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The Effect of Transparency (Information) and Independence of Central Bank on Productivity Growth in Iran

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Abstract

This study has investigated the effect of transparency and independence of Central Banks on productivity growth during 1981–2018 in Iranian economy. Transparency and independence of central bank were measured by Dincer and Eichengreen (2012) index and Cukierman (1993) index respectively. The variables in this study which are in annual form are central bank transparency, central bank independence, GDP growth, productivity growth, inflation rate and free trade. Auto Regressive Distributed Lag (ARDL) method used for model estimation. The coefficient of the error term is negative, statistically significant and equal to -0.308. It concluded that 30% of the disequilibrium in the short-run is adjusted to achieve long run equilibrium. The results show that the transparency of the central bank has a positive effect and the coefficient is equal to 0.36 on the short-run productivity growth, but it is effective on the long-run productivity growth equal to 1.08. In this study, Cukierman and et al. (1992) index used to calculate central bank independence. In addition, Dincer & Eichengreen's (2012) index was used for the transparency index. Considering the positive impact of central bank transparency on productivity growth, the central bank should continuously promote policy transparency and dissemination of received information of macroeconomic variables during a month.

Highlights

- Explaining the Transparency and Independence features of the Central Bank.
- Calculating the Transparency and Independence of the Central Bank of Iran.
- Analyzing the Monetary Mechanism of Central Bank on Productivity Growth.
- Distinguish the short run and long run effects of Transparency and Independence of the Central Bank.

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1. Introduction

Nowadays, banking is considered as one of the most influential economic institutions all over the world. Moreover, achieving growth, prosperity and development is practically impossible without a dynamic, efficient and healthy banking system. Dynamism and efficiency of any system depend on the healthy context of a particular system, and banks are no exception given the nature of their business; rather, they need a transparent and healthy space more than other systems on a daily basis. Nowadays, many central banks consider transparency as their top priority and a crucial issue for the realization and effectiveness of monetary policy, effective communication with people and accountability. Therefore, the main objective of transparency can be found in issues such as public understanding, effectiveness of monetary policy and accountability. In general, the importance of transparency can be divided into two types: informative and motivational. In the first type, the disclosure of certain information reduces uncertainty and allows market participants to respond more consciously to fluctuations by updating expectations. Motivational effects are also structural changes in economic behavior due to differences in information structure (Mehrabani, 2017). Independence is another important variable for central banks. Independence of central bank means that governments make political promises to come to power and when these promises are fulfilled, money supply and inflationary pressures are increased.

One of the most important variables in recent years in Iranian economy is productivity, which has had an undeniable impact on Iranian economy. In economics, more information has always been preferred. In fact, financial transparency means that financial information is available to the public, that is, having access to the information and statistics and preventing rent-seeking, which is based on stability, fiscal discipline, improving the economic situation and productivity of a country (Shahabi Nejad et al., 2014; Badea, 2018). Similarly, an independent central bank can resist political pressure to a great extent, thus providing more economic stability. On the other hand, the provision of complete and transparent information by the central bank and its independence can lead to prediction of the central bank's policy or non-coordination with the government. All this may reduce the effectiveness of policy and labor productivity and the economy as a whole. Demertzis et al. (2007) have shown that transparency is not effective on output, but it is effective on its fluctuations. In the case of inflation, fluctuations are explained by reduced transparency and relatively 50% of fluctuations are explained by the change in the transparency index. Dincer and Eichengreen (2008) show that higher transparency of central bank performance has been the most important change in the monetary policy recently, and there is higher transparency in countries with more stable and developed political systems and deeper and more advanced financial markets. Muto (2013) pointed out in a standard Keynesian model that central bank transparency does not necessarily stabilize changes in the output-inflation gap. Papadamou & Arvanitis (2015) found that the effect of transparency index of central bank on inflation was

negative and significant. Yavari et al. (2015) emphasized the importance of transparency in central bank monetary policy, pointing out that central banks usually implement monetary policy to achieve their objectives in a way that economic activists cannot realize. The results obtained showed that increased uncertainty in monetary policy increased the volatility of economic variables. Mehrabi (2017) used the transparency indices to study the global trend of central bank transparency by separating the geographical areas and based on the level of economic development.

Agoba et al. (2017) pointed out that the central bank independence and inflation relation depended on the model, the sample and the estimation technique used. Ehsani et al. (2017) and Ehsani and Izadi (2019) analyzed the effect of transparency of central bank on output turbulence using GMM method and transparency index of Dincer and Eichengreen (2012), and revealed that increased level of transparency of central bank reduced output volatility up to a given point and after that point additional central banks information increased output turbulence. Weber (2019) proposed that transparency of central bank increased the volatility of exchange rate in developed countries. An example of independence of ends can be found in Germany where the Bundesbank does not receive tools from the government (Eichler & Littke, 2018).

