

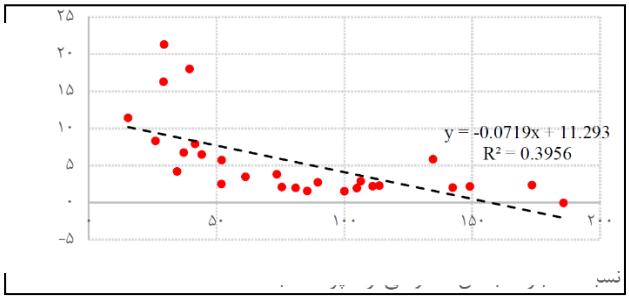
cryptocurrency and the inflation rate

Inflation ratio
Stock market turnover ratio

Real per capita income
The number of listed companies at stock exchange



Graph 10- The relationship between the expansion of the banking sector and the inflation rate



Graph 9- The relationship between the credit of the private sector from banks and other financial institutions and the inflation rate

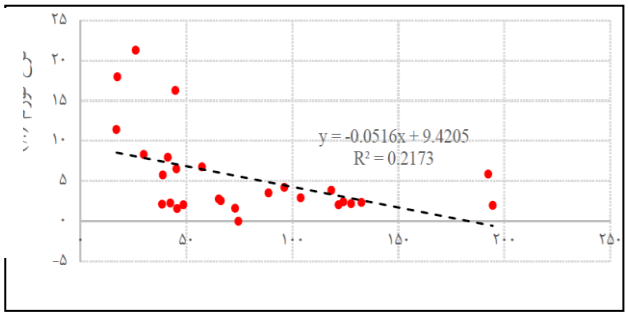
Inflation ratio
Bank deposit-to-GDP ratio

Inflation ratio
The ratio of the credit of the private sector from deposits to GDP

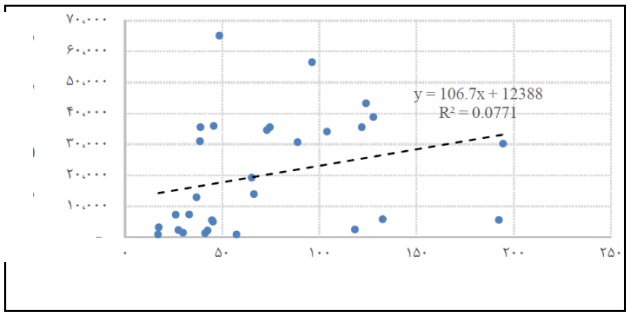
According to the findings of Graphs (5) and (10), there is a direct relationship between the deposits of the banking system and real income and a negative relationship between the deposits of the banking system and the inflation rate among the selected countries during the period under study.

Market value is considered as the best measure to measure the size of the real sector of the economy compared to the size of the national economy. This variable, which is obtained from the sum of the product of the number of accepted currencies in their current price, is a suitable measure to evaluate the position of the market in the economies of the world and two separate markets. This ratio has been reported in the period under review due to the importance of the index of the ratio of the value of cryptocurrency to GDP in comparative comparisons of the real sector of the economy, and the average and standard deviation of the mentioned ratio among countries have been drawn in the comparative Graph (11).

According to Graphs (12) and (13), a positive correlation between the average ratio of market value to GDP and real per capita income, as well as a negative correlation between the average ratio of market value to GDP and inflation rate can be observed during the period under review. Therefore, it can be expected that the macroeconomic performance will improve as the amount of cryptocurrency in countries increases.



Graph 12- The relationship between the ratio of market value to GDP and the inflation rate



Graph 11- The relationship between the ratio of market value to GDP and real income

Inflation ratio
Market value-to-GDP ratio

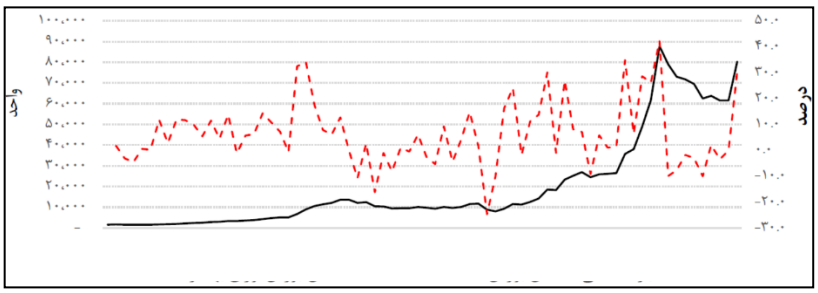
Real per capita income (dollar)
Market value-to-GDP ratio

Stock market index with the existence of the cryptocurrency

The stock market index, with the existence of the cryptocurrency, in a general sense, refers to a criterion based on which something can be recognized.

In the stock market, the indicators are actually important criteria, whose examination and analysis makes it possible to evaluate the past and present state of the stock market and even predict the future trend of the stock market from various aspects. Therefore, considering the very important role of stock market indices in investors' decisions, the fluctuations of indices are also very important for investors. There are different types of stock market indices, each of which shows the state of the stock market from a specific aspect, so investors should pay enough attention to the function of each index in the analysis of stock market indices. The total index, which is also called the price index and the cash return, expresses the general level of the price and dividend of the companies accepted in the stock exchange, to put it more simply, "the changes in the total index actually represent the average return of investors in the stock market." The return of investors in the stock market is obtained in two ways. First, receiving the annual cash dividend and second, the change in the share price during the investment period.

The changes in the total index also accurately reflect the average efficiency of the existence of cryptocurrency. Graph (13) has shown the trend of the index of existence of cryptocurrency and its seasonal returns. From the beginning of the period until the third quarter of 2013, the index of the total existence of cryptocurrency grew with a mild trend, and after that it had a slow and mild downward trend until the third quarter of 2017. The total index of existence of cryptocurrency reached about 90 thousand units. It has increased from the end of 2007 to the third quarter of 2017 and then suffered a deep recession until the end of 2019, and the stock market index has decreased to about 61 thousand units.



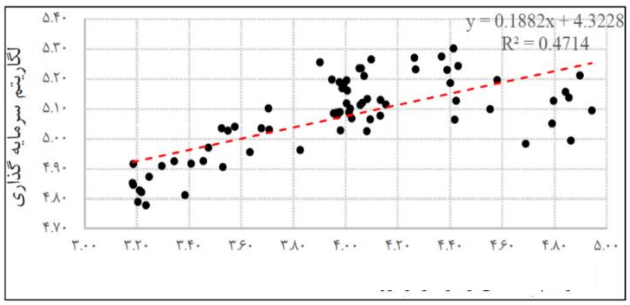
Graph 13- The seasonal trend of the stock market index with the existence of cryptocurrency
Source: Stock Exchange Company with the existence of cryptocurrency

Correlation coefficients

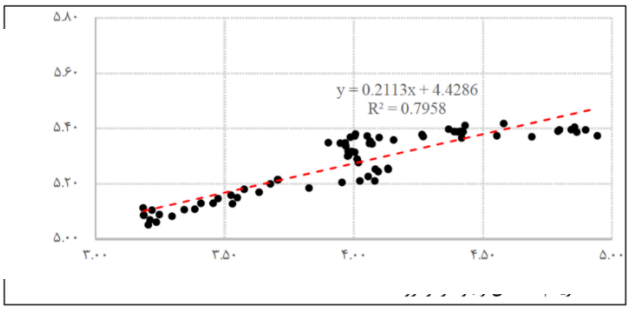
The dominant role of banks in financing investments and the small influence of the real part of the economy in the financial and economic system is one of the obvious facts of Iran's economy. For example, according to the statistics and index information published by the central bank, at the end of 2018, about 35 and 10 % of the country's market value and financing, respectively, were allocated to the existence of cryptocurrencies and capital bonds, and still a significant amount of the financial market is dominated by banks and their facilities. According to the experiences of advanced countries, the market-oriented financial system has many capacities to have a favorable effect on economic performance and endogenity. Economic activists generally consider the conditions of the existence of cryptocurrency, especially the stock market index, as a leading sector and predictive indicator in the economy; As its trends, fluctuations and dynamics show how to adjust the expectations of economic agents, policy changes and fundamental and unforeseen factors at different levels, and therefore can affect the optimal decisions of agents.

The distribution Graphs (14) to (15) show the bivariate regression related to the behavior of the real and nominal variables of the economy such as total consumption, total investment, total product, volume of liquidity, exchange rate and inflation rate with the stock market index despite the presence of cryptocurrency. The empirical connections and correlation of these variables in Iran's economy, which provides the need for policymakers to pay more attention to the position and influence of this market in Iran's economy.

For example, graph (14) shows that a one percent change in the logarithm of the existence of cryptocurrency causes a 0.21 % change in the logarithm of private sector consumption with a coefficient of determination of 79 %.



Graph 15- Correlation between the logarithm of investment and the logarithm of the existence

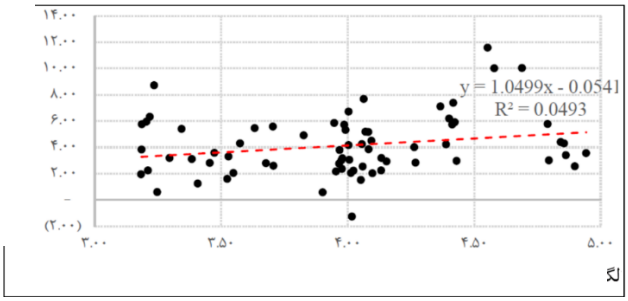


Graph 14- Correlation between the logarithm of private consumption, and the logarithm of the

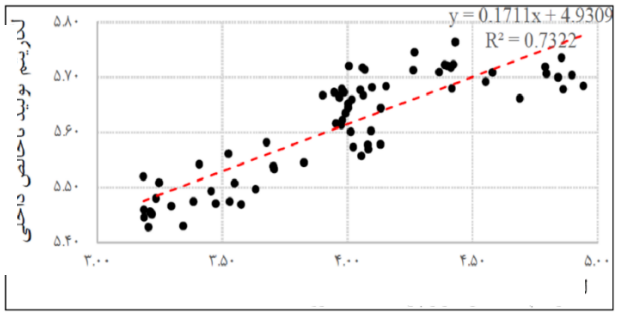
cryptocurrency index

existence of cryptocurrency index

The logarithm of the existence of cryptocurrency index



Graph 17- Correlation between the inflation rate and the logarithm of the cryptocurrency existence index



Graph 16- Correlation between GDP logarithm and the logarithm of the existence of cryptocurrency index

The logarithm of the existence of cryptocurrency index

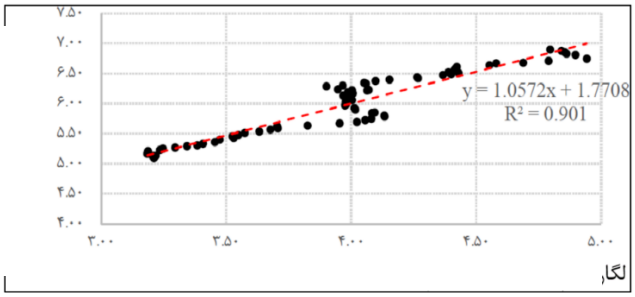
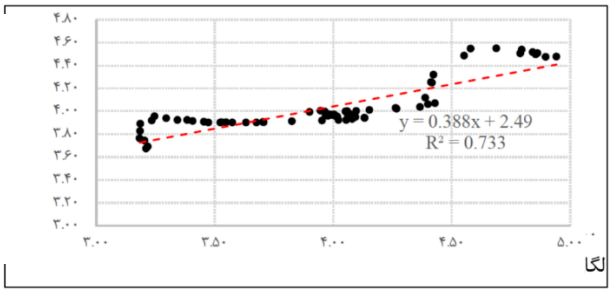


Chart 19- Correlation between the logarithm of the liquidity volume and the logarithm of the existence of cryptocurrency index



Graph 18- Correlation between the logarithm of the exchange rate and the logarithm of the existence of cryptocurrency index

The logarithm of the existence of cryptocurrency index

Model linearization

The model used is a simplified version of the model used by Freeman and Kidland (2000). This is a cash advance model with two payment instruments: cash and check. Households continuously use different goods with fixed proportions. The "size" of goods varies according to the cost of production and the price, which is proportional to the size. Suppose that z > 0 the size of the product; F(z) is the distribution function of accumulation of sizes, and f(z) is the corresponding density function, with the mean $\xi = \int_0^\infty zf(z)dz$. To use this framework, we put this payment system into a simple general equilibrium cash advance model.

There is a continuum of identical households with common priorities.

$$E_0 \sum_{t=0}^{\infty} \beta^t U(x_t), \tag{25}$$

Where, xt is a non-salvageable final good. Each unit xt consists of a complete continuum of goods z with a ratio determined by the density f(z):

$$x_t = \frac{1}{\zeta} \int_0^{\infty} x_t z f(z) dz$$

Each household consists of a producer/seller who produces goods that he sells to other households, and a buyer who buys goods from other households. No household can consume its own production.

Goods can be purchased with cash (currency) or check. We assume that there is a fixed cut-off value for $\gamma > 0$, such that goods z greater than γ are paid by check, and the rest are paid by cash. There is a fixed cost for processing checks, measured in terms of final goods, proportional to the number of checks: $k[1 - F(\gamma)]$.

Following Baumol (1952) and Tobin (1956), we assume that households choose the number of times to adjust their portfolio during a period. In particular, we assume that if household s^ttrades bonds for exchangeable assets in this period, it must pay $\phi v(s^t)n(s^t)$per unit time, where $v(s^t)$is the random process, and (s^t)represents the state of the economy at time t. Therefore, the variable $\phi v(s^t)$introduces randomness in the demand for money. The Baumol-Tobin case is obtained when σ=1, so the cost is a linear function of the number of trips to the bank.

The household has one unit of time per period, which can be divided between bank trips and time to produce goods. The marginal product of labor (and real wages) is given by the random process $y(s^t)$. Total production is $y(s^t)(1 - \phi v(s^t)n(s^t)^{\sigma})$, of which $\chi(s^t)k(1 - F(\gamma))$is for processing costs. The check is paid. Therefore, consumption is given by the following equation:

$$x(s^t) = y(s^t)(1 - \phi v(s^t)n(s^t)^{\sigma}) - x(s^t)k(1 - F(\gamma)) \tag{26}$$

Following Freeman and Kidland (2000), we assume that each period is divided into $n(s^t)$ equal steps. At the beginning of the period, the household starts with nominal wealth $w(s^t)$, which can be allocated to exchangeable assets (cash $C(s^t)$ and deposits $D(s^t)$or risk-free government bonds $B(s^t)$is During the first sub-period $n(s^t)$, a member of the household uses money to buy consumer goods. During this primary subperiod, another member of the household produces goods and sells them for money. At the end of the sub-period, the producers transfer the continuation of their transactions to the bank. This position at the beginning of the second subperiod exactly repeats the position at the beginning of the first period. This process is repeated $n(s^t)$times during this period. The choice of variable $n(s^t)$is the only economically relevant decision made by households.

A natural distinction is made between the monetary stock $M_1(s^t)$ in this model, which is the sum of cash used for transactions and deposits, and the monetary base $H(s^t)$, which is the sum of all available dollars. Indeed, at the beginning of the period, the representative household starts with $H(s^t)$dollars. These assets are the total economic base or external money. These dollars are

divided into currency and bank deposits, $\theta^d D(s^t)$, where $D(s^t)$is the level of current deposits and $\theta^d < 1$is the associated savings ratio for deposits. These savings, deposited in banks or the central bank, are upgraded with bank loans to increase the household deposit against which a check can be written, up to a maximum level of $D(s^t)$. As can be seen in the case of the United States until 2008, we assume that no interest is paid for these savings in banks.
Finally, we assume that the currency is subject to the risk of theft or loss: we assume that the deduction $\tau \geqslant 0$ of each currency unit disappears in each period. Payment is provided according to the deposit accounts of these losses. For symmetry, $\theta^c = 1/(1-\tau) > 1$ is considered as the number of cash units required to value the dollar purchase. As savings $\theta^d D(s^t)$ are required, the monetary base becomes:

$$\theta^c C(s^t) + \theta^d D(s^t) = H(s^t) \tag{27}$$

The limit of the leading portfolio of the representative household is given by the following equation:

$$H(s^t) + B(s^t) \leqslant W(s^t)$$

If we assume:

$$\Omega(\gamma) = \frac{1}{\zeta}\int_0^{\gamma} z f(z)\,dz$$

The total purchase deduction represents the cash payment, expressed as a function of the cut-off level γ, the representative household's leading cash advance limits.

$$P_t(s^t)x(s^t)\Omega(\gamma) \leqslant n(s^t)C(s^t) \tag{28}$$

$$P_t(s^t)x(s^t)(1-\Omega(\gamma)) \leqslant n(s^t)D(s^t) \tag{29}$$

Where, $P(s^t)$is the nominal price of goods. This feature is in line with the perception of each household in the role of its own "bank", but is still subject to the government-imposed savings requirement. This allocation can be decentralized by explicitly assigning different functions to households and banks. Monetary policy is given by the short-term nominal interest rate sequence $r(s^t)$. Each sequence of interest rates has an associated sequence of the monetary base, which we denote by $\widetilde{H}(s^t)$to distinguish it from the total dollar amount held by households—assuming, in equilibrium$\widetilde{H}(s^t) = H(s^t)$, $\mu(s^{t+1})$is the associated growth rate of the monetary base, of course, such that:

$$\widetilde{H}(s^{t+1}) = (1+\mu(s^{t+1}))\widetilde{H}(s^t)$$

Finally, we assume that central bank transfers for households will increase or decrease the total amount of the monetary base in a lump sum,

$$T(s^{t+1}) = \widetilde{H}(s^{t+1}) - \widetilde{H}(s^t)$$

So the nominal wealth at the beginning of the next period will be given by the following equation:

Therefore, the nominal wealth at the beginning of the next period will be given by the following equation:

$$W(s^{t+1}) = H(s^t) + B(s^t)(1+r(s^t)) + P(s^t)y(s^t)(1-\phi v(s^t)n(s^t)^{\sigma}) - P(s^t)x(s^t)\,[1+k(1-F(\gamma))] - (\theta^c-1)C(s^t) + T(s^{t+1})$$

Note that the "damaged" currency $(\theta^c-1)C(s^t)$ appears as a negative object, which reduces tomorrow's nominal wealth.

It is customary to normalize all nominal variables in each period to the monetary base $\widetilde{H}(s^t)$. We denote normalized variables with lowercase letters, such that $b(s^t) = B(s^t)/\widetilde{H}(s^t)$, $h(s^t) = H(s^t)/\widetilde{H}(s^t)$, etc. In addition, to avoid the anomaly, we show the dependence of the variables on the natural state s^t with the subscript t.

Therefore, the problem of consumers can be written as follows:

$$V_t(w_t) = \max_{\{x_t,n_t,h_t,c_t,d_t,b_t\}} U(x_t) + \beta E_t\,[V_{t+1}(w_{t+1})]$$

$$\begin{aligned}
h_t + b_t &\leqslant w_t,\\
\theta^c c_t + \theta^d d_t &= h_t,\\
p_t x_t \Omega(\gamma) &\leqslant n_t c_t,\\
p_t x_t (1-\Omega(\gamma)) &\leqslant n_t d_t,\\
w_{t+1}(1+\mu_{t+1}) &= h_t + b_t(1+r_{t+1}) + p_t y_t\,(1-\phi v_t n_t^{\sigma})\\
&\quad - p_t x_t\,[1+k(1-F(\gamma))] - (\theta^c-1)c_t + \mu_{t+1}
\end{aligned}$$

If we assume that $\lambda_{it}\ (i=1,2,3,4)$ represents the Lagrange coefficient in the primary fourth limits, the first order conditions of the household problem are given by the following equation:

$$\begin{aligned}
x_t:&\quad U'(x_t) - p_t\,[\lambda_{3t}\Omega(\gamma) + \lambda_{4t}(1-\Omega(\gamma))] - \beta E_t\left[\frac{V'_{t+1}(w_{t+1})}{1+\mu_{t+1}}\right] p_t\,[1+k(1-F(\gamma))] = 0,\\
n_t:&\quad \lambda_{3t}c_t + \lambda_{4t}d_t - \beta E_t\left[\frac{V'_{t+1}(w_{t+1})}{1+\mu_{t+1}}\right] p_t y_t \phi v_t \sigma n_t^{\sigma-1} = 0,\\
h_t:&\quad -\lambda_{1t} + \lambda_{2t} + \beta E_t\left[\frac{V'_{t+1}(w_{t+1})}{1+\mu_{t+1}}\right] = 0,\\
c_t:&\quad -\lambda_{2t}\theta^c + \lambda_{3t}n_t - \beta E_t\left[\frac{V'_{t+1}(w_{t+1})}{1+\mu_{t+1}}\right](\theta^c-1) = 0\\
d_t:&\quad -\lambda_{2t}\theta^d + \lambda_{4t}n_t = 0,\\
b_t:&\quad -\lambda_{1t} + \beta E_t\left[\frac{V'_{t+1}(w_{t+1})}{1+\mu_{t+1}}\right](1+r_t) = 0.
\end{aligned}$$

The First-order condition (FOC) according to bt is as follows:

$$\frac{\lambda_{1t}}{1+r_t} = \beta E_t\left[\frac{V'_{t+1}(w_{t+1})}{1+\mu_{t+1}}\right]$$