Theoretically, more information may lead to more accurate predictions or more trade noise. Kwabi et al. (2020) showed that independence of central bank had a positive effect on foreign investment inflows significantly. Organizational quality also interacts with independence and transparency of central bank in absorbing the foreign equity portfolios. Andries et al. (2020) showed that an increase in central bank transparency significantly reduced ad hoc risk for banks. Tiberto et al. (2020) examined how central banks' trying to make more accurate information about their own aims in terms of price stability (transparency of monetary policy) and financial stability (transparency of financial stability) can reduce information asymmetry in the credit market about the profit conveyed by banks to participate in financial intermediation. In short, central bank transparency communication is a serious instrument to reduce the asymmetry of information. Therefore, the main question in this study is proposed as follows: do transparency and independence of the central bank have an effect on productivity growth in the Iranian economy?

This research, by studying the literature and research backgrounds, has measured the transparency and independence of the Central Bank of Iran. It has also analyzed the long-term and short-term effects of the transparency and independence of the Central Bank of Iran on the total factors productivity which can be useful for policy makers as well as researchers in this field.

The remainder of this paper organized as follows. Section 2 provides the literature review and research background. In Section 3, modeling and research methodology are addressed. In section 4 the ARDL regression results presented, and finally in section 5, the conclusion and some recommendations offers.

2. Theoretical Foundations

2.1 Total Factor Productivity

The purposes of society are economic growth and increasing the welfare. Whatever more facilities people enjoy in the community, the living standard and social welfare will be higher. The study of economies has recently shown that high economic growth increases productivity, and the role of capital investment in new growth has been partial compared to the increase in productivity (Syverson, 2011; Soltanisehat et al., 2019; Iyke, 2018). Understanding productivity levels and how they change over time can help meet the goals of economic growth and community welfare. Improving efficiency and productivity in the community will lead to increased production given the available resources in the community, and it will lead to economic growth. Historical experience shows the importance of increased productivity to increase economic growth (Guo et al., 2019; Rogge, 2019). Various factors affect productivity, among which monetary policy and its transparency and independence is one of the most important factors (Fakher & Abedi, 2016; Moran & Queralto, 2018) which are defined in the following.

2.2 Transparency Definition

Transparency is one of the good governance indices (Sadeghi Amroabadi & Kazemi, 2020). The term is often considered synonymous with concepts such as openness, accessibility and access to information, communication and accountability. In the economic perspective, paying attention to transparency is a completely new concept that often goes back to some fields such as information economics and political economy (Eijffinger & Geraats, 2006). The World Trade Organization (WTO) defined transparency as trust in access to information, which includes three main elements.¹ The first element is public access to information in rules, regulations and policies. Informing stakeholders about rules and regulations and their changes is the second important element, and uniform and impartial implementation of rules and regulations is considered to be the third element. The Organization for Economic Cooperation and Development (2002) defines a transparent business environment as one in which business enterprises have essential information about the conditions under which they operate and the lack of information asymmetry is not an important problem for their performance. For a more precise definition of transparency in an institution, first, the directions in which transparency flows should be considered and second, the nature of transparency should be determined (Demertzis & Hallett, 2007; Lustenberger & Rossi, 2018; Andries et al., 2020).

Transparency decline monetary policy uncertainty, inflation and interest rates, and private sector decision becomes easier (Muto, 2007). Moreover, this transparency and accountability strengthen people's better understanding of the central bank's abilities to increase price stability – that can lead to economic

¹ https://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm11_e.htm

growth in the long-run – as well as a better understanding of why the central bank cannot create a permanent increase in production and employment through expansionary policy. People's better understanding of the central bank's capabilities increases the possibility for them to support monetary policy, which is the long-term goal and principle of price stability. Some researchers show that transparency has costs such as unemployment, but Weber (2020) empirically rejected this. Moreover, transparency and accountability increase the independence of central bank and its good effects (Muto, 2013; Lustenberger & Rossi, 2018).

A brief definition for the areas of independence of central bank is as follows: a) independence of policy: it shows the powers delegated to the central bank in formulating the implementation of its main tasks in the areas of monetary policy and the selection of strategic tactics, b) independence in financial operations: the amount of powers delegated to the government to its expenditures finance by obtaining loans from the central bank, c) personnel independence: it refers to the degree of interference in determining the administrative procedure, employment, selection of employees, managers and officials of the central bank. Central bank independence can create investment, economic growth and productivity for the economy by generating economic stability (Cukierman et al., 1993; Tayssir & Feryel, 2018).

3. Methodology

In this study, the econometric method used to investigate the effect of independence and transparency of central bank on the total factor productivity in Iranian economy. The period covers a 37-year period from 1981 to 2018 in Iran. The required data were extracted through historical study and using various statistical sources such as the database and publications of Islamic Republic of Iran's Central Bank. The model and variables are discussed in the following.