Substitution of this result in the first-order condition with respect to h_t, $c_t$and q^fgives:

$$\lambda_{2t} = \frac{r_t}{1+r_t}\lambda_{1t},$$

$$\lambda_{3t} = \frac{[\theta^c - 1 + \theta^c r_t]}{1+r_t}\frac{\lambda_{1t}}{n_t}$$

$$\lambda_{4t} = \frac{\theta^d r_t}{1+r_t}\frac{\lambda_{1t}}{n_t}.$$

Substituting these coefficients in the remaining first-order conditions, using cash advance constraints, and the definition of ht shows that the system of equations related to the household problem can be written as follows:

$$n_t U'(x_t) = \frac{\lambda_{1t} p_t}{1+r_t}\left([\theta^c - 1 + r_t\theta^c]\Omega(\gamma) + r_t\theta^d(1-\Omega(\gamma)) + n_t[1+k(1-F(\gamma))]\right)$$

$$r_t h_t = \left[p_t y_t \phi \nu_t \sigma n_t^{\sigma} - (\theta^c - 1)\frac{p_t x_t \Omega(\gamma)}{n_t}\right],$$

$$n_t h_t = p_t x_t G(\gamma),$$

Where, $G(\lambda) = \theta_c U(\lambda) + \theta_q(1 - U(\lambda))$. The first equation determines the value of the coefficient λ_{1t}, so we ignore it from now on. The second and third equations show:

$$r_t = \frac{1}{G(\gamma)}\left[\frac{y_t}{x_t}(\phi\nu_t\sigma n_t^{1+\sigma}) - (\theta^c - 1)\Omega(\gamma)\right]$$

and using the feasibility in the goods market (Equation (29)) to eliminate ratio y_t/x_t gives:

$$r_t = \frac{1}{G(\gamma)}\left[\frac{\sigma\phi\nu_t n_t^{1+\sigma}}{1-\phi\nu_t n_t^{\sigma}}[1+k(1-F(\gamma)] - (\theta^c - 1)\Omega(\gamma)]\right] \quad (30)$$

Which is solved for $n_t$as an ascending function of r_t. Note that in the case of Baemol-Tobin (σ=1), we arrive at the expanded square root formula for the equilibrium value n_t. We denote the solution to equation (30) by $n(r_t)$.

Given the solution for the (unobservable) value n_t, we use the two cash advance equations to achieve to the money-to-product ratio,

$$\frac{M_{1t}}{P_t x_t} = \frac{1 + (\theta^c - 1)\Omega(\gamma)}{n_t} \quad (31)$$

Where, $M_{1t} = \theta^c C_t + D_t$. This equation shows in a subtle way, in equilibrium, money, cash and deposits are decreasing functions of the nominal interest rate.

Rewrite equation (31) as follows:

$$r_t^* \equiv r_t + \frac{(\theta^c - 1)\Omega(\gamma)}{G(\gamma)} = \frac{[1+k(1-F(\gamma))]}{G(\gamma)}\frac{\sigma\phi\nu_t n_t^{1+\sigma}}{1-\phi\nu_t n_t^{\sigma}}$$

The right side of the equation, denoted as r_t^*, is the nominal interest rate plus a fixed amount, which is adjusted for the opportunity cost of cashing the asset, $(\theta^c - 1)$. If this opportunity cost were zero, the solution for $n_t$would approach zero, if the nominal interest rate approached zero, the real money balance would go to infinity. This feature of the model conflicts with current evidence in the US, and is why we consider this case with $\theta^c > 1$.

Note that the term $\phi v_t n_t^\sigma$measures one component of the welfare cost of inflation (the other component is given by $k(1 - F(y)x_t$. We will examine the estimates of the welfare cost of inflation for interest rates in this range in the numerical section. which, at most, is 1% of GDP. If we use the approximation $1 - \phi v_t n_t^\sigma \sim 1$, the previous equation becomes:

$$r_t^* = \frac{[1 + k(1 - F(\gamma))]}{G(\gamma)} \sigma \phi v_t n_t^{1+\sigma},$$

Which shows the well-known logarithm-logarithm characteristic of monetary demand. The Baumol-Tobin case was obtained by assuming a linear cost function (σ=1), which indicates an interest rate elasticity of 1.2.

Calibration and simulation of the designed pattern

One of the most important stages of experimental evaluation of stochastic dynamic general equilibrium models in both real business cycles and new Keynesian schools is calibration. Researchers often, without any concern about the accuracy of data and information, place the values of the parameters in their model from the reliable and numerous findings of other scientists in developed economies such as the economies of North America and Western Europe due to the multitude of studies conducted in the field The use of stochastic dynamic general equilibrium models, but for developing countries in general and for oil developing countries in particular, which includes Iran, model calibration has its own difficulties due to the lack of significant research background. However, in this article, an attempt has been made to value the parameters of the model by using the available data and the studies that have been done in this field in the country.

Assigning values to the structural parameters of the model is the purpose of this section. Calibration usually involves both taking parameters from past literature that have a similar economic structure, and estimating parameters from time series data for a particular economy, or a combination of both.

Calibration provides us with an initial understanding that determines whether the model is weak or strong. A good calibration provides us with an accurate and valuable picture of the data. Also, microeconomic studies are also used for calibration, but care must be taken during aggregation and macro view.

The following are the most important reasons for using calibration:

- Absence of data: We can calibrate the parameters due to the absence of data.
- Low amount of data
- The distortion of the expected statement in the model: The distortion of the expected statement in the model causes the inconsistency of the fulfilled parameters.

The degree of success of the presented model in new Keynesian Stochastic Dynamic General Equilibrium studies is often evaluated by examining the consistency and closeness of the torques produced from the model calibration with the real world torques. The moments of interest are often: the standard deviation of the main variables such as production or consumption, which is a

measure of fluctuations in an economy, the ratio of the standard deviation of the variables of interest to the standard deviation of the variable such as production or investment, which is the basis, and explains the fluctuations relative and the correlation coefficient between the time series of some variables, which shows the co-movement between the variables.

The literature on monetary and fiscal policies has taken a huge leap from calibrating stochastic dynamic general equilibrium models to estimating them (often using a Bayesian approach) over the past decade. In these models, the calibration of parameter values is done for several reasons: first: in order to check the dynamics of these models; Second: to check the similarity of these models with real world data, and third: to evaluate the policy applications of these models under a series of logical assumptions; Therefore, as these models include issues such as underspecification and real features in the data, it is important to calibrate them in the deep parameters that appear. Also, it should be noted that using calibrated DSGE models is not always accurate for subsequent calibrations. The Bayesian technique is suitable for this calibration problem, because this technique is a specific method for parameter estimation that uses prior information about the parameters along with the data to analyze the DSGE model. One of the features of the Bayesian approach is that it creates a framework for policy design that solves the problem of uncertainty in parameter estimation.

Therefore, calibration can be considered as a final tool. Researchers often calibrate these models because DSGE models can analyze interesting economic questions. In this case, Bayesian estimation or maximum likelihood estimation should be used after calibration, because these techniques are an accurate way to obtain parameter values. When using maximum rectification techniques to estimate DSGE models, estimates are extracted from data without considering the role of previous parameters. Even if Bayesian techniques are used to estimate the parameters and there is certainty about the prior parameters, there is no concern that the estimates are obtained by the prior distribution or the data. It is only important that the posterior estimates are reasonable. This happens when previous estimates and data are reasonable.

The work related to Kidland and Prescott is one of the first works done in the field of calibration. They have used calibration to empirically test business cycles, and used long-run data characteristics and, in some cases, microeconomic evidence to select parameters. They applied the neoclassical growth model calibrated on large ratios and examined the model in terms of real business cycles.

Kidland and Prescott, Hansen and Heckman and Sims presented well the experimental methods related to the calibration literature.

In Koli's opinion, estimation is a complete approach, because the estimation itself helps to value the parameters. He also emphasizes the two-way action and reaction between theory and measurement. King and Rebello discussed the difference between traditional econometric methods and calibration. Generally, the parameters selected in the calibration are different according to the selected model source and sample data. This issue is discussed in Campbell's educational article.

Cooley and Prescott state that many of the parameters are derived from the model's balanced growth trajectory and long-term sample characteristics (eg, sample means). Some studies refer to early and past articles; some use microeconometric evidence for calibration.

Therefore, the model is prepared for solution and simulation after selecting the parameters; Therefore, the first performance of the model is evaluated and judged based on the ability of the model to coordinate with the realized facts using sample data. Briefly, researchers derive

probable values for parameters by looking at data or using past experimental studies. Optimally, these processes should use the characteristics of the data.

In this section, the results of the calibration of the structural parameters of the model are reported before the simulation process and the analysis of the Impulse-reaction functions of the model. Some parameters have been calibrated and estimated based on available data and information and econometric calculations. All required time series data is obtained from Central Bank's time series database. Now the findings related to the calibration of the structural parameters of the model and the calculation of the stable values of the model variables are reported, and then the simulation and analysis of the findings of the instantaneous response functions are expressed. In table (1), the parameters of the model are set and then the model is solved based on previous studies and revealed facts and available statistical information, and Diener program under MATLAB is used for calibration and simulation in this study.

Table 1- Calibrated values of model parameter

Initialization	Parameter definition	**Parameter name**
Household sector		
0.963	Savings household discount rate	β^s
0.954	The discount rate of the borrower's household	β^b
0.5	Parameter of consumption behavior habit	ζ
0.75	Ratio of loan to household wealth	ν_h
0.8	The weight of wage income in the borrowing limit	ϕ_w
2.17	The inverse of the labor supply elasticity relative to the real wage	η
1.57	Relative risk aversion coefficient of saving households	γ^s
1.57	Relative risk aversion coefficient of borrower households	γ^b
2.39	The inverse of substitution elasticity between money and consumption	γ^m
Entrepreneurial sector (producers of wholesale goods)		
0.25	The weight of the capital value in the borrowing limit	ϕ_k
0.42	The share of capital in the production function	α
0.042	Fixed capital depreciation rate	δ_e
4	Investment adjustment cost	κ_i
0.55	Loan-to-Equity Ratio for firms	ν_e
Retail sector		
0.74	Retail price stickiness factor	θ_R
0.715	Degree of price indexation of final goods	γ_p
Foreign sector		
0.11	The share of imported goods in the household consumption basket	α_c
0.35	The share of imported goods in the company's investment expenses	α_i

Initialization	Parameter definition	Parameter name
1.56	Elasticity of substitution[1] between imported and domestic consumer goods	η_c
1.5	Elasticity of substitution between imported and domestic capital goods	η_i
	Government and Central Bank	
0.83	Coefficient of the autoregressive process of the logarithm of oil revenues	ρ_{Or}
0.84	Coefficient of the autoregressive process of the exchange rate logarithm	ρ_{ex}
0.35	The ratio of taxes to government spending	T/G
0.33	The ratio of banknotes in circulation to the monetary base	M/MB
¾	Deposit to monetary base ratio	D/MB
0.89	Coefficient of policy rule on π	κ_π
0.36	Coefficient of policy rule on y	κ_y
0.82	Coefficient of the autoregressive process of money growth rate	ρ_Θ