3.1 Model Specification and Data

In this study, ARDL model was used for model estimation to use dynamics of model (lags), cointegrated model and separate short-run and long-run effects. The dependent variable is productivity growth of total factors of production in Iranian economy. The independent variables are independence and transparency of Iran's Central Bank (Table 1). The research model has the form of Equation 1:

$$PG_t = \alpha + \beta_0 + \beta_1 CBT_t + \beta_2 CBI_t + \beta_3 INF_t + \beta_4 GGDP_t + \beta_5 TO_t + \varepsilon_t \quad (1)$$

Where:

PG_t : Productivity growth of the Iranian economy at time t that is based on the following equation 2:

$$TFPG_t = (\ln Y_t - \ln Y_{t-1}) - \alpha_t (\ln K_t - \ln K_{t-1}) - \beta_t (\ln L_t - \ln L_{t-1}) \quad (2)$$

Which Y is real GDP, K is capital value and L is labor variable and α and β are the average of capital and labor ratio to total GDP. CBT_t : Transparency of Central Bank; CBI_t : Independence of Central Bank; INF_t : Inflation rate; $GGDP_t$: GDP growth; TO_t : Trade openness.

All the variables are real and based on 2012 base year.

Table 1. Research variables

Dependent variable	Total Factor Productivity growth (PG) based on labor productivity growth, and capital, labor elasticity and capital are obtained via the below relation and estim: of production functions for the Iranian economy $\hat{TFP} = \eta_L \hat{A}^P L + \eta_K \hat{A}^P K$
Independent variables	CBT: Central Bank Transparency – Positive- using the Dincer & Eichengreen Index CBI: Central Bank Independence – Positive- using the Cukierman Index
Control variat	INF: percentage of changes in the price index of consumer goods and services– negative GGDP: annual GDP growth rate per capita based on the currency unit- positive TO: trade openness, ratio of sum of exports and imports to GDP- positive

Source: Financial statements and notes of the Central Bank of Iran; www.cbi.ir

The explanatory variable of GDP is in real and the effects of inflation have been purified from it, and therefore it will not have a strong collinearity with the inflation variable. Also, the explanatory variable of production growth is included in the model as growth and does not have a strong collinearity with the variable of trade openness. In addition, VIF test performed and the coefficient of the test was all less than 5, which indicates a lack of strong collinearity between the independent variables.

The research model is modeled based on the literature and research background. In other words according to studies [Jalali Naeini \(2015\)](#), [Jafari Samimi and Derakhshani \(2015\)](#) and [Sattari et al. \(2019\)](#), the importance and impact of transparency of central bank on the economy and productivity are discussed: Also, according to international trade theories, the variable of trade openness can increase productivity with the advent of technology and knowledge. Also, the growth of production by increasing research and development, education, health, etc. all increase the productivity of factors of production. Increased inflation will strengthen brokerage and unproductive activities and reduce production efficiency (productive and knowledge-based activities). In other words, based on the theories of institutional economics, the structure of the central bank affect the total factor productivity ([Muto, 2013](#)). Based on theories of risk and uncertainty, transparency declines monetary policy uncertainty ([Eijffinger, 2007](#)). This transparency and accountability strengthens people's better understanding of the central bank's ability to encourage price stability - which in the long run lead to economic growth and productivity growth ([Muto, 2013](#)). The importance of transparency can be classified into two types of information and motivation. In the first type, with the release of a certain piece of

information, uncertainties are reduced and market participants can be more aware of fluctuations by updating expectations. Motivational effects are also structural changes in economic behavior due to differences in information structure. For example, the more the central bank tries to publish macroeconomic forecasts, the better its impact on monetary policy. The private sector, meanwhile, focuses more on published forecasts and less on informal information. (Hussain et al., 2017; Mehrabi, 2017).

Based on economic theories, rising inflation increase the cost of living of labor and fall into the poverty trap of manpower and reduce its productivity and by increasing the price of the product, it increases the profitability and interest of the firm (Dew-Becker & Gordon, 2005). Also based on theories of risk and uncertainty, inflation lead to increased economic volatility and reduced economic growth and productivity (Yildirim, 2015). Also, increasing the volume of trade based on international trade theories will lead to the introduction of knowledge and technology and increase productivity (Beverelli et al., 2017; Shu & Steinwender, 2019).

3.2 Measurement of Transparency of Central Bank

The information on central bank transparency was obtained from the websites of central banks in different countries (the Central Bank of Iran)². The index designed by Dincer and Eichengreen (2012) is used for quantitative study of this concept. The transparency index is an accurate measure that focuses on the information provided by the central bank at each stage of the decision-making process. This index is based on five main components: 1) political transparency, 2) transparency of economy, 3) procedural transparency, 4) transparency of policy, and 5) functional transparency. Each component has three evaluation questions and the answers to fifteen questions result in a total score. The corresponding number is the degree of transparency.