In order to explain the above table, it should be noted that the discount factor of the saving household (βs) and the discount factor of the borrower household (βb) were calculated based on the average interest rate of bank facility deposits during the study period from the time series information of the Central Bank during the period under study. According to this,, the calculations related to the household discount factor are as follows:

$$\beta^s = \frac{۱}{R^d} = \frac{۱}{۱.۰۳۷۷} = ۰.۹۶۳$$
$$\beta^b = \frac{۱}{R^l} = \frac{۱}{۱.۰۴۷۸} = ۰.۹۵۴$$

The consumption habit parameter (ζ) has been chosen in various studies, and the average of these values has been used in this research.
Also, we faced the limitation of information for the parameter of the weight of wage income in the borrowing limit (ϕw), and for this reason, the selected figure of 0.8 was used. Also, Hollander and Liu have used the same number to value the mentioned parameter.
Tai and Tavaklian's studies have been used for the inverse parameter of labor supply elasticity with respect to the real wage (η).
The coefficient of risk aversion of households (γs and γb) is adapted from Tavaklian's study.
The average ratio of the capital stock of listed companies to their total current liabilities during the period of 1997:1 to 2020:4 has been used for the parameter of the weight of the capital value in the borrowing limit (ϕk).
The share of capital in the production function (α) is adapted from the studies of Amiri and Tavaklian, and due to the comprehensiveness of the study of Amiri and Khayani, the parameters related to the share of import of consumer and capital goods are adapted from this study.

[1] Elasticity of substitution is the ratio of percentage change in capital-labour ratio with the percentage change in Marginal Rate of Technical Substitution.

The parameter of depreciation rate of fixed capital (δe) is calculated based on research calculations and the use of statistics and from dividing the average expenses of the formation of gross fixed capital by the capital balance during the period under review, which is almost the same as the findings of Amini and Neshat Haji's study.
The study of Hollander and Liu and Amiri and colleagues has been used to estimate the investment adjustment cost parameter (κi).
The coefficients of the AR(1) processes in the above table are all extracted from the statistical estimates of the regression equations during the investigated period.
Finally, the average one-year deposit rates and civil partnership loans of Central Bank during the period under study have been used to calculate interest and loan rates.

Stable and long-term values of model variables

In table (2), stable and long-term values of some model variables have been calculated and reported based on calibrated parameters in table (1) and logarithmic-linear equations for Iran's economy.

Table 2- Stable and long-term values of some model variables

Value	Variable	Value	Variable
1	$\bar{l}$	1.9	$\bar{y}$
1.3	$\bar{\pi}$	1.4	$\bar{c}$
1.72	$\overline{q^{\psi}}$	2.5	$\overline{k^{e}}$
2.3	$\overline{m^{2}}$	1.1	l_t

In this section, the long-term equilibrium values of endogenous variables of the model are simulated according to the calibrated parameters of the logarithmic-linear model. The simulation process includes two general parts. The first part is the data generation process for the model variables, and the second part examines the impact of the exogenous shocks specified in the model on the model's endogenous variables in the form of Impulse-reaction functions (IRFs)[1].
The framework of this section is as follows: first, the simulation and generation of data related to the endogenous variables of the model, and then the power and accuracy of the model in simulating the real trend of the variables of Iran's economy are tested according to different torques. In the following, the Impulse-reaction functions of the proposed shocks have been discussed and analyzed.
In fact, these functions show the dynamic effect of shocks on the behavior of variables as predicted by the model.
The simulation process of research variables has been done in the form of Dinar software for a period of time according to real data from Iran's economy. Real data includes seasonal time series of variables of total domestic consumption (c_t), investment (i_t), capital stock (k_t^e), gross domestic product (y_t), inflation (π_t or pi_t), total granted facilities by bank (l_t), the nominal

[1] In signal processing and control theory, the impulse response, or impulse response function (IRF), of a dynamic system is its output when presented with a brief input signal, called an impulse (δ(t)). More generally, an impulse response is the reaction of any dynamic system in response to some external change.

exchange rate[1] (ex_t), the total index of existence of the currency code $[\![q^{\psi}{}_t]\!]$ and the volume of liquidity (m_t^2) during the period of 1997:3 to 2019:4.

The model is logarithmically linearized, so the variables are included in the model as deviations from the long-term balance; Therefore, the model simulates the deviation from the long-term balance of variables (gap of variables). Therefore, the time series of the logarithm of the real variables should be converted into the form of deviation from the long-term equilibrium in order to compare the trend of the real data with the simulated trends. Hodrick-Prescott filter will be used for this purpose.

The strength of the simulated model is measured after preparing the time series of the logarithm gap of the time series of the real variables. These moments include the average time series of real and simulated data, the standard deviation of these series, the correlation of these series, as well as the co-movement moment of real and simulated time series with the base variable of the production gap. The results of these torques are listed in table (3).

Moments of real data and model data

According to table (3), the moments of endogenous variables[2] of the model are compared with the moments of real data and the success of the model in simulating the economic realities of the desired variables is evaluated. Therefore, first we take the natural logarithm from the data to obtain the cyclical component of the series, and then the variable cyclical component is extracted using the Hodrick-Prescott filter[3] with the smoothing parameter (λ = 1600) for seasonal data that is generally used by researchers. Quarterly data of National Accounts 1997:3-2019:4, taken from the website of the Central Bank and the Stock Exchange Organization, have been used to calculate the moments of real data.

The mean and standard deviation of real and simulated data deviations from the long-term values of GDP, private consumption, Gross fixed capital formation, abbreviated as GFCF, capital stock, total loans granted to households and companies, inflation, the total index of the existence of cryptocurrency and the volume of liquidity are close to each other, which can indicate the proper performance of the model in the simulation. The coefficient of the first-order autoregression process of GDP is 0.8 in real data and 0.82 in simulation. Also, the coefficient of the first order autoregression process for the real data is 0.46 and for the simulation model is 0.43 in the inflation rate variable. According to table (3), obvious differences are not observed in other variables between the moments of real and simulation data, based on which the inefficiency of the simulation model can be concluded.

[1] The nominal exchange rate E is defined as the number of units of the domestic currency that can purchase a unit of a given foreign currency. A decrease in this variable is termed nominal appreciation of the currency.

[2] An endogenous variable is a variable in a statistical model that's changed or determined by its relationship with other variables within the model. In other words, an endogenous variable is synonymous with a dependent variable, meaning it correlates with other factors within the system being studied.

[3] The Hodrick–Prescott filter (also known as Hodrick–Prescott decomposition) is a mathematical tool used in macroeconomics, especially in real business cycle theory, to remove the cyclical component of a time series from raw data.

Table 3- Comparison of calculated moment of real and simulated data

First order autocorrelation		Standard deviation		Mean		Variable
Simulation	Real	Simulation		Simulation	Real	
0.8190	0.801	0.059	GDP	0.88	0.91	GDP
0.8802	0.785	0.077	private consumption	1	1.03	private consumption
0.69	0.71	0.062	Private investment	1	1.1	Private investment
0.9974	0.96	0.21	Capital stock	1.05	1.2	Capital stock
0.6145	0.537	0.013	Total loans	0.9	0.86	Total loans
0.4305	0.461	0.038	swelling	1.001	1.11	Inflation
0.6929	0.674	0.04	stock price	1.00	0.94	stock price
0.91	0.923	0.083	Amount of liquidity	1.39	1.45	Amount of liquidity

Instantaneous impulse-response functions

In the following, the prediction of the model is analyzed using the mechanisms related to the dynamic impact of shocks expressed in the form of impulse -reaction functions. These functions indicate the reaction of the model's endogenous variables to exogenous shocks for a certain period of time. In other words, the exogenous shock leads to a few percent deviation of the endogenous variable from its long-term equilibrium. These functions show that during a certain period of time, and this effect lasts for several periods of time.

Graphs (20) to (21) show the shock-reaction functions caused by the shock of the cryptocurrency existence index, the household credit shock, the collateral power shock of companies and a productivity shock on macroeconomic variables.

The shock of the total existence of cryptocurrency index

Graph (20) shows the effect of a standard deviation related to a positive shock to the total cryptocurrency existence index on the macro variables of Iran's economy in a 5-year period. Financial markets, especially the real sector of the economy, play various roles in the macroeconomics through channels of wealth effects, financial accelerators and banks' balance sheets, and the complexity of the interaction between the markets and the real sector of the economy is also increased with their further expansion. In these conditions, the bigger these markets are, the effects of a shock to the economy can strengthen and expand the initial shock to the economy and increase the range of real business cycles by changing expectations, creating emotions and feelings, and generally financial disturbances in the system. Therefore, the monetary and economic authorities should carefully consider the dynamics of the real sector of the economy in the macroeconomic performance, especially after the financial crisis of 2007-2008. The real part of the economy plays a small role in Iran's economy, and the channels of the existence of crypto-currency on the macro-economy have many capacities to be activated, which can help in the optimal allocation of resources in the economy, in attracting liquidity for long-term investment, financing household consumption expenses (through investment funds) and creating credit for economic actors.

According to graph (20), the total household consumption becomes negative in the same period as a result of a financial shock and creating motivation for more investment and the use of its yield in future periods in saving households, but it returns to the equilibrium levels of the market. After two seasons, it remains above the initial equilibrium level until the end of the period. This finding can clearly show the smoothing of consumption caused by the increase in financial wealth during the lifetime of Iranian households. It is expected that the stock wealth channel will be strengthened with the expansion of Iran's financial markets and the activation of various tools for investment and risk coverage, such as warrants and futures contracts and real privatization of state-owned companies, and people will have more confidence in financing expenses. Durable consumer goods during the lifetime of the real sector of the economy.
By entering a positive shock to the existence of cryptocurrency, bank deposits in the same period show a decrease of 0.05% at the same previous levels of the bank interest rate, which indicates the transfer of household deposit resources towards the use of yield opportunities in the existence of cryptocurrency. But the deposits will gradually return to the initial equilibrium levels up to 5-6 seasons.

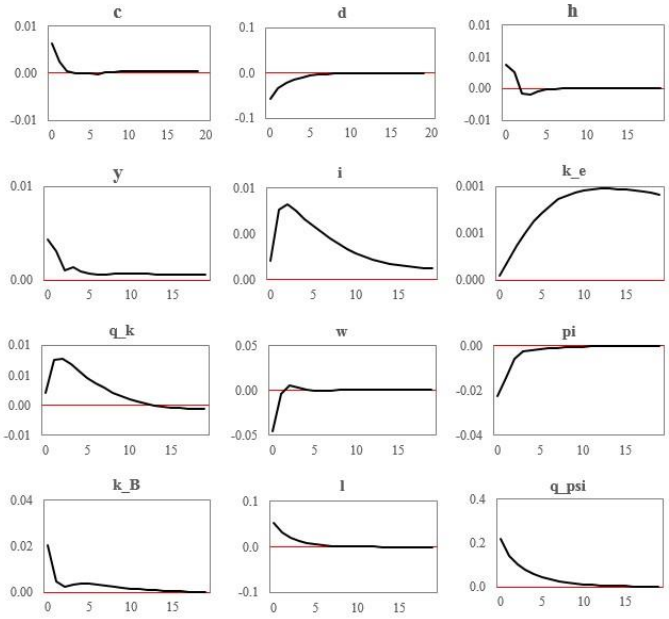


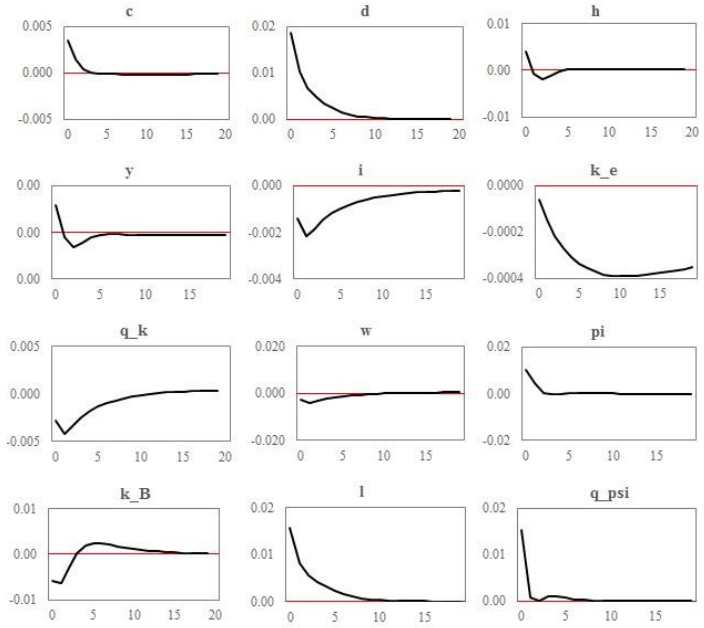
Diagram 20- The effect of the shock of cryptocurrency presence indicator

Capital increases immediately following this investment and inventory shock. Investment expenditure reaches about 0.01% above the equilibrium level after three seasons, and then returns to the previous equilibrium level gradually until the end of the period. The capital balance continues its increasing trend up to 0.001% in the form of a concave function and a decreasing growth rate due to the investments made. Part of the resources from work-oriented projects will be directed towards capital formation, and will reduce the labor force and reduce production in the same first period. But they return to the equilibrium levels until 3 seasons, and after that, due to the growth of consumption and investment expenses, they are higher than the equilibrium levels, and they return to the equilibrium levels from the 6-7 seasons.

As a result of this shock, the price of physical capital increases due to planning for more investment and acceleration in the process of market capitalization, and continues to grow for three quarters and then returns to the initial equilibrium levels until 13 seasons, and then it is slightly below the initial equilibrium level. As a result of the decrease in the demand for labor, the real wage decreases below the equilibrium level, and gradually increases towards the equilibrium level. The inflation rate will decrease, and it will gradually return to the initial equilibrium level up to 10 seasons, and therefore the effect of this shock will not have a stable effect on the inflation rate. Contrary to expectations, the capital of banks faces a decrease, and this can be caused by the weak link between the performance of the banking sector and the real sector of the economy in the formation of market capital to grant facilities to companies and households. The amount of facilities granted by banks also decreases, and it seems that due to the difficult conditions of granting loans and facilities by banks and the high interest rate of the facilities, it leads the companies to the conclusion that financing through the real sector of the economy involves a cost. Less money for them and their shareholders. However, the amount of granted facilities will gradually return to the initial levels for up to 6 seasons, because the real sector of Iran's economy still does not have a large financing capacity.

Household credit shock (loan-to-wealth ratio)

Liquidity limitations and unlimited access to financial resources always make households face problems in terms of theory and real conditions in shaping and smoothing the process of their consumption expenses. The findings from the simulation of the research model show that consumption, deposits, labor and production in the first period show a positive reaction to this shock due to a positive shock to the credit power of households, and each gradually returns to their equilibrium levels. By entering this impulse on the economy and leading households to receive more loans and facilities for consumption, investment and as a result capital accumulation, they react negatively, but little by little investment returns to the initial equilibrium level. The price of physical capital and wages also follow the same pattern of investment with less intensity.



Graph 21- Effect of household credit shock (loan-to-wealth ratio)

The inflation rate becomes positive in response to this exogenous shock and the effects of increasing total demand, but it returns to equilibrium levels gradually for up to 3 seasons. In the same period, banks' capital receives a negative effect due to the increase in demand for loans and facilities due to the positive credit shock, and the need to observe capital adequacy and risk assessment of loan applicants becomes more important. Iran's economy is facing many problems in the banking sector since the middle of 2015, which has made the actual functioning of this sector face many difficulties. According to the results of the examination of the data on the facilities granted by the banks in the reports of the Central Bank, one of the most important problems of this sector can be mentioned the very large volume of deferred and questionable claims due to the lack of risk assessment and the lack of receipt of appropriate collateral by the banking system, which is practically facing has made the banking sector with bankruptcy crisis. According to the results, the link between the real sector of the economy and the banking sector can greatly reduce the pressure on the banks' capital and assign part of the banks' duties, such as credit evaluation of loan and facility applicants, to the real sector of the economy.The stock price in the market grows as a result of this credit impulse, which is mainly in the form of accepting stock assets as collateral in granting facilities, but the effect of the credit shock on the stock price disappears quickly.

The shock of the loan-to-equity ratio of the wholesale goods producer (entrepreneur)

Also, companies are also facing liquidity restrictions to finance their investment projects. According to the results of the review of the annual budget laws of the whole country, the loans and facilities of the banking sector in the last two decades in Iran have been allocated based on preferential and mandated rates by the monetary authority and the government, and therefore due to the consideration of the effective rates of return and the attention has been paid to the return of capital in addition to political and social justifications, therefore, the necessary efficiency has not been achieved in Iran's economy. In this situation, banks' resources are frozen and locked in diminishing assets such as real estate and economic enterprises, and the large amount of

outstanding claims and government debts to the banking sector severely affect the functions of the banking sector, especially in the field of granting short-term facilities and therefore companies are also facing many problems with the financing of working capital and investment plans. In these conditions, the balance sheet of companies moves towards an inappropriate financial structure, and reduces the net worth of the company. The credit power of the company is reduced by the net reduction of the specific value of the company, and they are prevented from receiving limited facilities. This issue can negatively affect their investment and employment decisions and as a result their product and future value and credit.

According to the following findings, there is a direct relationship between the credit shock of companies and consumption, employment, wages and production. Also, it seems that the recessionary conditions prevailing in Iran's economy in recent years show the problems of the structure of (credit) balance sheets and liquidity of companies and banks. In recent years, despite the large amount of overdue claims in the banks' balance sheets and the ever-increasing principal, interest and late payment penalties of overdue and doubtful facilities, these overdue facilities have been taken over by the monetary authority, and no new loan and facility contracts are created, and previous debts are converted into loans with new conditions. As a result, the financial costs swallow the profits of the companies, and make it impossible for the companies to use the unused capacities and make new investments.

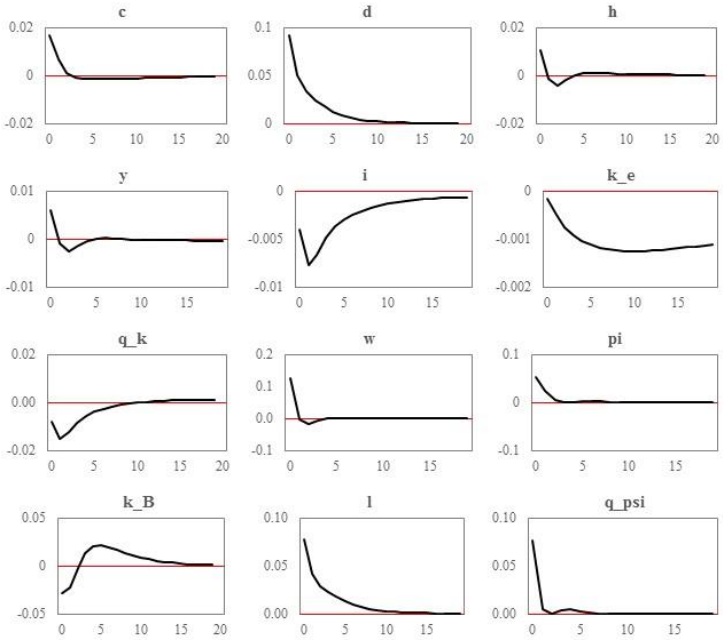


Chart 22- The effect of entrepreneur's credit shock (loan to equity ratio)

Productivity shock[1]

So far, the impact of financial shocks on the model has been investigated. Now, in order to find out if the results of the model simulation are consistent with the findings of other studies, graph

[1] Productivity shocks play a central role in real business cycles as an exogenous impulse to macroeconomic activity. However, measured Solow-Prescott residuals do not behave as an exogenous impulse.

(23) has examined the effect of a standard deviation positive shock to productivity or technology (available in most domestic and foreign studies, and included as a structural shock) on the real macro variables of Iran's economy. The price of physical capital, wages, banks' capital, the amount of facilities and loans, and the stock price increase in the same first period due to a positive shock of production productivity, consumption, investment, deposits, capital accumulation.