3.3 Measurement of the Central Bank Independence Index

Experimental studies have used various indicators such as Grilli, Masciandaro and Tabellini, the Cukierman index and the turnover rate of central bank governors to measure the degree of central bank independence. In this study, the Cukierman index was used because of the availability of data from this index which has been used in most studies. Cukierman (1993) studied independence of central bank based on two legal and real indices. The legal index of independence of central bank is divided into four main components: 1) dismissal and appointment and the central bank governor tenure. 2) The decision-making body responsible for resolving disputes over monetary policy. 3) Central bank objectives, and 4) central bank constraints on lending to the public sector. These components are based on 16 different legal variables, with each variable ranked

² www.cbi.ir

between zero (lowest degree of independence) and 1 (highest degree of independence). It contains 16 questions from which the overall index is calculated as follows: The first 4 variables are transformed into a variable based on a simple mean, and a weight of 0.2 is assigned to the obtained mean. The next three policy formulation questions are transformed into one question, but the results are obtained using the weighted mean. Thus, the question on dispute resolution is given a weight of 0.5 and the rest are given a weight of 0.25. The weight of 0.15 is assigned to the obtained weighted mean of these three questions. The question on objectives is considered as a separate variable and its weight is equal to 0.15. The first four questions related to the limits of lending to the state are calculated separately which is weighted. Yet, the last four questions are converted into a variable by calculating the simple mean, and then a weight of 0.1 is assigned to the resulting number. The total index is the sum of the final numbers of the above steps. [Cukierman \(1993\)](#) introduced another index to determine the degree of independence of the central bank, which is based on the performance of the central bank and not on the law. The reason is that this law may not be practically implemented in some developing countries, even though the central bank rules are quite clear.

4. Empirical Results

The index of central bank transparency includes five sub-indices which they are further discussed based on the existing rules, central bank information and statements and previous empirical studies.

4.1 Examination of Central Bank Transparency

A) Investigation of Political Transparency of Central Bank of Iran

Political transparency refers to the degree to which policy objectives are transparent. It includes an explicit prioritization of objectives, a formal statement of objectives and a quantification of the most important objectives. According to the Monetary and Banking Act of 1974, paragraph B, article 10, the main central bank objectives are to maintain the value of money, balance of payments, trade facilitation and support economic growth. More specifically, the main role of the central bank is to create favorable conditions for economic development by implementing monetary and credit policies and assisting the government in implementing various programs, including stabilization and economic development programs. In this way, maintaining the value and stability of the national currency and balance of payments, together with continuous economic growth through monetary policy, is one of the important objectives of the central bank. Therefore, the central bank has several tasks, and there is no exact priority for it ([Jalali Naeini, 2015](#)). Also, in terms of setting certain quantitative targets for specific objectives, the Monetary and Banking Act of 1960 and a review of central bank publications show that the central bank does not have a quantitative target for monetary variables. The Monetary and Banking Act of 1972 also does not contain specific quantitative targets for monetary variables, and such targets were

not mentioned in the central bank's publications during the period under study. However, after the revolution in Iran, quantitative values for monetary variables were specified in the economic, social and cultural development programs launched since 1989. There is a large gap between the rates of stated targets and the extent to which they have been met in practice. Therefore, it can be stated that there is virtually no independent monetary policy and the monetary sector was used as a policy tool by the government (Mozini & Ghorbani, 2019). It should be noted that during 2013–2015, the government strictly controlled liquidity to some extent, which is different from the previous period. Since 2017, the situation is similar to the previous period.

B) Investigation of Central Bank Economic Transparency

It includes the dissemination of economic information for monetary policy. This section relies on the economic data and models to predict and evaluate central bank policy. Since 1960, the Central Bank has published monetary statistics and the degree of existing elements in the debt-to-asset ratio through the Journal of Annual Statistical Tables and the Balance Sheet of Central Bank. Also, the status of other macroeconomic accounts in Iran, decisions of monetary and Credit Council, monetary policy and the reason for the adoption of each policy by the central bank were mentioned. These reports are usually annual and are published with some delay. In the meantime, the Central Bank provides explanations for some decisions taken. It is noteworthy to mention that the regular report of the Central Bank on some monetary and macroeconomic variables was published with a long delay from 2007 to 2013; however, since 2013 it has become regular again. It should be mentioned that the reports on economic variables do not include the monetary authority's forecasts on the trend of these variables.

C) Examination of the Procedural Transparency of the Central Bank

It is about the process by which monetary policy decisions are made. Whether there is an explicit monetary policy rule or not, based on observations of the central bank's behavior and studies such as Jalali Naeini (2015), Jafari Samimi and Derakhshani (2015), Sattari et al. (2019) and Hagehashemi et al. (2021), it can be concluded that the central bank did not use specific monetary policy tools such as interest rate, monetary base growth rate, and liquidity to control inflation during the period under study (2017), expert opinions do not play a significant role in the decision-making process and much of this process is subjected to the spending needs and requirements of the government.

D) Reviewing Policy Transparency of the Central Bank

It means the immediate disclosure of a policy decision along with the explanation of that decision and the explicit desire of the policy or its implication for future policy operations (Sattari et al., 2019). By studying the announcements and publications of the central bank, it seems that the central bank did not announce any specific procedure or rule until 2013, except the introduction of the

entire monetary base as an intermediate target, and did not enforce other policy approaches such as inflation targeting and forecast-based targeting. In addition to the observations, [Jalali Naeini \(2015\)](#), [Jafari Samimi and Derakhshani \(2015\)](#) and [Sattari et al. \(2019\)](#) also emphasize the lack of a comprehensive policy approach in formulating the central bank's targets. Since 2018 until now, the central bank has used this rate as an intermediate target to control liquidity and implement monetary policy by officially announcing the target inflation rate. Since the central bank has been passive in setting these targets, in practice it has paid less attention to the immediate announcement of this policy in its publications and on its website.

E) Examination of the Operational Transparency of the Central Bank

It refers to the implementation of the policy operations of the central bank. This includes the discussion of control failures in the achievement of operational objectives and disturbances of macroeconomic that affect the monetary policy transmission's mechanism. The assessment of macroeconomic result of monetary policy in the light of objectives is included in this section. Exploring the central bank's website and database shows that the reports titled "Summary of Economic Developments" are the only reports that examine economic shocks and possibly the performance of monetary policy or the expression of policy errors by the central bank. However, this report was published so irregularly until 2014 ([Sattari et al., 2019](#)). It should be noted that the status of the variable improved in 2013–2015, but again there is no mechanism to report such errors in practice. This may indicate the lack of proper mechanism to report these errors by repeating the gap between the targets and their realization level since 2016.

4.2 Examining the Process of Central Bank Independence

The index of central bank independence was calculated using [Cukierman and et al. \(1992\)](#) index based on four axes: a) the manner of appointment and dismissal of the central bank governor, b) the formulation of banking policy, c) the objectives of the central bank, and d) the constraints on lending. Since the objectives and policies have been discussed in the above section, the other three axes, i.e., the central bank governor, the lending policy and the role of the bank in financing, are examined in this section.

A) Recall and Appointment of the Governor of the Central Bank

One of the most important factors affecting central bank independence that has been used in all the indicators of independence is the length of the term of office and the governing conditions for the chairman and members of the board of directors of the central bank and how these members are selected. Under article 28 of the Monetary and Banking Act, 1960, the Governor of the Central Bank is appointed for a term of three years and their re-election is unhindered. Since the term of the presidency is 3 years, the governors of the central bank have little leadership stability and this has a negative impact on the independence of the

central bank. There are also conditions for the Governor of the Central Bank, which are as follows: A) academic eligibility: having a doctorate in one of the fields of economics, money and finance; B) experimental eligibility: having 7 years of experience at the policy and management level in the fields of economics, money and finance, or 5 years of management experience in the specialized fields of the Central Bank, the Director General, etc.; C: having a good reputation and the ability to perform the duties; D) having no history of effective criminal convictions; and E) having no widespread financial misconduct. The dismissal criteria also stipulated that the dismissal and replacement of the Governor shall occur in the event of the fulfillment of one or more clauses of the following conditions: Loss of one or more of the above conditions or absence of one or more conditions for the position, inability or failure to perform statutory duties and realize the objectives of the Central Bank. The resignation of the Governor of the Central Bank shall also be accepted by the Governor.

B) Lending Policy

Under the monetary and fiscal regulations adopted by the legislature in 1960 and 1972, the banking system supervision assigned to the Central Bank and the financing and provision of facilities to the private sector, and the household sector entrusted to the banks. Also in Article 11 of this 1972 Act, provision of credit to government institutions and ministries is one of the functions of the government. Moreover, in the subsequent amendments to this Act, including the 1979 amendment, the Interest Free Banking Act of 1983 and the development plans, reference is made to non-provision of credit by the central bank, it is not the responsibility of the government and only the law stipulates the legality of this clause. The interest rates and terms of credit with the government institutions and ministries are also not mentioned in the Monetary and Banking Act. They are mostly determined by the Development Plan Law and the Monetary Council, as is the interest rate on government deposits and facilities. Similarly, in practice, in the event of a budget deficit, the route to monetize the budget deficit has been the most accessible option in recent years. Therefore, public banks are responsible for financing the budget in the event of a budget deficit, both legally and practically.

C) The Role of the Central Bank in Financing

The role of the central bank in financing the government was not mentioned in any of the monetary policies. Basically, the roles of the central bank are to maintain the value of money, balance of payments by facilitating trade exchange and supporting economic growth as per Monetary Acts in 1960 and 1971 and the Interest Free Banking Act. The use of the capacity of the central bank for public finance was not mentioned at all in the rules. But based on various findings and what has been observed in practice, the government budget deficit is monetized in many cases and the central bank has become the banker of the government. The money supply has been steadily increased to cover the budget deficit when oil revenues are declining and to cover government expenditure when oil revenues

are substantial. Thus, the budget deficit has been monetized. Thus, it can be stated that the country's monetary sector has been used as a policy tool by the government (Mozini & Ghorbani, 2019). After the historical study of the process of transparency and independence of Central Bank of Iran, the effects of transparency and independence are analyzed using ARDL model.