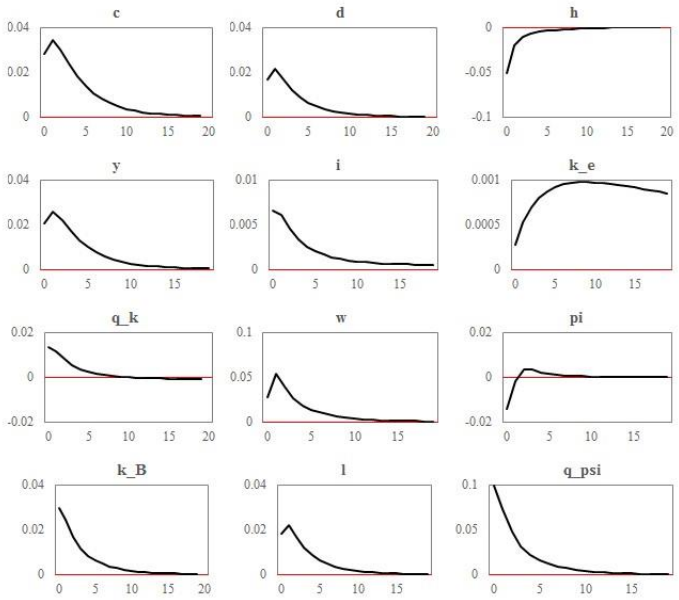


Diagram 23- Productivity shock effect

Production, consumption, investment and deposits will increase for the next 2 to 3 periods to more than 2, 3, 0.5 and 2 percent, respectively, and after that, they will return to their previous equilibrium levels until the end of the period. , and the effect of this shock on the variables of the real sector remains stable until the end of the period. The effect of the productivity shock on the model has been evaluated due to the positive effect on the capital accumulation and the negative effect on the labor force. The price of physical capital and wages increase, and gradually return to the previous equilibrium levels. As expected, the effect of this shock on inflation in the first period leads to a decrease in inflation. But it reaches zero after 3 periods, and it is slightly positive in the fourth period, and after that, it returns to its previous level until the seventh period, and the effect of the first shock is neutralized. Therefore, the reaction of the macroeconomic variables to the productivity shock in this model confirms the theoretical expectations and the findings of other studies, so here and the expectations correctly strengthen the other results of the simulation and estimation of the model.

The amount of loans and facilities received increases with a positive productivity boost, and leads companies to invest in productivity-improving technology. Finally, the productivity shock effect improves the profitability expectations of companies in the same period and therefore increases the stock price by 0.1%. After that, the effect of this shock gradually decreases up to 10 seasons, and stock prices return to their previous levels.

Other shocks

Markup shock of the price of domestic goods

The prices of domestic goods of households reduce their consumption as a result of a markup shock, but they use part of their deposits and stock wealth for consumption expenses in future periods due to the existence of consumption habits and consumption smoothing behavior throughout the life cycle. Firms increase their labor demand, investment, capital accumulation, and product to take advantage of price increases and earn more profits. The inflation rate, the price of capital and the amount of facilities will increase. The real wages and capital of banks will decrease according to the amount of granted facilities.

Currency shock

The exchange rate system of the country is managed based on the floating exchange rate system, and the central bank is obliged to guarantee the stability of the currency market. However, Iran's economy has faced several currency shocks in the past two decades, which have left lasting effects and consequences on the structure of the economy. Here, the effects of a currency shock on the endogenous variables of the research have been investigated. The application of international sanctions due to the continuation and acceleration of nuclear industry development programs in 2001 (H) can be one of the most important factors in creating this currency shock, which hit Iran's economy in the early 2011. In this period, with the embargo on the sale of Iran's oil and petroleum products and petrochemicals by the countries of the world, the exchange rate made a big jump at once and caused extensive changes and transformations in macroeconomic variables, which we witnessed in 2018-2019 in the crisis of inflationary stagnation ruling Iran's economy.

According to the results of the simulation model of this study, consumption decreases in the first period through the application of a currency shock, and despite the fact that households try to smooth the process from their deposits and financial wealth, they have not succeeded in doing so. And the consumption will not return to its previous equilibrium level until the end of the period, and in a way we are witnessing a permanent decrease in household consumption and their purchasing power. Household deposits also decrease due to the reduction of purchasing power effects as well as the move towards the use of foreign exchange yield, but it returns to its previous equilibrium levels gradually until the end of the period. The labor demand increases at first, but gradually decreases with the reduction of the company's competitive power due to the increase of imported capital goods and inputs, leaving inflationary effects for up to 5 seasons. Production, investment and capital accumulation also decrease due to this shock, and the effect of this shock remains stable on these variables. The price of capital and wages increase slightly, and gradually return to the initial equilibrium levels for up to 10 seasons. The demand for receiving facilities by households and companies increases in the first period, but gradually returns to the initial equilibrium level. The stock price index, which was initially increased due to the profitable growth of export companies' stock prices, quickly becomes negative for 3 seasons with the decrease in the competitiveness of companies, and this negative effect remains below the initial equilibrium level of the real sector of the economy until the end of the period.

Oil shock

Reliance of the government budget and the country's economy on foreign exchange earnings from the production and export of oil and oil products is one of the most prominent features of Iran's economy. Various studies have been conducted on the impact of oil shocks on Iran's

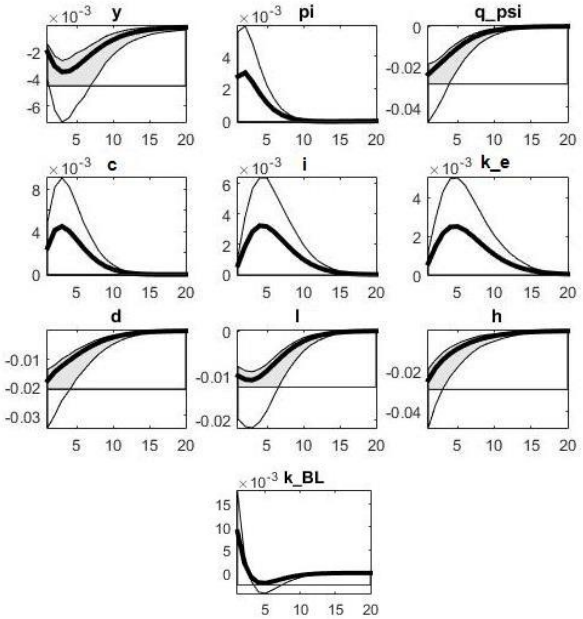
economy. However, the findings of this research do not contradict the findings of these studies, and this indicates the advantages of the current model. It is worth mentioning that with the arrival of an oil shock, the investment of companies decreases in the same period, and gradually returns to the initial equilibrium levels until the end of the period. It seems that this finding is another reason for the existence of the Dutch disease in Iran's economy and the existence of externalization effects of private sector investment from the government's capital expenditures in the economy. The existence of cryptocurrency also shows a positive effect in response to the shock of oil revenues, but it gradually returns to the initial equilibrium level up to 10 seasons.

Monetary policy shock

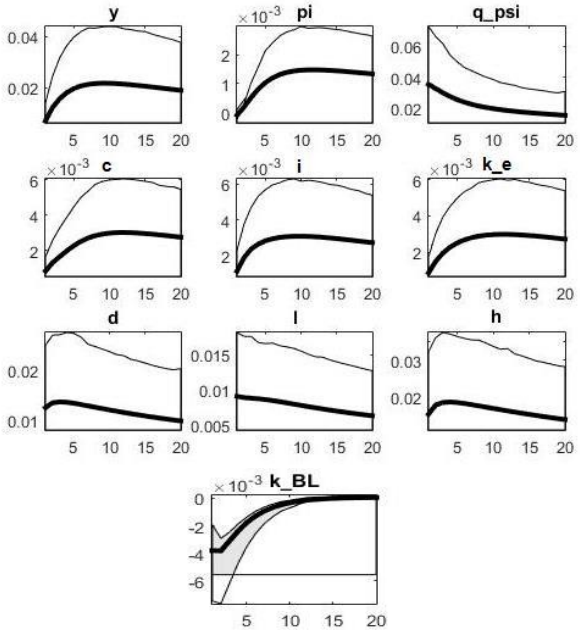
As predicted in the designed model, the volume of liquidity and the growth rate of the monetary base are the most important tools of monetary policy in the Iranian economy, which the central bank has always used for monetary policy during the past two decades. According to the results of this research, macroeconomic variables show a positive reaction to a monetary policy shock (not predetermined), and in most cases, the variables return to their initial equilibrium levels after a few periods. The existence of cryptocurrency also reacts positively to this shock, but it converges to this level again after three to five periods of fluctuation around the initial equilibrium level, and therefore the monetary policy shock cannot leave a stable effect on the existence of cryptocurrency.

Monetary shock

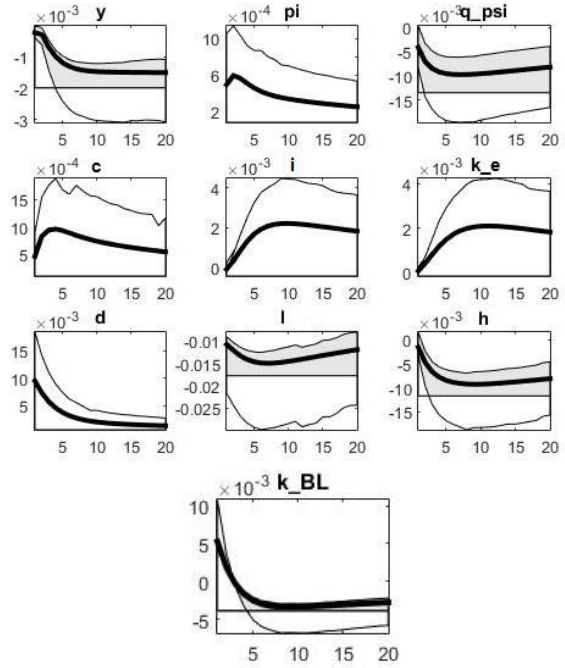
The effect of a monetary shock, such as a change in the taste of households to keep more money, on the investigated endogenous variables is shown in graphs 24.



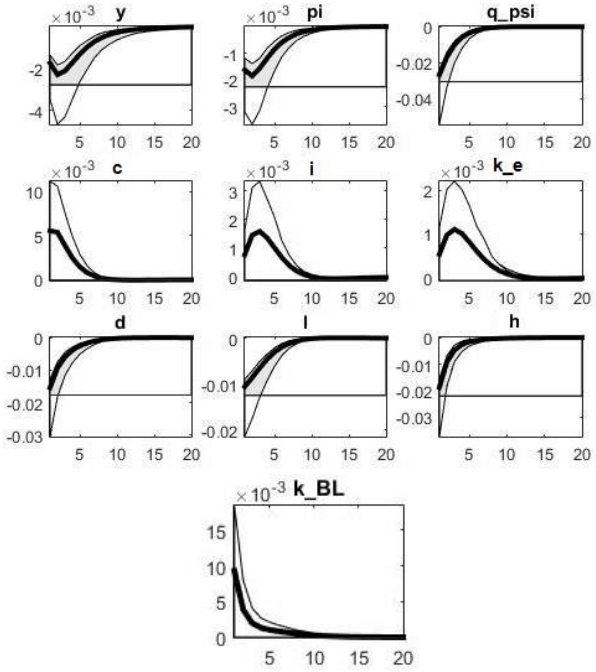
Instantaneous reaction functions of the markup shock of the price of domestic goods