4.3 Model Estimation

The first step in this study is to measure the total factor productivity. Using the time series data of 1981-2018, the production function of Iran's economy is estimated by GLS method which real GDP is the dependent variable and physical capital and labor are independent variables. The variables entered into the model in a real and logarithmic manner, and all three variables remained stationary at the level. The results of model estimation are as shown in tables 4-8. D-W statistic shows no autocorrelation. All the classical regression assumptions, such as the absence of extreme collinearity, heteroskedasticity and heterogeneity variance indicates that there is no problem in the estimation, Therefore, the results are reliable and the dependent variable of productivity is measured based on Equation 2 for the Iranian economy.

Before estimating the final model using ARDL method, it is necessary to check the variables stationarity to avoid spurious regression based on the augmented Dickey-Fuller (ADF) test (Noferesti, 2009). The results of ADF test show that the variables of central bank transparency, independence, productivity and openness are non-stationary; they are retained with one time differentiation and the variables of inflation and economic growth are stationary (Table 2).

Table 2. Stationary statistic (ADF)

VARIABLE	ADF STATISTIC	PROB.	RESULT
INFLA	3.28	0.001	I(0)
INDE	4.02	0.000	I(1)
GGDP	3.92	0.000	I(0)
TRAD	3.01	0.005	I(1)
TRAN	3.85	0.002	I(1)
PRODU	4.06	0.001	I(1)

Source: Research findings

Also the stationary test with structural breaks (Zivot and Andrews test) by Lumsdaine and Papell test done that the results show the stationary with two structural breaks (Table 3). In other words, a number of variables are stationary and a number of them are retained with a one-time difference. Now, the results of testing the classical assumptions of the productivity model and estimating the coefficients are presented.

Table 3. Stationary test with structural breaks (Zivot and Andrews test)

	α Statistic (prob.)	θ Statistic (prob.)	γ Statistic (prob.)	μ Statistic (prob.)
INFLA	5.012 (0.000)	2.268 (0.011)	2.221 (0.020)	4.124 (0.001)
D(INDE)	4.745 (0.001)	3.278 (0.009)	4.159 (0.002)	4.789 (0.000)
GGDP	4.002 (0.005)	4.068 (0.002)	3.357 (0.004)	4.987 (0.000)
D(TRAD)	6.260 (0.000)	3.008 (0.001)	2.741 (0.011)	2.732 (0.014)
D(TRAN)	4.068 (0.001)	4.858 (0.000)	4.369 (0.001)	4.008 (0.001)
D(PRODU)	4.741 (0.000)	4.017 (0.001)	4.852 (0.000)	5.201 (0.000)

Source: Research findings

4.3.1 Classical Hypothesis Test of Regression

The first classical assumption (normality of the residuals) states that the mean of the errors is zero. In the present study, the Jarque-Bera test used to test the above hypothesis. The results of this test show the probability 0.64 that indicates the residuals are normal and confirm the null hypothesis (Figure 1). The second classical hypothesis is the variance heterogeneous test of residual. The Harvey test used to examine variance heterogeneous. The results of this test showed that the probability of the statistic is equal to 0.788 and as a result, the null hypothesis is confirmed. Thus, there is no problem of variance heterogeneous. The third classical hypothesis is the absence of autocorrelation of residuals. The Godfrey test used to examine the absence of autocorrelation at higher levels. The results show that the probability value is equal to 0.381 and show no autocorrelation using the Godfrey test.

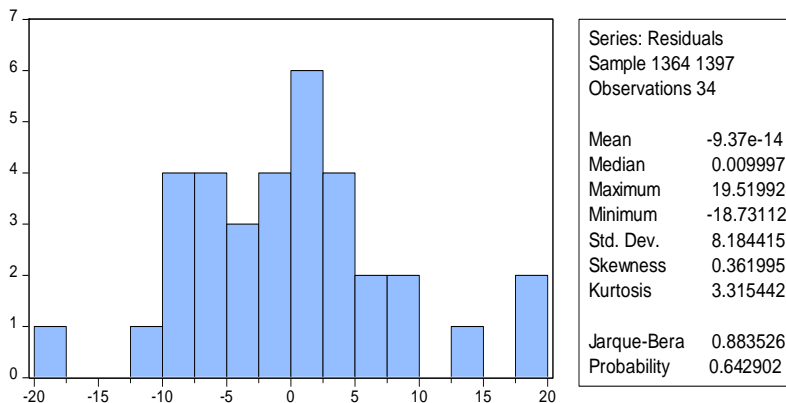


Figure 1. Normality of Residuals

Source: Research findings

4.3.2 Discussion

Having examined the stationarity of the variables and the conventional classical assumptions for the ARDL model, the model is now estimated in three sections: short-run, long-run, and error correction.

A. Short-Run

Based on the results of the different specifications, the best way is to specify the model in linear form where all variables enter the model in level. The maximum lag in the ARDL template for data is considered equal to 2, and the order of lags of each variable in the template is identified as (1,1,1,0,2,0) according to the Akaike Information Criterion (AIC). The estimation results of this model are shown in table 4 based on the short-run dynamic model.