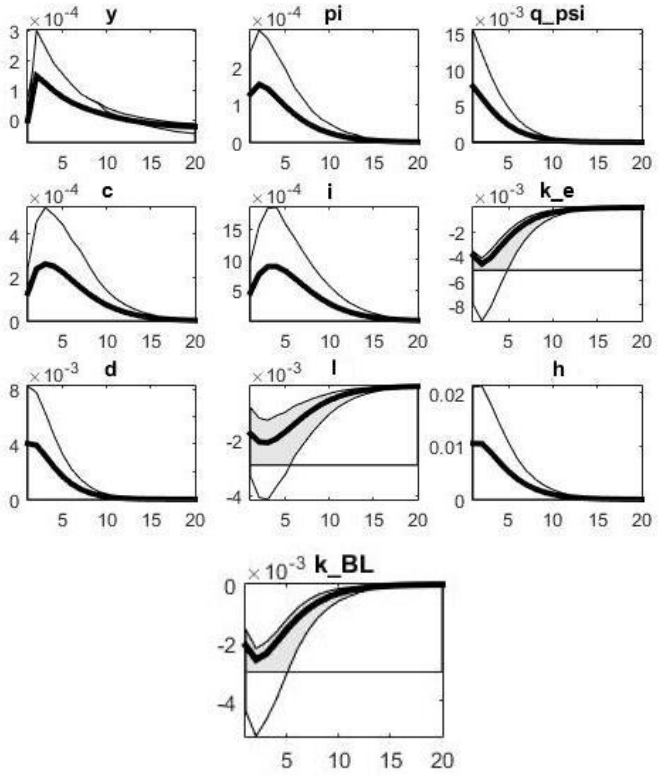
Instantaneous reaction functions to productivity shock



Instantaneous response functions to oil income shock



Instantaneous reaction functions of currency shock



Instantaneous reaction functions of monetary policy shock

Graph 24- Instantaneous response functions of model estimation

The reaction of monetary policy to the dynamics of cryptocurrency existence

Now that we have found that the presence of the real sector of the economy in the country's economy can affect the macroeconomic performance and cause dynamics in the macroeconomic variables, we may want to know what actions should be taken when the existence of cryptocurrency becomes very volatile, and emotions Emotional and pessimistic and self-fulfilling expectations affect the trend of indices and transactions. In monetary policy decisions, central banks paid less attention to the real sector of the economy than before the financial crisis of 2007-08, and used only inflation targeting, production gap, and exchange rate fluctuations in some less developed countries as decision criteria. However, the attitude of central banks in many developed countries was adjusted with the occurrence of the mentioned financial crisis, and various studies were conducted to investigate the role of monetary policy's reaction to the fluctuations and dynamics of the real sector of the economy in the economy. Now, at the end of this section, we are looking for what should be the role of monetary policy in times when the real sector of the economy faces unexpected positive and negative fluctuations and dynamics. Can an active policy response be effective in realizing expectations and eliminating excitement in the market, or should the central bank react passively? The model designed in this research can be used in various ways to answer this hypothesis. Here, to test this hypothesis, we assume that the central bank faces two different scenarios for the dynamics of the real sector of the economy, following Nistiko (2012):

1. In the first scenario, the central bank in its monetary policy rule, which is defined based on the growth rate of liquidity volume, reacts to the deviation of the total cryptocurrency existence index from its long-term equilibrium value ($\hat{q}_t^{\psi}$) with the coefficient of the policy rule (with a value of $\kappa\psi$ = 0.1).
2. In the second scenario, in the monetary policy rule, the central bank reacts to the changes in the rate of return of the index of the total existence of cryptocurrency with the coefficient of the policy rule (with a value of $\kappa\psi$ = 0.05).

The following relationships are presented according to the two scenarios considered for monetary policy:

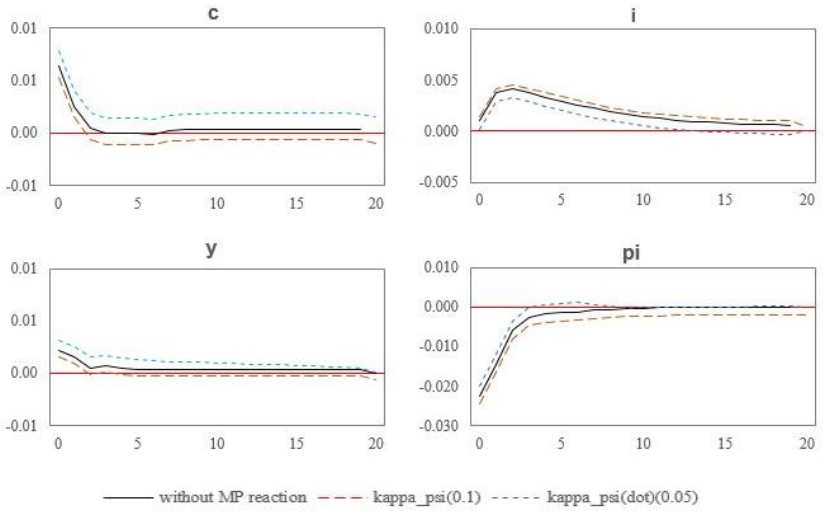
$$\widehat{\Theta}_t = \rho_{\Theta}\widehat{\Theta}_{t-1} + \kappa_{\pi}(\hat{\pi}_t - \hat{\pi}_t^*) + \kappa_y\hat{y}_t + \kappa_{\psi}\hat{q}_t^{\psi} + \varepsilon_t^{\Theta} \quad (9)$$

$$\widehat{\Theta}_t = \rho_{\Theta}\widehat{\Theta}_{t-1} + \kappa_{\pi}(\hat{\pi}_t - \hat{\pi}_t^*) + \kappa_y\hat{y}_t + \kappa_{\psi}\hat{q}_t^{\psi} + \varepsilon_t^{\Theta} \quad (10)$$

Chart (25) shows the results of the model simulation effect of the shock of the total index of the existence of cryptocurrency on consumption, investment, production and inflation rate with two scenarios for the behavior of the central bank's monetary policy rule in response to this shock. In this diagram, the black lines show the changing behavior of its long-term and stable situation in the normal state, regardless of the monetary policy maker's attention to the behavior of the existence of cryptocurrency. The red dashed line shows the first scenario, and the behavioral equation (9) in which the growth rate of the money volume reacts to the deviation of the index of the total existence of cryptocurrency from its stable and long-term state, and finally the blue dotted line shows the second scenario and the behavior of the central bank (Equation 10).

Diagram (25) shows that in the second scenario, where the central bank commits itself to reacting to the changes in the rate of return of the index of the presence of cryptocurrency, the real

consequences of the shock of the index of the existence of cryptocurrency will be more limited than in the first scenario, and the economic situation and conditions will be more will be in control of the monetary authorities. These findings are consistent with the results of Nistico's study (2012) for the American economy and Bayat et al.'s study (2015) for the existence of cryptocurrency tools. It can be argued that due to the continuous monitoring and dominance of the central bank over the foreign exchange market, interest rates, monetary and inflationary conditions, the central bank's response should be active and in line with other objectives of the central bank, such as price stability, currency stability, and macroeconomic stability in general. Therefore, in order to prevent the transfer of the monetary and financial resources of the country among parallel markets such as the currency market, gold, the existence of crypto-currency, housing and deposits or the maintenance of physical assets, the response of the central bank to the dynamics of the real sector of the economy should be compatible with the dynamics of its growth rates and not the deviation of the total existence of the cryptocurrency index.



Graph 25- The reaction of monetary policy to the price shock of the existence of cryptocurrency

Conclusion

Now that we have found that the presence of the real sector of the economy in the country's economy can have a significant impact on the macroeconomic performance, and cause dynamics in the macroeconomic variables, we may want to know what actions should be taken in times when the existence of cryptocurrency becomes very volatile and emotional and pessimistic and self-fulfilling expectations affect the trend of indices and transactions. Almost central banks paid less attention to the real sector of the economy in monetary policy decisions than before the financial crisis of 2007-08 and only inflation targeting, production gap, and in some less developed countries they made decisions based on exchange rate fluctuations.

However, the attitude of central banks in many developed countries was modified with the occurrence of the aforementioned financial crisis, and various studies were conducted to investigate the role of monetary policy response to the fluctuations and dynamics of the real economy sector in the economy. Now, at the end of this section, we are looking for what should be the role of monetary policy in times when the real sector of the economy faces unexpected

positive and negative fluctuations and dynamics. Can an active policy response effectively help to realize expectations and eliminate emotions in the market, or should the central bank react passively? The model designed in this research can be used in various ways to answer this hypothesis. Here, to test this hypothesis, following Nistiko (2012), we assume that the central bank faces two different scenarios for the dynamics of the real sector of the economy:

1) In the first scenario, the central bank in its monetary policy rule, which is defined based on the growth rate of liquidity volume, reacts with the policy rule coefficient (with a value of $\kappa\psi$ = 0.1) to the deviation of the total cryptocurrency existence index from its long-term equilibrium value ($\hat{q}_t^{\psi}$) .

2) In the second scenario, in the monetary policy rule, the central bank reacts to the changes in the rate of return of the total index of the existence of cryptocurrency ($\hat{q}_t^{\psi}$)with the coefficient of the policy rule (with a value of $\kappa\psi$ = 0.05).

According to the two scenarios considered for the monetary policy, the following equations are presented:

$$\widehat{\Theta}_t = \rho_{\Theta}\widehat{\Theta}_{t-1} + \kappa_{\pi}(\hat{\pi}_t - \hat{\pi}_t^*) + \kappa_y\hat{y}_t + \kappa_{\psi}\hat{q}_t^{\psi} + \varepsilon_t^{\Theta} \quad (32)$$

$$\widehat{\Theta}_t = \rho_{\Theta}\widehat{\Theta}_{t-1} + \kappa_{\pi}(\hat{\pi}_t - \hat{\pi}_t^*) + \kappa_y\hat{y}_t + \kappa_{\psi}\hat{q}_t^{\psi} + \varepsilon_t^{\Theta} \quad (33)$$

The results of the simulation of the model on the effect of the shock of the total index of the existence of cryptocurrency on consumption, investment, production and inflation rate with two scenarios for the behavior of the monetary policy rule of the central bank in response to this shock are reported in graph (25). In this diagram, the black lines show the changing behavior of its long-term and stable situation in the normal state, regardless of the monetary policy maker's attention to the behavior of the existence of cryptocurrency. The red dashed line represents the first scenario and the behavioral equation (31), in which the growth rate of the money supply reacts to the deviation of the total currency existence index from its stable and long-term state, and finally the blue dotted line is the second scenario shows the behavior of the central bank (equation 32). According to the findings of graph (25), in the second scenario where the central bank commits itself to reacting to the changes in the rate of return of the index of existence of cryptocurrency, the real consequences of the shock of the total index of existence of cryptocurrency will be more limited compared to the first scenario, and the economic situation and conditions It will be more in the control of monetary authorities. These findings are consistent with the results of Nistico's study (2012) for the American economy and Bayat et al.'s study (2015) for the existence of cryptocurrency tools. It seems that it can be argued that, due to the continuous monitoring and dominance of the Central Bank over the foreign exchange market, interest rates, monetary and inflation conditions, the response of the Central Bank should be active and in line with the other goals of the Central Bank such as price stability, and currency stability and in general, macroeconomic stability. Therefore, in order to prevent the transfer of the monetary and financial resources of the country among parallel markets such as the currency market, gold, the existence of crypto-currency, housing and deposits or the maintenance of physical assets, the response of the central bank to the dynamics of the real sector of the economy must be compatible with the dynamics of its growth rates, and not the deviation of the index of the total existence of the cryptocurrency.