Table 4. Short-term estimated model; Dependent Variable: PRODU

Variable	Coefficient	t-Statistic	Prob.
PRODU(-1)	-2.008	-2.566	0.028
INFLA	-0.473	-4.005	0.002
INDE	-0.672	-3.432	0.006
INDE(-1)	819.631	3.595	0.004
GGDP	1.099	1.647	0.130
TRAD	-3.091	-1.519	0.159
TRAD(-1)	-1.084	-3.437	0.006
TRAD(-2)	0.809	3.392	0.006
TRAN	97.504	2.581	0.027
TRAN(-1)	6.886	2.160	0.056
C	3.620	1.224	0.248

Durbin's h -statistic (Prob) : 1.475 (0.140)

R-squared	0.814	F-statistic	4.378
Adjusted R-squared	0.628	Prob(F-statistic)	0.014

Source: Research findings

To check the goodness of fit of the model in this research, Ramsey test used. Based on the results of this test, the estimated model form is accurate (Table 5).

Table 5. Ramsey Test

Stat.	Probe.	Result
0.477	0.665	Correct specification of the model

Source: Research findings

The estimation results show that the effect of the index coefficient for central bank independence on productivity growth is negative and significantly equal to 0.67. In other words, when the central bank independence is increased, the aggregate productivity is decreased. Moreover, based on the results, the transparency index has become significant with a lag. According to the results,

the productivity growth is also increased by the coefficient 97.5 by increasing the transparency in the short-run. Inflation rate has also become significant in the short-run and the results emphasize that inflation has an short run effect on productivity growth and when inflation increases, productivity growth is immediately decreased; thus inflation has a negative effect on productivity growth. The degree of openness affects productivity growth and productivity increases as trade increases. It is noteworthy that this variable has no lag effect on productivity growth. For the economic growth variable, the results suggest that this variable does not affect productivity growth in the short-run; therefore, and in general, the transparency index, independence, openness degree and inflation rate variables are effective on productivity growth in the short-run. And their coefficient is consistent with the theoretical literature.

B. Long-Run

The F- Bond test used to examine the long-run relationship. As shown in **Table 6**, the critical limit of the upper band is equal to 4.0131 with a sample size of 21 at an error level of 5%, which is smaller than the calculated test statistic for the research model (10.738). Therefore, the existence of a long-run relationship is confirmed at the 95% confidence level.

Table 6. F-Bounds Test: Null Hypothesis: No levels relationship

		Asymptotic: n=1000		
F-statistic	18.30934	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15
Actual Sample Size		21	Finite Sample: n=35	
			10%	2.331
			5%	2.804
			1%	3.9
			Finite Sample: n=30	
			10%	2.407
			5%	2.91
			1%	4.134
				5.761

Source: Research findings

The results of the estimation of the long-run relationship are presented below:

Based on the results in table 7, the long-run model of central bank independence at the 95% confidence level has the required significance in the long-run. According to the estimation results, increasing central bank independence increases productivity at the level of the whole economy in the long-run, and increasing one unit of independence increases productivity growth

by 1.09 units. As in the short-run, central bank transparency affects productivity growth by 0.36 units in the long-run. In other words, changes in central bank transparency improve productivity in the long-run. The research results are based on the literature and research background. In other words according to studies Jalali Naeini (2015), Jafari Samimi and Derakhshani (2015) and Sattari et al. (2019), the importance and impact of central bank transparency on the economy and productivity are discussed: Also, according to international trade theories, the variable of trade openness can increase productivity with the advent of technology and knowledge. Also, the growth of production by increasing research and development, education, health, etc. all increase the productivity of factors of production. Increased inflation will strengthen brokerage and unproductive activities and reduce production efficiency (productive and knowledge-based activities).

Table 7. Long-term estimated model; Dependent Variable: PRODU

Variable	Coefficient	t-Statistic	Prob.
INFLA	-0.157	-4.097	0.002
INDE	1.094	2.267	0.046
GGDP	1.085	1.377	0.198
TRAD	0.132	1.968	0.077
TRAN	0.365	2.725	0.021
C	3.620	1.953	0.079

Source: Research findings

Another variable is inflation. Based on the results and in the long-run, an increase (decrease) in the inflation will decrease (increase) the productivity of the whole economy. According to the results, a one unit increase in inflation will decrease productivity by 0.15. The degree of openness also affects productivity growth in the long-run. Thus, a one unit increase in trade growth increases productivity by 0.13 units. Similarly, economic growth rate has a positive effect on productivity growth in the long-run and is not effective. That is, productivity is increased by 1.08% increase in economic growth rate. Therefore, and in general, the independence of the central bank, transparency, inflation rate and the degree of openness have a significant and long-run impact on productivity growth and economic growth is ineffective in the long-run. Also the trade has a positive and significant effect that show the economy needs the technology that it can come through the trade.

C. Error Correction Model

The results of estimating the error correction coefficients for the model are summarized in table 8. The error term ECM coefficient is negative, statistically significant and equal to -0.308. Therefore, it concluded that 30% of the short-run disequilibrium is adjusted to reach the long-run equilibrium in each period based on the error correction term.