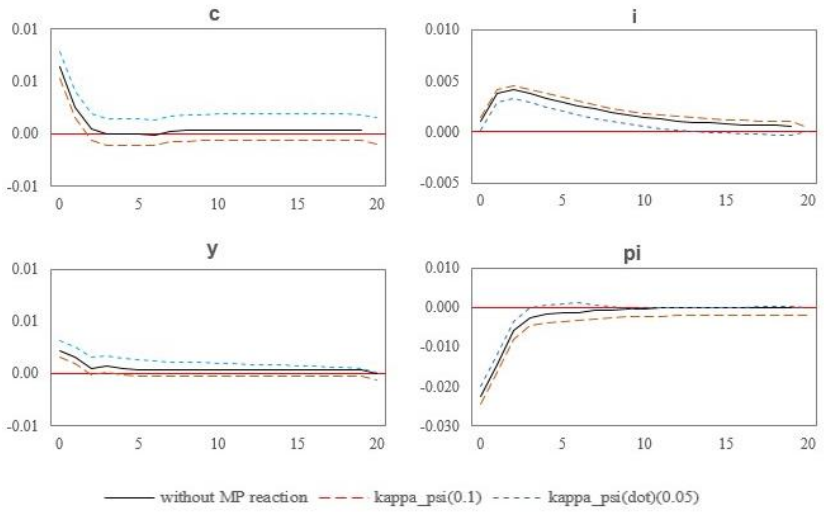


Diagram 25- The reaction of monetary policy to the price shock of the presence of cryptocurrency

The designed DSGE model was estimated using the real data of the existence of cryptocurrency instruments during the period of time using the Bayesian econometric method, and the validity of the results was tested. Impulse-reaction functions of shocks were used to investigate shocks. The most important results of this article are briefly described below.

1) At the beginning of the estimation stage, the average of the prior distribution of the parameters is equal to the calibrated values obtained from other domestic and foreign studies.

2) The symmetrical and smooth form of the posterior distribution diagrams of the parameters indicates the appropriate selection of the distribution of the parameters.

3) Convergence is evident based on Brooks-Gelman criteria in the process of generating random data.

4) The results of the shock- reaction functions obtained from the estimated model for the shock of the index of the total existence of the cryptocurrency, the credit shock of households and enterprises, as well as the shocks of productivity, price mark-up, currency, foreign exchange, oil and monetary policy are almost the same as the impulse-reaction functions resulting from the simulation and valuing of the model, as it is obtained based on these functions, the following important results.

- The credit shock of households and companies leads to a deviation in consumption, investment, capital accumulation and inflation rate from the long-term equilibrium level. The amount of deposits and employment deviates from their long-term equilibrium level positively in the first period of the shock, but this effect dissipates quickly. The amount of receiving loans and facilities decreases, and banks face the weakening of the balance sheet due to the inability to assess the risk situation of loan applicants, and the effects of recession in the future periods, and the amount of production deviation from the long-term equilibrium level becomes negative.

The effects of monetary policy on the dynamics of the presence of cryptocurrency have been investigated using simulation results. For this purpose, two scenarios have been considered for the reaction of monetary policy (growth rate of liquidity volume) to shocks in the real sector of the economy. According to the findings of this section, the central bank's reaction to the growth

rate of the total index of the real sector of the economy against the reaction to the deviation of the total index from its long-term equilibrium level can be more effective in reducing the real effects of the shocks of the real sector of the economy on macroeconomic variables, because the center bank controls the state of asset yield in other parallel markets such as currency, price level and deposit and loan, and therefore more guarantees the reaction to the emotional dynamics of the market yield against the reaction to the level of the market index, the stability of the macroeconomics.

In this regard, suggestions for future studies are presented:

1. Evaluating the role of cryptocurrencies in international trade and trade balance

Investigating the impact of using cryptocurrencies in facilitating international trade and improving the trade balance of developing countries and Iran. This research can examine the benefits and challenges of using cryptocurrencies in international exchanges and their impact on exports and imports.

2. Analysis of social and employment impacts caused by cryptocurrencies

Investigating the impact of cryptocurrencies on the labor market and employment, focusing on creating new job opportunities and changes in the type and nature of jobs. This study can analyze the role of cryptocurrencies in reducing unemployment and improving the digital skills of the labor.

3. Studying the effect of cryptocurrencies on economic and financial inequalities

Evaluating the impact of cryptocurrencies on income and financial inequalities in developing countries and Iran. This study can analyze whether the use of cryptocurrencies can help reduce economic inequalities or increase them.

4. Investigating the risks and benefits of cryptocurrencies in the banking system

Analysis of the risks and benefits of cryptocurrencies entering the banking and financial system. This study can examine the impact of cryptocurrencies on the stability of the banking system, risks related to cyber security and innovation opportunities in financial services.

5. Analysis of interactions between cryptocurrencies and traditional financial markets

Examining interactions and correlations between cryptocurrencies and traditional financial markets such as the stock market, bond market and currency market. This study can analyze the fluctuations and mutual effects of these markets.

6. Formulation of forecasting and risk management models in the use of cryptocurrencies

Development of forecasting and risk management models for the use of cryptocurrencies in developing economies and Iran. These models can analyze the risks associated with price fluctuations and political and economic factors affecting the value of cryptocurrencies.

7. Analysis of the effect of cryptocurrencies on transparency and economic corruption

Examining the role of cryptocurrencies in increasing financial transparency and reducing economic corruption. This study can analyze how the use of blockchain technology and cryptocurrencies can help improve financial transparency and reduce opportunities for corruption.

References

[1]. Adebola, S. S., Gil- Alana, L. A., & Madigu, G. (2019). Gold prices and the cryptocurrencies: Evidence of convergence and cointegration. Physica A: Statistical Mechanics and its Applications, 523, 1227-1236.
[2]. Andres, J., Lopez- Salido, J. D., and Nelson, E. (2009). Money and the natural rate of interest: Structural estimates for the united states and the euro area. Journal of Economic Dynamics and Control, 33(3):758-776.
[3]. Asimakopoulos, S., Lorusso, M., & Ravazzolo, F. (2019). A New Economic Framework: A DSGE Model with Cryptocurrency.
[4]. Athey, S., Parashkevov, I., Sarukkai, V., and Xia, J. (2016). Bitcoin pricing, adoption, and usage: Theory and evidence. Technical report, SSRN.
[5]. Benigno, P., Schilling, L., and Uhlig, H. (2019). Cryptocurrencies, currency competition, and the impossible trinity. Technical report, NBER Working Paper No. w26214.
[6]. Bianchi, D. (2018). Cryptocurrencies As an Asset Class? An Empirical Assessment. Technical report, SSRN Working Paper.
[7]. Bloomberg (2017a). Japan's BITPoint to Add Bitcoin Payments to Retail Outlets. https://www.bloomberg.com/news/articles/2017-05-29/japan-s-bitpoint-to-add-bitcoin-payments-to-100-000s-of-outlets.
[8]. Bloomberg (2017b). Nasdaq Plans to Introduce Bitcoin Futures. https://www.bloomberg.com/news/articles/2017-11-29/nasdaq-is-said-to-plan-bitcoin-futures-joining-biggest-rivals.
[9]. Bodenstein, M., Erceg, C. J., and Guerrieri, L. (2011). Oil shocks and external adjustment. Journal of International Economics, 83(2):168-184.
[10]. Boehme, R., Christin, N., Edelman, B., and Moore, T. (2015). Bitcoin: Economics, technology, and governance. Journal of Economic Perspectives, 29(2): 213-38.
[11]. Catania, L., Grassi, S., and Ravazzolo, F. (2018). Predicting the Volatility of Cryptocurrency Time|Series. Technical report, MIMEO.
[12]. Catania, L., Grassi, S., and Ravazzolo, F. (2019). Forecasting cryptocurrencies under model and parameter instability. International Journal of Forecasting, 39(2): 485-501.
[13]. Cheah, E. T., Mishra, T., Parhi, M., & Zhang, Z. (2018). Long memory interdependency and inefficiency in Bitcoin markets. Economics Letters, 167, 18-25.
[14]. Yao, S., Sensoy, A., Nguyen, D. K., & Li, T. (2022). Investor attention and cryptocurrency market liquidity: a double-edged sword. Annals of Operations Research, 1-42.
[15]. Fernandez-Villaverde, J. and Sanches, D. (2016).] Can currency competition work? Technical report, National Bureau of Economic Research.
[16]. Fry, J. (2018). Booms, busts and heavy- tails: The story of Bitcoin and cryptocurrency markets? Economics Letters, 171, 225-229.
[17]. Gandal, N., Hamrick, J. T., Moore, T., & Oberman, T. (2018). Price manipulation in the Bitcoin ecosystem. Journal of Monetary Economics, 95, 86-96.
[18]. Giudici, P. and Pagnottoni, P. (2019). Vector error correction models to measure connectedness of bitcoin exchange markets. Applied Stochastic Models in Business and Industry, forthcoming.
[19]. Grinis, R., Kislitsyn, A., Drozdov, I., & Shulga, K. (2021). Are Cryptocurrency Markets Running Behind the Fed? A Significant Shift in Crypto Markets Microstructure. A Significant Shift in Crypto Markets Microstructure (October 20, 2021).
[20]. Koutmos, D., King, T., & Zopounidis, C. (2021). Hedging uncertainty with cryptocurrencies: Is bitcoin your best bet?. Journal of Financial Research, 44(4), 815-837.
[21]. Saadat Mehr, Massoud; Ghaffari, Hadi; (2019), a comparative study of the effect of monetary and financial policies on Iran's economy in the form of a DSGE model, economic studies and policies spring and summer 2018 - number 35, rank B (Ministry of Science (24 pages - from 51 to 74)
[22]. Kazroni, Alireza; Mohammadzadeh, Parviz; Haghighat, Jafar; (2018), the effect of monetary impulses on employment under foreign exchange regimes in Iran: DSGE approach, modern economy and trade, summer 2018, year 14 - number 2, rank B (Ministry of Science/ISC (28 pages - from 77 to 104)

ACKNOWLEDGMENTS

The current study has not received any grant, fund or contribution from private or government institutions. Also, the authors declare that there is no conflict of interests

ETHICAL CONSIDERATION

Authenticity of the texts, honesty and fidelity has been observed.

CONFLICT OF INTEREST

Author/s confirmed no conflict of interest.