Table 8. Estimation of error correction pattern; Dependent Variable: PRODU

VARIABLE	COEFFICIENT	T-STATISTIC	PROB.
D(INDE)	359.091	2.580	0.027
D(TRAN)	0.672	4.9307	0.000
D(TRAN(-1))	-0.809	-6.045	0.000
D(TRAN)	32.412	2.309	0.043
COINTEQ(-1)*	-0.308	-11.236	0.000

R-squared 0.896866 Adjusted R-squared 0.871082

Source: Research findings

The results of the CUSUM and CUSUMQ parameter stability tests also show the stability of the model parameters (**Figure 2**). Transparency has a positive and significant effect and show for growing the productivity, it need the transparency of central bank for monetary policy.

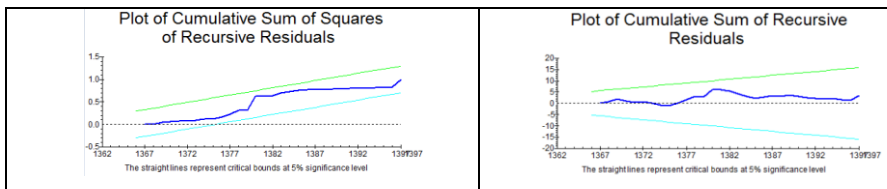


Figure 2. CUSUM and CUSUMQ parameter stability tests

Source: Research findings

5. Concluding Remarks

In this study, Cukierman and et al. (1992) index was used to calculate central bank independence based on four axes, i.e., (a) appointment and dismissal of the central bank governor, (b) formulation of banking policy, (c) central bank objectives, and (d) lending constraints. In addition, Dincer & Eichengreen's index was used for the transparency index. It should be noted that various laws such as the Banking and Monetary Act of 1971, 1960 and the amendment to the Monetary and Banking Act of 1979, the Financial Documents Issuance Act of 1967, Treasury Bonds and the Documents Issuance Act of 1972, the Interest Free Banking Act of 1983 and the 1986 amendments and subsequent amendments were used to examine the independence and transparency of the central bank and the statements in each index. On the other hand, before and especially after the Islamic Revolution tasks, restrictions and powers for the monetary and banking system, especially for the central bank, were set in social, economic and cultural development programs. According to the research findings and in the short-run, central bank transparency has a positive impact on productivity growth. Therefore, at 5% level and in the short-run, transparency will increase productivity. Also, the results for the long-run show that the effect of this variable is significant. In other words, economic transparency affects long-run productivity growth in Iran. In other words, this hypothesis can be accepted in the long-run. It should be noted that the study of Muto (2013) for the European Union

emphasizes that transparency does not necessarily have a significant impact on productivity, but it is based on [Tiberto et al. \(2020\)](#). In the short-run, central bank independence has a negative significant impact on productivity growth. That is, when central bank independence increases, the productivity of the whole economy decreases, but in the long-run the effect of this variable is positive. That is, the aggregate productivity of the economy is increased by the increase in independence. Thus, this hypothesis can be confirmed in the long-run. This result is in line with [Ehsani and Izadi \(2019\)](#), [Jordan & Luther \(2020\)](#) and [Tiberto et al. \(2020\)](#). In line with the research hypotheses, some suggestions are presented:

A) Considering the positive impact of central bank transparency on productivity growth, the central bank should continuously promote policy transparency and dissemination of received information of macroeconomic variables during a month.

B) Considering the importance of consultation with experts in the economic field of the central bank, it is necessary to establish various specialized committees in the monetary field. Moreover, the outcome of discussions and voting conflicts between experts and monetary officials should be communicated regularly.

C) The central bank should take measures to announce the target inflation rate and inform about the necessary measures to achieve the desired target.

D) Given the positive impact of central bank independence on productivity growth, serious consideration should be given to central bank independence from senior officials in general. It should be noted that central bank independence, especially due to the prevailing developmental view of money in the Iranian economy, does not only require the will of central bank officials; rather, there must be a comprehensive agreement among senior officials for independence of central bank.

E) According to the results, it is necessary to change the rules to prevent the monetization of the budget deficit and the expansion of liquidity in the economy, and the financing of the government should be done through channels other than the central bank.

F) Given the negative effect of inflation on productivity, the central bank should avoid overprinting the currency and improper expansion of credit to control the impact of inflation on economic fluctuations.

According to the research results, some suggestions for future research are presented below. A) Due to the sharp economic fluctuations in Iranian economy in recent decades, it is necessary to study the effect of transparency and the central bank independence in the framework of methods such as Switching VAR that have the ability to model fluctuations in the economy.

B) It is also necessary not to deal with the general discussions about the transparency and the central bank independence; moreover, the effect of each component of the transparency index on the economic variables should be explored. Therefore, the importance of each component of transparency is examined.

C) Given the poor performance of the central bank on the transparency and independence, it is also necessary to explore in detail the reasons for the failure of the central bank in deepening its transparency and independence, although the research literature on these two topics has a wide range of focus.

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Conceptualization, methodology, validation, formal analysis, resources, writing—original draft preparation: All Authors.

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The authors declare no conflict of interest.

Data Availability Statement

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